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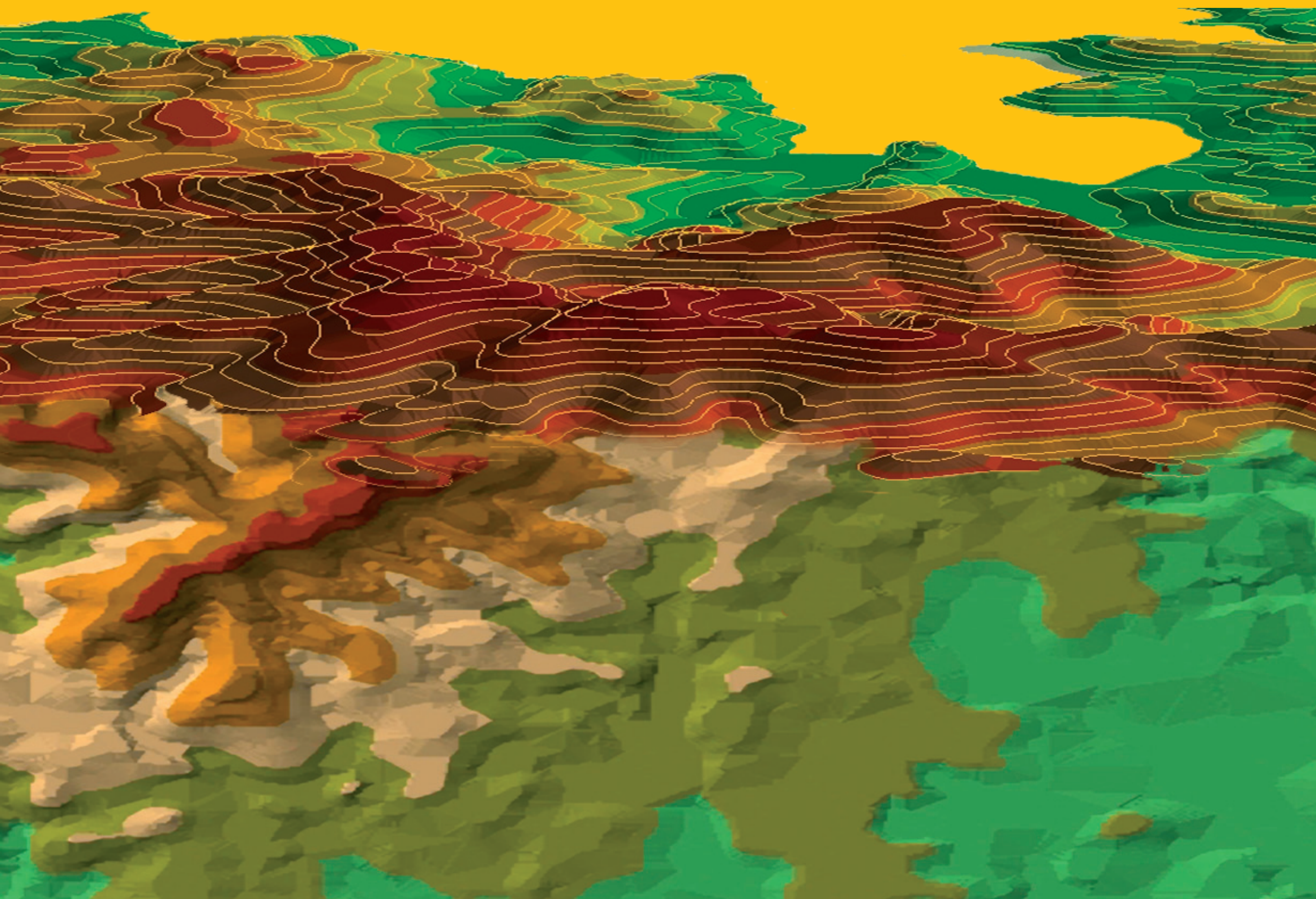

Fig. 15: The former weaving mill in Dolní Rokytnice, now considered for reconstruction to recreational use (Photo J. Kolejka)

Fig. 16: Extensive premises of the former woollen goods spinning factory in Dolní Chrastava (Photo J. Kolejka)

Illustration related to the paper by J. Kolejka, J. Klimánek and B. Fragner

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FOREWORD

The coming into existence of the post-industrial society at the end of the 20th century brought forward the issue of studying the industrial heritage. The industrial heritage is not comprehended narrowly as a set of objects and sites created and then abandoned by industries but rather as a bequest – both positive and negative – of the former industrial society. In terms of research, the industrial heritage was taken charge of by architects and town planners in some western countries who had become aware in time of its significance comparable with the cultural, artistic and architectonic heritage of cities and rural areas from the pre-industrial era. Contrary to agriculture, forestry, water management or town planning, industries had never been large-scale users of the geographic environment. In spite of the fact, they affected landscape structures and appearance of the territory either directly by their operations or indirectly through their requirements. Only in the two last decades the industrial heritage becomes the subject of interest for geographic sciences namely in traditional industrial countries where it is most endangered by the transformation of economy and society. Thus, spatial aspects of the industrial heritage relate to all geographic disciplines. The studies are focused not only on various patterns of the spatial distribution of brownfields but also on industrial and related urban, montane, stream and other relief forms, climate changes in industrial areas, transformation of soils, occurrence of abandoned premises of the former industrial society, not only industries, changes in the perception of sites and objects of the industrial heritage, attitudes of developers and regional authorities.

This number of the Moravian Geographical Reports brings articles exploring a number of geographic aspects of the industrial heritage, resp. industrial society in the contemporary landscape.

POST-INDUSTRIAL LANDSCAPE: THE CASE OF THE LIBEREC REGION, CZECH REPUBLIC

Jaromír KOLEJKA, Martin KLIMÁNEK, Benjamin FRAGNER

Abstract

Procedures used in defining post-industrial landscapes in the Liberec Region, Czech Republic, their classification and standardization using available data sources and GIS technology, are discussed in this article. Data on the distribution of brownfields (including contaminated sites, industrial constructions of architectural heritage, mining points and areas, human-made landforms, industrial and landfill sites) were used for analysis.

Shrnutí

Post-industriální krajina: Příklad Libereckého kraje (Česká repulika)

V příspěvku je demonstrován postup vymezování postindustriálních krajin na území Libereckého kraje, jejich klasifikace a typizace za využití dostupných datových zdrojů a technologie GIS. Ke zpracování byla použita data o rozmístění brownfields, kontaminovaných míst, architektonických objektech průmyslového dědictví, těžebních bodech a plochách, montánních antropogenních tvarech reliéfu, průmyslových a skládkových areálech

Key words: *post-industrial landscapes, data sources, identification, typology, GIS solutions, Liberec Region, Czech Republic*

1. Introduction

The Liberec Region in the north of the Czech Republic, the second smallest Czech region after the Capital of Prague, covers 3,163 km^2 and has approximately 450,000 inhabitants (in 2009). It is constituted by four districts: Liberec, Jablonec nad Nisou, Semily and Česká Lípa. The region is situated peripherally (Fig. 1) at the edge of the Bohemian Basin in the border mountains, and partly reaches beyond them to the Lužická Nisa River basin up to the northern forefront of the Czech Highlands. It owes its peripheral location to the separation of both Lusatian regions from the Bohemian Kingdom during the Thirty Years' War in 1635 as well as to the separation of a major part of Silesia after Prussian-Austrian wars in 1740–42, 1744–45 and 1756–63. Wars had weakened the position of Czechs in the region and resulted in a consequent Germanization which peaked at the turn of the 19th and 20th centuries. Starting with the beginning of the 19th century, numerous areas in the region became subject to intensive industrialization, and the period was marked with a transition from manufacturing glass and textile (linen) to large-scale industrial production. Owing to its natural conditions (mountain region, high-quality glass sands, vast forests, metal ores, brown coal deposits) and the neighbouring Saxon and Prussian, later German markets, it offered favourable environment to industries which utilized natural resources effectively. In the second half of the 19th century the region was connected to Austro-Hungarian and German railroad networks and its industrial production experienced another boom. Massive industrialization continued until World War I. By then the region had highly specialized in glass and textile productions (processing particularly imported raw materials – cotton). Engineering played a lesser role at the time.

Economic crises alternated with periods of prosperity. The early 1930s proved particularly critical, as the region suffered from global economic crisis effects. The crisis had a major impact on the local glass and textile industries. Its effects combined with the reluctance of the central government in Prague to tackle local problems resulted in the spreading of Nazism among the predominantly German inhabitants. Following the Munich Dictate in 1938, most of the region was separated from Czechoslovakia, its Czech inhabitants were forced to move out, yet the region enjoyed a period of relative economic prosperity within the

Fig. 1: Localization of the Liberec Region within the Czech Republic

militarized Third Reich. The Potsdam Conference at the close of World War II initiated the resettlement of most German inhabitants to Germany and the return of Czechs from inland Czechoslovakia to the region. However, the numbers of inhabitants outside big towns did not match the pre-war population density. Rural areas in the borderland regions thus suffered from even more intensive depopulation than those in the inland. Not all businesses were fully reactivated in the post-war years. Industrial modernization launched in the 1970s resulted in abandoning of old production and service industrial facilities. The process culminated in the 1990s after a not very successful economic privatization which took place in the country. The collapse of some industrial companies was accompanied by the demise of numerous cultural, educational, trade and storage facilities whose existence was conditioned by industrial support. Demilitarization did not affect only facilities which until 1991 had been operated by the Soviet Army but also those belonging to the Czech Army. The abandoned buildings and sites tend to be characterized by the presence of un-remediated chemical contaminations. The existence of the post-industrial landscape is indisputable. The challenge is to localize it with maximum accuracy and to provide data necessary for the decision making on its future.

The paper aims to document possibilities for identification, mapping, classification and typology of post-industrial landscape on the example of a selected region of the Czech Republic and thus to demonstrate the utilization of available data and processing technologies for the purposes of objective delineation on this landscape type to allow planning and gain deeper knowledge.

2. Current knowledge of the post-industrial landscape

The existence of the post-industrial landscape is a generally accepted fact of the contemporary world. However, its scientific research still fails to meet requirements. In all probability, the primary research initiative can be accredited to architects studying industrial heritage buildings. Historical industrial architecture has been attracting the attention of professionals since the 1970s. Industrial architecture became the centre of attention due to rapid structural changes in western industrial economies which resulted in closing down of a number of businesses whose facilities no longer met operational standards but whose architectural value was high. Looming demolition of such buildings triggered response from the general public, yet conclusive plans of action usually failed to be agreed on. Societies studying and conserving the most valuable buildings as industrial heritage were established in developed industrial countries. Their focus tends to be regional and is restricted to specific interest areas (e.g. Cuffley Industrial Heritage Society in England, The Scottish Industrial Heritage Society in neighbouring Scotland or The Industrial Heritage Archives of Chicago's Calumet Region USA). Some societies (Research Centre for Industrial Heritage of the Czech Technical University in Prague) gained academic status or even gained considerable reputation both nationally and internationally (The International Committee for the Conservation of the Industrial Heritage -TICCIH). In 2003, the Nizhny Tagil Charter for the Industrial Heritage was published by TICCIH. It draws attention to the fundamental significance of industrial heritage for the human culture, whether in urban centres or open landscapes (Loures, 2008).

The spatial aspect of industrial heritage, whether presented in the context of industrial or post-industrial landscapes, did not become the centre of attention until some two decades later. At the time, the synchoric and synergic relations not only among industrial buildings but also the accompanying complexes of facilities and sites (transport, residential, service, etc.) began to be taken into consideration as part of changes caused by industry in individual components of the geographical environment, both natural and social. Industrially formed landscapes are classified by M. Antrop (2005) among landscapes of revolutionary periods. Such landscapes are formed quickly and disappear quickly as a result of technological and social changes and war conflicts. The industrial landscape, which has a significant to dominant impact on landscape character, structure and function, is usually studied in close relation to the urban landscape. Industrial or post-industrial landscapes may form "islands" within cities and thus become epicentres of future reconstruction and functional changes (Gospodini, 2006). The existing practical implementation of knowledge gained through industrial and post-industrial landscape research can be traced particularly in the urbanized metropolitan landscapes of Western Europe, North America, New Zealand or Japan (Hall, 1997; Whitehand, Morton, 2004; Loures, 2008).

However, industrial landscapes are not necessarily purely urban. Industrial buildings, facilities and associated infrastructure are frequently situated outside the settlement centres (Hayes, 2006) and yet remain dominant within the surrounding landscape. Industrial landscapes are often identified with landscapes affected by large-scale surface mining of raw materials (mostly fuel materials – coal, crude oil, peat, or building materials – gravels, sands, rock or some metal ores) (Germany – Hüttl, 1998; Czechia – Sklenička, Charvátová, 2003; Vráblíková, Vráblík, 2007; Spain – Conesa, Schulin, Nowack, 2008; Poland – Dulias, 2009). Areas affected by underground or surface coal mining outside urban centres thus represent "rural" industrial spaces with associated facilities of the energy and metallurgical industries (Ruhrland, Lorraine, Lower Lusatia, Upper Silesia, Ore Mountains piedmont). These "urban" and "rural", once industrial landscapes, have undergone a spontaneous transformation into post-industrial landscapes through mere de-industrialization, i.e. through stopping the industrial production, abandoning industrial facilities or their transformation for other purposes. Only rarely have the coordinated efforts of the state, NGOs and private organizations led to targeted transformation of extended areas into contemporary post-industrial landscapes. Examples of such efforts can be seen in larger areas in the Ruhrgebiet (Emscher-Park – Fragner, 2005; Wehling, 2006), Wales (the vicinity of Blaenavon town as the UNESCO World Heritage Site – Rogers, 2006), or England (the Dearne Valley in South Yorkshire – Ling, Handley, Rodwell, 2007; London Area – Holden, 1995).

Although the term "post-industrial landscape" has become frequented in the specialized literature and various measures concerning its future are seriously considered, its geographical definition (delimitation and content) remains vague and indefinite (see Loures, 2008). In case of Slovenia (Hladnik, 2005), the industrial landscape as a special landscape type is defined according to the ratio of industrial areas (registered in the CORINE) project within the entire area of a cadastre. According to Ch. Ling, J. Handley and J. Rodwell (2007), any area significantly affected by mining (on example of the Dearne Valley) and showing numerous abandoned buildings, brownfields but also subject to rehabilitation programmes and requiring other than conventional approach for the decision making on its future can be considered a post-industrial landscape (Bloodworth, Scott, McEvoy, 2009). T. Stuczynski, et al. (2009) developed an original concept for the geographical identification of post-industrial regions in EU. They implemented the CORINE LC 2000 database which registers industrial, mining and waste disposal sites, without differentiating facilities within these categories that are or are not in operation. Every pixel of 100 × 100 m located in the centre of a movable window of 5 × 5 km (in ERDAS system) over a CORINE map was considered a post-industrial site, provided that a pixel with a waste deposit or a mining site occurred within the square. The authors drew on the premise that until 1970 the traditional industry had always been accompanied by waste deposits and mining sites. Post-industrial areas are then constituted by thus defined post-industrial areas extended to include waste and mining sites. Their area was recalculated per area of a given NUTS-x in EU-27. If the ratio amounted to a minimum of 0.3% of the region's size, it was defined as post-industrial and subjected to further verification through the statistical evaluation of social and economic data. A total of six types of post-industrial regions (Type 1 Eastern transitional industrial, socially and economically weak, Type 2 Western, economically and socially strong (medium density of post-industrial sites), Type 3 Western, economically and socially strong (high density of post-industrial sites), Type 4 Southern, socially and economically weak, Type 5 Urban, Type 6 Western, socially weak) were identified within the EU-27 area (on NUTS-3s as reference areas). Another aspect of the post-industrial landscape is vegetation succession into former industrial or other abandoned areas. Among other things, this spontaneous process has initiated the establishment of a new scientific discipline, restoration ecology, which studies these phenomena (Naveh, 1998). In the post-industrial landscape thus appears and prospers an "industrial nature" (Cílek, 2002) or a "new wilderness" (Lipský, Weber, Šantrůčková, 2010) as a landscape segment left to its spontaneous development regardless of the original, purely human-conditioned situation.

Apart from the above-listed exceptions, the spatial aspects, definition, classification and typology of post-industrial landscapes remain outside the focus of research. Descriptions of individual studied areas were developed, which was essential for their protection and further planning. Conservation of such areas was timely, as rehabilitation measures, although motivated by efforts to achieve such landscapes' ecological and social rehabilitation, would have resulted in disappearance of this type of cultural heritage. Yet, it is apparent that knowledge of various post-industrial landscape types is an important factor in the process of adopting stances on this subject within the decision making sphere and investors as well as in forming opinions of the general public. A prerequisite for considering the future of post-industrial landscapes is their highly exact definition, localization and description and consequent classification and typology. Individual post-industrial landscape types then may be subjected to measures which are standardized to a certain degree.

3. Definition characteristics of post-industrial landscapes

Post-industrial landscape is a legacy of the Industrial Revolution. Landscapes initially directly and indirectly created and now abandoned by industries are characterized by a number of specific physiognomic, structural and functional attributes which represent relics of the past industrial era. While "recent" in functional industrial landscapes, these characteristics are "fossil" in post-industrial landscapes. The characteristics are valid for all contemporary landscape structures.

The description of post-industrial landscape attributes may be related to individual structures of the contemporary cultural landscape (natural – primary, economic – secondary, human – tertiary and spiritual – quaternary). These structures affect one another strongly in the contemporary landscape, which means that changes in one of them tend to trigger changes in the remaining structures. All the structures demonstrate logical territorial differentiation of the landscape's building components. Detailed descriptions of these structures and their characteristics in a post-industrial landscape are listed in the following tables (Tab. 1, 2, 3 and 4). Needless to say, the post-industrial landscape is a descendant of the industrial landscape. While objects and processes shaping the industrial landscape are active and recent, the very same objects and processes are considered passive (being subject to contemporary processes of disintegration, conversion or extinction) and fossil (their origin dates back to an era different from the one in which the given post-industrial landscape exists) within the post-industrial landscape.

Although data on long-term air pollution in post-industrial landscapes can be obtained in the Czech Republic thanks to a dense network of measuring stations, T. Stuczynski´s, et al. (2009) statement that post-industrial regions are characterized by this attribute particularly in places where rehabilitation measures have not been taken yet may be sufficient at this point. For that matter, H. Svatoňová, V. Navrátil and I. Plucková (2010) point out the same in their study of post-industrial landscape in the Oslavany region.

A number of data listed in Tab. 2 as supported by information provided by databases must be interpreted from raw data on waste deposits, chemical contamination, brownfields, mining subsidence areas, etc.

Similar to Tab. 2, data on the listed abandoned facilities were obtained through the special-purpose interpretation of data from available databases. Protected buildings are listed in a special database. Social and demographic characteristics (e.g. on unemployment) were not used at this processing stage. All data were converted to allow processing in GIS SW.

4. Material and methods

The process of systematic research, mapping, classification and typology of post-industrial landscapes in the Liberec Region (Fig. 2) encompasses selecting suitable data sets, their analysis and interpretation, necessary adjustments for GIS technology, followed by processing and result evaluation. Data sets suitable for the purposes of the project were obtained (Tab. 5). They draw on available public sources, commercially accessible data provided by companies operating in the Czech geo-information market as well as specialized databases of the Research Centre for Industrial Heritage of the Czech Technical University in Prague.

4.1 Justification of selection and evaluation of the used data, special purpose oriented interpretation

Basically every implemented data set required a specific approach and interpretation for the project's purposes.

Landscape factor (Natural structure components)	Post-industrial landscape
geological environment	abandoned mining sites, non-reclaimed waste deposits, deposits of material subject to recycling and processing, chemical contamination of the rock environment, surface and underground mining facilities
relief	anthropogenic relief forms subject to natural destruction, division or reshaping
atmosphere	dust and smell pollution, radioactive and uncontrolled chemical contamination
water	abandoned and unmaintained hydraulic engineering facilities with residual contamination, rehabilitation water objects, water courses changed by humans
soil	primitive soils at initial stage of regeneration, chemical soil contamination
biota	pioneer natural seeding tree vegetation, ruderal and segetal vegetation on non-natural ground
energy	passive energy impact of degenerating and dilapidating man-made objects and surfaces

Tab. 1: Post-industrial landscape characteristics indicated by natural components parameters (underlining – these characteristics were supported with relevant data in further processing)

Landscape factor (Economic structure components)	Post-industrial landscape
industrial buildings and sites	abandoned industrial facilities, unused or converted to non-production purposes, not protected
transport facilities and sites	abandoned transport facilities and sites, unused or converted to non-transport purposes
housing facilities and areas	abandoned buildings, squatters and homeless quarters, shelters of illegal immigrants or criminals
service facilities	abandoned service facilities, including those converted to other purposes
agricultural facilities	abandoned agricultural facilities and areas, including those converted to non-farming purposes, originally constructed to supply industrial working class
military facilities and areas	abandoned military facilities and areas, including those converted to non-military purposes
water management facilities	abandoned, non-operating, unmaintained and derelict water management facilities
mining facilities and sites	abandoned and to other purposes converted mining facilities, unused and abandoned waste dumps

Tab. 2: Post-industrial landscape characteristics indicated by parameters of the economic structure parameters (underlining – these characteristics were supported with relevant data in further processing)

Landscape factor (Human structure components)	Post-industrial landscape
places of worship	abandoned and (un)maintained places of worship and cemeteries
cultural facilities	cultural facilities built in times of industrial heyday, now used by different range of clients or abandoned
educational facilities	educational facilities built in times of industrial heyday, abandoned
public administration facilities	administrative facilities built in times of industrial heyday
sports, leisure, entertainment and catering facilities and areas	sports, leisure, entertainment and catering facilities built in times of industrial heyday, abandoned
healthcare facilities	healthcare facilities built in times of industrial heyday
protected buildings and nature areas	protected industrial heritage

Tab. 3: Post-industrial landscape characteristics indicated by parameters of the human structure parameters (underlining – these characteristics were supported with relevant data in further processing)

Landscape factor (Spiritual structure components)	Post-industrial landscape
positively perceived buildings and areas	positively perceived buildings and areas which date back to or commemorate the heyday and development of industry and industrial society
negatively perceived buildings and areas	derelict buildings and areas with bad reputation which date back to or commemorate the heyday and development of industry and industrial society

Tab. 4: Post-industrial landscape characteristics indicated by parameters of the spiritual structure parameters

No.	Data source	Source administrator	Selected properties	Relation to industrial heritage	Implementation
1	ZABAGED – basic set of geographical data	Czech Office for Surveying, Mapping and Cadastre	1:10 000, polygons, S-JTSK	mining sites, industrial sites, waste deposits, mine dumps	upon concluded generalization it is necessary to separate post-industrial sites and wrap polygon in buffer
2	CORINE Land Cover 2006	Ministry of the Environment of the Czech Republic	1:50 000, polygons, WGS 84, min. area 25 ha	industrial units – class 121, mineral extraction sites – class 131, dump sites – class 132	good, post-industrial sites must be separated, polygon enwrapped in buffer
3	National inventory of contaminated sites	CENIA- state organization	localization of centres according to coordinates obtained in field through GPS technology, S-JTSK points	chemical contamination	buffer-enwrapped points
4	Czech brownfields catalogue	Czechinvest - state organization	approx. 1:10 000, points, S-42	brownfields according to their original use, site catalogue with localization according to settlements or addresses	buffer-enwrapped points
5	undermined areas	Czech Geological Survey	approx. 1:50 000 polygons and points S-JTSK, (min. area 4 km2 as area, smaller than a point)	undermined areas and points	good in sites exceeding 4 km^2, extract from the undermined areas DB, polygons and points enwrapped in buffer
6	urbanized metropolitan areas of over 50,000 inhabitants	ARC ČR 500, own interpretations of aerial photographs	built-up areas of residential, production and service character	mix of industrial and post-industrial landscape objects within dominant urbanized metropolitan landscape	utilizable as a mask for filtering areas whose landscape character is defined by the metropolis, not the industrial heritage
7	district towns	Czech Statistical Office	cadastres of district towns	enables separation of the towns' urban landscape from the remaining area	delimitation of district town areas according to a code in attribute table
8	industrial heritage buildings	Research Centre for Industrial Heritage of the Czech Technical University in Prague	GPS localization of the buildings' gravity points in an Excel table	preserved industrial architecture monuments	alongside localization, the original purpose of the building is listed

Tab. 5: Data sources used for the identification and evaluation of post-industrial landscapes of the Liberec Region

From the extensive CORINE project database for the area of the Czech Republic were selected only relevant types of sites which are or may be related to a post-industrial landscape. The relevant categories were 121 (Industrial or commercial units), 131 (Mineral extraction sites) and 132 (Dump sites). While categories 131 and 132 were adopted for further processes without changes, category 121 was subjected to selection. The latter involved selecting only such industrial units which contained a minimum of one brownfield. However, not even this method of selection does not safeguard reliably that the given unit represents merely a brownfield and that none of its parts are used for industrial production at the same time. Similar uncertainty is associated with categories 131 and 132, where usually one part of the unit tends to be active rather than fossil, as the definition of the post-industrial landscapes requires. The above-listed method of data selection and processing is thus conventional and the obtained results may be subject to certain errors.

ZABAGED, a 1:10 000 scale database of the Czech Office for Surveying Mapping and Cadastre, encompasses over 40 data layers in vector form. One of the layers includes mountain (mining) relief forms, which represent indicators of post-industrial landscapes. The database records only larger forms (with respect to scale) which mostly originated in the time of industrialization until present. Within the area of the Liberec Region such forms are recorded only on several sites in the western Giant Mountains (Krkonoše Mts.), close to the town of Semily and in the foothills of Mt. Ještěd.

