

## DEVELOPMENTAL DYNAMICS OF LOCALITIES SEVERELY AFFECTED BY ANTHROPOGENIC ACTIVITIES ON THE EXAMPLE OF DOLY BÍLINA

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### ABSTRACT

The paper focuses on the area of Doly Bilina in the Most district, on the landscape that has been severely affected by extraction of mineral resources for a long time and represents in terms of natural conditions one of the most damaged regions where no possibility of a return to original condition comes into consideration. By using appropriate remedial and recultivation measures, however, we can create a sort of "alternative" natural environment, which should be able to fulfil a greater part of all wood-producing and beneficial forest functions after a certain time, as did the original landscape system.

**Key words:** Old maps – landscape – anthropogenic disturbance - recultivation

### INTRODUCTION

Historic maps are increasingly used nowadays as sources of information on the development of horizontal structure and dynamics of a landscape or its parts. The data are subsequently used in geography, landscape ecology and in a range of practical applications (landuse and regional planning, recultivation and revitalization projects, regeneration of forest stands, etc.), where they represent an irreplaceable systematic groundwork reporting on the hitherto form of landscape structures and their quantitative and qualitative development over time (e.g. Tasser, Walde, Tappeiner, Teutsch, Noggler 2007; Olsson, Austrheim and Grenne 2000; Iverson 1988).

The paper focuses on the area of Doly Bilina in the Most district, on the landscape that has been severely affected by extraction of mineral resources for a long time and represents in terms of natural conditions one of the most damaged regions where no possibility of a return to original condition comes into consideration. By using appropriate remedial and recultivation measures, however, we can create a sort of "alternative" natural environment, which should be able to fulfil a greater part of all wood-producing and beneficial forest functions after a certain time, as did the original landscape system.

The historic development of landuse in the surroundings of Doly Bilina was studied within the framework of a pilot project dealing with the differentiation of strategy for the development of recultivated landscape as a tool to achieve an optimum target condition. Resulting analyses for monitored periods inform about the number of whole-area landuse changes in the model area on two maps. The first map features broader territorial relations and it is therefore marked as "*The outer environment of Doly Bilina*" (area of 32,823.10 ha).

The second map focuses on the area of Doly Bílina in a greater detail and is called "*The locality of Doly Bílina*" (area of 7,441.59 ha).

## **MATERIAL AND METHODS**

### 1 Wider spatial relations

A starting point in the proposed differentiated strategy for the revitalization and development of devastated landscape of the Bílina district was the demarcation of model area with respect to broader territorial relations and natural conditions. The potential condition of geobiocoenoses was also reconstructed, based on which particular remedial and recultivation measures were suggested. Furthermore, relatively homogeneous surfaces were demarcated in the territory, to which the set of specific measures relates, chosen with respect to their similar development so far, and to some extent to their future functional potential. For this purpose, principles and procedures of biogeographic landscape differentiation in geobiocoenological conception were applied (Buček, Lacina 2007).

The area of study is situated in the north of the Most biogeographic region forming a unit of the Hercynian subprovince (Culek 1994). The relief can be characterized as a plateau merging into upland with the altitudes ranging from 220-350 m a.s.l.

According to Quitt (1971), the concerned area falls in a warm climatic zone (T2), considerably affected by the rain shadow of the Krušné hory (The Ore Mountains).

The original agricultural land use is documented by the representation of predominant soil types – chernozems and cambisols, with phaeozems occurring in the belt along the Bílina River, and with pararendzinas on heavy clay substrates (the Teplice agglomeration district) (Culek 1994).

The natural vegetation cover features namely geobiocoenoses of the Forest Altitudinal Vegetation Zone (Tier) 2 – Beech-Oak (56% of the area), and FAVZ 3 – Oak-Beech (ca. 44% of the bioregion area) with the increasing height gradient. In the Ore Mts. Basin, we find remains of the originally predominant association of acidophilous thermophilic oakwoods in residual segments (Culek 1994). However, natural and near-natural communities occurring in this space were devastated by mining and the alternative vegetation (if any) today consists of secondary ruderal associations of spoil banks and industrial sites.

The outer environment of Doly Bílina neighbours with the Milešov bioregion in the south and in the east, and with the biogeographic region of the Ore Mountains in the north, from where some sub-montane to montane species descended into the studied area (Simon, Buček, Drobilová, Mazal 2007).

