

A HISTORIC GEOGRAPHIC APPROACH TO THE ANTHROPIC DISTURBANCE IN THE BÜKK REGION

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Abstract

This paper introduces a historical geographical study on the process of land cover transformation in the Bükk Region, which can be regarded as a two-faced area concerning its anthropogenic disturbance. Based on historic mapping that began as early as the late 18th century, a database was produced, and the data were interpreted in the context of economic and social processes that took place in the area. Results could be presented in maps using the so-called Anthropogenic Disturbance Index (ADI). These maps demonstrate the peculiar land use pattern in the Bükk Region, namely co-habitation of the significantly transformed margins and the natural or quasi-natural central part. Between them, there are linear areas of intermediate disturbance. These areas, however, due to the foundation and activity of the Bükk National Park and modification of their economic value after the change of the political system, have not increased during the last several decades; rather a re-naturalization of the landscape is aimed.

Keywords: land-use, anthropogenic disturbing, Bükk Region

1. Introduction

The Bükk Mountains are the karstic mountains of highest average height in Hungary. Its central part is a plateau bordered by steep slopes. The not rare prehistoric finds, ruins of ancient earth fortresses and medieval monasteries prove the early and more or less continuous landscape modifying human activity probably due to wealth sources of raw materials. To study anthropic impacts geo-informatics data base

was used. Data were collected by studying and analyzing archives, registers, historic maps and map explanations, and in this way the temporal changes could be traced. Data characteristic for long time-span are land use and land cover (LULC) that qualitatively and quantitatively reflect both temporal and spatial changes and transformations. Identifying the types of human activities by using essential and determinable features of landscape character, temporal changes of spatial network of a landscape can be revealed

and degree of anthropic transformation can also be estimated and modelled. Moreover, detailed analysis of landscape development may establish and support plans and project of regional development (Dávid – Karancsi, 2010).

2. Methods and techniques

Since the administrative area of the settlements and that of the Bükk National Park has changed time to time, it seems to be reasonable to choose the so called Bükk Region, a meso-region according to the landscape cadaster (Dövényi et al. 2010), as the study area because its history and character can be regarded as coherent, although its micro-regions may be quite varied. The temporal network of the research is provided by the three Military Surveys (1766–1785; 1806–1869; 1872–1884), the topographic mapping in 1941, the CORINE Land Cover (CLC) survey in 2012, and the CLC maps of 2016 modified based on the Google aerial views. Land cover, anthropic linear landmarks (e.g. roads) and point-like elements (e.g. mine entrances) were digitized by using ArcGis 10.4 software, and information on types and condition of a given element was attached to it in the attribution table. The next step was to identify the characteristic land use types and to determine their temporal changes. Amongst these types the two extreme ones were selected, namely forests and urbanogenic areas that suffered different impacts for centuries (Baráz 2014; Hudák – Várnagy 2013; Sütő 2013). Reliability of landscape transformation data were supported by standard deviation as it was applied in disturbance analysis of Rózsa et al. (2020). The changes were compared to land use data concerning the time of the given survey; moreover, we tried to trace the social, economic and historic processes that could be related to the changes (Baráz 2014; Hudák – Várnagy 2013; Sütő 2013). Then contents of the transformed geomorphic and land cover patches were generalized, and strength of the impact was quantified. For

this step the so called Human Influence Index and hemeromorphy was used (WCS & CIESIN 2005, Sütő et al. 2018, Rózsa et al. 2020).

3. Results

From raw material exploitation to significant nature protection activities landscape transformation processes have shown great varieties in space and time in the Bükk Region (Fig. 1). In the marginal areas, appearance and development of settlements has considerably involved progressive increase in the area of anthropic surface, such as roads, pasture, arable lands, building and industrial areas (Sütő 2013). From the end of the Middle Ages forestry and deforestation was expanded along some valleys, and around some castles and monasteries even in the sensu stricto Central Bükk area (Bartha 2000). In the 18th century, based on wood and limestone as raw materials, small-scale manufactures also appeared (lime and coal burning, glass making), and grazing became more and more intensive (Járási 2002; Petercsák 2002; Sütő - Homoki 2009).

From the margins, along the larger valleys, elements of arable farming also expanded (Frisnyák 1995; Viga 2002). Damages coming from floods and streams can be traced even in the registers and explanatories of the 18th century mapping (Tóth 1991). The montanogenic surface transformation became one of the most intensive local environmental modifying activities in the Bükk Region, too. The primitive small-scale iron ore mining (Uppony Mountains, Garadna Valley) was followed by quarrying and later expansion of coal mining; traces of the latter can be observed on the maps of the First Military Survey.