A slightly problematic method is determination of built-up areas in large towns. The project Landscape Atlas of the Czech Republic based on a map manuscript

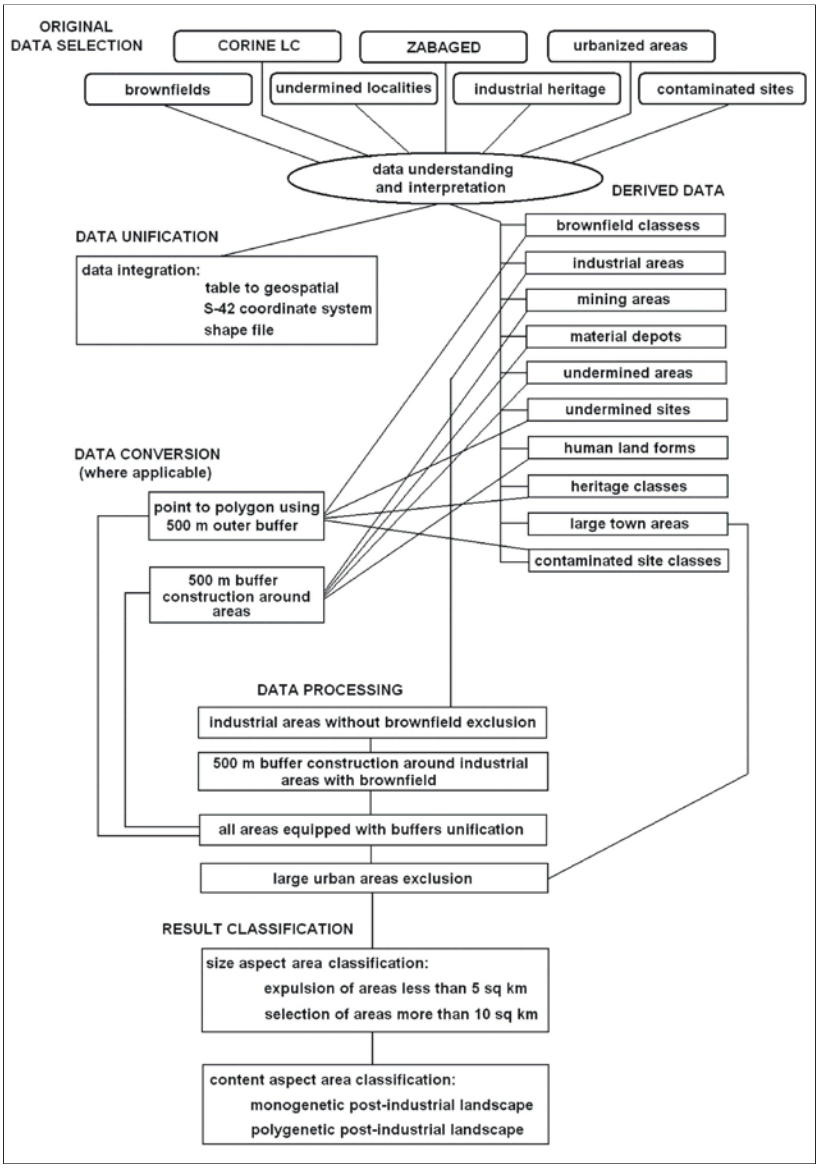

Fig. 2: Main processing methods applied in the process of identification, classification and typology of post-industrial landscapes of the Liberec Region

called "Contemporary Landscape Regions" yields a data layer of towns over 50,000 inhabitants (by J. Kolejka, A. Hynek, P. Trnka). The cadastre database of the Czech Statistical Office provides data on cadastres of only district towns (as type of units of the given category in the attribute table). However, this does not mean that they encompass only built-up areas. It is not a drawback in the given context, as the concept of post-industrial landscapes does not deal with the existence of built-up areas, apart from building brownfields and architectural industrial heritage.

The Czech brownfields catalogue operated by state company Czechinvest comes in two basic forms. The general public has access to a database which encompasses approximately 800 items within the Czech Republic. The second database encompasses approximately 2,500 items and is accessible only to state administration officials, having not been made available for the purposes of the project. The obtained results (definition of post-industrial landscape) thus draw only on the publicly accessible database, which may restrict them to a certain degree. However, it must be stated that the occurrence of brownfields significantly correlates with the occurrence of old chemical loads (contaminated sites) and major errors are thus not to be taken into account. Original data on brownfields were obtained in tables. Their association with concrete geographic locations was made according to address points and the Czech Republic ortophotomap which provided the coordinates. Only in exceptional cases, when the address was incomplete, the brownfields' location was related to the given cadastre's gravity point as a compromise.

For the purposes of creating the Czech Republic Landscape Atlas, the Czech Geological Survey provided a number of data layers related to undermined areas. The Landscape Atlas of the Czech Republic published them and consequently used them in this task. Individual data layers differ in size categories of the subsidence areas (sites exceeding 4 km^2 , sites of less than 4 km^2 as points) and in age of the units' origin (for the project's purposes, only sites and points representing mining subsidence areas developed in the 19^{th} and 20^{th} centuries were used). The two following data layers on mining subsidence were thus used for further processing: mining subsidence areas (polygon layer) and mining subsidence sites (point layer), both vectorized from the map already published in the Landscape Atlas.

The data set of industrial architecture buildings representing industrial heritage was obtained through the selection of relevant data from an extensive database provided by the Research Centre for Industrial Heritage of the Czech Technical University in Prague. An Excel table (xls) encompassing the given characteristics of architectural objects (particularly factory production and administrative buildings, as well as some transport facilities – bridges or railway stations) together with terrain-collected GPS coordinates of the objects' gravity points were uploaded in the ArcGIS v.9.2 system and consequently converted to a database table in dbf. format. According to geographical coordinates it was then possible to cartographically visualize the contents of other attribute columns and to process the data cartographically.

Data on the contaminated sites regardless of their origin included in the National Inventory of Contaminated Sites were provided by state organization CENIA which comes under the Ministry of the Environment of the Czech Republic. Apart from the data on the contaminated sites it also encompasses the information on waste deposits (regardless of the fact whether the deposits have a contamination effect or not), as collected by the Czech Geological Survey. The data were initially geographically organized according to administration areas of municipalities with extended competences and all thematic data were complemented with accurate location in geographical coordinates. The database's drawback was the fact that identical data sometimes occurred under different administration areas. In the course of combining the component sets into a unified database for the entire Czech Republic, the errors were discovered and the duplicity was removed. Based on thematic data accompanying the information on individual sites, it is usually possible to detect the contamination source in the given site (production or other company as well as the production sphere). In places the records were limited to a simple statement that the given waste deposit is registered by the given organization.

4.2 Data Integration in GIS

Owing to the fact that the required geodata come in various formats, cartographic projections and coordinate systems, it was necessary to formally integrate them into a shape file for further processing in GIS SW from ESRI ArcGIS v.9.2. All files were converted into the S-42 coordinate system. The system allows smooth north-south orientation of map outputs without the need to demonstrate cardinal points in maps by a compass rose. Although the ArcGIS SW v.9.2 allows a simultaneous processing of geo-referenced data of different data formats, different cartographic projections and different coordinate systems, a unification of all these parameters proved useful particularly at the classification and typology stages of geo-data processing, when a unified if extensive attribute table was required.

4.3 Data Conversion

In terms of topology, the presented available and implemented data fall into two categories:

- point data (only geographic coordinates of the studied objects' gravity points are known): brownfields, old chemical loads, small-scale mining subsidence areas, industrial heritage buildings (Figs. 3, 4 and 5); the attached attribute table allows users to determine or to extrapolate data on the type of the object, its origin and possibly also its size),
- polygon data (geographic coordinates describe refractive points of the objects' borders): industrial areas, mining and waste sites, human made mining land forms, outlines of towns exceeding 50,000 inhabitants and of district towns cadastres (Fig. 6); the attached attribute table allows users to determine data on the objects' type, origin and others.

4.4 Data Processing

It is obvious that the concentrations of relevant point objects and their possible connection to the polygonal objects serve as sufficient indicators of post-industrial landscapes (post-industrial areas in general). The question remains when the distance between the individual point objects becomes short enough to be included in a single common area. Opinions on this matter may differ among experts of various fields. Nevertheless, the points (and similarly also the areas) must represent cores of the potential post-industrial areas.

D. Hladnik (2005) distinguishes forest landscape cores which cannot be situated less than 300 m from a given forest unit edge. The 300 m value refers to expert knowledge on a maximum migration range of plant species (e.g. wind dispersal of seeds). Forest landscape cores are thus wrapped in buffers (buffer zones or impact zones) of 300 m in width. Interviews conducted with inhabitants of the studied post-industrial areas of the Rosice-Oslavany (South Moravian Region, 20 km west of Brno) and Kamenice regions (Liberec Region, 20 km east of Liberec) revealed a certain consensus about a tolerable distance of unpleasant objects (a minimum of 500 m). Naturally, this distance is purely subjective and without a certain degree of convention cannot be applied to the impact

Fig. 3: Liberec Region – brownfields

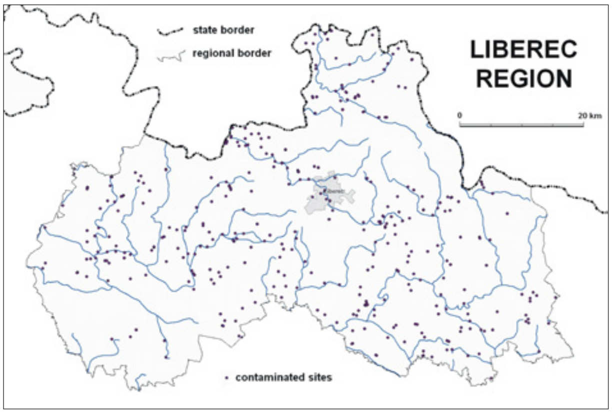

Fig. 4: Liberec Region – chemical loads

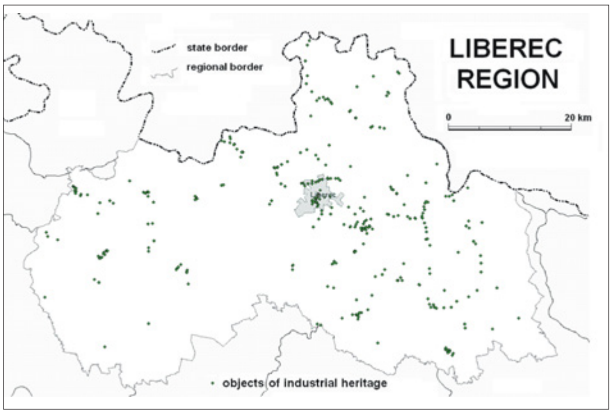

Fig. 5: Liberec Region – industrial heritage

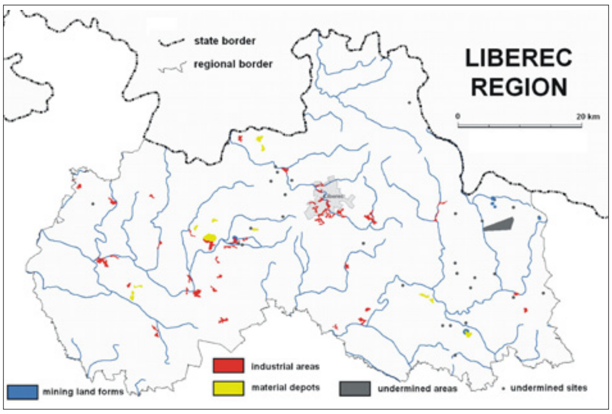

Fig. 6: Liberec Region – industrial, mining and waste dump areas according to CORINE LC, undermined sites and areas and mining land forms

range of every brownfield, mining subsidence area, contaminated site, waste dump or extraction site. Without any doubt, different types of environment (geological and hydro-geological environments, terrain and surface layer of the atmosphere) will display various impact ranges and the forms of the given environment will affect the forms therein. A virtually infinite number of such combinations may occur and it is practically impossible to study individual points and areas and to delimit the impact range of a given object for every single place. For these reasons, including the uninformed opinions of people inhabiting areas around all points and areas, uniform impact zones of 500 m in width were established (Fig. 7). These zones are represented by buffers in GIS. Industrial and commercial areas (CORINE) are exception to the rule.

A qualified selection had to be conducted in the category of industrial commercial facilities. Only units within which or within 100 m of outside of which a minimum of one brownfield was located (maximum localization error of a common tourist GPS receiver) were selected for further processing. Thus selected units of class 121 were provided with an analogous buffer wide 500 m (Fig. 8).

All buffer-enwrapped units were then subjected to unification with the help of a relevant ArcGIS tool, whenever the overlapping or at least point contact of buffer zones made it possible (Fig. 9).

However, areas of large towns, in this particular case of district towns, had to be eliminated from the obtained results, as the visual and other effects of post-industrial sites within them disappear in the mosaic of contemporary land use and their current function in the given administrative centre. Within the region, the town of Liberec plays the role of regional metropolis as well as the formal status of a district town. Outside large towns, the universal effect of post-industrial units on the landscape cannot be denied. In a number of cases (in places of concentration of such studied objects) the impact can be dominant, both in terms of its physiognomy and the environment (Fig. 10).

4.5 Results

The result of processing geo-data indicating post-industrial areas is a set of sites of various shapes and sizes. However, only areas exceeding a certain size can be considered post-industrial landscapes. Determining the minimum size is a subjective task which can draw on the following indices:

- the minimum differentiated area must exceed the smallest area of mining subsidence, which amounts to 4 km^2 originally, provided with a buffer,

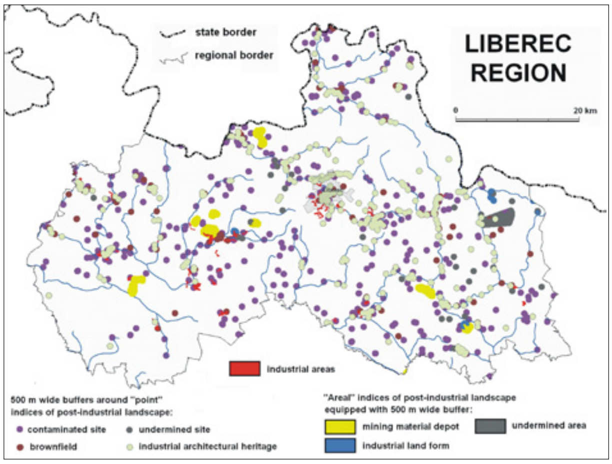

Fig. 7: Buffer impact zones of 500 m in width constructed around the points of contaminated sites, architectural industrial heritage, brownfields, mining subsidence areas, anthropogenic mining relief forms, extraction and dump sites

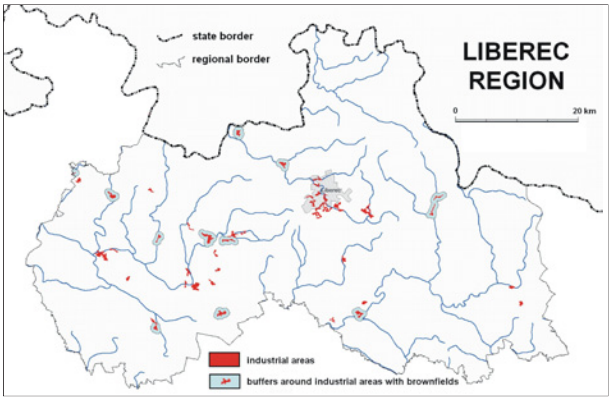

Fig. 8: Selection of industrial areas with brownfields and enwrapping them in 500-meter buffers

- the most common size of cadastre within the Czech Republic (apart from the border regions and towns) is 4–6 km^2; as a norm, this area is considered the basic planning unit for territorial and landscape planning (e.g. for designing general plans of the territorial systems of ecological stability),
- approximately 5 km^2 represent a commonly sized small town where post-industrial areas may play a dominant role with respect to its appearance (perception) and planning,
- the Czech Republic represents a geo-morphologically varied area whose appearance changes after approximately 1-hour-walk, which may represent roughly 5 km route generally and approximately 4–6 km^2 in wide valleys,
- the mean distance between rural settlements ranges from 3 km in old settlement areas in Bohemia to 7 km in Moravia; however, standard 5-km (or higher) distance between settlements may be considered here as well if we take into account mountain areas of the Czech Republic.

Although the indices selection may seem arbitrary, it still supports subjective and as such conventional selection of minimal extent for areas which could be denoted as "post-industrial landscapes". This denotation is valid unlike the denotation of small-area sites which upon meeting the same criteria show smaller surface and thus can be defined as "post-industrial areas", potential cores of future post-industrial landscapes, provided they are extended by inclusion of new indicator objects. Application of this conventional rule in the Liberec Region helped define post-industrial landscapes meeting the condition of a minimum 5 km^2 extent (Fig. 11). For comparison purposes, post-industrial landscapes of double extent of 10 km^2 were determined, which is significant particularly for all-state comparison at the national level (Fig. 12).

It is obvious that post-industrial landscapes defined by the existing procedure come in rather bizarre shapes at times. The highly diverse shapes of delimited post-industrial landscapes are result of connected buffer zones around individual post-industrial landscape indicator objects. Buffers around point objects made up particularly diverse shapes. The ArcGIS technology offers a tool "Simplify Polygon" (in toolbox Cartography Tools – Generalization) which implements several generalization algorithms. Experiments revealed that the "Bend Simplify" algorithm provides good results, as it maintains an object's shape and reduces local extreme projections of the outline. Line smoothing was pre-set by selecting the so-called Reference Baseline in sections of 1,000 m. The resulting outlines of individual post-industrial landscapes (Fig. 13) are more acceptable in further use of results, particularly in the decision-making sphere. Sizes of sites within new (generalized) outlines remained virtually untouched. Thus delimited individual post-industrial landscapes which met the size criterion and simultaneously drew on (encompassed) a selection of all or some indicator objects were subject to classification for the purposes of defining post-industrial landscape types in the Liberec Region (Fig. 14).

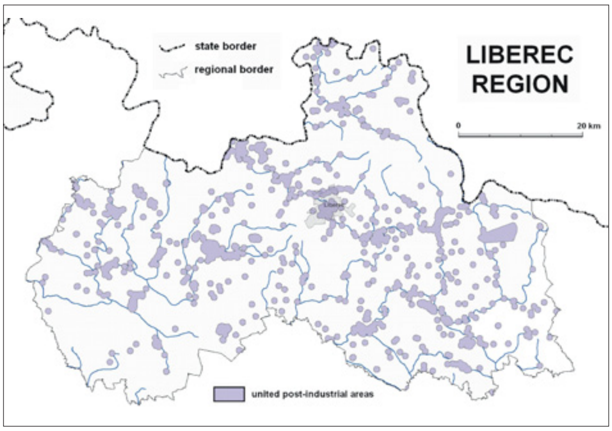

Fig. 9: Unified areas indicating post-industrial units

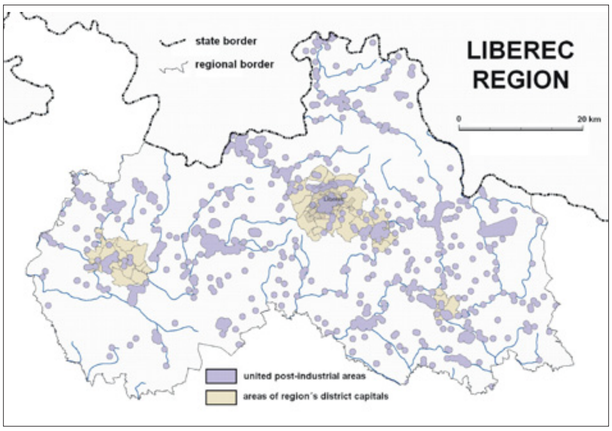

Fig. 10: Comparison of post-industrial units with the areas of district towns for the purposes of delimiting "rural" industrial landscapes

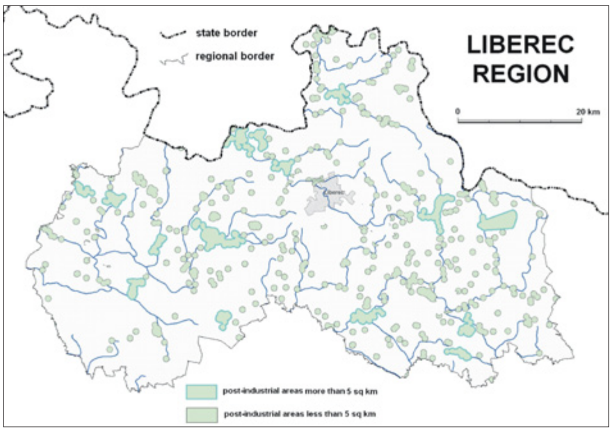

Fig. 11: Identification of "post-industrial landscapes" according to the criterion of a minimum 5 km^2 extent, smaller sites represent quality-wise similar but smaller "post-industrial areas"

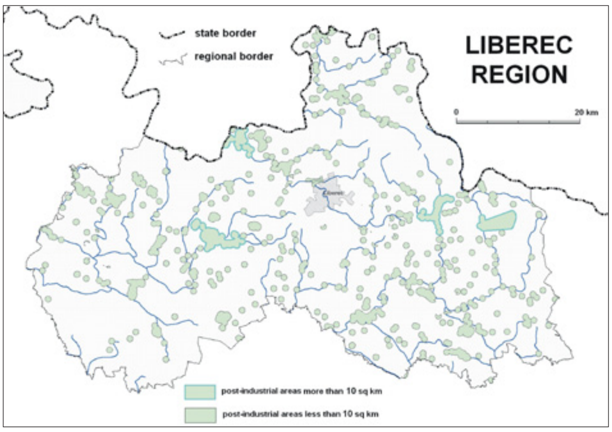

Fig. 12: Comparative delimitation of post-industrial landscapes covering over 10 km^2

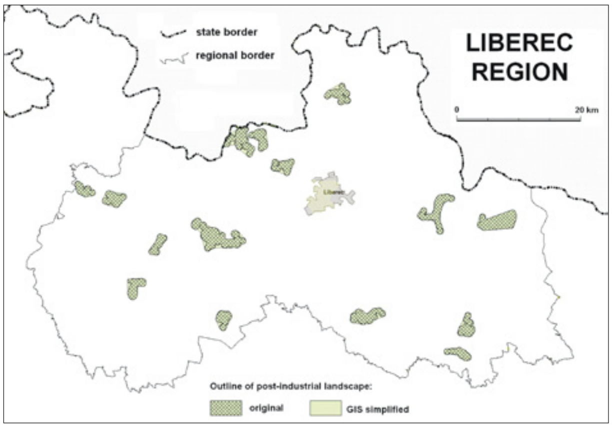

Fig. 13: Comparison of original and generalized outlines of the Liberec Region's post-industrial landscapes

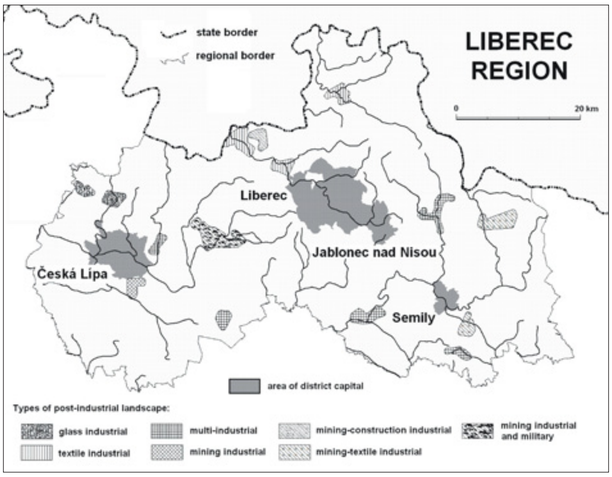

Fig. 14: Post-industrial landscape types in the Liberec Region

The classification itself draws on the knowledge of the proportional representation of factors which played an active role in the genesis of the given post-industrial landscape. The present land use or PIL structure will be studied in the future and included into the other ways of classification. Generally speaking, these include industrial and other activities (during the industrial period) which in the given territory left traces indicating post-industrial landscapes (see the processed data). Initially, the delimited areas were classified according to the proportional representation of polygonal elements – i.e. extraction sites, industrial sites, dump sites and human made mining land forms. Within the Liberec Region, most of these sites (apart from industrial-production facilities) are associated with mining activities. Even without implementing some of the exact methods of numerical taxonomy, it turned out that the identified post-industrial landscapes originated either dominantly from mining activities or from mining accompanied with other industrial, settlement or military activities. According to the significantly most numerous accompanying activities (data on which were obtained through inventory of all industrial heritage objects, brownfields and contaminated sites), the second attribute "mining" was added to the primary term "post-industrial landscape" to describe the accompanying activity leading to the formation of the post-industrial landscape. In other cases (where mining activities were not recorded) the classification drew on the proportional representation of industrial and other activities. Upon distinct dominance of a given industrial activity, the said post-industrial landscape was labelled after it. If another activity was represented in a given post-industrial landscape together with a dominant one (numbers cannot be defined exactly – in a minimum of three cases), a two-word denomination was created in which the first word represents the dominant activity and the second the accompanying one (such case did not occur in the Liberec Region but the conditions were defined for other regions of the Czech Republic). If a higher number of different activities occurred in the given post-industrial landscape, it was classified as multi-departmental. Fig. 14 reveals that owing to their considerable territorial range, mining activities played a key role in the formation of post-industrial landscapes of the Liberec Region. Traditional regional industrial activities accompanying mining (textile and building industries, possibly also military activities) played a complementary role in the genesis of post-industrial landscapes. Other post-industrial landscapes of the Liberec Region – generally most numerous – are a result of traditional regional industrial activities – glass and textile industries (Figs. 15 and 16 – see cover p. 2), including their local combinations with wood processing, paper, toy-making and engineering industries. A total of 15 post-industrial landscapes of 7 types were identified in the Liberec Region, each of them covering over 5 km^2 (4 covering over 10 km^2).

5. Conclusion

Only characteristics representing human activities and their outcomes were used in the classification and typology of the Liberec Region post-industrial landscapes. As is apparent from the outline of implemented methods and individual steps, several weak parts can be spotted in the process. These include inputs in the processing process which introduce a considerable impact of the given researcher. The first weakness is the selection of indices and necessary data, which lack social and economic data among other things. However, these cannot be used before the stage of classification of already defined areas. More than 2,000 various localized data describing points and sites entering the processing procedure were employed in the process of identification. It is implausible to obtain the same spectrum of economic and social data for each of them.

The determination of buffer zone width around every interest object is also debatable. 500-meter buffers are to symbolize the given object's spatial impact on its surroundings. In this case there was no other option but to use the above-mentioned procedure. Firstly, it enabled the transition of point data on area ones and thus objectify, to a certain extent, the process of finding "connected" concentrations of these points. It is not possible to individually assess the actual impact of every single point and area on their environment which offers a countless variety of possible shapes and sizes. However, a justification of the selected method is provided.

Another case of a subject entering the processing can be seen in the utilization of adopted size classification of identified areas, of which only those exceeding 5 km^2 are further classified as landscapes while the smaller ones are considered only as areas. In this case references to similar size criterion were made, regardless of the fact that they do not bear a direct relation to the solved issue.

A considerable weakness is inherent in the data themselves, their geometric and semantic quality. From the perspective of the processing process itself, particularly in the CORINE LC database, it is not possible to separate safely all the active and passive sites, i.e. indicators of industrial and post-industrial landscapes (see other comments by Balej, 2007). Yet, the adopted procedure (in the opinion of the authors) managed to remove from further processing such sites which provably do not represent post-industrial landscape indicators, i.e. industrial areas without brownfields. However, it must be taken into consideration that the used brownfields databases are not complete and as such cannot be fully replaced with data on contaminated sites and industrial heritage objects (regardless of their high mutual spatial correlation – highly similar occurrence of point and area concentrations).

Despite the above-mentioned weaknesses, the unquestionable strengths of the adopted method must be stressed. These lie in the possibility to replicate the procedure in other places and at another time, providing that similar data are available, which is possible in developed industrial countries. This procedure helps localize post-industrial landscapes and determines their outlines, which is crucial for any future decision making. Within thus determined boundaries it is possible to classify individual post-industrial landscapes and based on their type to consider possible measures in their future management. The planners require clear PIL outlining (including the size) and the description of the causes of the PIL origin (types and number of factors) as the necessary starting points for the future planning operations and the fund raising.

