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Land Use/Cover Changes in Selected Regions in the World

Volume XVI

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PREFACE

Dear readers,

we present here Volume XVI of the Atlas Land Use/Cover Changes in Selected Regions in the World – IGU-LUCC Research Reports (Atlas LUCC for short) prepared by the International Geographical Union – Commission on Land Use and Land Cover Change. It is second volume (after volume XIV published in 2019) of the atlas, which is largely devoted to the outputs of the project G18P02OVV008 "Heritage of Extinct Landscapes: Identification, Reconstruction and Presentation" within the Ministry of Culture of the Czech Republic Program for the Support of Applied Research and Experimental Development of National and Cultural Identity for 2016–2022 ("NAKI II"). The project deals with the issue of the heritage of extinct landscapes in Czechia and the issue of land use and land cover is one of its main topics. For more information about the project, see Chapter 1. There are also two contributions prepared by colleagues from other universities in Czechia.

The requirement to publish further volumes of LUCC atlases was made at the conference of IGU Commission on Land Use/Cover Change held in September 2019 in Koper, Slovenia. At the conference in Koper, the participants interested in the work of the LUCC Commission met and discussed further activities of the Commission and the election of a new commission chairman for the years 2020–2024. The current commission chairman is Monica Dumitrascu, a researcher and director of the Institute of Geography of the Romanian Academy of Sciences. The attendees further recommended that the work of this Commission should continue in the next years as it represents a major focus of geographic research for complex understanding to the nature-societal interactions on various geographical levels (e.g. local, regional, global). In the opinion of those present, this is not only about basic research, but also about understanding the long-term trends of landscape development and change. The attendees of the conference in Koper recommended preparation of further Volumes of the Atlas LUCC, as it represents an important documentation of the research activities of the collaborators involved in the work of the Commission. During the discussion, it was recommended to reduce the number of hard copies of the Atlas LUCC and to support the publication of a digital version on the commission website (now: http://lucc.zrc-sazu.si/). On this website you can find all information about the Commission. If you are interested in working on IGU-LUCC activities, contact any member of the current Steering Committee. You can also submit contributions for publication in further Volumes of the Atlas LUCC, which is prepared alternately by Yukio Himiyama in Japan (Hokkaido University of Education Hokumoncho, Asahikawa; himiyama.yukio@a.hokkyodai.ac.jp) or Lucie Kupková in Czechia (Charles University, Prague; lucie.kupkova@natur.cuni.cz).

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I

Disappeared landscapes of Czechia

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CHAPTER 1

Disappeared landscapes of Czechia: Introduction and evaluation methods

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1. Introduction

This Atlas of Land Use/Cover Changes in Selected Regions in the World represents the results of the NAKI II project entitled "Dědictví zaniklých krajin: identifikace, rekonstrukce a zpřístupnění" (Heritage of Extinct Landscapes: Identification, Reconstruction and Presentation).

The aim of the project is to identify, document, reconstruct the heritage of the lands that have disappeared during the dynamic changes of society in Czechia since the end of the 18th century – in particular:

1) to identify, document, and reconstruct cultural heritage and values of different types of landscapes by using both historical sources and modern technologies;
2) to present, on the example of extinct landscapes, the diversity of cultural landscape heritage and to contribute to creating conditions for its systematic conservation, presentation and use by professionals, relevant institutions, for example in the area of landscape protection or regional development, as well as by public.

We would like to present the legacy of the disappeared Czech cultural landscape also to the international group of experts. That is the reason why this atlas, which is distributed in printed and digital versions to a wide range of people interested in the topic of land use/cover and its changes, has been elaborated.

The results of an analysis of eight transformed/extinct landscapes (model areas) in various parts of Czechia are presented in this atlas. Landscape changes are analysed and evaluated in the so-called "core area of interest", where the biggest change occurred (mostly 2 or 3 cadastral areas), and in the so-called "wider area of interest", which includes municipalities within 8 km of the core area. The distribution of core areas within Czechia is shown at the Figure 1. All areas were examined by using the same methods. Therefore, we will introduce the methods of processing individual outputs in the beginning of this Chapter.

The methods used for the analysis of individual model areas in this volume of Atlas LUCC XVI (2021) are identical with those used for analysing the model areas in the volume of LUCC XIV. This is why this opening chapter, which includes the description of individually used methods of the analysis, is adopted from the volume of LUCC XIV (2019, pp. 9–14).