### 2 Characteristics of the ecotope in the model area

The relief character is severely affected by anthropogenic activities, namely by open brown-coal mining. Thus, an entirely new anthropogenic relief comes to existence due to mining with the character of a flat, at some places dissected upland.

As for geological composition, the studied area varies but present rocks were largely uplifted from coal seams and displaced. Prevailing are Tertiary mudstones, siltstones, sideritic mudstones and sideritic siltstones (Simon, Buček, Drobilová, Mazal 2007). During recultivation, extracted rocks would be covered over with substrates of better texture and different characteristics (e.g. loess loams, marlites, bentonite) onto which earth layers of various thickness would merge. The given recultivation procedure enables the existence of a new soil type referred to as anthropozem (Čermák, Kohel, Ondráček 1998), in our area of study with the predominance of clay soils of heavier texture (Eutric Anthroposol). The

mere layering of extracted materials produces only so-called "anthropogenic substrates (mine dumps, spoil banks, landfills). The largest spoil bank in the studied locality is near the former village of Radovesice (NE section of the area).

The existing vegetation at the locality of Doly Bílina is formed mainly by initial stages of geobiocoenoses gradually emerging on the already recultivated plots. The most abundant associations in mesotrophic conditions are *Carpini-querceta typica* (typical hornbeam-oakwoods). Conditions for *Carpini-querceta aceris* (maple-hornbeam oakwoods) start to be created at the base of spoil banks, and initial stages of *Carpini-querceta tiliae* (lime-hornbeam-oakwoods) can be distinguished on overlaying loess substrates. Gradual development of fluvisols can be expected along the local watercourses supporting the creation of abiotic conditions necessary for the emergence of ash-alder associations (*Fraxini-alneti*) and alder associations (*Alneti*) at a more advanced stage of succession (Simon, Buček, Drobilová, Mazal 2007).

### 3 Development of coal mining in the Bílina area

Mining in the locality of interest is currently operated by Severočeské doly, a.s. (North-Bohemian Coal Mines, joint-stock company), which has been running the business there since 1994. The Bílina open-pit mine extracts annually 8-9 mil. tons of brown coal and up to 50 mil. m<sup>3</sup> of topsoils. Pit volume under the soil surface occupies 1.222 bil. m<sup>3</sup> today. Extracted rocks are deposited both on the internal spoil bank of Doly Bílina and on two external spoil banks in Radovesice (ca. 680 mil. m<sup>3</sup>) and in Pokrok near Tušimice. The deepest point of active mining occurs now at the quota of 40 m a.s.l. (Severočeské doly, a.s. 2008).

According to Government Resolution no. 444/91 Coll., coal mining in the pit should end within the existing boundaries given by ecological limits in about 2030 and the coal pit site should be recultivated by 2050 with the major share falling to forest recultivations to be followed by agricultural and water utilization measures. The acreage of exhausted surfaces redeveloped and recultivated per year adds to about six thousand hectares (Tab 1).

**Table 1: Recultivation works accomplished at the locality of Doly Bílina – Outlook 2050**

Surfaces	Hectares	Percent
Agricultural	3,325.32 ha	25.3%
Forest	5,624.62 ha	42.7%
Water	2,244.32 ha	17.0%
Other	1,973.81 ha	15.0%
<b>TOTAL</b>	<b>13,168.07 ha</b>	<b>100.0%</b>

Source: Severočeské doly, a.s. 2008

### 4. Methods

Methods used for the monitoring of sites and for the subsequent analysis of their changes in the historic context were developed within the framework of research project MSM 6293359101 "Research of biodiversity sources and indicators in the cultural landscape in context of its fragmentation dynamics" resolved by the Silva Tarouca Research Institute for Landscape and Ornamental Gardening (VÚKOZ, v.v.i., Branch Brno, Department of Landscape Ecology). The concerned methodology is based on the digital analysis of five sets of cartographic documents available for the period 1836-2005.

Basic condition for the interpretation of old maps is to adhere to a relatively identical scale, quality and measure of generalization of the maps used in order to achieve the greatest possible objectivity of outputs.

#### 4.1 List of cartographic documents used

##### 2<sup>nd</sup> military mapping (2MP)

- dating 1836-1852, scale 1:28 800, Gusterberg system of coordinates;
- before this set of maps came to existence, a cadastral trigonometrical survey was carried out of our territory; this is why the maps from that period nearly correspond with contemporary documents as for their accuracy.