One of the most frequent post-industrial landscape types in the Czech Republic, which was not defined and spatially delimitated prior to this project, is the post-mining landscape (Sklenička, Charvátová, 2003). Planning within this type of landscape involves creation of eco-stabilizing systems drawing on ecologically (and location-wise) most stable sites. Knowledge of where a given post-industrial landscape type is situated, of its extent, outline, size and internal characteristics gives one the opportunity to formulate projects necessary for its future planning. These may have a wide range

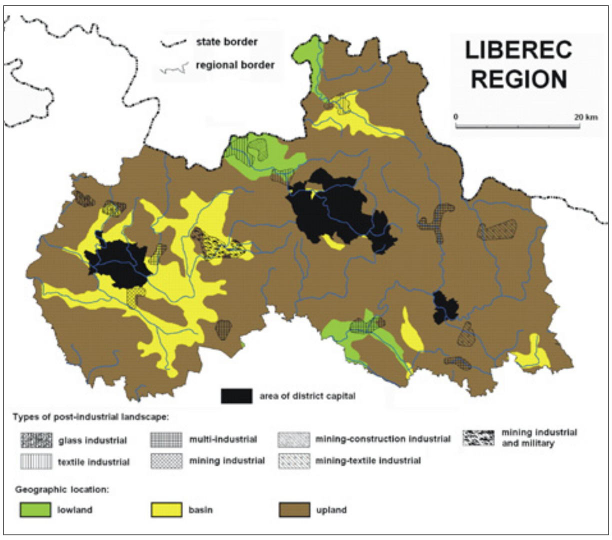

Fig. 17: Geographic location of the Liberec Region post-industrial landscape types

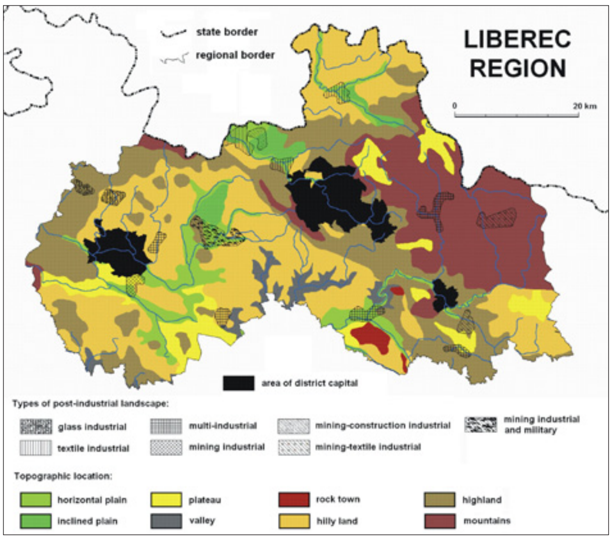

Fig. 18: Contextualization of individual post-industrial landscape types within local types and terrain macro-forms in the Liberec Region

of application: protection of the said landscapes as natural and cultural heritage, various special-purpose revitalization, transformation and conversion, as well as denaturalization or removal of traces of old industrial and accompanying human activities.

Putting the identified types of post-industrial landscapes within their natural context, whether represented by their specific geographic location (Fig. 17) or positioning within the relief (Fig. 18) as the primary physiognomic parameter of any landscape (apart from human land use, which is taken into account by typology of the given post-industrial landscape to a certain degree but not entirely), offers another perspective of the issue.

It is becoming apparent that distribution of post-industrial landscapes within the Liberec Region is relatively regular as to the types of geographical location and their positioning within the terrain. It is evident that in the given region so-called "driving forces" played an important role in the selection and distribution of industrial activities (apart from associations with produced raw materials and water energy sources) in accord with the regular distribution of favourable localization conditions which show little dependence on position and relief. The identified types of post-industrial landscapes in the Liberec Region thus may become subject to territorial planning, development of entrepreneurial and tourist activities as well as natural and cultural heritage conservation activities.

Acknowledgement

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THE POST-INDUSTRIAL LANDSCAPE IN RELATION TO LOCAL SELF-GOVERNMENT IN THE CZECH REPUBLIC

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Abstract

The relation between local government and the post-industrial landscape is discussed in this article for a case study area in the Czech Republic, the Tanvald region (area with the spatial concentration of glass and textile industries before 1989). The situation significantly changed with the return of the market economy, when many industries were closed and it was necessary to find new modes of development for them. This research is based not only on the results of semi-structured interviews with representatives of local government (mayors) in the study area, but also uses selected statistical data and information collected during field research. The article concludes with a new typology of roles played by local government in the redevelopment process and with recommendations on how to improve decision-making processes associated with brownfield redevelopment.

Shrnutí

Vztah lokální samosprávy k post-industriální krajině na území České republiky

Článek se zabývá problematikou vztahu lokální samosprávy k objektům tzv. post-industriální krajiny na území České republiky a to na příkladu Tanvaldska (území s vysokou prostorovou koncentrací sklářského a textilního průmyslu před rokem 1989). Situace v tomto regionu se samozřejmě zásadně změnila v období po návratu tržní ekonomiky, kdy došlo k uzavření mnoha průmyslových objektů a areálů, pro které bylo nutné hledat nové alternativy využití. Příspěvek vychází nejen z výsledků řízených rozhovorů, které se uskutečnily se starosty obcí v rámci studovaného regionu, ale je dále založen na analýze vybraných statických dat a na poznatcích získaných přímo v průběhu terénního šetření. V závěru článek přináší vlastní typologii rolí, kterou místní samosprávy sehrávají v procesu opětovného využití brownfields a přináší doporučení, jakým způsobem zlepšit rozhodovací procesy.

Key words: *brownfields, redevelopment, municipalities, mayors, Tanvald region, Czech Republic*

1. Introduction

Issues of the post-industrial landscape and brownfield redevelopment in the Czech Republic have become very common after the collapse of the planned economy in the two decades after 1989. In the 1990s, the return of the market economy caused a decline or even collapse of many economic activities and, after 2000, the trends connected with increasing globalisation and Europeanisation had a huge impact on the further modification of traditional economic activities (especially with respect to the deindustrialisation process). One of the results of the afore-mentioned processes is the occurrence of derelict, abandoned, neglected and unused areas and buildings, which are known as brownfields. The issues connected with brownfields are given attention not only by scientists but also among political representatives at different hierarchical levels (local, regional, national, EU), private entrepreneurs and citizens, because areas with brownfields often have huge impacts on their surroundings (especially economic, environmental and aesthetic impacts). On the one hand, the existence of brownfields usually brings not only risks (e.g., contamination of underground or surface waters, contamination of soils, increase in air pollution, spatial concentration of the social problems associated with homeless people, drug addicts, etc.), but also opportunities for future redevelopment. The brownfields are perceived as zones and locations suitable for future development projects, which is why the research on brownfields is popular not only among experts from different disciplines (e.g. economy, architecture, geography, sociology, urban planning, law, etc.) but also among other groups of stakeholders (e.g. political representatives, entrepreneurs) actively participating in the decision-making processes related to redevelopment planning. In this context it is necessary to emphasize that the concrete redevelopment plans have usually both their supporters and their opponents, and the final way of brownfield redevelopment is influenced by decisions made by political representatives at different hierarchical levels (the mayors play the key role at municipal levels).

International research regarding brownfields has a longer tradition than the research activities in the Czech Republic, where the number of brownfields started to increase significantly in the period 1990–2011. The developed countries with market economies (e.g. USA, UK, Canada) already have long-term experiences with the redevelopment of brownfields – for example the situation in Canada was analysed in detail by De Sousa (2001, 2003). Naturally, for the situation in the Czech Republic, it is useful to understand the broader context within the European Union, focussing on the experiences from other countries in Central Europe (e.g., Banzhaf, Netzband, 2004; Keil, Berg, 2003; Wiegandt, Reißing, 2000). Moreover, there could be very important experiences from the former Eastern Germany, where the economic shift from a centrally planned economy to a market economy occurred earlier than in the Czech Republic, and its impacts on spatial structures (especially large-scale deindustrialisation) were more significant than in the Czech Republic (for details, see Mehnert et al., 2005; Steinführer, 2006; Kabisch, 2004).

The huge variety of issues associated with the redevelopment of brownfields is also discussed in the Czech Republic. There are significant differences among Czech scientists, especially in how they deal with studying the issue of brownfields: one group of authors emphasizes the environmental dimensions of the problem (e.g., redevelopment of brownfields as a good alternative to urban sprawl – see for example Kirschner, 2006 or Srb, 2002); another group of authors perceives industrial brownfields as an important architectural heritage, which should be preserved for future generations (e.g., Fragner, 2005; Karásek, 2007). Other researchers deal with special kinds of brownfields (e.g., Komár, 1998 or Šilhánková, 2006 paid attention to the regeneration of military brownfields); analysis of the situation in specific sites or zones in which brownfields occur (Dařílková, 1998; Kuta, Kuda, Sedlecký, 2005; Kuta, Kuda, 2004); or on the relation between redevelopment and spatial planning (Vojvodíková, 2005). Other authors address the impacts on post-industrial society, where according to Czech sociologist I. Možný (2002), more than 50% of the labour force is working in the tertiary sector (services) and the importance of both the primary and secondary sectors (including all kinds of industries) is permanently decreasing.

In Czech geography, brownfields have been subject to research by geographers who were dealing with the transformation of industrial activities in the period after 1989: in this context the most important studies were published by I. Sýkorová (2007), J. Temelová and J. Novák (2007), V. Toušek and P. Tonev (2003), and J. Kunc (1999). Other groups of Czech geographers paid attention to brownfields together with the concept of so-called urban sprawl – for example O. Mulíček and I. Olšová (2002) or A. Létal, I. Smolová, Z. Szczyrba (2001). It is necessary to emphasize that the research focused on the relation between the use of brownfields and greenfields is popular not only among geographers, but a similar approach was used for example by Czech architect J. Jackson (see Jackson 2002, or Jackson and Garb, 2002), who is one of the co-founders of the non-profit organisation 'Institute for sustainable spatial development of the settlements' (details available on the web page: http://www.brownfields.cz/), which aims to facilitate and to improve the redevelopment process by increasing the knowledge of selected groups of stakeholders.

2. Objectives and methods

Generally, it can be assumed that brownfield redevelopment in the Czech Republic is influenced by the interactions between different groups of stakeholders from the public, private and non-profit sectors (Fig. 1). The bodies and offices of public administration at different hierarchical levels (municipal, regional, national, and EU), however, often play a key role in the processes of brownfield redevelopment because they influence future spatial development by means of master plans, negotiations with owners and NGOs, investments of public money for preparation of brownfields for future commercial and non-commercial investments (especially decontamination and demolition of the abandoned buildings), and legislation, etc. At the national level, there is the 'National Strategy of the Czech Republic for Regeneration of Brownfields' (Národní strategie regenerace brownfieldů, 2008). This national strategy, which includes both short-term and long-term objectives and economic, legal and environmental educational frameworks for brownfield regeneration, is based on the research study of the agency of CzechInvest (see www.czechinvest.org). This study identified all kinds of brownfields (with the exemption of mining brownfields) in the territory of the Czech Republic with a size larger than 1 hectare

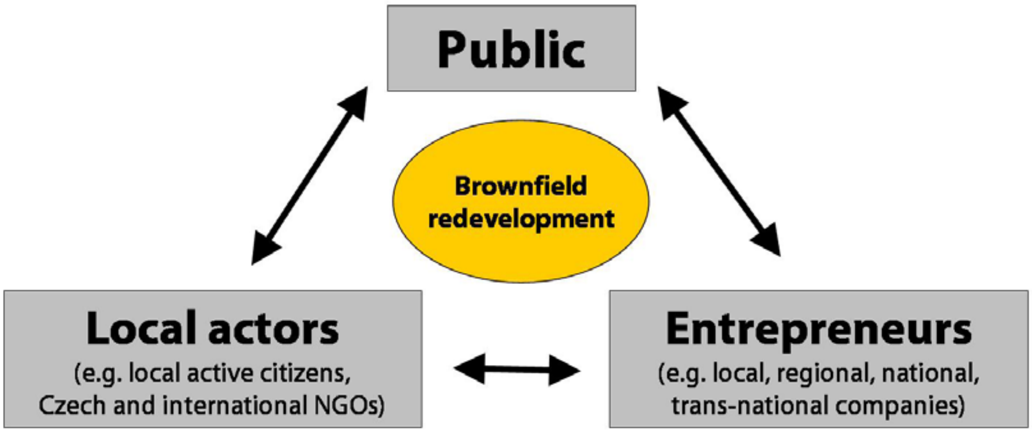

Fig. 1: Interactions between the Major Groups of Stakeholders Influencing Brownfield Redevelopment in the Czech Republic (see Acknowledgement). Source: Authors' proposal

(in total 10,326 hectares). At the regional level, the problems associated with brownfield redevelopment are resolved by regional authorities and the regional development agencies. One disadvantage of the national and regional strategies for municipalities is that they pay attention only to the most important and largest brownfields – e.g., while the 'National Strategy of the Czech Republic for Regeneration of Brownfields' (Národní strategie regenerace brownfieldů, 2008) identified only 2,355 brownfields in the Czech Republic, it estimated that the total number of all brownfields was significantly higher, ranging from 8,500 to 11,700 brownfields (in total between 27,000–38,000 hectares). The Czech political representatives at national and regional levels pay attention especially to the redevelopment of brownfields with a large area or with heavily contaminated brownfields and the brownfields of smaller size are neglected – therefore the successful redevelopment of the majority of small brownfields sites in the Czech Republic depends on decisions made at the municipal level.

This research project pays attention to issues connected with brownfield redevelopment at the municipal level in two (in the conditions of the Czech Republic: "typical") post-industrial case study areas, which were industrialised in different ways:

a) the Tanvald region, with abandoned textile and glass industrial brownfields sites; and
b) the former mining region of Rosicko-Oslavansko.

Several kinds of research were carried out in both case study areas (e.g., interviews with mayors, personal meetings with local entrepreneurs, questionnaire surveys with local inhabitants, field research, etc.). Naturally, this article does not recount all the results of the research project (the final synthesis of all results will be prepared and published), but pays attention only to the results associated with local government in the Tanvald region. The main objective of the article is to identify the strategies and problems which have to be resolved by representatives of local government in terms of brownfield redevelopment. We used semi-structured interviews with the mayors of the selected case study area – Tanvald region (these interviews were conducted in August 2010), and the most important results of the interviews are combined with selected information from field research, statistical analyses (population and economic data), and with interpretations from the literature.

3. Tanvald Region – The case study and its previous development

The case study area of Tanvald region is located in northern Bohemia – about 15 kilometres to the east of the regional "capital", Liberec (Fig. 2), and it consists of eight municipalities according to present administrative divisions. The study area of Tanvald region is not identical to the administrative division of the Czech Republic and it is different from the administrative borders (e.g. municipalities with extended competences); the case study area was named after the largest municipality of the studied region. The spatial delimitation of the study region was based on the objectives of the research project "The Fate of Czech Post-industrial Landscape" – to be more specific, especially with attention to the spatial concentration of post-industrial structures associated in particular with former textile and glass industries (former industrial structures and zones: more details are available in Fig. 2).

The region was already intensively industrialised in the 19th century and it was an example of a traditional industrial area associated especially with the glass and textile industries. The natural centre of the region

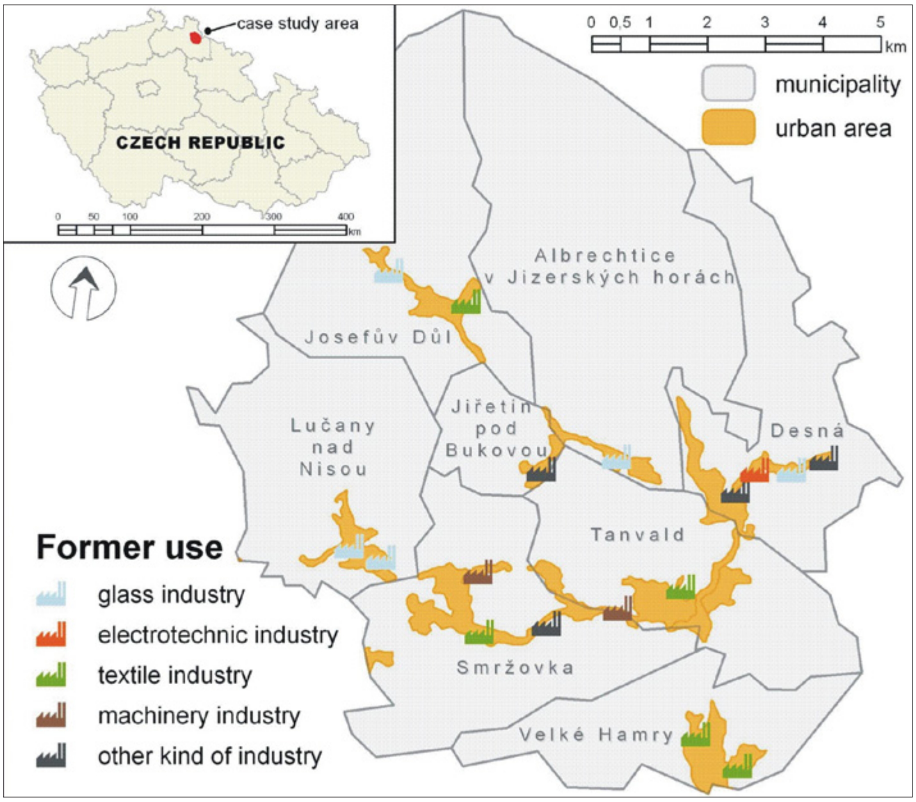

Fig. 2: Spatial distribution of post-industrial structures in Tanvald region in 2010 and location of the case study area in the Czech Republic. Source: Authors' proposal

is the largest town – Tanvald (6,954 inhabitants in 2010), and settlements and industries were developed in the valley of the Kamenice River. From a long-term perspective, the development of the region can be divided into two important periods. The first period, before World War II (WWII: Tab. 1), was influenced by industrialisation processes, in which the size of the population in the Tanvald region was increasing (with the single exception of the first census after World War I). The Great Economic Depression (1929–1933), however, caused not only the first significant decline in local industrial production but also the political radicalisation of the local German population (in the form of a huge increase in support of the Nazi policy and movements of local German separatists supporting reunification with Hitler's state).

Development in the period after the Second World War (Tab. 2) was influenced by the outcomes of the war - especially the forced displacement of the German population and replacement of the original German local inhabitants by Czech "new-comers" - and caused not only a significant decrease in population (compare the figures from Tab. 2 with Tab. 1), but it had several

Municipality	1869	1880	1890	1900	1910	1921	1930
Albrechtice v Jizerských horách	2,292	2,042	2,209	2,266	2,351	1,890	1,890
Desná	1,270	1,807	2,123	2,447	2,347	1,681	1,740
Jiřetín pod Bukovou	317	366	358	403	540	537	550
Josefův Důl	3,600	4,126	5,032	5,386	5,431	4,423	4,320
Lučany nad Nisou	3,644	4,056	4,413	4,725	5,038	4,323	5,119
Smržovka	4,551	4,979	5,919	6,539	7,602	6,614	7,296
Tanvald	4,349	4,911	6,174	6,829	8,133	6,902	7,985
Velké Hamry	2,602	3,218	3,263	4,050	4,564	4,033	4,114
Total	**22,625**	**25,505**	**29,491**	**32,645**	**36,006**	**30,403**	**33,014**

Tab. 1: Population changes in the Tanvald region in the Period before the Second World War (1869–1930)
Source: Historický lexikon obcí České republiky 1869–2005 (2007), ČSÚ

Municipality	1950	1961	1970	1980	1991	2001	2011*
Albrechtice v Jizerských horách	827	684	494	390	332	329	344
Desná	3,516	3,697	3,436	3,372	3,811	3,549	3,367
Jiřetín pod Bukovou	279	403	470	575	612	656	581
Josefův Důl	1,956	1,590	1,437	1,319	1,071	990	944
Lučany nad Nisou	2,386	1,967	1,893	1,754	1,438	1,573	1,808
Smržovka	4,161	4,272	3,747	3,526	3,418	3,430	3,707
Tanvald	5,240	5,114	6,168	7,592	7,055	7,001	6,950
Velké Hamry	2,582	2,531	2,273	2,118	2,063	2,721	2,881
Total	**20,947**	**20,258**	**19,918**	**20,646**	**19,800**	**20,249**	**20,582**

Tab. 2: Changes in population in the Tanvald region in the period after the Second World War (1950–2011)
*Source: Census data: Historický lexikon obcí České republiky 1869–2005 (2007); *Population Data – state 1st January 2011 – Počet obyvatel v obcích (2011), ČSÚ*

very important impacts on the settlement structure, economic situation, land use, etc. In spite of these changes, industrial activities continued to develop quite successfully during the period of the centrally planned economy (1948–1989) because the extensive industrial development was heavily supported by economic policies implemented within the Czechoslovak state.

In the period after the political changes in 1989 (with the return of the market economy) it is necessary to emphasize the importance of privatisation, restitutions of the formerly nationalised property, and later globalisation and Europeanisation. Many industrial companies were not able to compete with other competitors in global markets and had to decrease their production, or even declare bankruptcy. First, the textile companies were already negatively influenced in the 1990s as result of the loss of eastern markets, the operation of obsolete technologies and by being in competition with products from countries with a cheaper labour force. The deindustrialisation process did not stop in the 1990s, however, as it continued into the last decade and even the traditional glass industries declined or stopped production. The decreasing industrial production, accelerating before the latest economic depression, caused the collapse of the traditional "strong" industrial producers such as the glass industry. There were 7.565 jobs in industries in Tanvald region in 1989, while in 2008 there were only 2,491 jobs in industries on the same territory (Tab. 3). Moreover, the deepening of the deindustrialisation process worsened the situation of many problems in the Tanvald region: an increase in the unemployment rate in all study municipalities between 2009 and 2010 was particularly important (Tab. 4), with the creation of further abandoned, neglected, unused and "deprived" areas and the occurrence of "new" brownfields.

Municipality	Year 1989	Year 2008	Decrease 2008/1989
Albrechtice v Jizerských horách	529	0	-100,0%
Desná	1,344	931	-30,7%
Jiřetín pod Bukovou	356	228	-36,0%
Josefův Důl	309	0	-100,0%
Lučany nad Nisou	665	228	-65,7%
Smržovka	1,813	509	-71,9%
Tanvald	2,058	543	-73,6%
Velké Hamry	491	52	-89,4%
Total	**7,565**	**2,491**	**-67,1%**

Tab. 3: Decrease of jobs in industries (in %) in the Tanvald Region during period 1989–2008 (as of 31st December)
Source: Data from Výzkumné centrum regionálního rozvoje MU (http://vcrr.muni.cz/)

Municipality	2001*	2002*	2003*	2004*	2005	2006	2007	2008	2009	2010	2011
Albrechtice v Jiz. horách	8.3	8.3	8.0	10.6	7.9	7.9	8.6	6.6	6.0	11.3	13.2
Desná	5.4	8.4	8.8	8.0	8.0	6.7	7.2	7.0	8.6	12.1	9.9
Jiřetín pod Bukovou	9.1	9.9	9.5	8.9	6.0	6.5	5.7	6.8	6.0	12.2	9.2
Josefův Důl	6.9	10.0	8.7	8.9	7.8	5.9	4.7	4.4	5.1	7.4	10.6
Lučany nad Nisou	4.7	7.2	7.5	7.0	5.5	5.3	3.8	3.3	5.7	11.1	9.9
Smržovka	8.8	11.2	11.1	10.0	9.0	8.2	7.1	8.0	10.2	15.1	13.3
Tanvald	8.0	10.0	11.1	10.5	9.5	9.2	8.4	7.6	10.2	14.7	13.1
Velké Hamry	5.4	7.7	8.8	9.8	8.7	7.4	9.4	8.2	9.2	15.7	12.2

Tab. 4: Changes in the unemployment rate (in %) in the Tanvald region in the period 2001–2011 (as of 31st December)
Source: Ministry of Labour and Social Affairs of the Czech Republic (http://portal.mpsv.cz/)
*Notice: * Method for calculation of unemployment rate (%) was changed at the end of 2004. Before December 31st 2004, unemployment rate was calculated as share of all unemployed population and economically active population, after January 1st 2005, unemployment rate started to be calculated as share of unemployed population available for work and economically actives population.*

4. Tanvald region: selected results of the semi-structured interviews with mayors

The interviews, which were conducted during August 2010, with all eight mayors in the Tanvald region, were structured into several thematic parts:

a) current state of brownfields in the municipality,
b) perceptions of the brownfields among local citizens,
c) future plans of the local government for redevelopment,
d) participation of non-profit organisations in the redevelopment process,
e) cooperation with other governmental bodies,
f) the role of private investors,
g) impacts of brownfields on the environment,
h) conflicts usually connected with brownfields and,
i) the master plan in relation to brownfield regeneration.

The majority of brownfields in the case study area have industrial origins – e.g., the brownfields used in the past for the glass industry are located in five municipalities: Desná, Josefův Důl, Lučany, and Albrechtice v Jizerských Horách, Jiřetín pod Bukovou (Fig. 3).

Fig. 3: The former glass factory in Josefův Důl in the Tanvald region (Photo: J. Kolejka)

The brownfields formerly used for the textile industry were identified in three municipalities: Tanvald, Velké Hamry, Smržovka (Fig. 4). Besides these sites, there is one brownfield from the electrotechnics industry in Desná, and one brownfield used in the past for the machinery industry in Tanvald (former company: Litmas). The brownfields are usually perceived among local citizens as aesthetic problems – according to the respondents, the neglected and abandoned buildings damage the image of the municipality, especially in Desná, Josefův Důl, Tanvald and Smržovka, where the worsening image could be a serious obstacle to the development of tourism.

The most interesting information provided by the participants was the issue of future redevelopment plans, and very significant differences were identified among the study municipalities. The situation is strongly influenced by the individual skills, experiences and the contacts of local representatives. Several municipalities actively implement the redevelopment policy and try to influence the redevelopment process. For example, there were negotiations between the mayor of Desná and the managers of the Czech National Gallery about a possible alternative use of a brownfield as a local gallery. Also, there is a plan for multifunctional redevelopment of brownfields for housing and services in Tanvald, and there is a project with support from the Czech-Poland trans-boundary fund for the use of industrial heritage for the development of tourism in Albrechtice v Jizerských Horách. In this context, it is interesting that the mayor of Albrechtice is also the Director of DETOA Albrechtice, s.r.o. (Fig. 5), and he successfully achieved development of both his municipality and his company. DETOA Albrechtice, s.r.o. (see http://www.detoa.cz/), which is one of the few industrial companies still operating in Tanvald region, survived the last economic depression because of the implementation of new strategies: traditional production activities (production of wooden toys and piano keyboards) were combined with new marketing tools, such as an excursion path for tourists showing the methods of production in the factory (Fig. 6), a shop for tourists and organized creative workshops for children in which they can design and create toys following their own fantasies. On the other hand, there are other municipalities which implement rather passive policies in relation to brownfield issues and redevelopment, and their mayors emphasized the limited competencies, powers and financial opportunities of their municipalities (e.g., Jiřetín pod Bukovou, Velké Hamry). In this context, it is necessary to add that the majority of brownfields in the Tanvald region is owned by private entities and the mayors have only limited options in terms of how to influence the redevelopment projects.