First, the sites of industrogenic activities are centers of urbanogenic land-use, as well; the first built surfaces were the signs of the beginning of urbanogenic processes. The formation of the so called 'huta' settlements (Óhuta, Újhuta, Répáshuta – Bükkszentkereszt, Bükkszentlászló and Répáshuta today) demonstrates the complex

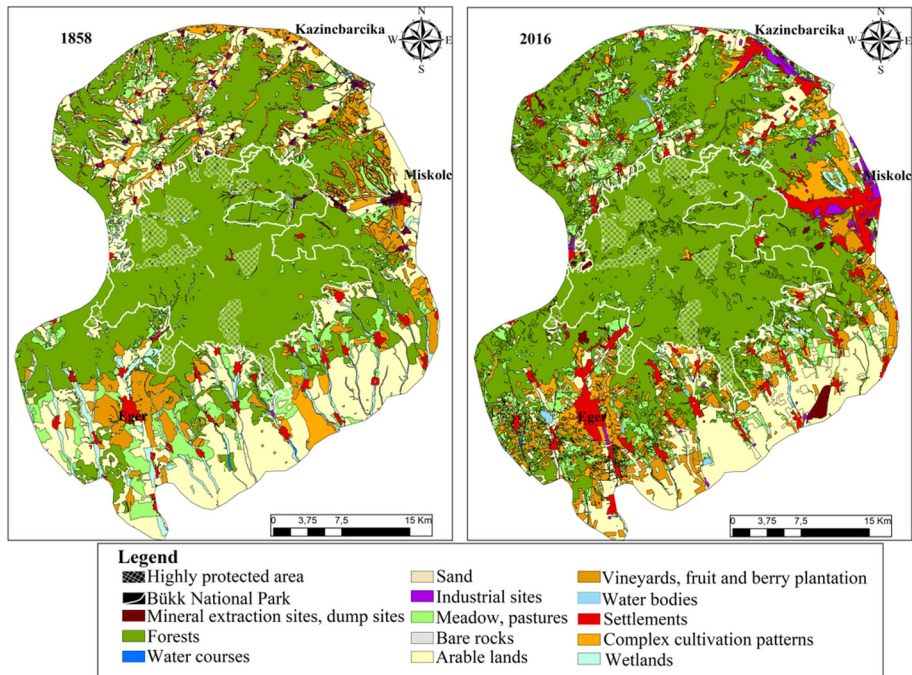


Fig. 1. Land use in the Bükk Region in 1858 and 2016

role of early furnaces and kilns in landscape transformation (the Slavic word 'huta' means 'kiln' or 'furnace'); these settlements preserved their important landscape transformation role as late as the last century, because their development involved deforestation and forest management in their surroundings (Veres 2002). From the foundation, the settlements have controlled greater and greater area, and in most cases the increased size of the settlement has remained even after the decrease of population (Sütő et al. 2017). Except the above mentioned 'huta' settlements, settlements with permanent population survived essentially in the longer and larger valleys.

The formation of the industrial area at the margin of the Bükk, which was induced by coal mining in Borsod County and quarrying in the Bükk Mountains, triggered population expansion that involved increase in almost every type of anthropic impact and transformation. Consequently, the large-scale industrial activity deformed and transformed the former cultural landscape,

the traditional balance between land use in hills and in riverside areas was upset. The heavy industrial centers became essential determining factors of the landscape, and they transformed interconnection of landscape factors of the settlements (Sütő 2013). Moreover, mining and, in particular, quarrying has considerably reshaped some parts of the area (Dávid 2008).

The transportogenic elements are perhaps the most artificial ones, which have the highest contrast with their close environment. They are essential because they connect the most important artificial landscape elements (i.e. settlements), and, at the same time, they may represent ecological barriers dividing natural or quasi-natural patches; this way, they may narrow territory of living organisms (Forman 1997; Csorba 2005).

4. Discussion and conclusions

Despite anthropic transformation forests represent the land-cover matrix of Bükk Region even today. As data and mapped

Table 1. Variation of forested area in the Bükk Region (source: own compilation)

Year	Average extent of forested area (km ²)	Range of changes (R) (km ²)	Standard deviation (km ²)	Cover of forests (%)	Deviation from average (%)
Totally between 1783 and 2016	862.6	168.3	62.9		
1. 1783-1785				49.4	2.2
2. 1858				48.4	0.0
3. 1874-1883				44.1	-8.9
4. 1941				46.4	-4.0
5. 2016				53.6	10.6

information suggest dominance of forest was continuous since the time of the First Military Survey, and, in fact, its rate is higher than 50 % (Table 1).