##### Czechoslovak topographic maps

- dating 1952-1958, scale 1:25 000, S-1952 system of coordinates;

##### Czechoslovak topographic maps

- dating 1970-1986, scale 1:25 000, S-42 system of coordinates;

##### Czech military topographic maps

- dating 1988-1995, scale 1:25 000, S-42 system of coordinates;

##### Base maps of the Czech Republic

- dating 2005-2006, scale 1:10 000, S-JTSK system of coordinates;
- topographic material comes from the current Czech Office for Surveying, Mapping and Cadaster and the version used was its seamless raster digital form (ZABAGED).

#### 4.2 Editing and creation of outputs

Particular map sheets for the selected periods were edited in the ArcGIS (ArcView) environment and subsequently analyzed with the use of the same software (Mackovčín, Demek, Havlíček 2006). Partial outputs are landuse maps for the studied periods, from which two resulting synthetic maps of identical scales to evaluate the number of changes in 1836-2005 were constructed.

The construction of maps illustrating landuse changes in certain periods was made with the differentiation of 9 categories of land surface units (landuse elements):

1. Arable land
2. Permanent grassland – meadows, pastures
3. Garden, orchard – outside the intravillan
4. Vineyard, hop-field – outside the intravillan
5. Forest
6. Water surface – both natural and artificial surfaces
7. Built-up area – urban and rural developments, industrial and agricultural sites, etc.
8. Recreation surface – camping places, sports grounds, allotments, etc.
0. Other – mining sites, spoil banks, waste banks, etc. – only outside the intravillan

During the last methodological step, the resulting data were converted into diagrams to illustrate the dynamics of development of individual land surface categories in the chosen model area.

## RESULTS

### 1 Landuse in the period of the 2<sup>nd</sup> military mapping (1836-1852)

#### 1.1 The outer environment of Doly Bilina

In about 1836, the outer environment of Doly Bilina showed the greatest surface representation of arable land (20,883.10 ha) while forests occupied only about a third of that area (6,014.10 ha), occurring in fact only in two larger complexes – in a reaching corner of the geomorphological unit of the Ore Mountains (NW and N parts of the studied territory) and in the České Středohoří /the Middle Mountains/ (SE part of the territory). The forest complexes remained nearly untouched in the studied time period. In this period, small-scale farming predominated in the Most Basin. Although the map shows an extensive matrix of arable land, this was in reality particularized into a large amount of tiny fields. Particularly evident was the mosaic structure in the southern part of the outer environment with fields and orchards interlaced with enclaves of meadows and pastures.

Water surfaces are represented by ponds for extensive fish farming. Built-up area formed only a fragment of the total area (1,195.60 ha) and represented largely dispersed rural developments. The future big towns of Most and Teplice were at the very beginning of their growth, which rapidly increased due to the launched mining activities in the studied area. Interesting is the development of the urban structure in the town of Osek, the area of which back in about 1836 remained nearly untouched until these days.

Open-pit mining of coal or building materials (namely limestone) occurs only locally and on a small scale (75.50 ha of the total area).

Landuse element	Area [ha]	%
<i>Arable land</i>	20,883.1	63.62
<i>Permanent grassland</i>	3,593.1	10.95
<i>Garden and orchard (outside the intravillan)</i>	849.4	2.59
<i>Forest</i>	6,014.1	18.32
<i>Water surfaře</i>	212.3	0.65
<i>Built-up area</i>	1,195.6	3.64
<i>Recreation area</i>	0.0	0.00
<i>Other</i>	75.5	0.08
<b>Σ</b>	<b>32,823.08</b>	<b>100.00</b>

*Surface and percenagel share of individual landuse categories in the outer environment of Doly Bilina in the period of the 2<sup>nd</sup> military mapping (1836-1852)*

#### 1.2 The Locality of Doly Bilina

The situation was similar to that in the outer environment; entirely predominant is arable land interrupted only by the surfaces of meadows and pastures. In this period, 18 settlements of village character were recorded in the region, of which a larger part had to gradually yield to increasing spatial requirements of SD Bilina mines. The concerned villages were Břežánky, Dříněk, Hetov, Hrdlovka, Hostomice, Chotějovice, Chotovenka, Chudeřice, Jenišův Újezd, Libkovice, Ledvice, Lyskovice, Radovesice, Růžové Pole, Světec, Štrbice, Zabuřany and Želénky.

Forests occur only in the SE section of the region near Radovesice, and the forestland shows relatively a high stability too as it can be found in the contemporary maps in a nearly unchanged size.