Fig. 4: The Former Textile Factory in Velké Hamry in the Tanvald region (Photo: J. Kolejka)

Surprisingly, the cooperation of the study municipalities with other governmental bodies is not regular and systematic, as the mayors were only occasionally asked by the agency CzechInvest and the regional authority in Liberec, to provide the information for national and regional brownfield databases. In this context, the mayors particularly criticised the fact that they have to provide information to the governmental bodies at higher hierarchical levels of public administration (regional and national), without receiving any feedback or being allowed to use the information from these databases.

The municipalities do try to persuade large private investors to invest money in their brownfields. For example, there were negotiations with a German company in Josefův Důl, and with a company from Israel in Desná. Naturally, there is often an effort to increase the participation of local entrepreneurs in the process of brownfield redevelopment, but the problem is that small companies are not usually interested in large abandoned industrial structures. According to the majority of mayors, the brownfields do not have any serious impacts on the environment because all environmental issues have already been resolved over the two decades since 1989. Conflicts and clashes of interest connected with brownfields are usually influenced by different expectations among the various groups of actors. For example, in Desná the local representatives planned to buy a brownfield from a private investor and re-build it as apartments, but the private owner, who bought the building in 1990s during the privatisation process, had financial requirements that were too high and a suitable compromise was not found. The majority of the study municipalities actively use their master plans as tools for modification of future brownfield redevelopment. Only one municipality, Lučany, does not use the master plan because it does not want to create any "artificial obstacles and barriers for potential investors". Other municipalities tend to change their master plans to make the development

Fig. 5: DETOA Albrechtice, s.r.o., a Factory that is still operating in the Tanvald region, producing wooden toys and piano keyboards since 1908 (Photo: J. Kolejka)

Fig. 6: DETOA Albrechtice, s.r.o.: The excursion path for tourists where visitors can observe the production of wooden toys and piano keyboards (Photo: J. Kolejka)

of new industries, services, housing and tourist activities, possible. Concerning other marketing tools (e.g. strategic plans, marketing tools providing information about brownfields for potential investors, etc.), the mayors were usually informed about their importance, but they emphasized that opportunities for the relatively small municipalities are limited. As an example, they do not have their own GIS departments and they are not able to create their own brownfield maps compared to larger urban municipalities (e.g. for Brno: see Mapa brownfields 2009). Naturally, the majority of mayors in the studied region expect help, at least in such technical terms, from regional and national levels of public government.

5. Conclusions

This research of the case study of Tanvald region has identified many interesting issues. Generally, the role of the municipality is very important because representatives of local government usually have the most detailed information about the potential of the area, problems in the surroundings and about the needs of different groups of citizens and other actors. The local representatives try to initiate redevelopment projects in brownfield zones and they usually support the redevelopment activities, which bring new job opportunities (especially revitalisation projects focused on the development of tourism, new industries and services) or new buildings for housing. Moreover, the support for the construction of new apartments is influenced by the fact that the sum of money being given by the state to local governments depends on the number of permanent inhabitants. The mayor of Jiřetín pod Bukovou expressed the above-mentioned strategy in the following statement: "The municipality develops successfully, if the number of inhabitants (citizens) is increasing, and therefore we support the construction of new housing and creation of new jobs".

The mayors in the Tanvald region have to find alternative solutions to the conflicts and clashes of interests among different groups of stakeholders and usually they are able to find balanced and compromised methods for development by including entrepreneurs and local inhabitants. The research showed that it is very important to use both public and private financial sources for effective and successful redevelopment of brownfields, hence the crucial role of public-private partnerships. Representatives of local government try to use not only public sources from the Czech national and regional subsidies programmes (Ministry of Local Development of the Czech Republic, Ministry of Environment of the Czech Republic, Ministry of Industry of the Czech Republic), but there is also an effort to use the EU's financial resources (e.g. structural funds for trans-boundary cooperation, rural development or environment). In addition, it is important to mention that representatives of municipalities play diverse and important roles in the process of brownfield redevelopment. The following roles were particularly prominent in the case study area:

a) Initiative role – representatives of local government often initiate redevelopment of brownfields in their own territory,
b) Marketing role – some municipalities try to influence potential investors by means of tools for territorial marketing,
c) Information role – local representatives inform their citizens about the planned activities focused on redevelopment of brownfields (information leaflets, brochures),
d) Negotiation role – local governments try to find a balanced solution between the interests of private entrepreneurs, local citizens and NGOs,
e) Decision-making role – the local representatives are responsible for successful spatial development and therefore their political decisions influence brownfield redevelopment (especially decisions connected with the master plan), and
f) Other roles – all other activities which facilitate the process of brownfield redevelopment.

From the perspective of the implementation of practical policies, it is necessary to emphasize that more regular and systematic cooperation between municipalities and bodies of public government at higher hierarchical levels is still missing. Municipalities have to provide the information for national and regional brownfield databases, but they receive almost no feedback and they are not allowed to use the information in these databases. In our opinion, this information should be openly published on the Internet, for example by means of so- called "prioritization tools", which are already operating in some other countries (e.g., see the web pages http://www.smarte.org/smarte/tools/index.xml; http://www.retinasee.eu/). The information should be available to all stakeholders who are actively participating in the decision-making process associated with brownfield redevelopment, because it could facilitate future brownfield redevelopment in the Czech Republic. Naturally, the creation of the site-oriented prioritization tool is connected with the use of GIS (e.g., see Thomas, 2002) and it could be a strong challenge for future geographical research in the Czech Republic.

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ASSESSING LANDSCAPE CHANGES IN A REGION AFFECTED BY MILITARY ACTIVITY AND URANIUM MINING (PRAMENY MUNICIPALITY AREA, WESTERN BOHEMIA, CZECH REPUBLIC): A MULTI-SCALE APPROACH

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Abstract

Areas of military activity and mining are parts of the most typical examples that enable study of the effects of anthropogenic landscape transformations. In this project, the municipality of Prameny and its surrounding area, located in the western part of the Czech borderlands, is examined. The landscape changes in the study area were affected by several events, including population loss after World War II, the operation of a military training camp, uranium mining, and the foundation of a protected landscape area. All of these events were influenced by macroregional factors. Analyses of population data, old maps and aerial photographs, as well as the results of field mapping, were used to assess the long-term effects of past events on the local landscape and its position within the region at several scales. The results demonstrate variations in persistence, and the qualitative importance of the effects of military activity and mining on the social and natural subsystems of the landscape.

Shrnutí

Hodnocení změn v krajině v regionu postiženém vojenskou aktivitou a těžbou uranu (Prameny, západní Čechy, Česká republika): víceúrovňový přístup

Území vojenské aktivity a těžby náleží k typickým případům, na nichž je možné studovat antropogenní transformace krajiny. V předkládané studii se zaměřujeme na obec Prameny a její okolí v západní části českého pohraničí. Místní krajina byla postižena několika zásadními událostmi, zahrnujícími vysídlení po 2. světové válce, fungování vojenského výcvikového tábora, těžbu uranu a konečně vyhlášení CHKO Slavkovský les, přičemž tyto události byly podstatně ovlivněny makroregionálními faktory. S využitím analýzy dat censů, starých map a leteckých snímků a výsledků terénního mapování jsou studovány dlouhodobé efekty dřívějších událostí v krajině, stejně jako její pozice v regionu, a to v několika měřítkách. Provedený výzkum ukazuje variabilitu v trvalosti efektů způsobených vojenskou aktivitou a těžbou na úrovni sociálního a přírodního subsystému krajiny.

Key words: *military training camp, mining, periphery, landscape development, Prameny municipality area, West Bohemia, Czech Republic*

1. Introduction

Landscape development over the past few hundred years is characterized by increasing intensity of human influence, which was conditioned by growing and changing demands of society and has resulted in transformation of the Earth's surface with an increasing extent of human-made, human-induced and human modified landforms as well as human influence on natural processes (Jones, 2001). Therefore, it has to be emphasized that the anthropogenic transformations and changes to the natural environment form a process which is mutually linked to modifications of social structures (Balej et al., 2008), and research in this field calls for an interdisciplinary approach. In some areas, the gradual landscape development was interrupted by events of a rather political nature, which have caused significant changes to landscape utilization, to overall landscape design and to the functions of the territory. Among these areas, certain attention has been devoted to military training fields (MTFs), which represent large areas with limited permeability of borders and specific functions in contrast to their surroundings.

The main aims of previous studies focused on MTFs have had two dimensions. Firstly, emphasis was given to the effects of military activities on the natural environment. Attention was paid especially to military constructions (Illyés, 2010), to impacts of foot traffic and off-road vehicles on soils and to disturbances of vegetation cover (e.g., Whitecotton et al., 2000; Anderson et al., 2005), and reflects an increasing appreciation of the environmental responsibility of military activity in MTFs (Demarais et al., 1999). Moreover, the recent studies suggest that local disturbance combined with limited access to some parts of MTFs frequently allows the evolution of diverse ecosystems. Secondly, the attention devoted to MTFs at a regional level was focused on their effects on and position in regional social and economic structures. This approach is mostly related to a conversion process that was intensified after the end of the Cold War period (Brzoska et al., 1995, 2000; Gazenbeek, 2005). In the Czech Republic, three of eight MTFs have been transferred to civil administration since 1989, while some others are expected to be abandoned by the army in the future. The evaluation of environment, conversion process and potential regional development of MTFs in the Czech Republic is quite specific as it emphasizes the fact that these territories represent a specific type of peripheral or marginal area (Seidl, Chromý, 2010). In this respect, the research was focused on several MTFs in the Czech Republic during the past two decades (e.g., Komár, 1993; Poštolka, 1998; Raška, 2006).

While studies in the 1990s reflected the newly established situation and their aim was to evaluate potential development (scenarios) of MTFs, we can observe a lack of studies that focus on areas of former military activity that have been abandoned in past years and which offer the opportunity to study the conversion process with pre-existing long-term datasets. The example of such an area used in this study is the former MTF Prameny (later known as Kynžvart) in the western part of the Czech Republic, which operated between 1947 and 1954. Nevertheless, the conversion process of this MTF after 1954 has to be evaluated carefully for two reasons:

a) the development of the area consists of two periods with different political, economic and social driving forces, i.e. the socialist (industrial) period and the period of transition since 1989 (post-industrial),
b) the conversion process and regeneration of the local and regional landscape was influenced by uranium mining that replaced MTF in the early ‘50s.

On the other hand, both of these reasons strengthen the rationale for the research, the aims of which were to identify the landscape change (regeneration) between the 1950s and the present-day at several spatial scales. At a local to a microregional scale, our aim was to evaluate the persistence of earth surface transformation and land use patterns in the area of military and mining activity. At a microregional to a mesoregional scale, we primarily used the socioeconomic data to discuss integration of the former MTF into the regional socioeconomic structures (system). Furthermore, our focus enables us to document and extend the results of former research in the whole region, which concluded that “there is not another region of this size in the Czech Republic that experienced all basic types of regional development after the Second World War” (Hampl, 2003).

2. Conceptual remarks

The research conducted for this study was based on conceptual assumptions that have to be explained in order to justify the methodical procedures that were used to achieve the results presented and to enable discussion of these results.

These conceptual assumptions are as follows:

1. The concrete effects of landscape disturbances (herein understood as disturbing impacts of military activity and mining within the study area) will differ with varying spatiotemporal scales,
2. While some effects at certain spatiotemporal scales will be more apparent in the ecological subsystem within the environmental system of any landscape, the others will be important in its social subsystem (cf. Balej et al., 2008). Therefore, a variety of approaches has to be applied,
3. The regeneration of a landscape after disturbance and integration of a local landscape into regional structures is also dependent on development before the disturbance and necessitates the application of long-term data.

The assessment of the regional context of landscape regeneration, which is often represented by social characteristics, can only be carried out using combined quantitative and qualitative data; the use of which reflects the transition from industrial to postindustrial society at a macroregional scale (Hampl, 2003).

3. Methods

3.1 Study area – hierarchical levels

According to the concepts mentioned above, we determined different spatial levels at which the landscape change is assessed. The base level is represented by the municipality of Prameny, which lies in the center of the Slavkov region, located in the Western Czechia, southward of the towns of Karlovy Vary and Cheb (Fig. 1). The municipality is located in the Karlovarská vrchovina Highland, a slightly undulating elevated area (360–983 m a.s.l.; Balatka, Kalvoda, 2006), which was formed with Variscan granitoids and Upper-Proterozoic metamorphites. The presence of uranium bearing ores and Sn-W ores is related to the existence of metamorphic rocks at the intersection of deep faults in the area. The larger part of the highland is protected under the conservation law as the Slavkovský les (Forest) since 1974 due to its natural and cultural values. The municipality of Prameny was a center of Prameny MTF, which was operating from 1947 until 1954 when it moved to the Doupovské hory Mts. (the Hradiště MTF; Fig. 1).

In order to analyze the effects of landscape disturbances at a local scale, we focused on the surroundings of the Čistá town (Lauterbach, Litterbachy), which was most intensively affected by both military activity and mining; the town was totally destroyed during military training. At this hierarchical level, we studied geomorphic effects of military training and mining and we discuss the rate of landscape regeneration during the latter half of the 20th century.

The third hierarchical level was determined to evaluate integration of the post-military landscape into the regional structures. The level was delimited as two groups of municipalities around the municipality of Prameny. At first, it consists of the inner perimeter consisting of 6 municipalities that have slightly homogeneous natural conditions, and were partly affected by military activity and mining, and secondly, the outer perimeter (40 municipalities) that forms a transition belt into a chain of mesoregional to regional centers. This chain of centers is linked by main transportation connections, which are considered to represent the outermost junctions of commuting. This belt has a heterogeneous natural environment, but in general, it was considered as a reference territorial and functional horizon that enables the evaluation of the integration of a microregional level of the study area into the regional structures.

3.2 Data and methods

The analysis at a regional hierarchical level was based on population and economic data from historical census data (Collective, 2005a, 2005b). In addition, the land use structure development was evaluated using the databases of LUCC in Czechia (Bičík, Kabrda, 2008) in the municipality of Prameny and in inner perimeter municipalities. While the

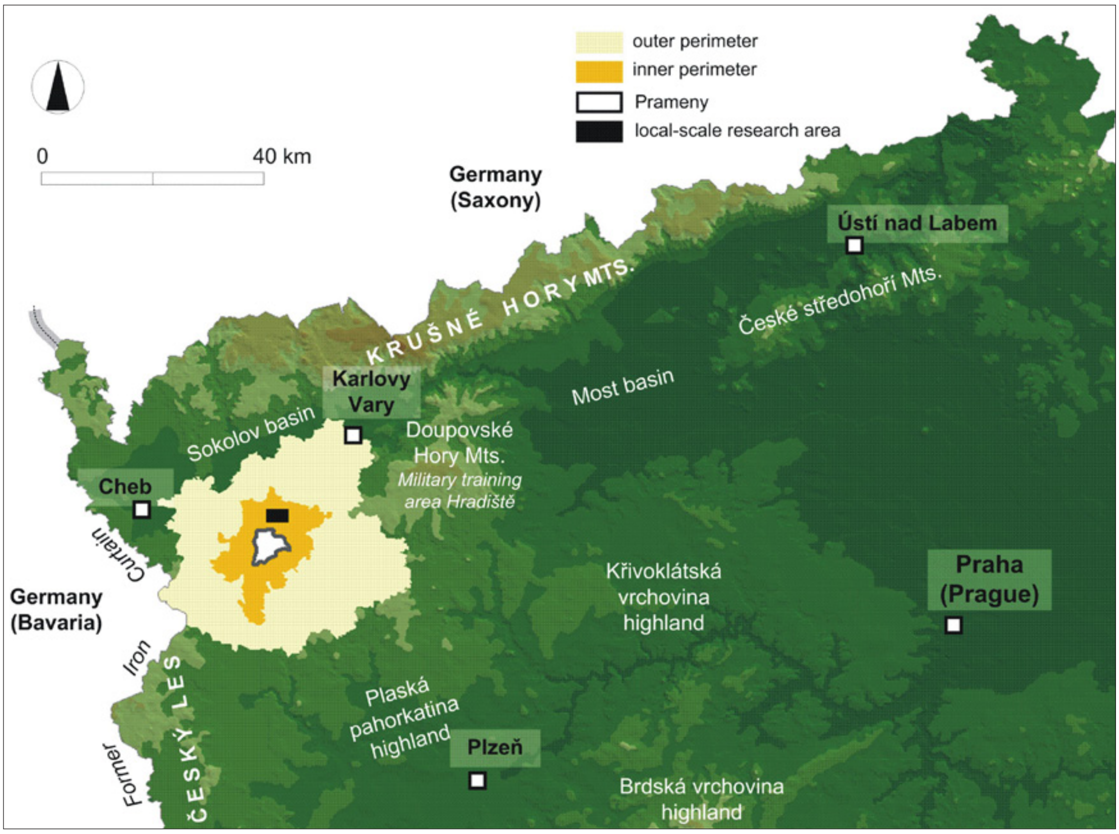

Fig. 1: Location of study areas in three hierarchical levels: (a) local scale "Čistá" – black rectangle, (b) microregional scale "municipality of Prameny" – white with grey margin, (c) mesoregional scale of inner and outer perimeter – orange and yellow

population and economic data can be evaluated at a municipal scale, the territorial units for land use structure development are accessible for so-called basic territorial units (BTU; Bičík, Kabrda, 2007). In our case, five municipalities remain similar to the BTUs (Prameny, Rovná, Krásno, Nová Ves, Mnichov), while the two remaining (Mariánské Lázně, Lázně Kynžvart) have been grouped with surrounding cadastres into one BTU. At a local level, we carried out field mapping and analyses of aerial orthophotos in ArcGIS 9.2. We used the orthophotos from 1952 and 2007 to evaluate the regeneration of the landscape. We analyzed spatiotemporal changes of two major effects of landscape disturbance:

1. the length and structure of off-road tracks caused by military vehicles in the first time horizon and by agriculture in the present day, and
2. the area and structure of forest cover.

For this purpose, the orthophotos have been georeferenced and all visible off-road tracks and forest patches have been detected. The statistical results were obtained by zonal statistics for sampling hexagonal net.

4. Results

4.1 Integration of regenerating landscape into the regional structures

Regional development of the study area was affected by several events of different nature (Fig. 2A) which influenced the integration of the area into the regional structures. The area belongs to the Czech borderland belt, which was inhabited by the prevailing German population before World War II. The most distinct effects of post-war displacement of the German population can be identified in mountainous areas, representing peripheral territories in contrast to sub-mountainous regional centers. Nevertheless, contrary to industrial microregions in the Krušné hory Mts., in which the post-war depopulation and functional changes caused transition from stable areas to new peripheries, the study area ranks among classic peripheries with long-term population deficits and low economic productivity (cf. Hampl, 2003). The displacement of inhabitants from the study area has caused a loss of more than 50% of the population in the outer and inner perimeter municipalities, and of more than 70% in the municipality of Prameny (see Fig. 2C, Tab. 1). Total depopulation in the Rovná municipality was connected with the destruction of buildings and, recently, the majority of the population lives in six new prefab houses.

Similarly to some other peripheral mountainous areas, the natural environment of the study area had a preconditioned prevailing traditional orientation toward extensive agriculture with a below-average ratio of arable land (cf. Bičík, Kabrda, 2007; Fig. 2B).

Military activities in the Czech borderland started at the end of the 1940s reflecting (i) a necessity to restore order in the abandoned borderland, (ii) a plan to disconnect former cross-border relations, and (iii) a newly established geopolitical situation (Kovařík, 2009; Fig. 2A). The MTF Prameny was established in 1947 and caused further depopulation of the area. After a few years of disputes between the national authorities involved, the MTF was transferred to the Doupovské hory Mts. in favour of uranium mining around Čistá town (Tomíček, 2000, 2006). Both the military activity and uranium mining caused the

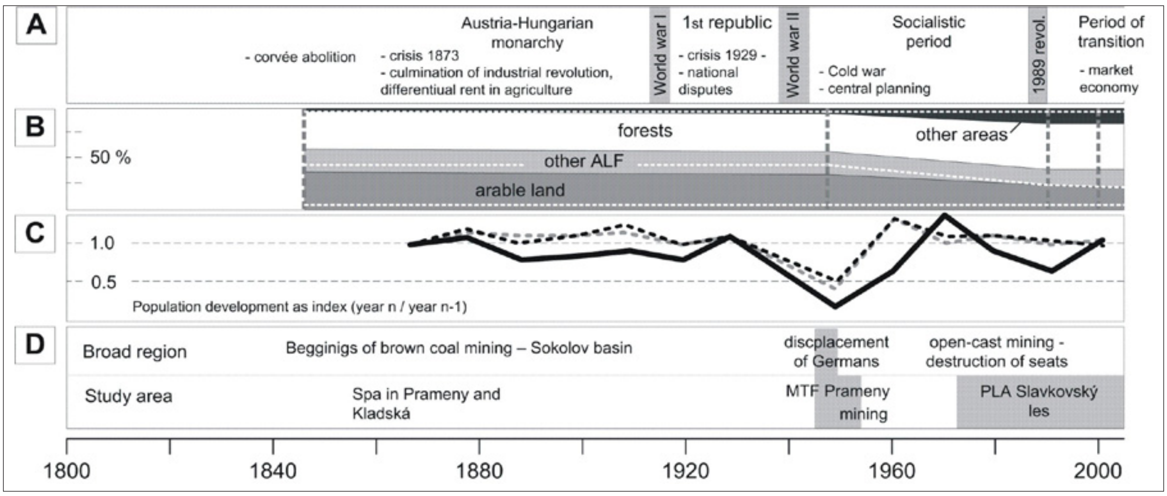

Fig. 2: Coincidence of major political events (A), developmental trends of land use structure (B) and population (C), and driving forces of landscape changes at a regional level and in the Prameny study area (D). Explanation: B - regional trends as filled graph, trends in Prameny as white dotted lines, other ALF (agricultural land fund without arable land); C - black line (Prameny), black dotted line (inner periphery), grey dotted line (outer periphery).
Data: own, Collective, 2005b; Bičík, Kabrda, 2007

	Population change (index)			Economic activity in sectors in 2009 [%]		COM (2001)	UNEMP (2008)	Comments (specifics)
	1950/30	1990/50	2010/1990	AGR	SER			
Prameny	0.20	0.45	1.06	23.64	32.73	57.97	moderate	high debt
Rovná	0.00	82.00	1.16	13.58	33.33	18.07	high	
Krásno	0.42	0.45	1.35	8.14	29.07	58.13	low	countryside tourism
Nová Ves	0.09	1.49	1.15	40.43	17.02	42.86	high	
Mnichov	0.29	0.78	0.94	12.00	38.67	58.27	moderate	mineral water
Mariánské Lázně	0.79	1.66	0.88	1.92	36.86	22.68	low	spa
Lázně Kynžvart	0.55	1.09	0.94	5.44	28.24	48.74	low	spa

Tab. 1: Population and economic characteristics of the municipalities of Prameny and the inner perimeter. Explanation: AGR – agriculture; SER – services; COM – commuting to work; UNEMP – unemployment rate (high: > 13.0% , moderate: 8,0–12,9%, low: < 7,9%). Data: Czech Statistical Office

delay in resettlement of the area in contrast to other areas affected by post-war depopulation (see the peaks of population development in the Fig. 2C).

The resettlement of the area after the end of uranium mining was not fully successful, however. The process was decelerated by both internal and external (regional factors). The internal mesoregional factor is represented by the foundation of the protected landscape area Slavkovský les (Forest) in 1974 (Fig. 2C and 2D). The regional factors include the total transformation of settlement structures resulting in the concentration of the population into basin areas, which focused on open-cast brown coal mining and on the industrial sector (Fig. 3A). The deficit in post-war resettlement can only partly be seen from data about land use structure (Fig. 3D), because they do not give the comprehensive information about relative extent of land use and spatial pattern at a level of individual cadastres. In spite of these limits, the graphs in the map show a slightly larger decrease in the extent of permanent cultures and meadows in Prameny, Rovná and Nová Ves in contrast to other basic territorial units, which were not affected by military and mining activity, and represent or are located nearer to the mesoregional centers.

The developmental trends after 1989 were influenced by the transition process, which is – among other factors – characterised by the increasing role of social capital in regional development, and therefore these trends accentuated the differences in the developmental potential of microregions that were gained during the previous period (cf. Hampl, 2003). This is documented in the Tab. 1, Fig. 2C and Fig. 3 with the data after the first ten years of the period of transition. The effects of delaying the resettlement process is shown in the municipalities of Prameny, Rovná and Nová Ves, i.e. those in the highest parts of the Karlovarská vrchovina Highland (representing the center of the classic periphery) and those mostly affected by post-war depopulation, military activity and mining. These municipalities contain a higher ratio of population younger than 65 years and the lowest number of native inhabitants.

Statistical data shows a population increase in the municipality of Prameny. On the other hand, the qualitative indicators show growing differences between the outer perimeter municipalities and the municipalities of Prameny, Rovná and Nová Ves. As expected, the municipality of Prameny and other rural municipalities within the inner perimeter attain a high unemployment rate and the highest rate of the population commuting to work (Tab. 1). Two of these municipalities deal with extraordinary developmental problems, i.e. with very high public debt (Prameny) and a high rate of unemployment in the economically active ages between 15 and 65 (Rovná).

4.2 Landscape regeneration at a local scale

The study area at a local level in both time horizons, as assessed from aerial images, was composed of a relatively compact matrix of pastures, meadows and surrounding patches of forest vegetation. However, in the first time horizon the land cover and land use structure differed because no pastures and meadows were used for agriculture due to military activity. The major changes in horizontal landscape structure are visible in forest vegetation and in linear anthropogenic transformation (off-road tracks).