In general, it can be stated that variation of the forested area tends to reflect the large-scale socio-economic changes. Statistical data concerning variation of the forested area in the mesoregion are shown in Fig. 1 and listed in Table 1. Map of anthropogenic disturbing based on First and Second Military Surveys suggests stagnation or slight decrease of forested areas (Sütő et al. 2018). The Third Military Survey reflects dramatic changes of this pattern, namely a considerable decrease in the area of forests (Fig. 2) that was caused by industry developing in the Sajó Valley.

Coal mining, which was also just started in the area and which also required huge amount of wood, was not able to satisfy the increasing demand for energy because of technical and transportation causes; therefore, massive logging occurred. Moreover, since the social changes, control over forestry was difficult, and reforestation of the deforested areas hardly happened. Since the Third Military Survey, however, considerable, approximately 20% increase in forested area can be observed, which suggests that, despite conflict of interest between forestry and nature protection, nature protection efforts have had a positive impact on the land use pattern. The forest matrix has become absolute dominant (app. 54%), and its area

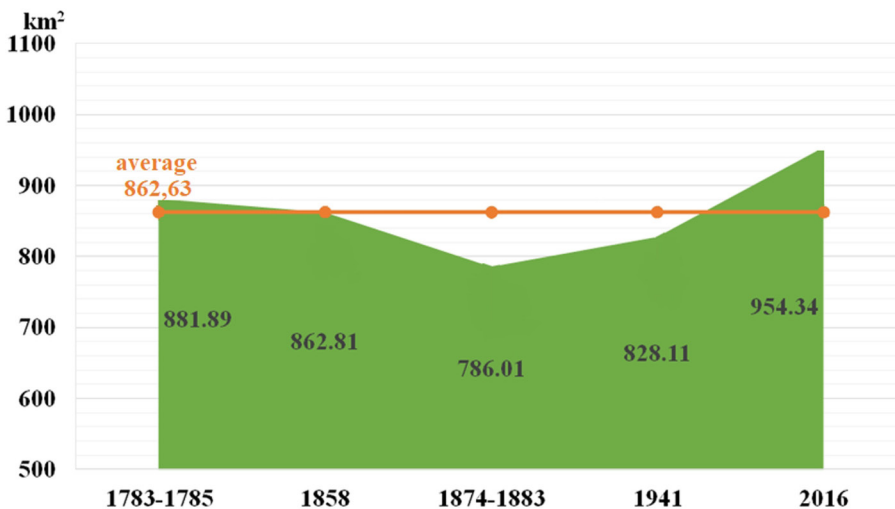


Fig. 2. Variation of the forested area in the Bükk Region (own compilation)

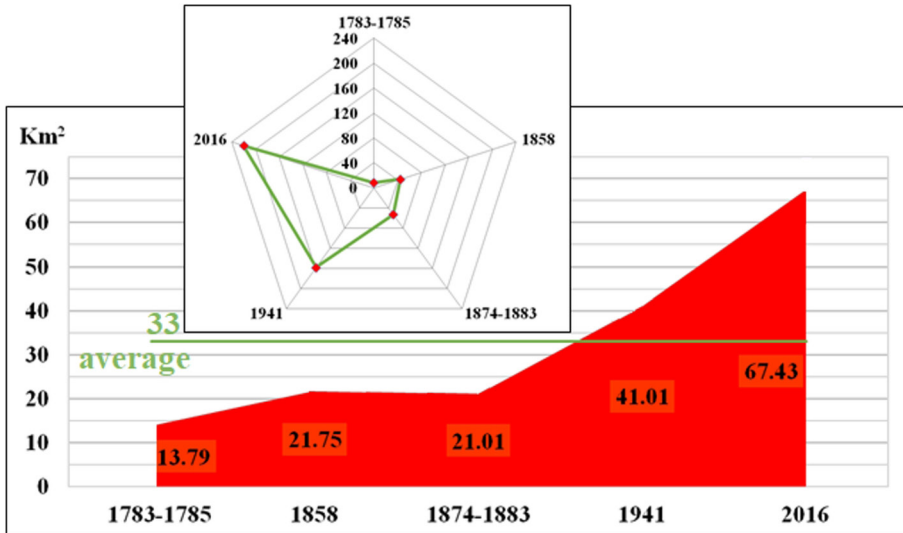


Fig. 3. Relationship between the extension of artificial areas and the number of the population (source: own compilation)

Table 2. Changes in area of artificial surface (source: own compilation)

Year	Average extent of forested area (km²)	Range of changes (R) (km²)	Standard deviation (km²)	Cover of artificial surfaces (%)	Deviation from average (%)
Totally between 1783 and 2016	33.0	53.6	21.7		
6. 1783-1785				0.8	-58.2
7. 1858				1.2	-34.1
8. 1874-1883				1.2	-36.3
9. 1941				2.3	24.3
10. 2016				3.8	104.3

almost reaches the extension of 1000 km².