The largest "centre" of incipient open-pit coal mining was at that time some 3 km in the north-west of Radovesice.

Landuse element	Area [ha]	%
<i>Arable land</i>	5,616.52	75.47
<i>Permanent grassland</i>	841.73	11.31
<i>Garden and orchard (outside the intravillan)</i>	208.77	2.81
<i>Forest</i>	453.46	6.09
<i>Water surface</i>	68.47	0.92
<i>Built-up area</i>	193.21	2.60
<i>Recreation area</i>	0.00	0.00
<i>Other</i>	59.43	0.80
<b>Σ</b>	<b>7,441.59</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the locality of Doly Bilina in the period of the 2<sup>nd</sup> military mapping (1836-1852)*

## 2 Landuse in 1950

### *2.1 The outer environment of Doly Bilina*

The structure of the surface of the landscape appeared much more variegated than in the previous period. This was caused both by the increased acreage of permanent grasslands (PGL) to the detriment of arable land, but namely by a clearly visible increase in the surface share of mining sites up to 2,002.70 ha (ca. 26-fold increase as compared with the period in about 1836!!). Their rapid increase started immediately in the period after World War II in consequence of applied new open-pit mining methods. Until then, the extraction was implemented almost exclusively by underground mining methods that were rather time-consuming and thus hampering any decisive development of mining volumes. The greatest surface increase of this landuse category occurred near Most and Bilina.

The increased surface of built-up area (3,215.70 ha) apparently related to the increased acreage of mining sites, which could be particularly seen in the case of the towns of Teplice and Most but also in those of villages Bilina and Duchcov that considerably sprawled thanks to the inflow of new labour force.

Forests and water surfaces remained practically at the same size while the size of gardens and orchards registered a slight decrease (ca. only by 145 ha).

Since the 1950s, recreation areas have been appearing in the maps, which are in the outer environment of Doly Bilina represented mainly by allotments in the outskirts of larger towns. This new category, however, is still insignificant in term of its size (101.30 ha).

Landuse element	Area [ha]	%
<i>Arable land</i>	20,883.1	55.20
<i>Permanent grassland</i>	4,133.8	12.59
<i>Garden and orchard (outside the intravillan)</i>	703.8	2.14
<i>Forest</i>	6,016.5	18.33
<i>Water surface</i>	283.1	0.86
<i>Built-up area</i>	3,215.7	9.80
<i>Recreation area</i>	101.3	0.31
<i>Other</i>	2,002.7	6.10
<b>Σ</b>	<b>32,823.08</b>	<b>100.00</b>

*Surface and percnagel share of individual landuse categories in the outer environment of Doly Bilina in 1950*

### 2.2 The Locality of Doly Bilina

Most evident in a detailed look on the locality of Doly Bílina is the invasion of opencast mining sites in its SW and central parts.

The immediate surroundings of mining sites are occupied by pastures, which still make it possible to use the deteriorated arable land.

The rural development was in this period still in its original abundance and even sprawling (esp. the villages of Břežánky, Jenišův Újezd and Hrdlovka).

Some ponds for fish breeding were awashed during mining and water surfaces in the area of Doly Bilina were therefore reduced. The forest area remained practically unchanged similarly as in the outer environment.

Landuse element	Area [ha]	%
<i>Arable land</i>	4,406.95	59.22
<i>Permanent grassland</i>	871.71	11.71
<i>Garden and orchard (outside the intravillan)</i>	110.22	1.48
<i>Forest</i>	547.72	7.36
<i>Water surface</i>	73.67	0.99
<i>Built-up area</i>	425.31	5.72
<i>Recreation area</i>	2.87	0.04
<i>Other</i>	1,003.15	13.48
<b>Σ</b>	<b>7,441.59</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the locality of Doly Bilina in 1950*

## 3 Landuse in 1970

### 3.1 The outer environment of Doly Bilina

In that period, a trend is observed that generally occurs in the whole country, consisting of downsizing arable land for the benefit of woodland and PGL. Nevertheless, in the area of study, it is possible to speak about the downscaling of all mentioned landuse categories (except for built-up area and water surfaces) at a cost of rapidly expanding sites for opencast coal mining, the area of which further increased by about 1,600 ha

Extensive PGL complexes in the surrounding of mining sites did not illustrate the increased sward resources of the landscape as it might be incorrectly assumed. In the period of the 1970s- 1990s, fallow land was designated so that was predestined for mining, too. With respect to that, the concerned surface area size should therefore be taken for meadows and pastures.