The forest vegetation follows the same pattern that was already apparent in the 19th century, so that most changes were within the individual enclaves of forests, and only a few enclaves originated from after 1952, including the one in the former location of Čistá town. The typical process was forestation of forest-free patches within the forest enclaves, resulting in increasing continuity of forest vegetation cover. However, the process was already detected on aerial photos from 1952, showing

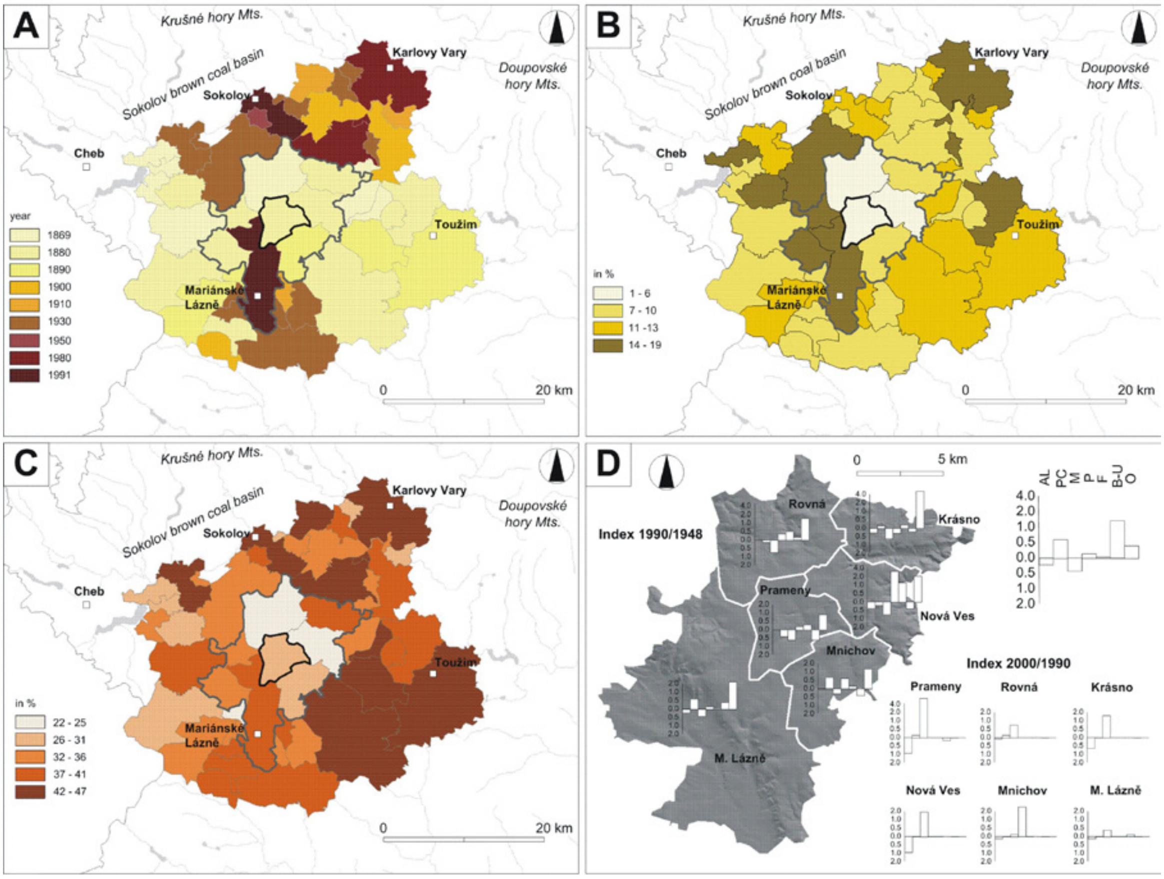

Fig. 3: Population, economic and land use characteristics of the study area A – year of maximum population, B – number of inhabitants older than 65 years, C – number of native inhabitants (black line delimiting the municipality of Prameny, grey line delimiting the inner perimeter), D – index of change in selected land use categories in years 1990/1948 and 2000/1990 (AL – agricultural land, PC – permanent cultures, M – meadows, P – pastures, F – forest land, B-U – built-up area, O – other areas). Data: Collective, 2005a; Bičík, Kabrda, 2007

forest strips of different age, and therefore, this process cannot be directly attributed just to the end of military activity. The total area of fully-grown forest increased by 62 percent between 1952 and 2007, while the area of young forests decreased by 10 percent.

The density and character of off-road tracks represent an important factor, which influences soil quality. The major effect of off-road vehicles is compaction of the soil, although the level of compaction also depends on soil moisture, vegetation and parent material (Becher, 1985). In locations with high slope inclination, the off-road traffic frequently causes disturbance to vegetation and acceleration of sheet erosion. The comparison of the density of off-road tracks in the years 1952 and 2007 is shown in Fig. 4, which documents local concentrations of tracks created by military activity. The average density of off-road tracks, expressed as a number of pixels ($5m^2$ in size), decreased from 1,239 per km^2 in 1952 to 618 per km^2 in 2007. The highest density of tracks in 1952 was 7,743 pixels per km^2 and 2,865 per km^2 in 2007, and the number of sampling fields without any off-road tracks doubled from 1952 to 2007. The spatial pattern of off-road tracks in 2007 was absolutely different from that during the military activity. The new pattern was quite uniform, reflecting the structure of pastures and meadows in the area. Besides the off-road tracks, we identified new drainage ditches, some of them connected with a system of ponds (see next to mining facility in the Fig. 4, year 2007) built in the location of 19th century mills. The local impacts of military activity are represented by trenches as well as total destruction of Čistá town, but the impacts of recent training for bomb attacks on non-forested surfaces are almost not visible.

The relics left behind by mining include two different types of transformation; modifications to the original surface along the Cínový potok Brook, which are typically collapse depressions and accumulation levees caused by tin mining (Fig. 5A), and secondly, the relics of medieval mining and uranium mining in the 1950s. The relics after historical mining are apparent as artificial constructions (Fig. 5B), and subsurface systems of mine drifts (Kaláb et al., 2006, 2008). The relic left by uranium mining is represented only by a dump pile; its effects are much more apparent in social indicators (limited development of the area in times of uranium mining).

5. Discussion and conclusions

The present research of the study area gives a concrete opportunity to discuss several questions from a geographical perspective. In our case study, these questions are:

- are there some differences in the persistence of effects of disturbances caused to the social and natural (ecological) subsystem of a landscape?
- is it possible to ascribe the peripheral (marginal) position of the area located in a center of the former MTF only to military activity and uranium mining, or to other reasons as well? And within both of these questions,
- what qualities can be ascribed to landscape transformations after the end of military activity and to persisting relics after military activity and mining?

At first, our research showed, that physical disturbances to the area caused by military training were almost totally buried by new features connected with agricultural activity in the past 50 years. The length of off-road tracks has decreased and has changed its spatial pattern. In the present-day, the area is utilized for extensive agriculture, which causes no local disturbances, the traffic load on off-road tracks is low and episodic and forest enclaves

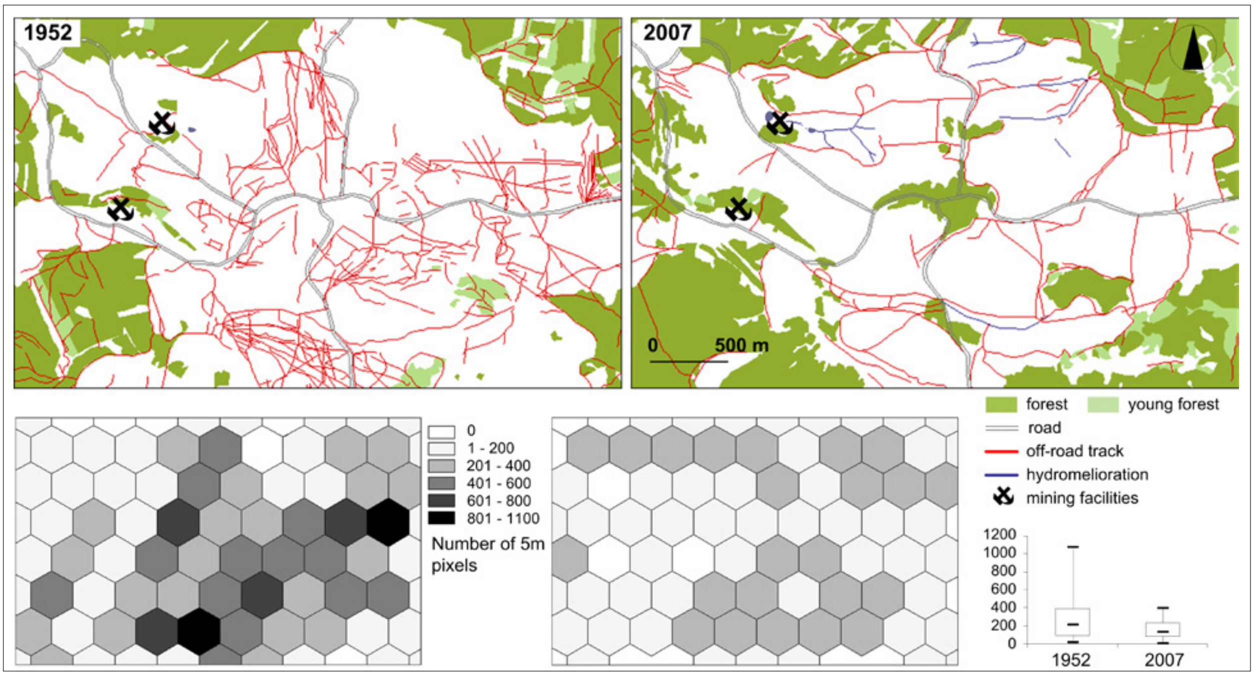

Fig. 4: Comparison of off-road track density and forest vegetation cover in years 1952 and 2007. Below: spatial pattern of off-road track density in sampling net (the rectangles have a similar area as the maps above them), box-plot with statistical distribution of off-road tracks within the sampling hexagons.
Data: aerial photos VGHMÚř Dobruška, GEODIS Brno, a.s.

Fig. 5: A – surface relics after tin mining at the Cínový potok brook; B – Entrance to the upper deck of medieval mine drifts (Photo K. Kirchner)

are continuous. The relics left behind by mining and military activity are limited to the local vicinity and include collapse depressions, mining facilities, drifts and trenches. The importance of a set of mining facilities (e.g. national technical monument Důl Jeroným Mine) and post-mining features, which could represent anthropogenic geomorphosites of regional significance (Reynard et al., 2009), led to intensive geotechnical research of the locality (Kaláb et al., 2006), the aim of which is to contribute to the foundation of an outdoor mining museum. In contrast, the social environment seems to be much more affected by former activities and the inner perimeter of the study area still holds a peripheral to almost marginal position. This position is not an absolute result of military activity and mining, however. To explain the situation, we can apply the concept of path-dependency (e.g. Boschma, Lambooy, 1999), which implicitly showed its relevance in studies of other peripheral borderland areas of the Czech Republic (e.g. Koutský, 2005; Rumpel et al., 2009; Vaishar et al., 2011). The regional application of the path-dependency concept to the study area can be understood in two ways:

1. dependency on the natural environment with prevailing orientation on agricultural production and with a long-term population deficit,
2. following the post-war depopulation trends, which were only accelerated by military activity and uranium mining.

The acceleration of these trends caused the delay in resettlement of municipalities located in the center of the former MTF. In this respect, it can be concluded that the peripheral (marginal) position of the study area was not a new result of military activity and mining, but on the contrary, the location and intensity of these activities was induced by the former peripheral position of the area (cf. Hampl, 2003). Moreover, the path-dependency concept seems still to be valid for the area and it is very difficult if not impossible to "change the path", as was shown by the developmental problems of the municipality of Prameny and Rovná, regardless of whether it was using internal or external incentives.

To summarize, the paper has shown the physical and social effects of military activity and mining on a peripheral landscape in the Czech borderland, and has discussed the persistence of these effects as well as their dependency on the long-term development of the study area.

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OPPORTUNITIES FOR THE CHANGE OF A POST-MINING REGION – CASE STUDY OF THE SOKOLOV–EAST MICROREGION (CZECH REPUBLIC)

Zdeňka LIPOVSKÁ

Abstract

The Sokolov-East region is a typical post-industrial mining region. Mining is finished in most of the area and the two remaining mines are supposed to be closed in approximately 2035. The impacts of mining are evident both in environmental and socioeconomic areas. The paper outlines the possibilities for regional development which could minimize the negative effects of the end of mining. A SWOT analysis and TOWS matrix were used as tools for strategic planning.

Shrnutí

Příležitosti pro přeměnu hornického regionu - případová studie Mikroregion Sokolov-východ (Česká republika)

Sokolovsko je typickým postindustriálním hornickým regionem. Těžba je zde na většině území ukončena a ve zbývajících dvou lomech se ukončení předpokládá kolem roku 2035. Důsledky těžby jsou v území zřetelné na každém kroku a to nejen v oblasti environmentální, ale i socioekonomické. Tato práce se prostřednictvím SWOT analýzy a TOWS matice jako nástrojů strategického plánování snaží nastínit možnosti rozvoje regionu, které by minimalizovaly negativní vlivy ukončování těžby.

Key words: *regional development, post-mining regions, post-mining potentials, Sokolov region, Czech Republic*

1. Introduction

Around the word, mining has been a basis for the development of industrial societies (Conlin and Jolliffe, 2011). Nowadays, many European mining regions and cities suffer from the decline of mining or its complete termination. Lintz and Wirth (2009) state that there were a total of 226 mining regions in Europe and 54% of them were still in operation in 2006. After the end of mining, the resources are depleted, while problems remain or arise. Kuhn and Scholz (2010) sum up the situation of industrial regions by the statement that upturn is followed by downturn and they call these regions as regions shaken to the core.

Problems connected with mining and its decline can be divided into two categories: environmental and socioeconomic. Regarding the first category, opencast mining affects all environmental and landscape components. Its impacts on biodiversity, water quality, and land use are frequently very high. In fact, mining is one of the anthropogenic activities causing some of the most dramatic disturbances on nature (Ibarra, Heras, 2005). Sklenička and Lhota (2002) call this process the landscape memory loss. It means that not only the ongoing landscape development is disrupted, the original ecosystems are removed, but also the original topography is significantly changed (Fig. 1 – see cover p. 4). Thus, opencast mining results in total ecological destabilization and in the elimination of aesthetic values and landscape's recreational potential (Sklenička et al., 2004). Moreover, this is accompanied by considerable changes in the settlement structure (e.g. Bulmer, 1975).

Landscape reclamation is more than ever acknowledged nowadays as an essential instrument of environmental protection (e.g. Dias, Panagopoulos and Loures, 2008). Mining companies are therefore required to create financial reserves for future reclamation. Apart from forest and agricultural reclamation, new forms of reclamation are promoted recently. In particular, water reclamation is widely used within Central Europe (e.g. Lusatia in Germany, a territory delimitated by the cities of Władysławów, Kozmin and Adamów in Poland, the Most region in the Czech Republic). This way of reclamation is generally held to be favourable not only from the environmental point of view but it is also prospective for being used for tourism and recreation. On the other hand, some researchers (e.g. Brzóska et al., 2002) highlighted some related problems such as the lack of water for flooding and mainly the quality of water in future reservoirs. As to the new forms of reclamation, biomass cultivation for energy purposes represents another possible perspective use of post-mining areas.

From the socioeconomic point of view, mining is usually associated with an economic mono-structure. Therefore, the decline of mining in the region results in a crisis for the region's entire economic foundation. This leads to a high level of unemployment with all related social problems, in turn encouraging a wave of emigration (Wirth and Lintz, 2006). The result is a loss of human resources, purchasing power and taxable capacity in the region (Műller, Finka and Lintz, 2005).

To sum up, the decline or the end of mining entails an overall decline of the mining region. To prevent such unfavourable effects of the decline of mining, innovative development strategies are needed. The main challenge is thus to persuade local, regional and national actors to realise that resources from the dying industry can provide a basis for such strategies.

One of projects focused on implementing the idea of turning the problems of post-mining regions into potentials is the ReSource Project within the framework of which this paper came to existence. The ReSource Project tries to help in restoring the competitiveness of post-mining areas and stimulating their sustainable development. It offers an optimal platform for exchange and for the joint development of new approaches. By carefully aimed publicity measures, it increases the political awareness of challenges existing in post-mining landscapes[1].

One of the aims of the ReSource Project is to find strategic options for post-mining regions that would become a base for the strategic planning of regional key actors. The SWOT (strengths, weaknesses, opportunities, and threats) analysis, a method widely used for strategic planning, and the TOWS matrix, the improvement of the SWOT analysis, were used. The results found for the Sokolov-East Microregion will be summarized in this paper.

2. Study area

The case territory coincides with the area of the Sokolov-East Microregion, which is the regional partner of the ReSource Project. The micro-regional union is a voluntary union of 14 municipalities (towns of Březová, Chodov, Loket, Nové Sedlo, and Sokolov, and villages of Dolní Rychnov, Hory, Jenišov, Královské Poříčí, Lomnice, Mírová, Vintířov, Staré Sedlo, and Šabina). The Microregion is specific by three aspects:

1. effect of opencast coal mining, which will continue approximately until 2035,
2. post-war exchange of population, and
3. border location (border with Saxony).

The association of municipalities is located in the Czech Republic, in Western Bohemia, in the Karlovy Vary Region, in the Sokolov District and also marginally in the Karlovy Vary District.

Some parts of the text address broader issues of the region and thus could not be related only to the Microregion's area. In such cases, the broader area is referred to as the Sokolov region and includes all the area affected by mining (34 municipalities – see Fig. 2).

3. Methodology

The methodology is based on the methodology of the ReSource project (packages 3 and 5; see http://www.resource-ce.eu/en/project-results/scientific-support/). The SWOT (strengths, weaknesses, opportunities, and threats) analysis was used to define external and internal factors of the Microregion and afterwards the TOWS (an acronym for different arrangements of the same words as in SWOT) matrix was used to define strategic options. The results of both phases were discussed with the key actors in the Microregion and Local action group Sokolovsko (LAG Sokolovsko).

The SWOT analysis is a method, which has its origins in business management, helping with organizing and highlighting basic behavioural issues about the positioning of a subject in relation to its environment (Foutakis, Thoidou, 2007). During the 1980s, public administration embraced this classical model of

[1] The Project includes ten partners from five countries. Regional partners are the District of Zwickau, the Economic Region of Chemnitz-Zwickau, IBA Fürst-Pückler-Land and the Centre for Enterprise and Technology, Mansfelder Land (Germany), Styrian Iron Route (Austria), the Microregion of Sokolov-East (Czech Republic), the City of Salgotarjan (Hungary), and the Regionalni center za razvoj Zagorje (Slovenia). Science partners are Leibniz Institute of Ecological and Regional Development (Germany), University Graz (Austria), Urbanistični inštitut Ljubljana (Slovenia), and the subcontracted partners are Eötvös Loránd University in Budapest (Hungary) and Mendel University in Brno (Czech Republic).

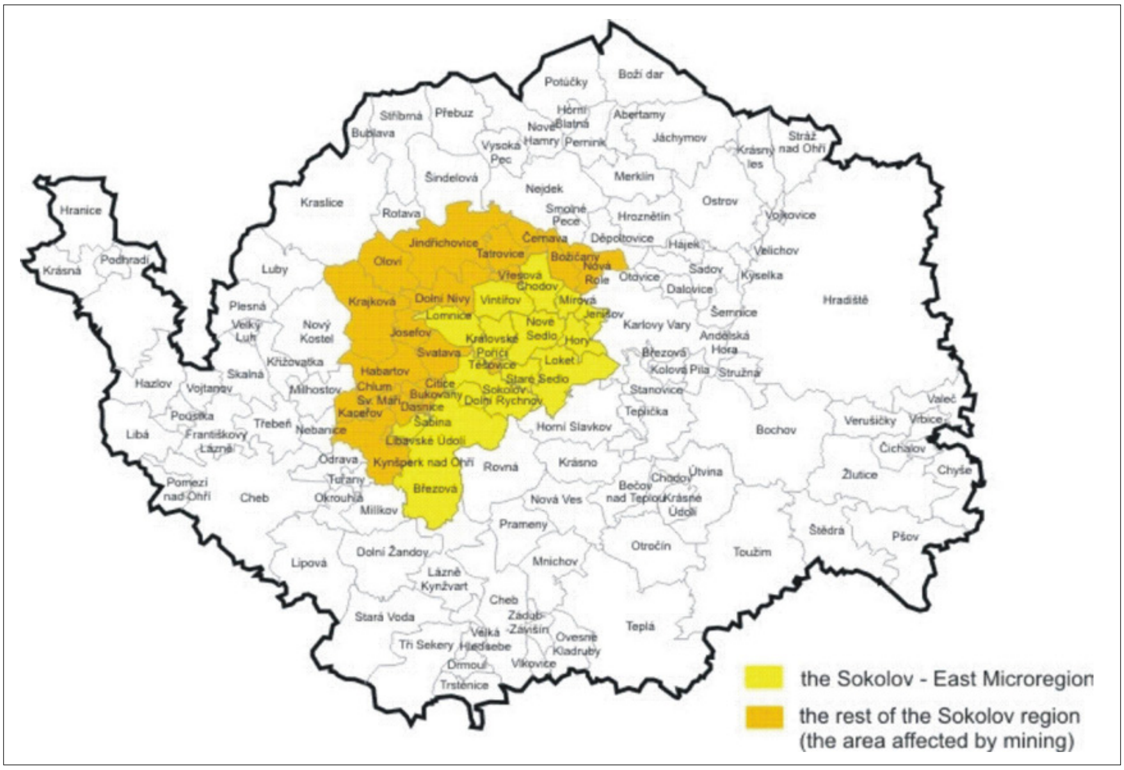

Fig. 2: Delimitation of the key area within the Karlovy Vary District (processed by J. Pokorná)

strategic planning, adopting the basic managerial model across such areas as regional development and municipal planning (e.g. Bryson, Roaring, 1987). The use of the SWOT analysis continues to permeate the academic peer-reviewed literature. Even though the method has been used already since the 1960s, the research still supports SWOT analysis as an exigent tool for the planning purposes (Helms, Nixon, 2010) and the method is still widely used in regional planning all over the word (e.g. Terrados, Amonacid, Hontoria, 2007; Brink et al., 2008; Tan Li, Chun Yan Zhang, 2010; Brebbia, Beriatos, 2011).

To organize the features and qualities of subjects *vis á vis*, four situations emerge through the interaction between the internal and the external environments: strengths, weaknesses, opportunities, and threats. The first and the second ones have to do with the internal environment while the remaining ones with the external environment of the subject (Foutakis, Thoidou, 2007).

In our approach, firstly the SWOT analysis was processed on the basis of documents regarding the strategic planning of the Microregion, member municipalities, LAG Sokolovsko, and wider area (namely the Master Plan of the Microregion Sokolov-East, the Integrated Development Strategy of the Sokolov – East Microregion, the Strategy Plan of LAG Sokolovsko, and the Development Programme of Královské Poříčí Municipality).

To identify the most important key-factors and to reduce complexity for the following strategy development process, five regional actors were asked to evaluate the individual factors depending on their importance for the whole region (scale 0–3, where 0 means no relevance, 1 low relevance, 2 medium relevance, and 3 high relevance). Further steps included only factors with a score above level 2 and more. The regional actors were also allowed to add new factors into SWOT if they would find some important ones missing.

Secondly, the SWOT analysis served as a basis for preparing factor-pair-matrices (TOWS matrices). The TOWS matrix was originally introduced for the formulation of individual company strategies by Weihrich in 1982 (Berndt, 2000). It represents a supporting tool for finding all possible combinations of internal and external factors of the SWOT analysis. Four different factor pair-matrices represent four different types of strategic options:

1. Strengths-Opportunities-Matrix – "Maxi-Maxi" strategic options that use strengths to maximize opportunities.
2. Strengths-Threats-Matrix – "Maxi-Mini" strategic options that use strengths to minimize threats.
3. Weaknesses-Opportunities-Matrix – "Mini-Maxi" strategic options that minimize weaknesses by taking advantage of opportunities.
4. Weaknesses-Threats-Matrix – "Mini-Mini" strategic options that minimize weaknesses to avoid threats.

In our case, the four factor-pair-matrices were used to hold a so-called laboratory workshop where the suggested strategic options and visions were discussed with the stakeholders of the region (members of the Microregion and LAG). Furthermore, they built the operational basis for development of new strategic options during the discussion.

Finally, the found strategic options from individual TOWS-matrices were sorted according to thematic consistency and the redundant ones were to be merged and a final TOWS-matrix (Tab. 1) that outlines the general strategic directions found in the discussion process was created.

4. SWOT Analysis

The SWOT analysis was used to analyze a certain status quo of the Sokolov-East Microregion. In the first step, a local analysis was conducted. In other words, internal factors (strengths and weaknesses) were analysed. The second step was

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">External</td></tr>
<tr><td>Opportunities</td><td>Threats</td></tr>
<tr><td rowspan="10">Internal</td><td rowspan="5">Strengths</td><td>Tourism
mining machine as outlook tower
tourist routes
open-air museum</td><td>Reclaimed area
environmental improvement
higher standard of living</td></tr>
<tr><td>Energy
hydropower plant
biomass, photovoltaics, heating plant</td><td>Industry
industry zones - chemical, wood-processing, glass and ceramic industries
Technology Centre of the Region</td></tr>
<tr><td>Industry
industry zones
Technology Centre of the Region</td><td>Waste
waste processing centre
waste combustion in Vřesová plant</td></tr>
<tr><td>Research, development
in engeneering
in tourism
in reclamation</td><td>Seniors
services for seniors</td></tr>
<tr><td>"Maxi-Maxi"</td><td>"Maxi-Mini"</td></tr>
<tr><td rowspan="5">Weaknesses</td><td>Employment structure
transfer of employment structure - services, industry zones, waste processing</td><td>Employment structure
transfer of employment structure - services, industry zones, waste processing</td></tr>
<tr><td>Education, retraining
secondary schools (renewable energy sources, reclamation, rescuers)
lifelong education, university faculty
Regional Multifunctional Centre of Integrated Rescue Service</td><td>Education, retraining
secondary schools (renewable energy sources, reclamation, rescuers)
lifelong education, university faculty
Regional Multifunctional Centre of Integrated Rescue Service</td></tr>
<tr><td>Water
water supply
flood protection</td><td>Services for inhabitants
sports facilities</td></tr>
<tr><td>Energy
hydropower plant
biomass, photovoltaics, heating plant
Tourism+D13
promotion of the region as touristic area</td><td>Seniors
services for seniors</td></tr>
<tr><td>"Mini-Maxi"</td><td>"Mini-Mini"</td></tr>
</table>

Tab. 1: The final TOWS matrix (authors Z. Lipovská, A. Vaishar)

a global analysis of external factors (opportunities and threats; i.e. potential chances and risks from the external environment). The two steps were based on the existing strategy documents as stated above. Afterwards, individual factors were organized according to their scores gained during the evaluation by key actors as follows:

Strengths

The strengths of the Microregion can be divided into the ones that are common to most post-mining regions (new reclaimed areas, potential for use of renewable energy sources), and on the other hand, the strengths that are specific for the Microregion Sokolov-East. Especially stable population and favourable demographic structure mean a unique combination of characteristics among the post-mining regions, which generally face the population decline. Furthermore, the time factor can be seen as a big advantage from the viewpoint of strategy building as a lot of other post-mining regions began to develop strategies not earlier than after the closure of mining.