At the same time, however, urbanogenic-industrogenic land use, which creates partly artificial surfaces, has led concentrated and essential transformation in the relationship of landscape forming factors, so it can be regarded as a dominant land use type in the margin of the mesoregion although its extension is much more subordinate (Fig. 1).

For the last 250 years, close relationship between progressive increase in the intensity of anthropic activities and in the concentration of population seems to be obvious (Fig. 3). Although it is a relatively small area even today, not more than 7 %

of the original matrix (Table 2), its role in expansion of anthropic disturbance can be mapped (Sütő et al. 2018).

Relative deviation values are relatively high (Table 2), which corresponds to the rate of increase. This rate of increase in artificial surfaces has increased anthropic disturbance by orders of magnitude.

On the basis of the analysis of changes in forested area and artificial surface in the Bükk Region, it can be expected that the pattern of anthropic disturbance may reflect temporal changes, too. Although 'hemeroby level' proved to be useful parameter for expression of human impact on the landscape

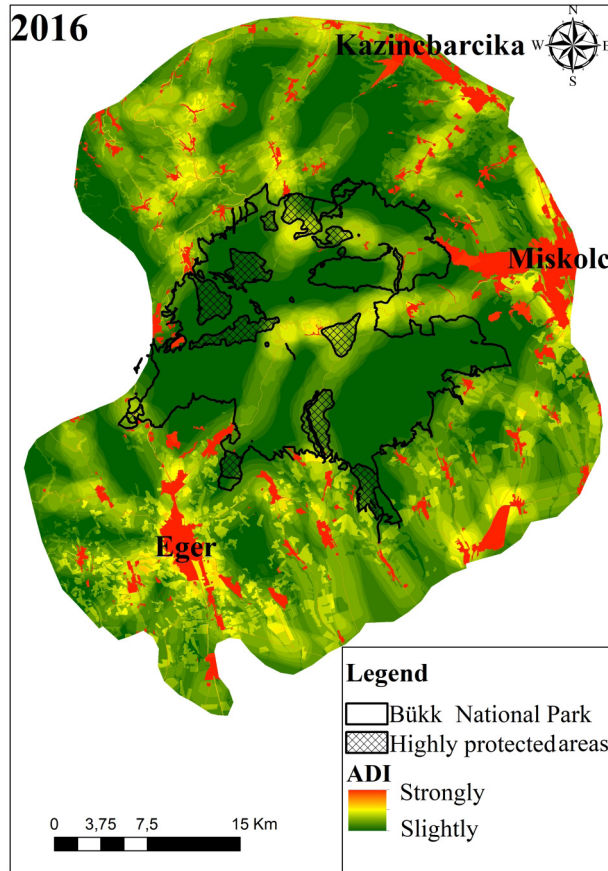


Fig. 4. Anthropogenic Disturbance Index map of the Bükk Region (source: own compilation)

(Horváth – Karancsi, 2011), we choose the so-called modified Anthropogenic Disturbance Index (ADI), which based on Human Influence Index, to demonstrate anthropogenic disturbance of the region. The ADI map clearly indicates the location of settlements as well as patches of mining and industrial sites in the zones of slightly used surface (Fig. 4). Transformation of the area of Miskolc, Kazincbarcika, and Eger cities, which are the continuously transforming centers of the developing mining-industrial area, is particularly obvious. During the socialist era the enforced urbanization triggered its rapid increase until the 1970s, and then its rate began to slow down or stagnate. Urbanization involved significant increase in population, too, and the new downtowns and housing estates increased the intensity of disturbance by expanding the area of

artificially covered surface. These areas have represented significant disturbance up till now, and locally have considerable impact on landscape character, too. Areas of higher disturbance concentrated in the margins, however, corresponding to the temporal changes, anthropogenic transformation progresses through “tracks” in the valleys to the central part of the Bükk Region. Today, due to urbanogenic land cover, transportation network, as well as artificial or semi-anthropogenic surfaces belonging to the industrial zone, marginal areas of the region can be characterized as industrial-agricultural landscape.

Trends and tendencies of anthropogenic transformation of the Bükk Region somewhat differ from the average pattern in Hungary. Due to hard natural conditions, changes in raw material requirements, and progress of

nature protection, natural or quasi-natural condition preserved and survived in two-third part of the protected terrains.

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