The increasing built-up area in the 1970s should be attributed to the construction of associated industrial sites where extracted coal was processed in various ways rather than to the spread of towns and villages. In the late 1970s, the "old centre" of the town of Most was demolished due to the finding of ample coal reserves in the underground. The town centre was moved in the SW direction, which is fully obvious only from the situation in the 1990s with an extensive mining site taking the place of its original location.

The increasing number of decanting plants and sludge pools contributed to the increased area of water surfaces. Some of them are presented in blue colour in the map and this is why they are included in Category 6 (Water surface) instead of Category 0 (Other areas).

Landuse element	Area [ha]	%
<i>Arable land</i>	15,064.9	55.20
<i>Permanent grassland</i>	1,949.0	5.94
<i>Garden and orchard (outside the intravillan)</i>	594.9	1.81
<i>Forest</i>	7,297.0	22.23
<i>Water surface</i>	315.2	0.96
<i>Built-up area</i>	3,872.2	11.80
<i>Recreation area</i>	113.4	0.35
<i>Other areas</i>	3,616.5	11.02
<b>Σ</b>	<b>32,823.10</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the outer environment of Dolý Bilina in 1970*

### 3.2 The Locality of Dolý Bilina

In a part of this period, coal-mining sites (Category 0) get with their surface area size right behind the hitherto largest category of arable land. Namely below the village of Duchcov, intensified mining engulfed completely the villages of Břežánky, Jenišův Újezd and Hrdlovka. Even the village of Radovesice had to be removed for the purpose of a large-scale spoil bank, which was at least given its name. Extensive industrial and manufacturing sites, interconnected by many kilometres of belt and rail conveyors emerged in the place of demolished settlements.

As mentioned above, grassland in the surrounding of mining sites represents a temporary fallow land that would gradually give in to coal mining.

The slightly increasing woodland area is obvious, too. However, the concerned newly established forest stands are plotted in the map as thin (growing up) forests.

Landuse element	Area [ha]	%
<i>Arable land</i>	3,619.86	48.64
<i>Permanent grassland</i>	588.90	7.91
<i>Garden and orchard (outside the intravillan)</i>	144.42	1.94
<i>Forest</i>	716.83	9.63
<i>Water surface</i>	61.99	0.83
<i>Built-up area</i>	301.36	4.05
<i>Recreation area</i>	2.74	0.04
<i>Other</i>	2,005.49	26.95
<b>Σ</b>	<b>7,441.59</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the Locality of Doly Bilina in 1970*

#### 4 Landuse in 1990

##### *4.1 The outer environment of Doly Bilina*

Arable land remained the most widespread landuse category with 43.69% coverage of the total area. Although the local forests increase their size (23.74), they still remain at about a half of the fields.

The mining sites localized in the outer environment of Doly Bilina shown in the studied period the largest area in the 1990s, i.e. 4,324.60 ha (13.18%), beyond which they should not reach according to ecological limits before the end of mining in 2030.

The built-up area continued to increase its size (12.25% of the total area) and Teplice became the largest urban unit in the region.

The area of water surfaces shown a pronounced increase but the trend arose again from the above-mentioned increase of sludge pools and coal-ash settling basins due to the increased volume of coal mining.

Gardens and orchards were continually downsizing (reaching not even 1% of the total area).

The area of vineyards and hop-fields belonged to a single locality near Most where grapevine was planted (36.30 ha).

Landuse element	Area [ha]	%
<i>Arable land</i>	14,341.5	43.69
<i>Permanent grassland</i>	1,294.0	3.94
<i>Garden and orchard (outside the intravillan)</i>	315.4	0.96
<i>Vineyard and hop-field</i>	36.3	0.11
<i>Forest</i>	7,791.2	23.74
<i>Water surface</i>	533.8	1.63
<i>Built-up area</i>	4,019.3	12.25
<i>Recreation area</i>	167.0	0.51
<i>Other</i>	4,324.6	13.18
<b>Σ</b>	<b>32,823.10</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the outer environment of Doly Bilina in 1990*

#### 4.2 The locality of Doly Bilina

The already almost largest space in the locality of Doly Bilina occupied the huge mining site opening below Duchcov, which advanced in this period up to the village of Braňany (SW boundary of the region). The Radovesice spoil bank was already clearly shown in the cutout.