- New reclaimed areas (score 2.6) – hydric, forest and specific reclamations create conditions for the development of tourism (e.g. swimming pool Michal, Medard Lake, Golf Course Sokolov).
- Good collaboration between LAG LEADER+ and the Sokolov-East (Microregion) Association of communes (2.6).
- Good accessibility and favourable location (score 2.2) – I/6 road (future freeway D6 Prague–Bavaria) is the Microregion's axis. The regional centre of Karlovy Vary is very close and the Microregion is situated within the "spa triangle" (Karlovy Vary, Mariánské Lázně and Františkovy Lázně).
- Existence of natural heritage (score 2.2) – the protected landscape area of Slavkovský les Forest is located near Sokolov.
- Existence of traditional industry (score 2.2) – glass and porcelain industries have a long tradition in the region.
- Time factor (score 2.0) – mining activities are expected to continue until 2035; therefore, it is possible to prepare measures for the replacement of mining with activities of other economic sectors. Compared with other regions under investigation within the ReSource project, Sokolov-East and Styrian Iron Route are the only regions where mining is still active. (Mining in the Zasavje region in Slovenia is to be finished in 2012.)
- Stable population and favourable demographic structure (score 1.8) – the Microregion as a whole showed a slight population increase (267 persons in 2005–2010). Only three largest towns saw a population decrease in the mentioned period. Higher increases were recorded in the rural communities of Jenišov (78% in 2005–2010), Mírová (30%) and Hory (13%), mainly due to the suburbanization effect of the nearby spa town of Karlovy Vary (Fig. 3). With an exception of Březová, the average age of residents in Microregion's villages is more favourable than the national average. Within the regions under ReSource project investigation, the Sokolov-East is the only region with the stable population. All the other regions face a population decline.
- Existence of the cultural heritage (score 1.8) – cultural heritage is represented namely by the historical town of Loket.
- Potential for use of renewable energy sources (biomass cultivation on stockpiles, use of geothermal energy from mining water – score 1.4) – these potentials have not been utilized so far but there are efforts to use the geothermal energy within the Microregion (cooperation with the Mansfeld-Südharz region).
- Projects supporting traditional crafts and cultural life (1.2) – reconstruction of the Bernard Grange (Fig. 4) with its conversion into a centre of traditional crafts is a good example of the revitalization of old handicrafts.

Weaknesses

Turning to weaknesses, unfavourable social and educational structure, high dependence of employment on mining, hence high unemployment, and poor environmental image belong to the characteristics of post-mining regions. On the other hand, lack of cooperation between the Mining Company and the Microregion as well as consequences of the post-war population exchange represent very specific conditions of the Microregion.

- Unfavourable social and educational structure (score 3.0) – the qualification gravity centre of the Microregion's population consists of people with the completed apprenticeship (including secondary vocational schools without the general certificate of education) and of people with the basic education (including incomplete). The share of people with no education is above average (Sokolov Administrative region 0.9% vs. CR national average of 0.4% in 2001). Contrary to the national situation, the share of people with the completed secondary, vocational and university education is below the average (Vaishar, Šťastná, Lipovská, 2010).
- High dependence of employment on the largest employer Sokolovská uhelná Mining Company (score 3.0) – about 4,000 people are employed by the Sokolovská uhelná and ca. other 6,000 by the downstream sector. The dependence of employment on just one sector is -or used to be- characteristic of

Fig. 3: Suburbanization effect in Jenišov near Karlovy Vary (Photo Z. Lipovská)

Fig. 4: Bernard Grange – Centre of traditional crafts (Photo Z. Lipovská)

all the mining regions under investigation.

- Lack of cooperation between the Sokolovská uhelná and the Microregion (score 2.8) – there is a lack of willingness to cooperate on the part of the Mining Company.
- Structural changes in economy followed by unemployment (score 2.6) – the unemployment rate in the Sokolov Region is highly above the national average, mainly due to the following two factors: decline of extensive mining activity in this region and structure of local population, which is characterized by a significant proportion of the Roma population. In connection with the decline of mining activities, many people have lost their jobs and it is difficult for them to get a new job in another field because of their qualification. The problem of the Roma minority has to do with the even lower educational level than the average Microregion´s one. High unemployment is a general problem of all post-mining regions under investigation within the ReSource project. All the regions have experienced a down-scaling in the number of employees working in the mining sector over the last 25 years.
- Poor environmental image (score 2.6) – brown coal mining and downstream industries have a very negative impact on all components of the environment (pollution, "lunar landscape"). The Sokolov region is known as one of the most affected regions in the Czech Republic. This problem is common to all regions under investigation within the ReSource project where coal mining took place.
- Consequences of the post-war population exchange (score 2.2) – a greater part of the original population was transferred after the Second World War. The number of displaced German inhabitants is estimated at 8 thousand. Mainly Czech people from

all over Czechoslovakia replaced them. In the 1950s and 1960s, many people came here to work for mining-related industrial enterprises. This explains why local people do not identify nowadays with the territory as inhabitants in other parts of the Czech Republic. This is a very specific problem of Sokolov-East which has no analogy in other regions under investigation.

Opportunities

Opportunities mean chances resulting from the external environment. The use of reclaimed areas for tourism and renewable energy production as well as a better use of EU funds seem to be perspective for all post-mining regions. In contrast, the cooperation with Bavaria and Saxony is to a great extent dependent on the border location of the Microregion.

- Use of the reclaimed area for tourism (score 2.8) – especially activities connected with the Medard Lake can attract tourists. The Sokolov Golf Course is of importance too. Effort to develop tourism is a common characteristic of all studied post-mining regions.
- Collaboration with Bavaria and Saxony (score 2.6) – common projects in tourism, education, innovation etc. have a vast potential.
- Policies supporting renewable energy sources (biomass, geothermal energy – score 2.2) – some studies have already been carried out to explore the use of geothermal energy form mining water in the Czech Republic (within the Project RIV/61989100:27350/99:00009238 Possibility of geothermal energy utilization from coalmine waters in the Czech Republic, Project GA105/09/0808 Exploration of Raw Material and Energy Use of the Potential of Mine Water in Flooded Uranium Mines). The study of using geothermal energy in the Sokolov region is planned (cooperation with the Mansfeld-Südharz region) within this ReSource project. Thus, there is a great opportunity, which could be used soon. Generally, a development in biomass cultivation for fuel is expected as the Czech Republic has committed to 8% and 13% of consumed energy originating from renewable resources until the end of 2010 and 2020, respectively. The first step of biomass cultivation on stockpiles in the Czech Republic was made within the Project No. 11M0571 of MEYS. This type of reclamation is highly recommended and thus a development in this area is expected. However, it will probably depend on the national energy concept and accordingly on the amount of subvention for the cultivation of biomass for energy purposes.
- Better use of EU funds (score 2.0)
- Support of local SME (score 2.0)
- Higher interest for living in the countryside (score 1.2)

Threats

All the below mentioned threats are considered to be common to all studied post-mining regions. No threats were identified that would be specific only for the case area.

- Emigration of skilled workers from the region (score 3.0)
- Increasing unemployment and related emigration (score 2.8)
- General trend of population ageing (score 2.4)

5. Identification of strategic options

The final TOWS matrix (Tab. 1) shows general strategic directions found in the whole process of strategy planning. The strategic directions are named by simple headlines and the individual strategic options under these headlines are then described in detail below. As it is evident from the matrix, some strategic options occur in multiply quadrants and therefore can be highlighted as multifunctional.

As a mining region, the Sokolov region is fully dependent on one sector – mining. Therefore, it is very important to diversify the regional economy into heterogeneous sectors.

Industry

Although most jobs should be dislocated into services, industry will remain an important sector in the region. The main challenge for local and regional actors is to diversify economy and to remodel it toward products with a higher share of added value. To support local industries, new industry zones are planned to be constructed. The Mining Company and the municipalities of the Microregion are the main initiators. One industry zone is already being built near Nové Sedlo. Nevertheless, a clear vision of industry zones' orientation is still missing. One idea is a specialization in the traditional industrial sectors of the region: chemical, glass, ceramic and wood-processing industries.

The Microregion's representatives advocate the idea of building a Regional Technology Centre near Sokolov. The Centre would serve as a starting base for industrial production in the region. A part of the Centre should be a workplace for applied research focused on branches that are applicable in the region (e.g. reclamation, revitalization – research areas, engineering).

Water

Many visions and strategic options in the region are linked to new lakes that are expected to be created by flooding the Jiří and Družba mines. The extensive Medard Lake (almost 500 ha) has already been created through hydric reclamation of the Medard mine (Fig. 5 – see cover p. 4). The new water reservoirs could be used as a source for water supply and for flood control of the region.

Energy

Furthermore, the water reservoirs are planned to be used for energy supply. The construction of hydroelectric power plant and heat pumps represents another opportunity. As the Sokolov region is a region with the traditional energy production, there is an effort to continue this tradition. The supply of renewable energy sources provides an auspicious opportunity since the new energy sources would mean an important step of the region to sustainable development.

Biomass cultivation on stockpiles is considered to have a vast potential. First reason is that this energy source is assumed to have the greatest potential of all renewable energy sources in Czech conditions. Secondly, the soil on stockpiles usually cannot be utilised for food production. In fact, there have already been conducted some researches in planting biomass on stockpiles in the Most region in the Czech Republic with quite a great success (e.g. Usťak, Mikanová, 2008).

Utilization of photovoltaic sources is also a possible variant in the post-mining area. However, it does not have such an energetic potential as biomass in the region due to the lack of solar radiation.

Waste management

Waste management can represent another area enhancing the regional development. Strategies linked to waste management of the region are based on increasingly stringent requirements for the waste treatment.

The core of this strategy option lies in the construction of complex waste processing structure (waste sorting, waste processing, recycling, new technologies for new products of recyclable raw materials). The unsortable component of waste would be processed in the Vřesová power plant as the Mining Company owning the power plant plans for its continual transformation from coal to waste as a main energy source for the power station.

Tourism

One of the Microregion's strategies is focusing on the development of tourism. Although this sector of regional economy is not likely to become the crucial one, it has a potential of becoming an important contributor to the local and regional economy. Newly reclaimed areas (water bodies with recreational facilities, forests), natural heritage (protected landscape area of Slavkovský les Forest) and cultural heritage (historical town Loket) should be the main tourist attractions. In relation to cultural heritage, symbols of mining heritage are still missing in the region. Nevertheless, regarding the use of cultural potentials, the Microregion´s authority is coming up with ideas how to enhance the attractiveness of the region. These plans are inspired by examples from German post-mining regions and focus on highlighting the region's mining traditions. For example, an old mining machine would serve as a view tower on the Smolnice dump, tourist routes along the mining attractions and an open-air museum (with railroad tracks, locomotive and replications of buildings) would be built. Regarding the recreation, it is expected that the construction of sports and recreation complex will contribute to retain young and educated inhabitants in the region.

Education, retraining

As stated above (in the SWOT analysis part), the region's educational structure is quite unfavourable. This is associated with low skill requirements on the one hand and relatively high salaries in the mining sector on the other hand. As a result, miners who have lost their jobs are very disadvantaged on the labour market. Development of education that should lead to a change in the employment structure (mainly from mining to services) is thus necessary. Indeed, development is needed both in the traditional education (secondary and university education) and in the retraining. Regarding the secondary and vocational education, schools should be focused on fields applicable in the region (engineering, renewable energy sources, reclamations, rescue services etc). Local actors support the idea for the localization of a University faculty within the Microregion. Border location can be used to establish bilingual schools, to organize bilingual camps and to exchange programmes in cooperation with Germany. An ambitious project which could bring a great benefit for the region is the Regional Multifunctional Centre of Integrated Rescue Service. It is a multi-purpose complex that would serve both the training needs of the integrated rescue system and volunteer rescue workers. Such a complex centre for rescuers is still missing in the Czech Republic; thus, the newly established centre would gain a national importance. Also, the location nearby the Medard Lake seems favourable for the success of such a project.

Research and development

Another important strategic field for the region is research and development. It is planned that centres of applied research will be established in fields applicable in the region – e.g. as a part of the Regional Technology

Centre. The areas of interest should be in line with other strategic options. This means that research should be applied mainly in engineering, small hydroelectric power station, testing of heat pumps in water-water system, reclamation and ecological succession, tourism, regional development, and information technologies.

Seniors

Focus on seniors relates to the common trend of population ageing. Although the Microregion has quite a favourable age structure of population, the problem of population ageing cannot be neglected. Therefore, not only the construction of medical, rehabilitation and social facilities but also the establishment of businesses focusing on activities for seniors (various forms of recreation, leisure time activities) should be supported.

Reclaimed areas, services for inhabitants

One of strategies that should be based on all the other strategic options is getting rid of the bad image. Bad image of the region (both in the environmental and social sense of the word) is an issue not only because it discourages people to visit the region but mainly because it also discourages new skilled people to settle down there. Besides the creation of attractive natural areas (water bodies, forests), promotion of the region as a "green region" (e.g. as an area of tourist destinations, as a region oriented on renewable energy, with businesses that have a positive approach to environment protection) is one step forward to reduce this problem.

In addition to the poor environmental image, the low standard of housing disadvantages the region in terms of its attractiveness for new migrants. It is expected that the higher standard of living should attract more educated and economically stronger groups of people. Hence, a gradual transformation of the social structure in the region would be enabled.

6. Strategic directions

Main weakness of the region is a typical problem of all mining regions – mono-structural economy and related dependence of employment on mining. Another problem connected with the decline of mining is unfavourable social and educational structure that leads to the deepening of unemployment problems.

Therefore, the main strategy directions of the Microregion are focused on the diversification of economy and employment structure.

Main directions in which economy should be diversified are services (in tourism, services for seniors), various industry sectors (mainly trying to utilize the tradition of chemical, wood-processing, glass, and ceramic industries with additional focus on new technologies) and energy (utilizing the tradition of the region as a centre of power engineering and focusing on new energy sources such as hydropower plants, biomass and photovoltaics). Besides, water supply (connected with the flooding of mines) and waste management (sorting, recycling and thermal processing) can assume new functions in the region. In fact, these functions could utilize one of the region's strengths: good accessibility and location. In addition to good accessibility, other strengths of the region such as newly reclaimed areas and the existence of natural and cultural heritage can be used for the development of tourism. To make the region more attractive, mining heritage is planned to be used (mining machine as a view tower, tourist routes along mining attractions and an open-air museum of mining).

To avert the threats of rising unemployment and emigration, education is crucial (in forms of retraining, secondary and university education). Also, the planned Regional Multifunctional Centre of Integrated Rescue Service seems to be perspective.

To ensure the progress of the region, research cannot be ignored. Hence, workplaces of applied research in fields applicable in the region are planned to be established (possibly as parts of the Regional Technological Centre).

All these aspects should help to disengage the Sokolov region from the bad image and to make it attractive both for current residents and newcomers.

7. Assessment of the strategic options and their chance for success

The suggested options cannot be seen as equivalent. They have different values in respect of innovativeness, transferability, acceptance by the key actors, and also potential synergy with other options. Thus, it is important to evaluate these factors. Here, innovativeness, transferability and potential synergy with other options were assessed by the author and other scientific project partners on the basis of expert opinions, while the acceptance by the key actors were described on the basis of interviews with the representatives of the Microregion and LAG Sokolovsko. The concepts were defined within the project ReSource: Innovativeness in this approach means that strategic option is unique, new (upgraded) and solves underlying problems on another, clever level of thinking. Transferability means that the strategic option can be implemented in different regional framework conditions. Concerning transferability, all suggested options seem to be transferable to other post-mining regions.

Regarding innovativeness, the regional technology centre means innovative approach because it represents a basis for industrial production as well as for applied research in fields applicable in the region. However, despite the importance for the Microregion and initial support provided by the regional authority of Karlovy Vary to place it within the Microregion Sokolov-East, the idea is not supported by the Mining Company, and it seems that the Regional Authority of Karlovy Vary will finally find another location. Industrial zones represent a more likely variant, and some of them are already being built. However, the specialization of the zones is not clear yet. The suggestion of the Microregion is to revive the tradition of regional industries such as chemical, wood-processing, glass, and ceramic industries.

Also, the centre for waste processing means a great challenge for the Microregion, which came up with this idea and finally gained the support of the Mining Company. Even though, there is a possibility that cities from other regions would establish a similar centre earlier and then the project in the Microregion would not be feasible.

The idea of the Microregion as an energy centre focused on renewable energy sources (hydropower plant, biomass, photovoltaics) is quite innovative in the Czech Republic. This strategy option is in synergy with the use of new water bodies for water supply and recreation. However, according to the representatives of the Microregion, this idea encounters the very nature of miners who believe that coal is not replaceable by renewable energy sources as well as the unwillingness of the Karlovy Vary self-government to invest into these projects even though they initially supported the idea.

The management of the Microregion is putting an effort to transform the region into a tourist area. Nevertheless, the Mining Company does not consider the vision beneficial in terms of jobs creation and refuses to cooperate with the Microregion in this field (e.g. the Microregion wants to attract people by erecting a monument of mining – old mining machine. But the Mining Company requires the Microregion to pay the price of secondary raw materials which goes up to dozens of millions CZK. It is thus impossible to implement the idea because the Microregion cannot afford it).

Regarding education, the strategy option of secondary education support seems viable, while the chance to establish a university faculty is very improbable currently because the new faculty is already planned to be established in the town of Karlovy Vary. Bilingual schools, camps and exchange programmes (cooperation with Germany) represent a good way for utilizing the border location of the Microregion.

The Regional Multifunctional Centre of Integrated Rescue Service is supposed to be beneficial for the Microregion as it will be of national importance.

From the synergy point of view, creating new water bodies by hydric reclamation is the crucial plan because almost all other strategies are dependent on this plan or synergic with it (especially visions connected with water supply and water energy use and development of tourism). Moreover, it is supported by all key actors (Microregion, surrounding municipalities, Mining Company, and self-government of the Karlovy Vary Region).

8. Conclusions

To sum up, the SWOT analysis and the TOWS matrix methods completed by discussions with the key actors proved as an efficient way of searching for strategic options for regional planning.

The found strategic options seem to be beneficial not only for the Sokolov-East Microregion yet they are also expected to be transferable to other post-mining regions. In addition, they are unique and innovative from the region's point of view.

Based on the experience from the laboratory workshop, the management of the Microregion is aware of possible strategy options and is active in the creation of plans and visions.

Still, the main problem consists in the fact that the only realistic stakeholder in the region is Sokolovská uhelná Mining Company. The Company owns a significant part of land in the region and moreover its executives believe that they can decide on the future of the region regardless of the views of local people. It follows that if the Mining Company does not share the visions of the Microregion, their greater part cannot be fulfilled. Especially the visions and plans related to tourism encounter this obstacle as the Company does not consider tourism to at least partly compensate for lost jobs.

The strategic options that are common for the Microregion and the Mining Company have a much greater chance for success. Waste processing centre of the region, development of light industry, and the Regional Multifunctional Centre of Integrated Rescue Service belong to strategies supported by both parties.

In most cases, however, also the support of the Karlovy Vary Region is needed as it decides upon the location of projects such as the Regional Technological Centre. Most projects related to renewable energy utilization, research and education also depend on the support of the regional authority.

Thus it follows that the cooperation of all possible actors is needed. A rapid action is important too because the opportunity may be missed due to the emergence of competing projects in the surrounding regions. In short, there is no time to waste time even if there are still more than twenty years before the mining will be finished. Long-term planning and coming up with innovative visions are the essential steps to start with.

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THE DATABASE ON BROWNFIELDS IN OSTRAVA (CZECH REPUBLIC): SOME APPROACHES TO CATEGORIZATION

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Abstract

The problematics of brownfields are discussed with respect to terminology and some examples of a few approaches to the categorization of brownfields. The status of the brownfield areas database in Ostrava in 2000 is then described, with the results of updates to 2010. Some particular cases of regeneration are then treated, with a focus on areas of mining brownfields, 15 of which were registered in the 2000 database.

Shrnutí

Databáze brownfieldů v Ostravě (Česká republika): přístup ke kategorizaci

Příspěvek se zabývá problematikou brownfieds. V úvodní části je krátký vstup do terminologie a ukázka některých přístupů ke kategorizaci. Další část se pak věnuje popisu stavu databáze ploch brownfields v Ostravě v roce 2000 a výsledkům její novelizace v roce 2010. V další části jsou popsány některé konkrétní příklady regenerací, se zaměřením na ploch důlních brownfields, kterých bylo v roce 2000 celkem 15.

Key words: *brownfields, database, Ostrava, Czech Republic*

1. Introduction

Brownfields are recognized as a problem in numerous European cities that require EU policy attention. Brownfields result from structural changes such as decline in traditional extractive manufacturing and mining industries (Ferber et al., 2006).

European institutions have been dealing with the issue of brownfields for a long time. There are numerous research projects and initiatives which aim at regeneration of these areas. To name but a few let us mention the following examples:

- NICOLE – The Network for Industrially Contaminated Land in Europe,
- CLARINET – The Contaminated Land Rehabilitation Network for Environmental Technologies in Europe,
- CABERNET – Concerted Action on Brownfields and Economic Regeneration Network,
- The RESCUE project "Regeneration of European Sites on Cities and the Urban Environment",
- COBRAMAN – Manager Coordinating Brownfield Redevelopment Activities, which is still ongoing project.

At present there is no common definition (based on legislation) for brownfields across Europe. One of the first European attempts to define the term brownfields was made by a European working group within the CLARINET network (Ferber, Grimski, 2002).

CABERNET, revising the CLARINET definition, has defined brownfields as sites that:

- have been affected by the former use of the site and surrounding lands,
- are derelict or underused,
- may have real or perceived contamination problems,
- are mainly in developed urban areas,
- require intervention to bring them back to beneficial use.

The issue of brownfields regeneration has become related to sustainable development because a successful regeneration should prevent the areas turning back into brownfields again in the near future. Following definitions of sustainable brownfields regeneration have been devised:

RESCUE provide an EU-wide definition of sustainable brownfields regeneration – "The management, rehabilitation and return to beneficial use of brownfields in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable, institutionally robust and socially acceptable ways within the particular regional context" (RESCUE, 2003)

Thorton et al. (2007) recommend actions which need to be taken in order to reach sustainable development on brownfield areas. These actions in form of policies and campaigns should:

- eliminate the present legal obstacles to brownfields regeneration (i.e. clarifying ambiguous legal liability),
- provide legal incentives/regulations and direct and indirect financial incentives to encourage development of brownfiels and discourage development of greenfields,
- place a high 'tax' on the development of greenfields in order to discourage it,
- reduce public opposition to 'derelict land' through information campaigns on the benefits of regenerating and reusing this type of site.

Yet another definition is provided by Williams and Dair (2007) which suggests that a sustainable development of brownfields is one that has been produced in a sustainable way (e.g. in terms of design, construction and participation processes) and enables people and organisations involved in the end use of the site to act in a sustainable way (Williams, Dair, 2007).

Despite all projects and initiatives there are still some issues prevailing such as lack of compatible databases (Ferber et al., 2006) which would allow (with the use of common structure and brownfields categorization) a comparison of brownfields across Europe.

In the next few paragraphs we will mention some categorizations that had been recommended and used by various authors and initiatives.

The categorization according to Spasovová (2004) assumes the existence of a complete assessment of area attributes. It divides areas into several categories from 1a: low chance of contamination, well situated with few or no buildings to 4d: contaminated area, poor transport access and high number of existing buildings – is an example of such delimitation.

Martinec et al. (2006) on the other hand assume that complete information is not always available and divide therefore the areas on the basis of generally available information - former area use. Martinec et al. define five main categories: mining, industrial, agricultural, military and social brownfields which are then further divided based on other attributes. Former use of the areas is a meaningful classification as it allows several assumptions about an area e.g. definition of expected contaminants. (Jackson et al., 2004).

ABC-Model of CABERNET group (Concerted Action on Brownfield and Economic Regeneration Network) is also a categorization which is worth mentioning. It classifies the areas according to their economic potential for future use (Ferber, Grimski, Millar, Nathanail, 2006).

- A-Sites – are highly economically viable and development projects are driven by private funding,
- B-Sites – are on the borderline of profitability; these projects tend to be funded through public-private co-operation or partnerships,
- C-Sites – are not in a condition where regeneration can be profitable. Their regeneration relies mainly on public sector or municipality driven projects. Public funding or specific legislative instruments (e.g. tax incentives) are required to stimulate the regeneration of these sites.

Another example for the classification of brownfields can be the LONDON BROWNFIELD SITES DATABASE (http://www.londonbrownfieldsites.org/Content/database.aspx).

This public brownfields database is in fact EP National Land Use Database (NLUD) for the London area, only it has been elaborated to greater detail. London's database contains areas sized from 0.1 ha while the minimal extent of an area in NLUD is set to 0.25 ha. The database contains over two thousand of brownfields in London which represent more than 2% of the Greater London Urban Area (2011) – http://www.homesandcommunities.co.uk/ourwork/national-land-use-database.

NLUD classifies brownfields into five main categories:

- CATEGORY A – Previously developed land which is now vacant,
- CATEGORY B – Vacant buildings,
- CATEGORY C – Derelict land and buildings,
- CATEGORY D – Previously developed land or buildings currently in use and allocated in local plan or with planning permission,
- CATEGORY E – Previously developed land or buildings currently in use with redevelopment potential but no planning allocation or permission,

Categories D and E relate to 'in use' or latent Brownfield land.

Also in the Czech Republic there is a project which has similar ambitions as the NLUD database. The National Database of Brownfields offers brownfield sites prepared to suit the plans of domestic and foreign developers. The primary foundation of the database is the Research Study for the Location of Brownfields, which was conducted over a two-year period beginning in 2005. CzechInvest, in cooperation with individual regional authorities, prepared the study in all regions of the Czech Republic with the exception of Prague. The database divides areas according to the former land use to the following categories:

- housing,
- tourism,
- transport,
- civil amenities,
- industry,
- mining,
- military sites,
- agriculture,
- other.

2. Brownfields database of Ostrava

Ostrava is a city located in the North Moravia area close to the borders with Poland and Slovakia. It is one of the largest cities in the Czech Republic and an administrative centre of the Moravian-Silesian region.

In the middle of the 18th century, Ostrava – named Moravská Ostrava back then – ranked only at the 53rd place in size among Moravian towns. The major swing in the town's history came at the turn of centuries when recent discovery of large coal deposits in the area had led to industrial boom. In 1828, Rudolf's iron works in Vítkovice were founded and huge impact

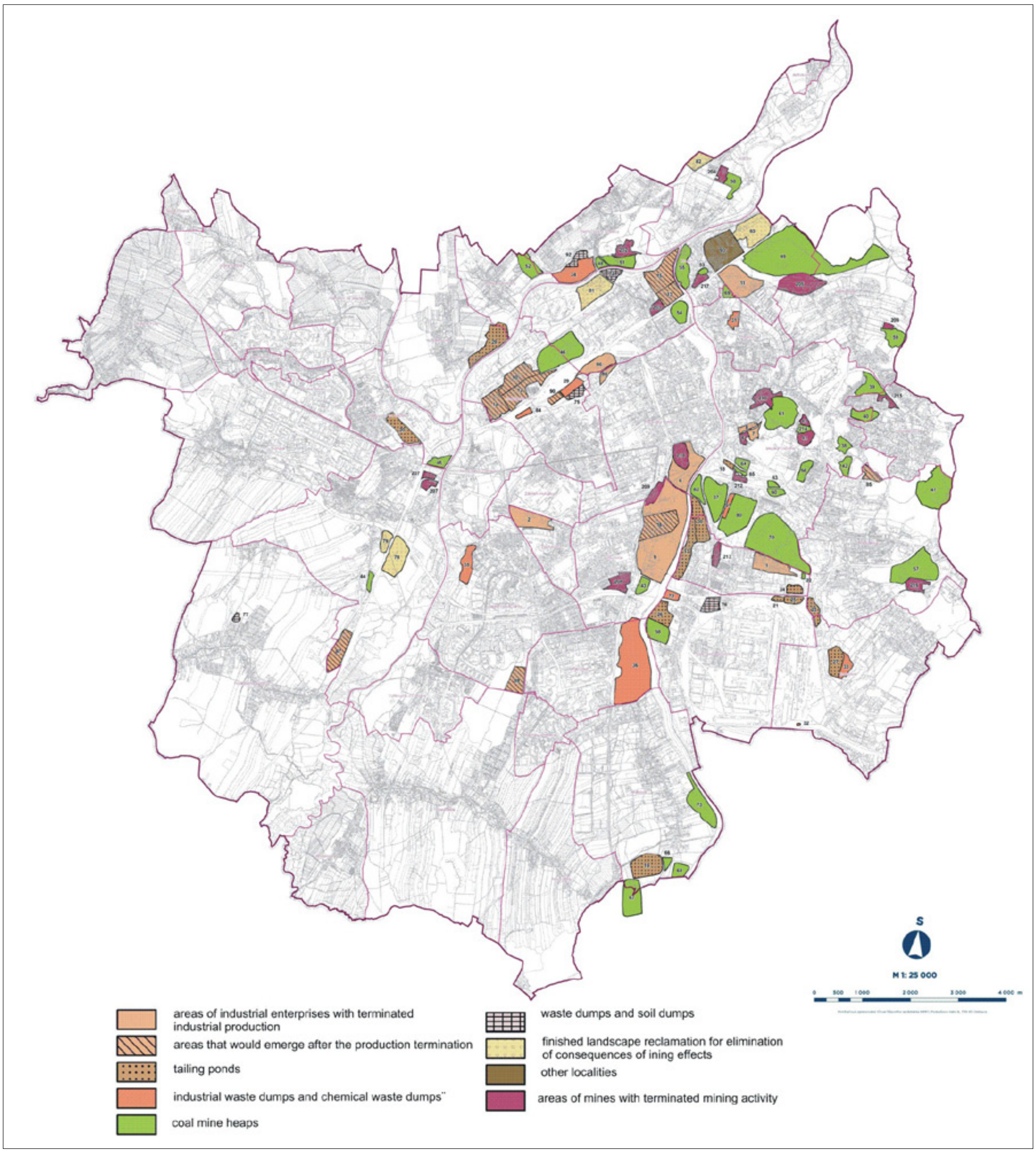

Fig. 1: Brownfields in the Ostrava city area – in 2000
Map was elaborated by the Division of the main architect of the Ostrava City – ing. T. Linart

on town's raise had also the finishing of Kaiser-Ferdinand's-Nordbahn from Vienna. In 1829, the town had only 1,752 citizens while forty years later its population amounted already to over 7 thousand.

At the end of the 19th century, Moravská Ostrava became the most significant industrial area of the Austrian-Hungarian Empire. In times of the First Czechoslovak Republic – in year 1924 – several villages joined Moravská Ostrava to form a common administrative unit. The population rose to 114 thousand. The contemporary city of Ostrava consists (since the year 1992) of 34 municipalities and its population is over 300,000 citizens (Bakala et al., 1993).

After the year 1945, Ostrava specialized in heavy industries – mining, iron and steel production and chemistry. The city retained this priority until the Velvet revolution in 1989.

In the early 1990s, big changes came to Ostrava in the form of close-down mines and reduction of industrial enterprises. This trend has brought many new phenomena. One of them is the emergence of brownfields which – as a result of Ostrava's historic development – are often located in urban areas of the city.

The main aim of this article is to show examples of brownfields with primary focus on the areas after

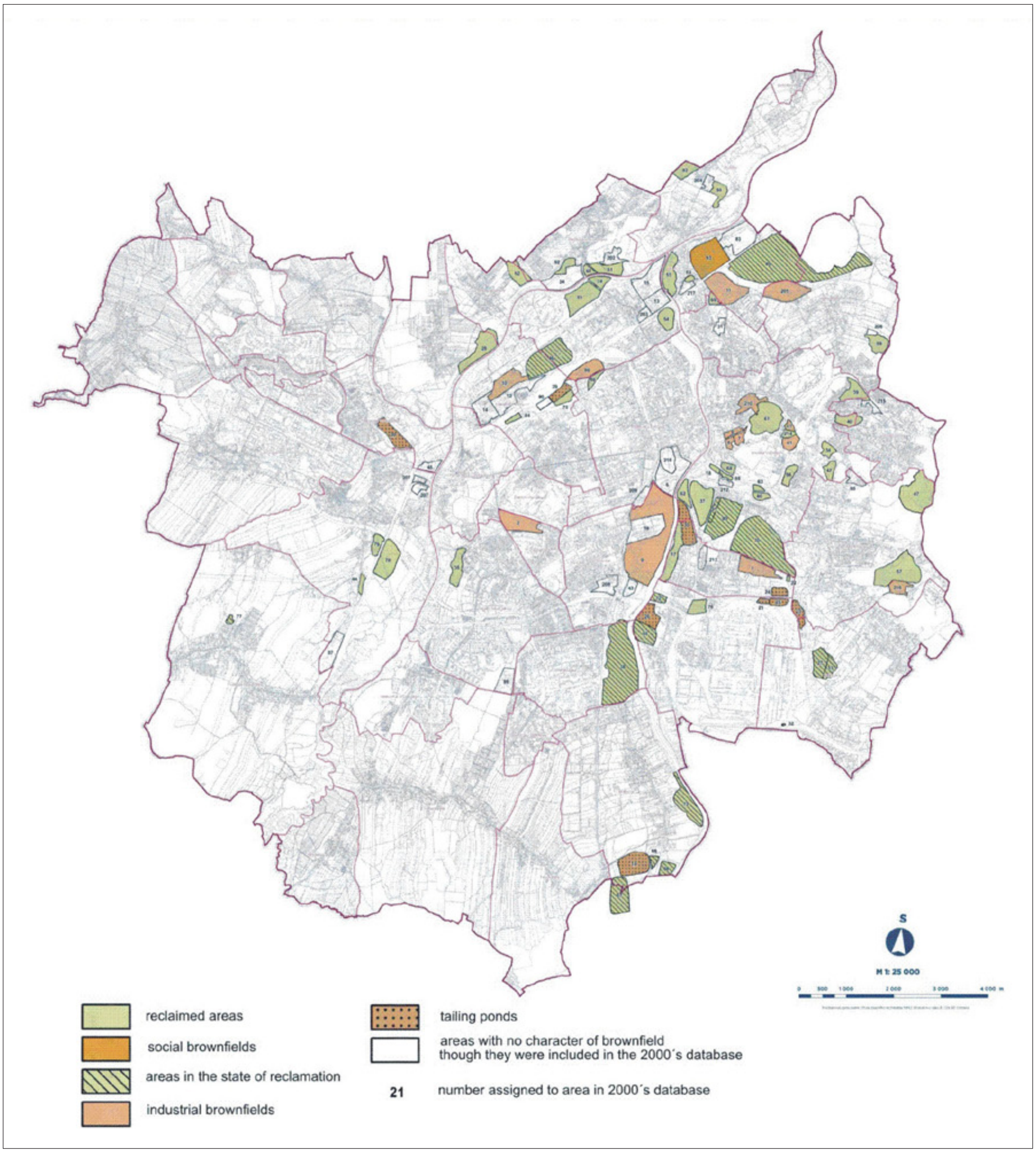

Fig. 2: Updated map of brownfields from 2000 (state in 2010)
The map was created by the Ostrava City Division of the main architect – ing. T. Linart

mining activities and to present how the perception, approach and regeneration of brownfield areas changed in the past 10 years in Ostrava and also to show the importance of including these areas in the Land use Plan and the work of city representatives. The brownfields database created in 2000 and updated in 2010 is used as a source of selected examples.

2.1 The database of brownfields – 2000 and 2010

Observing the massive closing down of plants and other heavy industry sites, city representatives soon realized that the consequence would not be only unemployment but that the influence of this process is reaching much farther; abandoned and no longer used sites represent also an important drawback - from problems that they cause to the adjacent land up to unfavourable viewing of the city by new investors seeking their potential opportunities. In 1998, the Ostrava City authority established close cooperation with the Faculty of Civil Engineering at VSB-Technical University of Ostrava, which resulted in coming to existence of the first brownfields database containing 110 brownfield sites, which were inserted into the city's information system. (Kuta, Koudela, 2004). Visualization of the state is depicted from Fig. 1. This cooperation continued in 2010 and the result was an updated map of brownfields in the city of Ostrava, which shows a more recent status of these 110 sites (Fig. 2).

The database from the year 2000 (it was prepared between 1998 and 2000, but the year 2000 will be used for reference in the article as it was in 2000 when the information from the database was transferred into the information system of the city) was prepared in times when the term brownfield was translated as "devastated industrial area" (without wider acknowledgement what exactly the term brownfield represented – see Koudela, Kuda, Zdařilová, 2004). Devastated industrial area was an area left in a poor condition after its former industrial use, loading its surroundings with expected ecological burden. Therefore, the database registered areas, which could be understood as areas devastated by industrial operation. Sometimes, a term "abandoned industrial areas" was used, too, as most of the areas were related to the cessation of industrial activities. Another frequently but incorrectly used term for brownfields was "old ecological burdens"; this is why the database included also tailing ponds and communal waste heaps which by themselves do not represent brownfileds as such. In order to get a complete picture of the situation it is necessary to understand the situation in the region as well as reasons why the database was created in a structure that does not seem to be best suited from the today's point of view. At the end of 1990s, Ostrava faced high unemployment rates with no optimistic prognosis for industry and a massive exodus of young generation out of the region, mainly due to lacking job opportunities. This was the reason why city representatives decided to map not only areas which were real brownfields but to map virtually all larger areas which remained after the industry with no regard to whether they had already turned into brownfields or not.

Areas in the 2000's database were divided into nine following categories:

- areas of industrial enterprises with terminated industrial production,
- areas that would emerge after the production will have been terminated,
- areas of mines with terminated mining activity,
- tailing ponds,
- coal mine heaps,
- finished landscape reclamation to eliminate consequences of mining effects,
- waste dumps and soil dumps,
- Industrial waste dumps and chemical waste dumps,
- other localities – areas "other localities" included also a social brownfield in Ostrava-Hrušov, which was very unusual at that time).

In 2010, cooperation on the brownfields database was restored as a part of the "Partnership for Czech Brownfields" project preparation with the intention to update the existing database from the year 2000. The aim was to make a new assessment of individual areas and re-classify them on the basis of the CABERNET definition that is currently dominantly used for the definition of brownfields (Vojvodíková et al., 2010).

The new 2010 update did not aim at creation of a new brownfields database, inclusion of areas emerged after 2000 or searching for smaller social or agricultural brownfields; its only aim was to update certain parameters and to add current status to the 10-year-old database.

It is also necessary to remind the fact that the categorization of areas as brownfields is not clearly defined by legislation and it often reflects rather historical circumstances or actual feelings of the evaluator. Also, this updated database aims at describing how the areas developed since the year 2000.

The areas were divided into six following groups:

- industrial brownfields,
- social brownfields,
- areas with no character of brownfield – (though they were included in the 2000's database),
- reclaimed areas,

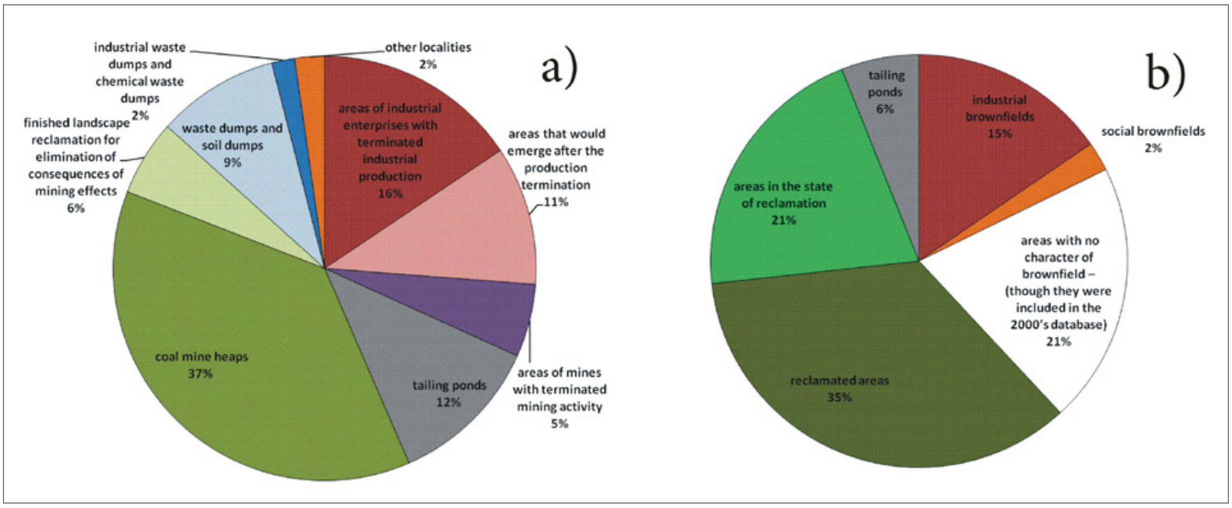

Fig. 3: a – Proportion of areas pertaining to the individual brownfield categories in the Ostrava database – year 2000 and b – Proportion of areas pertaining to the individual brownfield categories in the Ostrava database – year 2010

- areas in the state of reclamation,
- tailing ponds.

The first two groups describe the existing industrial or social brownfields (no other types of brownfields were worked with in the two databases). The third group encompasses areas that have never become brownfields or which are not brownfields any more. The issue of mine heaps, waste dumps and consecutive reclamation was split into two groups: areas with terminated reclamation activities and areas with ongoing reclamation activities (e.g. burning of the Heřmanice heap where currently redevelopment and extinguishing works are going on). Tailing ponds were classified in a separate group again.

Comparing the maps from 2000 and 2010 (Figs. 1 and 2) we can see that Ostrava has been rather successful in dealing with burdens caused mainly by industrial and mining activities.

In total, the brownfields database contains almost 1,900 ha of various areas. Percentage shares of individual categories can be seen in Figures 3a and 3b.

3. Comparison of the classification of sites in the Ostrava's databases between the years 2000 and 2010

Considering that the categories have changed in relation to the refinement of brownfields definition, the principal comparison dwells on comparing the number of sites in the individual categories and their transfers between the categories. For a better orientation in changes of individual areas, Fig. 4 was prepared, which shows an example of areas included in the 2000's database in the category: areas of industrial enterprises with terminated industrial production.

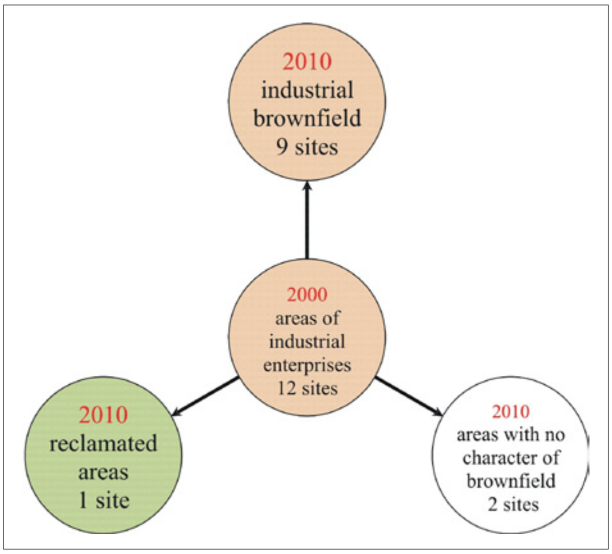

Fig. 4: Changes of the site classification into categories in the years 2000 and 2010

All 110 sites in the database were taken into account. The greatest share was that of mine heaps – there were 35 of them in 2000. Reclamation is finished on 26 heaps, 7 heaps are currently in the process of reclamation and 2 were reused (e.g. construction of Hornbach store on the Jeremenko heap). Out of 14 initially registered tailing ponds, four had been fully reclaimed (Fig. 5), 2 were in the process of reclamation and 8 were still in operation as active tailing ponds. This category in the 2010 database includes also 2 chemical waste dumps whose character is that of ponds.

In the category of industrial waste dumps and chemical waste dumps, two sites were classified with areas which are not brownfields anymore but only one of them can be considered as a successful case of reuse, where ground was made up and light industrial

Fig. 5: The site of an old tailing pond after reclamation – area Lhotka (Photo B. Vojvodíková)

operation was launched; the second site must have been classified in this category by mistake in the year 2000 – probably because it had been owned by MCHZ (Moravian-Silesian Chemical Works) – and nowadays it is a football field and garages (still in use).

From 10 areas that were supposed to become brownfields in the year 2000, only one has become a brownfield so far, namely the mine Jan Šverma in Ostrava-Mariánské Hory. At this point it might be useful to discuss why the brownfields database contained sites which could emerge as brownfields only in future?

Answer to this question should be sought in a far-sighted approach to brownfields - mainly on the part of municipality, which had acquired an overview of possible potential problems.

So what had happened on sites that did not become brownfields?

For example, current operation was preserved and pessimistic future visions of the whole region were not fulfilled (e.g. Coking plant Šverma or Coking plant Svoboda). Some areas immediately found a new

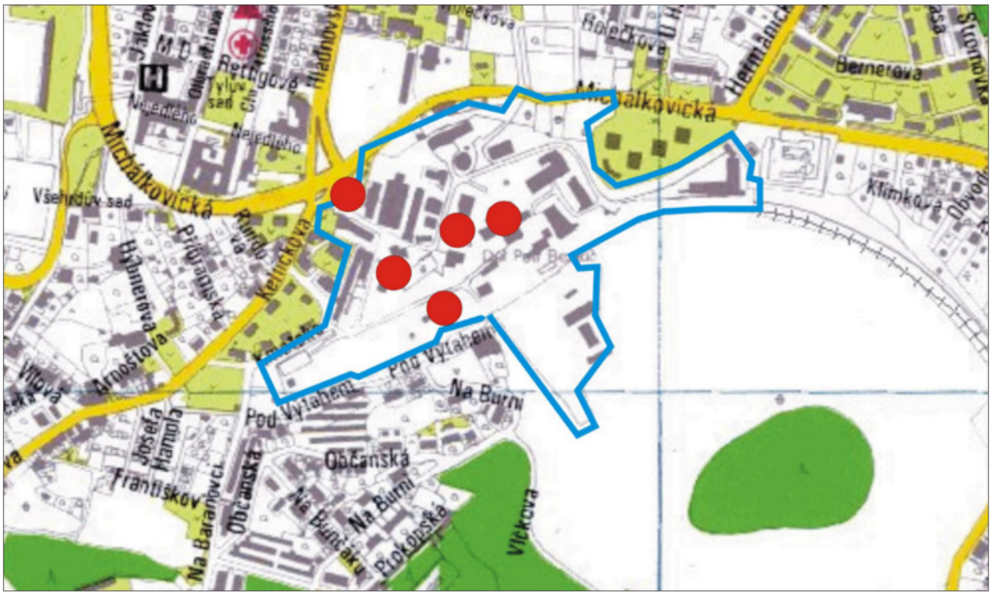

Fig. 6: The Petr Bezruc mining site with the construction closure due to former mine works

function (e.g. Strabag premises in the cadastre of Polanka nad Odrou), or the potential of the original use of the site was retained in the same or some other form. It is an example of the site of VVUÚ (Scientific and Research Coal Institute) where many companies are located which are successors of the former research institute and made use of laboratories existing on the site.

From the group of "areas of industrial enterprises with terminated industrial production" the most famous and definitely successfully regenerated locality is the coking plant Karolína right in the city centre of Ostrava. The second site which is now included among areas which are not brownfields anymore (the site of the former cement works) does not look like brownfield anymore – at least major parts of it, but its utilization in the future is not clear yet.

The coking plant Karolína (and the Karolína mine) is a unique project in the Czech Republic due to its complexity and amount of decontamination work done. The municipality of the Ostrava city played a key role in the process of regeneration from the very stage of the thoroughly contaminated brownfield site in 1990 – to the new development of New Karolína – housing, recreation and retail area – in 2010.

3.1 Sites left after mining enterprises

A separate chapter was devoted to areas left after mining enterprises. Reasons why these localities were tackled separately consist in their specific features. The first of them is the existence of the mining work itself – around the closed mine shaft the construction closure was announced (circle of 25 m in diameter). Even more such areas where construction is forbidden may occur on a single site, representing a significant barrier to the future utilization of the site (example see Fig. 6). Other typical features are preserved hoist towers and other objects which have become a part of the National technical heritage.

Former mining areas are specific also because of ownership issues. After the end of mine excavation in the Ostrava region (Decree No. 264/91 and 691/92 issued by the Czech government), all localities of former mines were united by their former owner OKD a.s. into one organizational unit. In 2002, most of the sites became state property. Their owner became State Enterprise DIAMO s. p., which owns many of the sites or their parts until now and carries out gradual remediation of them.

Nowadays we can find these mining sites in the following categories:

1. sites which have not become brownfields,
2. sites which are not brownfields anymore (a site that is only partly used and the rest of the site is green and maintained is not considered as a brownfield),
3. sites which still bear all signs of brownfields.

The first group representative is the Mine Michal, which was taken over by the Ministry of Culture of the Czech Republic at the time of its close-down in 1994. The Ministry established the Industrial museum in Ostrava there. This museum was later affiliated to the National Heritage Institute in Ostrava (website Coal mine Michal).

Premises of the Mine Anselm may represent another example – there is a Mining Museum there today. After the end of mining, it remained in the ownership of OKD a.s. The site is currently owned by the Vítkovice Holding and by the interest association of legal persons "Lower Vítkovice", which operates the entire Landek Park (see website Landek premises and the Mine Anselm).

The second group includes sites of certain use – even in the situation when the consequent reconstruction goes on slowly – or areas in which buildings were pulled down and which have become basically green sites now. From the aspect of their future use it is good to have them marked in the brownfields map mainly with respect to possible developers who might be unpleasantly surprised if not informed (A typical feature of brownfield sites is that in most cases, the precise documentation on the location of objects and old engineering networks does not exist and buried reinforced concrete foundations can be found even at places where no such objects should be present according to the map documents. These problems can result in additional costs on the part of the developer and they should be anticipated in the project).

One typical example was mentioned already – the Karolína coking plant and mine. Another example of successful regeneration which can be regarded almost as a textbook example is the Area of Mine Alexander which is currently owned by the Charity of St. Alexander. The first building in the ownership of Charity was "Carriage barn" acquired by purchase. From the beginning it made home for a sheltered workshop of woodworking and textile production and also the charity management is located here. The building underwent complete reconstruction in the years 2005 and 2006 in order to return it to the original historic state. In 2008, the Charity of St. Alexander acquired other two buildings with the statute of preserved cultural heritage by voluntary conveyance from the Ostrava City municipality, namely the "Carriage barn" and the "Administrative building". After the property transfer in April 2009, general reconstruction of the Carriage barn had been started that was finished in October 2010. The Administrative building should serve the purposes of so called sheltered housing in the future (see the website of the Charity of St. Alexander).

Untypical is the Mine Jeremenko site where a “water pit “is situated and draws mine water from the flooded closed mines in Ostrava.

The third group contains e.g. the Mine Trojice site, sites of the Mine Petr Bezruč or the Mine Michálka. All three sites are located in the cadastre of Slezská Ostrava and situated in the vicinity of Ema slag heap – the highest point of Ostrava. Today, the sites are partly used by various companies, but there are also objects which are abandoned and in a poor technical condition. Due to these objects, the sites look unattractive (Fig. 7). One of possible causes to persisting problems might be assigning the function of light industry to this site in the urban plan. For example, the site of the Petr Bezruč mine was determined for light industry in spite of the fact that there are five construction closures and the site is adjacent to a residential zone. In the new development plan, the site is included as a core area, serving as a centre for public amenities together with housing in the urban development of central residential zones (regulations for the functional and spatial arrangement of urban territory), and the statutory town of Ostrava together with the local authority of Slezská Ostrava invest much effort into its regeneration.

4. Discussion

The main topic for discussion is the approach chosen by Ostrava for the classification of brownfields as compared with other existing databases. As can be seen from the general description in the introductory chapters of the article, the town of Ostrava is clearly a pioneer in this field and so it sought its own original approach. As very useful can be considered the inclusion of the category of brownfields potentially emerging in the near future (a similar category appears in the database of the municipality with extended competences Ústí nad Labem). The map from 2010 shows the condition of the sites directly related to structural changes in the last decade of the 20th century. Another topic for discussion can be the inclusion of heap sites as brownfields where a problem may arise in the opinion of the authors whether the site in question is abandoned or not.

5. Conclusion

Areas which we denote as brownfields nowadays represent a problem for the development of municipal cadastre which they occupy. It can be said though that thanks to the emphasized support on both theoretical and practical levels, the term brownfield has become clearer and widely used. General public recognizes this term and thanks to the well established definition of the CABERNET group which is respected in the whole Europe, the term is becoming stabilized.

Fig. 7: Entrance to the Petr Bezruč Mine – 2010 (Photo B. Vojvodíková)

The development of the brownfields database in the city of Ostrava documents on the one hand the long-term character of regeneration process but on the other hand it shows also that the process can be positively or negatively influenced by many different players.

However, the fact that the term brownfield is missing in our current legislation allows to work with the definition and to modify it according to specific requirements and situations. What can indicate a problem in the development of our settlements in the future, are "new brownfields" (e.g. abandoned supermarket), where a legislative instrument for establishing a special fund for the regeneration of these sites does not exist so far neither any other procedure that would address the regeneration of new brownfields.