PGLs near the large-scale mine were at a greater part absorbed by the mining space and no signs of starting recultivation of the exhausted sites were apparent yet.

All developments except for the marginally reaching villages of Hostomice and Světec, Chotějovice, Ledvice, Štrbice, Želének and Zabuřany were eliminated but at some places replaced by manufacturing sites for coal sorting and distribution.

Water surfaces were again represented only by coal-ash settling sites with one exception being the Všechlapy water reservoir in the north of the area.

Landuse element	Area [ha]	%
<i>Arable land</i>	3,368.12	45.26
<i>Permanent grassland</i>	350.84	4.71
<i>Garden and orchard (outside the intravillan)</i>	65.89	0.89
<i>Forest</i>	702.57	9.44
<i>Water surface</i>	152.96	2.06
<i>Built-up area</i>	197.53	2.65
<i>Recreation area</i>	4.92	0.07
<i>Other</i>	2,598.75	34.92
<b>Σ</b>	<b>7,441.59</b>	<b>100.00</b>

*Surface and percentagel share of individual landuse categories in the locality of Doly Bilina in 1990*

### 5 Landuse in 2005

#### 5.1 The outer environment of Doly Bilina

The studied territory represented a much variegated landscape mosaic in 2005. However, the map interpretation did not guarantee any accordance to the actual image, the evidence of which is brought by our study. Figures documenting the area size of individual landuse elements indicate at the first sight a considerable loss of arable land (from 43.69% to mere 14.19%), so to say exclusively for the benefit of PGLs, which occupy 7,531.10 ha (22.94%!!) at that period. That was supported both by the national trend of the 1990s – mass conversion of arable land to sward resources, and the fact that the category includes all recultivations already accomplished on exhausted sites, which can be illustrated by PGLs and forests within the space of the Radovesice spoil bank that were already recultivated.

The above-mentioned reasons led to a remarkable increase in the area size of local forests although the character of newly afforested plots is of a thin forests so far.

For the first time in the entire period of study, the surface area directly affected by coal mining was reduced – nearly by 1,000 ha to 3,553.20 ha.

The built-up area shows a largely linear growth, the fact being contributed by both, the continually increasing area size of urban and rural developments, and by developing accompanying industries.

Recreation areas increase along with the sprawling urban units and their size in the concerned period is 259.30 ha.

Landuse element	Area [ha]	%
<i>Arable land</i>	4,659.2	14.19
<i>Permanent grassland</i>	7,531.1	22.94
<i>Garden and orchard (outside the intravillan)</i>	264.7	0.81
<i>Vineyard and hop-field</i>	38.0	0.11
<i>Forest</i>	11,223.2	34.19
<i>Water surface</i>	426.5	1.30
<i>Built-up area</i>	4,867.9	14.83
<i>Recreation area</i>	259.3	0.79
<i>Other</i>	3,553.2	10.83
<b>Σ</b>	<b>32,823.10</b>	<b>100.00</b>

*Surface and percentage share of individual landuse categories in the outer environment of Doly Bilina in 2005*

### 5.2 The Locality of Doly Bilina

As compared with the decreasing total area of mining sites in the outer environment, the size of this category continually increased even in the last surveyed period up to 2,858.90 ha (38.42%). However, a very steeply increasing surface area of PGLs and forests can be almost exclusively explained by recultivations of exhausted plots.

Villages partly preserved inside the locality are only Chotějovice, Ledvice, Štrbice, Želénky and Zabušany at which large production and industrial sites came to existence.

Landuse element	Area [ha]	%
<i>Arable land</i>	562.52	7.56
<i>Permanent grassland</i>	1,94.92	25.46
<i>Garden and orchard (outside the intravillan)</i>	55.17	0.74
<i>Forest</i>	1,97.22	21.46
<i>Water surface</i>	88.47	1.19
<i>Built-up area</i>	375.46	5.05
<i>Recreation area</i>	8.94	0.12
<i>Other</i>	2,58.90	38.42
<b>Σ</b>	<b>7,41.59</b>	<b>100.00</b>

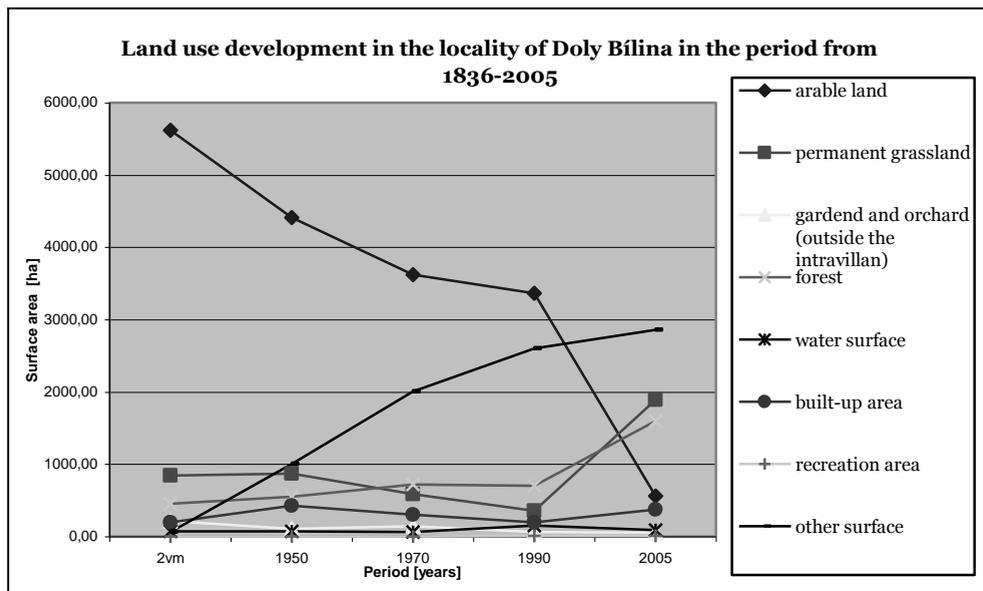
*Surface and percentage share of individual landuse categories in the Locality of Doly Bilina in 2005*

6 Landuse development in the period from 1836-2005

Global evaluation of landuse development in the outer environment of Doly Bílina shows that the greatest changes occurred directly in the Most Basin while the neighbouring forested parts of the České středohoří /The Middle Mountains/ and the Krušné hory /The Ore Mountains/ remained, so to say, unchanged during the period of study.

The landscape structure experienced the greatest change within the surroundings of Most, which was caused namely by dislocation of the town and by the subsequent development of adjacent mining sites.

**Fig. 1: Land use development in the locality of Doly Bílina in the period from 1836-2005** (Source: personal research)



However, the greatest number of landuse changes at all occurred directly in the locality of Bílina where the landscape diversity gradually yielded to the sprawling mining site of Doly Bílina (Fig 1).

The same place was subject to rehabilitation and recultivation of the already exhausted sites, which brought yet more land cover changes contributing to eco-stabilization and renewal of multiple functions of landscape, devastated by opencast coal mining

**DISCUSSION**

The results of our study show that historic maps are sources of irreplaceable primary data for systematic monitoring of cultural landscape development. They provide information not only on settlement permanency and character, dynamics of relations affecting landscape potential and distinctiveness, changes in landscape structure, localization of old burdens, intensity of anthropogenic disturbances, but also on the localization of stable undisturbed sites, which represent ecologically most valuable landscape segments.

This is why the number of scientific works studying the historic development of landscapes is exponentially growing at present. Some of them deal only with territories of a few cadasters (e.g. Drobilová 2007; Stránská 2007; Moravčíková 2006), while others apply methodological procedures to larger territorial units or to the whole country (e.g. Mackovčín, Demek, Havlíček 2006).

An essential point in the methodological procedure of interpreting historic map works is, however, the selection of a data source itself. Many map works of different age, quality and informative value were created for the territory of our country in the past. Some of them use stable cadaster maps as a basis (Lipský, Nováková 1994; Bičík et al. 1996; Skaloš 2006, etc.) which is thanks to detailed elaboration in the map and table format most utilizable namely in the area of detail at the level of cadasters. On the other hand, in larger territorial units, they make the interpretation of changes more difficult due to a considerable atomization.

Another type of raster basis may be aerial photographs (Blažek, Vávra 1998; Lipský 2000), which are however usable only for the last 40-60 years and their interpretation is not unambiguous and usually requires a field verification.

The choice of maps for the above characterized methodological procedure was made to achieve the greatest possible detail of imaging, scale and generalization, and with a particular emphasis on the whole-country coverage of the selected set of maps so that it is possible to subsequently use the same methodological procedure for the analysis of extensive areas, possibly the whole country.