Acknowledgement

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POST-MINING DUMPING GROUNDS AS GEOTOURIST ATTRACTIONS IN THE UPPER SILESIAN COAL BASIN AND THE RUHR DISTRICT

Łukasz GAWOR, Andrzej T. JANKOWSKI, Marek RUMAN

Abstract

Industrial regions of the Upper Silesia Coal Basin (Poland) and the Ruhr Basin (Germany) are inseparably connected with mining activity, which results in deposits of a huge volume of waste on dumping grounds. The dumping grounds have become a part of the cultural landscape and they can be considered as geotouristic attractions. The negative influence of dumping grounds on the natural environment, however, requires taking effective preventative measures. It is equally significant to carry out effective reclamation and economically-justified development of these dumping grounds for geotouristic sites. These actions, strictly connected with the application of interdisciplinary scientific research, must be reflected in appropriate legal regulations.

Shrnutí

Posttěžební skládky jako geoturistické atrakce v Hornoslezské uhelné pánvi a v Porůří

Průmyslové oblasti Hornoslezské uhelné pánve (Polsko) a Porůří (Německo) jsou nerozlučně spjaty s těžbou, což má za následek mimo jiné uložení obrovského množství odpadů na skládkách. Skládky se staly součástí kulturní krajiny a mohou být považovány za geoturistické atrakce. Nicméně, negativní vliv skládek na přírodní prostředí vyžaduje přijetí účinných preventivních opatření. Je nutné také provádět účinnou regeneraci a ekonomicky odůvodněné využití ploch skládek, např. jako geoturistické plochy. Tyto aktivity, úzce spojené s aplikací interdisciplinárního vědeckého výzkumu se musí promítnout do příslušných právních předpisů.

Key words: *geotourism, industrial heritage, post-mining dumping grounds, reclamation, Poland, Germany*

1. Introduction

Geotourism is defined as tourism that sustains or enhances the geographical and geological character of a place – its environment, culture, aesthetics, heritage, and the well-being of its residents. Geotourism incorporates the concept of sustainable tourism. Geotourism also takes a principle from ecotourism and extends it to culture and history (e.g. industrial heritage) as well, that is, all distinctive assets of a place (www.nationalgeographic.com). Geotourism may be also defined as a tourism surrounding geological attractions and destinations (Newsome, 2006).

In the industrial areas there are plenty of potenial geotouristic objects, from among these ones could be named industrial monuments (e.g. old shafts, miners estates) and mining waste dumps. The good examples for such objects may be found in the industrial regions of Ruhr Basin (Germany) and the Upper Silesian Coal Basin (Poland).

The objective of the paper is a comparison of these two industrial regions which origin is connected with coal mining activity with particular regard to post mining dumping grounds as geotourist attractions. The background for this comparison is the present legal situation and an analysis of law deeds concerning reclamation and using of coal mining waste dumps.

The applied methods comprise comparative analysis of post mining dumping grounds in the investigated regions, based on literature studies, statistical data analysis and evaluations during field works in Ruhr District and USCB. The research work has been done in the period 2004–2008 and all described objects have been visited by the authors.

Every year, the EU generates more than 400 million ton mining waste. This amounts to over 20% of the waste generated in Europe and comprises the single largest category. About 30 million ton per year of waste rock from coal-mining is generated in Upper Silesian Coal Basin (USCB) in Poland and about 25 million ton per year of waste rock in Ruhr District in Germany. Although about 15–16 million ton per year (or even more) of waste rock is being reused for civil engineering purposes, the remaining waste is deposited on waste-dumps (Szczepańska, Twardowska, 1999). Mining waste dumps cause negative environmental impacts and constitute hazards to the inhabitants. However, after effective technical and biological reclamation the dumping grounds may be well developed and they are able to get new functions. It is equally significant to carry out effective reclamation and economically justified development of dumping grounds e.g. as geotouristic sites.

2. Investigated areas

2.1 Ruhr Basin

The Ruhr Basin (German: Ruhrgebiet) is an urban area in North Rhine-Westphalia, which is situated in the north-western part of Germany. With 4,435 km^2, and a population of some 5.3 million, it is the largest urban agglomeration in Germany. It consists of several large, formerly industrial cities bordered by the rivers Ruhr to the south, Rhine to the west, and Lippe to the north (Fig. 1).

Geologically, the region is defined by the occurrence of coal-bearing layers from the upper Carboniferous period. The coal seams reach the surface in a strip along the River Ruhr and deep downward from the river to the north. Beneath the River Lippe, the coal seams lie at a depth of 600 to 800 metres. The thickness of the coal layers ranges from one to three metres. This geological feature played an important role in the development of coal mining in the Ruhr Area, which is also connected with occurring of numerous post mining dumping grounds (Kift, 2008).

2.2 Upper Silesian Coal Basin

The Upper Silesian Coal Basin (USCB, Polish: Górnośląskie Zagłębie Węglowe, GZW) is a coal basin in Silesia, situated in the southern part of Poland but also partly in the Czech Republic (the Ostrava-Karvina Coal Basin) (Fig. 2). It is a triangle shaped synclinal form with an area of about 6,100 km^2 (Cabała, Ćmiel, Idziak, 2004). The population reaches the number of some 3.5 million inhabitants.

The geological structure of the USCB shows a lot of similarities to mountainous and limnic coal basins of Variscian age in western Europe. The Carboniferous mudstone and sandstone complex with numerous coal seams has a thickness of up to 8,000 metres. The most favourable conditions for coal exploitation occur in the north and southwest of the basin where tectonic uplifting took place, exposing a part of the Upper Carboniferous coal-bearing formation. There is as well as in the Ruhr District a great number of mining waste dumps in the USCB (Cabała, Ćmiel, Idziak, 2004; Gawor, 2004).

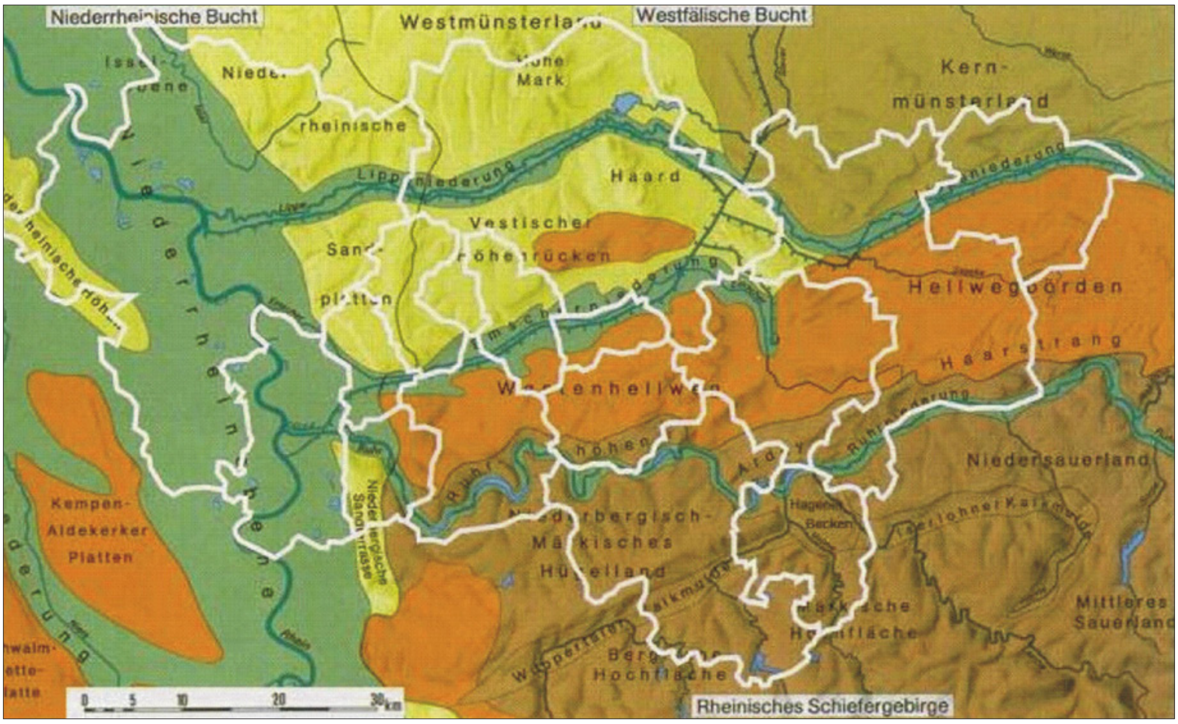

Fig. 1: Ruhr District (www.ruhrgebiet-regionalkunde.de)

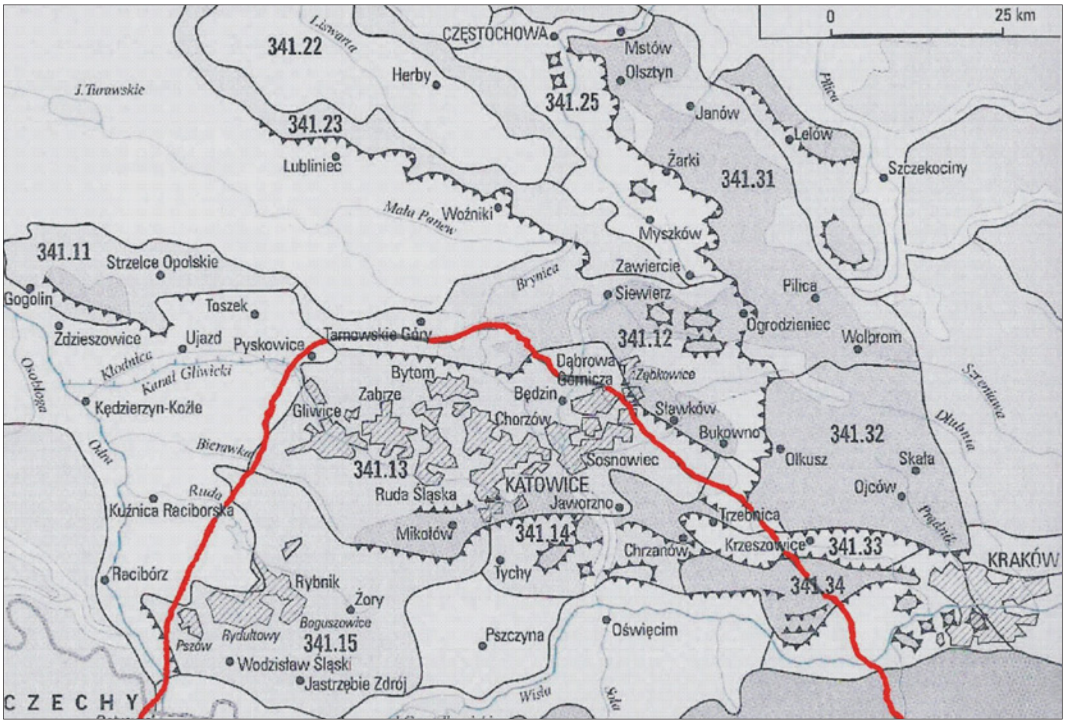

Fig. 2: Situation of USCB (after Kondracki, changed). Red line shows the border of USCB

3. Coal mining dumping grounds in the Ruhr Basin and USCB

In the Ruhr Basin there are 170 coal-mining waste dumps (Gawor, 2004). Most of the objects are reclaimed and well developed, there are only few objects which are still active, connected with the activity of 6 coal-mines. The largest waste dumps in the Ruhr Basin reach the elevation of more than 100 metres and the surface of 160 ha (waste dump Hoheward in Herten). The coal-mining waste dumps in the Ruhr Basin belong mainly to the third category of dumps, called – landscape dumps (e. g. waste dumps Hoheward, Norddeutschland (Fig. 3 Schwerin, Hoppenbruch) (Gawor, Main, 2007). These dumps represent recreation and sport areas, with well developed paths or cycling trails, they may also be examples of properly done biological reclamation. Many objects can be considered as touristic (geotouristic)

Fig. 3: Coal mining waste dump Norddeutschland in Neukirchen-Vluyn (Ruhr Basin) – an example of landscape dump (Photo Ł. Gawor)

attractions. There are opportunities to develop these dumping grounds – functioning in the past as degraded and devastated land – as an integral part of green zones, parks and recreation area of the Ruhr District.

In the Upper Silesian Coal Basin there are 136 coal-mining waste dumps, including 76 active dump sites (Gawor, 2004). The highest waste dumps reach the elevation of 100 meters and the surface area of 200 ha. The largest "Central waste dump" in Smolnica reaches even the surface of 255 ha. The coal-mining waste dumps in USCB belong mainly to the first category of dumps, called conical dumps (e.g. waste dump in Rydułtowy – Fig. 4 – see cover p. 3).

Some larger objects represent second category of dumps – table mountain dumps (e.g. waste dump in Zabrze Makoszowy). The dumping grounds of the second and third category cause serious threats to the inhabitants and natural environment, which is predominantly connected with fire hazards, because of the facilitated oxygen inflow to the not enough compacted waste material. There are only few objects which belong to the third category – landscape dumps (e.g. waste dump in Katowice-Murcki) (Gawor, 2004). There is though also an opportunity of using such objects as park and recreation areas, but their development is nowadays in an early stage.

Waste material in both regions consists of different rocks in the form of siltstone and mudstone with a variable amount of sandstone. Predominant mineralogical components of wastes are therefore quartz and feldspars, but clay minerals, mainly non-swelling (kaolinite, illite, and chlorite), are also important because of their ion-exchange capacities. In the waste rock occur in the accessory amounts of iron sulfide (pyrite, marcasite) and buffering minerals (calcite, dolomite and ankerite). A number of heavy metals is present in trace concentrations, mainly in the form of sulfides such as sphalerite, galena, covellite and chalcopyrite (Szczepańska, Twardowska, 1999).

4. Environmental problems connected with post mining dumping grounds

Negative influence of mining wastes on water environment (particularly groundwater) and fire hazards belong to the most significant environmental impacts of coal mining waste dumps. One of the serious problems is so called AMD (Acid Mine Drainage), which effect is a contact of sulfur compound, particularly pyrite FeS_2 with water. Major chemical effects are pH reduction (connected with increased acidity), increase of sulfate, iron, manganese and aluminum contents, oxygen reduction and destruction of the bicarbonate buffering system (Gray, 1997).

The problem is also a lack of systematical groundwater monitoring on and around the waste dumps as well as law regulations, concerning particular requirements according to the mentioned above monitoring systems.

Fire hazards on waste dumps cause serious problems and danger to the inhabitants. This problem is very significant in the case of conical and tabular dumps. There are also air pollution issues connected with self-ignition of waste dumps. The ways of preventing fire hazards are efficient, but the problem constitutes accessibility of endangered objects and the law regulations (e.g. due to the non-efficient regulations some procedures connected with preventing of fire hazards last several months).

The ways of reclamation on waste dumps comprise technical and biological reclamation. Technical reclamation is connected with three waste dumps generations: conical, tabular mountain and landscape dumps. This reclamation method is also strictly connected with fire hazards. Many waste dumps (especially in USCB) represent the conical type, which intensifies ignition hazards. There is a need of creating landscape waste dumps (as in Germany) with regard to their future development and use. Biological reclamation methods comprise afforestation and sodding as well as manuring of the land. After over 30 years of field works on waste dumps in USCB connected with biological reclamation it can be evaluated that sodding is the most proper reclamation method applied on waste dumps. The afforestation of waste dumps is believed as ineffective and nowadays there are tendencies to afforest only parts of waste dumps as a means of park and recreation cultivation (Hansel, Schulz, 1996).

The environmental impacts for after-use of the dumping grounds can be:

- fire hazards, if the biological reclamation and vegetation have not been maintained very well, which is connected with erosion processes, weathering of the waste material and possible oxygen access,
- mass movements on the slopes, when the elements of the infrastructure (particularly large elements – artificial installations, sport facilities) have not been built properly.

5. Development of post-mining dumping grounds and using them as geotouristic sites

Development and use of the waste dumps belong, according to the authors, to the most significant problems connected with disposing of mining waste.

The dumps are considered as important elements of cultural landscape of mining regions (Gawor, 2004). However, post mining dumping grounds in Germany seem to be in fact such elements and even symbols of the region (so called Landmarken). The problem is that in USCB similar objects are still seen in the mind of the inhabitants as degraded areas. In the opinion of the authors there is a great chance for USCB region to develop the dumps in a similar way as in the Ruhr District, using the German positive experience. It should be outlined, that this process should be taken into consideration just at the stage of early spatial planning.

There are plenty of good examples of developing and use of waste dumps in the Ruhr Basin. These are: the longest European artificial ski-centre "Alpincentre" at the waste dump in Bottrop (Fig. 5), the wind power plant on the dump Hoppenbruch in Herten, the sun-clock at the dump Schwerin in Castrop-Rauxell, the horizontal astronomy observatory at the dump Hoheward in Herten, the paragliding centre at the dump Norddeutschland in Neukirchen Vluyn, monuments at the dumps Rheinelbe in Gelsenkirchen and the dump Prosper in Bottrop, didactic (geotouristic) routes at the dump Grosses Holz in Bergkamen and many others. The coal mining waste dumps belong to the "Route der Industriekultur" (Route of the Industrial Culture) and form a thematic trip (Held, Schmitt, 2001).

There are only a few examples of waste dumps in USCB, which have been well developed as landscape waste dumps (e.g. waste dumps in Bieruń and waste dumps in Katowice-Murcki).

The landscape objects made of mining wastes originated in Bieruń Nowy as a part of the large project linking landscape architecture, reclamation and recreation aspects. The visual effect of the waste dumps is impressive, but the project was not being continued (Fig. 6 – see cover p. 3). There is a lack of small architecture objects, the area is no being managed and is used by the youth local society illegal e.g. as mountain bike area. Mountain bikers which are riding across the slopes destroy the vegetation on the surface and cause starting erosion processes.

Waste dump in Katowice Murcki is one of the few landscape dumps of the 3rd category, which has an interesting shaped plateau (Fig. 7). There could be though any recreation infrastructure on the dump (e.g. paths, sport facilities, installations) or a didactic route (e.g. describing origin of the dump, its composition and reclamation affairs).

One of the examples of using a dumping area for the purpose of recreation is The Park of Culture and Recreation in the Silesian District (Katowice). The park was established on the mining waste dumps, 75% of the 620 ha area comprise dumping grounds (Fig. 8).

In the early years of the construction 3,5 millions of trees and shrubs were planted, partly of foreign origin. In the area places are created in the process of revitalization, e.g. the Silesian Amusement Park (40 ha area), the Silesian Zoological Garden, the Upper Silesian Ethnographic Park (25 ha surface), and the Silesian Stadium (Oleś, Rahmonov, Rzętała, Pytel, Malik, 2004).

Fig. 5: Artificial ski area „Alpincenter" at the waste dump in Bottrop, Ruhr Basin (Photo Ł. Gawor)

The recreation function of the above mentioned areas is limited by poor accessibility and lack of funds for maintenance of analyzed objects. There is a possibility of including the waste dumps into the "Industrial Monuments Route of the Silesian Voivodship", which is similar to the Route of the Industrial Culture in Germany, but at first the objects must be reclaimed and developed. Afterwards the post mining dumping grounds may be built into geotouristic attractions in Upper Silesia (Lamparska-Wieland, Waga J. M, 2003). One of the most important rules is planning the development und use of waste dumps just in the first stage of projecting new objects. Some positive experiences in the field of development and using of waste dumps can be taken from countries which have longer tradition in reclamation of post-mining dumping grounds, e.g. Germany, Great Britain and France.

An attempt of categorizing of the post-mining dumping grounds exemplified on the objects described in text is presented in a Tab. 1.

Fig. 7: Plateau of the waste dump in Katowice Murcki (Photo Ł. Gawor)

Fig. 8: The Park of Culture and Recreation in the Silesian District (Photo. Ł. Bukowski)

The results of comparison based on the field work shows, that most of the Polish waste dumps are considered as worst and bad examples (excluding The Park of Culture and Recreation in the Silesian District, which is evaluated as good one) whereas the German ones belong to the good (one dump – Norddeutschland) and best categories (all the other dumps).

6. Legal regulations connected with management of mining wastes

One of the reasons of non-effective reclamation of the waste dumps in Poland is a lack of law regulations concerning mining waste, particularly connected with negative environmental impacts (e.g. protection of groundwater, fire hazards) and evaluation of reclamation methods.

A short comparison of the legal regulations in Germany and Poland shows that there are similar law deeds in Germany and Poland as statutes, ordinances (e.g. mining and geology law, waste law, environmental law) but there are no particular legal regulations on the regional level in Poland. Such regulations have existed in Germany for years (since the 80`s of the 20^{th} century, e.g. Bergehaldenrichtlinien – dumping grounds guidelines).

The implementation of the first EU directive concerning mining waste (Directive 2006/21/EC of the European Parliament and of the Council on the management of waste from the extractive industries) has taken place in Poland recently. There is, however, a need of creating regulations regarding waste dumps on the level of self-government, i. e. Voivodship in Upper Silesia.

7. Conclusions

The high effectiveness of technical and biological reclamation processes as well as development of dumping grounds in the Ruhr Basin is connected with the existence of local law deeds in the German law, which specify the aforementioned actions and which have been passed for the North Rhine-Westphalia province. So far no standards, technical specifications or legal law acts have been prepared in Polish legislation which would refer to dumping grounds of hard coal mining waste. The valid legal acts (statutes and resolutions) regulate the issues connected with dumping grounds' reclamation and development in a very general way. It is necessary to prepare supplements to legal provisions or new regulations concerning post-mining dumping grounds in Poland. It seems to be beneficial to create new regulations modelled on the German example in the form of local law acts (e.g. Voivod's Resolutions), elaborations of standards or technical specifications.

Not only does the effective reclamation of post-mining dumps on the area of GZW, carried out in accordance with the guidelines specified by detailed legal regulations, prevent from environmental threats but it also makes it possible to realize interesting (often spectacular) projects of these types of land's development. Therefore, it has a positive influence over the region's development by giving new practical functions to areas which have so far been considered by the law as "degraded and devastated". Post mining dumping grounds are a valuable element of cultural environment and constitute objects of the regions' industrial heritage. They may be potential geotouristic attractions and a source of artistic accents in the landscape – the characteristic "symbols of the region".

It should be outlined that in Germany the International Building Exhibition (IBA) Emscherpark, which encompassed many spectacular ways of using of the dumps (like Tetraeder, sun clock, sculptures and installations) had a decisive impact on the reclamation process in Ruhr District (Schwarze-Rodrian, 1996). A very important factor was also change of thinking and the creativity of inhabitants, who linked spatial planning, recreation, artistic visions as well as changes in legal regulations for further development.

Categories	Evaluation of the waste dumps (- none/not efficient; + well developed)			
	Worst	Bad	Good	Best
Reclamation	–	+	+	+
Recreation and sport facilities	–	–	+	+
Artistic installations, didactic paths	–	–	–	+
Examples	Szarlota, Makoszowy (USCB)	Smolnica, Murcki, Bierun (USCB)	The Park of Culture and Recreation in the Silesian District (USCB) Norddeutschland (Ruhr District)	Prosper, Hoheward, Hoppenbruch, Schwerin, Rheinelbe, Grosses Holz (Ruhr District)

Tab. 1: Categorizing of post-mining dumping grounds in Ruhr District and USCB
Source: Self work

The positive German experience connected with reclamation and development of dumping grounds is not limited only to objects created in result of storing hard coal mining waste. In the future it will also be possible to take advantage of the knowledge and methods of the projects' realization (know-how) with respect to, among others, dumping grounds created in open-pit brown coal mining, ore mining as well as post-metallurgical dumping grounds.

Efforts related to the use and disposal of the material up to now dumped are also concentrating on applying technical methods to reduce the production of waste underground, on opening up new markets of this material, on utilization of mining waste as a building material, and – what is consistent with the rule of sustainable development – on low-environmental-impact dumping.

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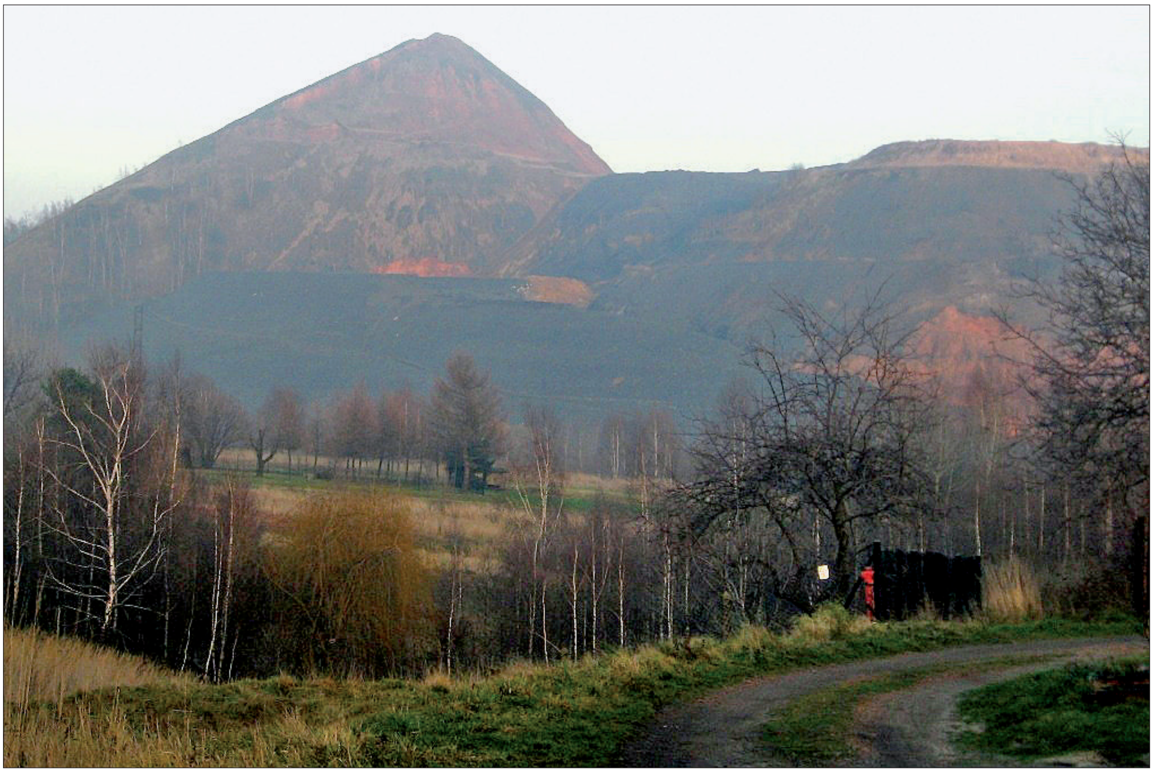

Fig. 4: Coal mining waste dump Szarlota in Rydułtowy (USCB) – an example of conical dump (Photo Ł. Gawor)

Fig. 6: Waste dumps in Bieruń (Photo Ł. Gawor)

Illustration related to the paper by. Ł. Gawor

Fig. 1: Družba mine (Photo: Z. Lipovská)

Fig. 5: Flooding of Medard mine (Photo: Z. Lipovská)

Illustration related to the paper by Z. Lipovská