## CONCLUSION

When concluding we have to point out that the condition of the studied landscape from the period of around 1836 can be restored neither with respect to the spatial pattern nor with respect to landuse. The desirable target condition of the Bílina landscape severely disturbed by anthropogenic activities should be seen in the form of harmonic cultural landscape (Buček, Lacina 2001), which is reinforced as compared with the common cultivated landscape (namely urbanized landscape) with fittingly distributed stabilization elements, conditioning the manifold functionality and usability of the concerned landscape space. The stabilization elements are carriers of a whole range of beneficial functions (water management, soil protection, recreation). They were coming to existence or developing either based on natural conditions only (natural watercourses, rocks, wetlands, etc.), or under intensive anthropogenic influence (riparian stands, forest margins, meadows, various types of fallow lands, etc.) but they still retain their stabilization capacity and favourable effect on the surrounding destabilized mining landscape.

The creation of such a landscape on heavily disturbed and altered sites such as the landscape in the locality of Doly Bílina is not a simple or short-term process. A combination has to be used of various recultivation procedures and methods that will lead to the creation of a well-organized and interconnected landscape complex meeting all attributes of a regenerated and fully functional landscape.

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**Table 2: Aggregate table of surface area and percental data for the studied period (1836-2005) for the outer environment of Doly Bilina**

Landuse element	2MP [ha]	%	1950 [ha]	%	1970 [ha]	%	1990 [ha]	%	2005 [ha]	%
<i>Arable land</i>	20,883.1	63.62	16,366.1	55.20	15,064.9	55.20	14,341.5	43.69	4,659.2	14.19
<i>Permanent grassland</i>	3,593.1	10.95	4,133.8	12.59	1,949.0	5.94	1,294.0	3.94	7,531.1	22.94
<i>Garden and orchard (outside intravillan)</i>	849.4	2.59	703.8	2.14	594.9	1.81	315.4	0.96	264.7	0.81
<i>Vineyard and hop-field</i>	0.0	0.00	0.0	0.00	0.0	0.00	36.3	0.11	38.0	0.11
<i>Forest</i>	6,014.1	18.32	6,016.5	18.33	7,297.0	22.23	7,791.2	23.74	11,223.2	34.19
<i>Water surface</i>	212.3	0.65	283.1	0.86	315.2	0.96	533.8	1.63	426.5	1.30
<i>Built-up area</i>	1,195.6	3.64	3,215.7	9.80	3,872.2	11.80	4,019.3	12.25	4,867.9	14.83
<i>Recreation area</i>	0.0	0.00	101.3	0.31	113.4	0.35	167.0	0.51	259.3	0.79
<i>Other areas</i>	75.5	0.08	2,002.7	6.10	3,616.5	11.02	4,324.6	13.18	3,553.2	10.83
<b>Σ</b>	<b>32,823.08</b>	<b>100.00</b>	<b>32,823.08</b>	<b>100.00</b>	<b>32,823.1</b>	<b>100.00</b>	<b>32,823.1</b>	<b>100.00</b>	<b>32,823.1</b>	<b>100.00</b>

**Table 3: Aggregate table of surface area and percental data for the studied period (1836-2005) for the locality of Doly Bilina**

Landuse element	2MP [ha]	%	1950 [ha]	%	1970 [ha]	%	1990 [ha]	%	2005 [ha]	%
<i>Field</i>	5,616.52	75.47	4,406.95	59.22	3,619.86	48.64	3,368.12	45.26	562.52	7.56
<i>Permanent grassland</i>	841.73	11.31	871.71	11.71	588.90	7.91	350.84	4.71	1,894.92	25.46
<i>Garden and orchard (outside intravillan)</i>	208.77	2.81	110.22	1.48	144.42	1.94	65.89	0.89	55.17	0.74
<i>Forest</i>	453.46	6.09	547.72	7.36	716.83	9.63	702.57	9.44	1,597.22	21.46
<i>Water surface</i>	68.47	0.92	73.67	0.99	61.99	0.83	152.96	2.06	88.47	1.19
<i>Built-up area</i>	193.21	2.60	425.31	5.72	301.36	4.05	197.53	2.65	375.46	5.05
<i>Recreation area</i>	0.00	0.00	2.87	0.04	2.74	0.04	4.92	0.07	8.94	0.12
<i>Other areas</i>	59.43	0.80	1,003.15	13.48	2,005.49	26.95	2,598.75	34.92	2,858.90	38.42
<b>Σ</b>	<b>7,441.59</b>	<b>100.00</b>								