2. Methods of map outputs creating

Each Chapter contains 13 map outputs. Emphasis is placed on outputs that show changes in land use (Figures 3 and 6–9), but also outputs characterizing the so-called landscape memory (Figures 10–13) are included. The following paragraphs list the methods used to create these map outputs. The structure and order of the methods described here correspond to the ordering of the outputs/results in Chapters 2–8 (results for certain area of interest). Each Chapter is introduced by two maps showing both the above-mentioned core area of interest (Figure 1) and the wider area of interest (Figure 2).

2.1 Landscape and land use/cover changes

The section Landscape and land use/cover changes includes four sets of results, in the case of two areas of interest (Krkonoše and Boletice) there are five sets of results. These are (1) comparative maps of land use at the time of the Stable Cadastre and at present, (2) landscape models, (3) comparative photographs, (4) cartograms characterizing land use changes between year 1845 and 2010. Sections 2.1.1–2.1.5 show the data processing methods for these four result sets.

2.1.1 Land use at the time of the stable cadastre and the present

The evaluation of land use changes occurring in the areas of interest from the middle of the 19th century (mapping of the Stable Cadastre) to the present is based on the set of two maps (Figure 3 in all Chapters).

For the first time horizon colour raster copies of the so-called imperial mandatory prints of the Stable Cadastre maps were used. These are maps from the years 1826–1843. In contrast to the so-called original maps of the Stable Cadastre, these maps capture the original situation of the landscape without additional drawing of later changes (see http://geoportal.cuzk.cz). Raster data was georeferenced, and vector map was created in ArcView.

Cadastral maps from the Register of Territorial Identification of Addresses and Real Estates ("Registr územní identifikace, adres a nemovitostí"; RÚIAN) were used as a basis for creating the map of the current situation of the landscape (see https://www.cuzk.cz/ruian/). Because these maps contained a large number of errors in the categories of land use, the data were corrected by using the current orthophoto from the State Administration of Land Surveying and Cadastre ("Český úřad zeměměřický a katastrální"; ČÚZK). The orthophoto was connected to ArcGIS via WMS (Web Map Service) server. A simplified legend was used for map outputs and evaluation of changes (the current cadastre records only basic categories of land use). Changes are evaluated numerically in tables and their spatial distribution is evident from the comparison of maps for both time horizons.

The map legend includes the categories of arable land, permanent grassland (sum of grassland categories), permanent

Fig. 1 – The core areas of interest within Czechia.

crops (gardens and orchards), forest areas, water areas, built-up areas and remaining areas. In some cases, the abandoned land category is also included for the current horizon. This is a land that has not been farmed in recent years/decades and it is affected by a spontaneous succession.

2.1.2 Landscape models

The aim of the landscape model-making is to present/illustrate and assess the state of the landscape of core area, or certain detail of the area, in several time horizons using archival and contemporary aerial photographs (Figure 4 in all Chapters).

The images were placed in the S-JTSK coordinate system using the intersection (collinearity equations) and control points, whose coordinates were subtracted from the current orthophoto and elevation model available from the web mapping service of the State Administration of Land Surveying and Cadastre (ČÚZK). The ZABAGED elevation contour model was then used for the purpose of depicting the elevation of the area. The procedure for processing individual data bases was as follows:

a) Archival aerial photos

Aerial survey images were obtained from the archive of the Military Geographical and Hydrometeorological Office in Dobruška (*"Vojenský geografický a hydrometeorologický úřad"*; VGHMÚř). Black and white images of 23 cm × 23 cm were scanned at resolution of 15 μm. With the exception of the camera constant shown on the frame of the image, the elements of internal orientation (i.e. the position of the main frame point and the lens distortion) were unknown and were neglected for further processing. Due to the interpretative purpose of the use, the resulting geometric distortions were acceptable. At least 4 points identifiable in both the archival photo and the current orthophoto were found in each image to obtain the elements of external orientation. Using the collinearity equations, the coordinates of the projection centre and the inclination of the photos were calculated. The images were further orthorectified above the ZABAGED elevation contour model. This model was subsequently used for 3D landscape visualization from 1990. For processing was used software PCI Geomatica, ArcMap and ArcScene.

b) Orthophotos from the 1950s

The orthophoto from the 1950s was provided by the Czech Environmental Information Agency (*"Česká informační agentura životního prostředí"*; Cenia). This orthophoto was projected on ZABAGED elevation contour model for 3D visualization. ArcMap and ArcScene software were used for processing.

c) Contemporary orthophoto

The current orthophoto available via the ČÚZK web mapping service is displayed above the ZABAGED elevation contour model. ESRI software was used for processing.

2.1.3 Comparative photographs

Old photographs were collected from archives or private collectors and places in landscape, locations from where these photos were taken were identified in the field. From these places the actual pictures were taken. The current photos show the state of landscape at the present, and also illustrate the change that took place in the given place (Figure 5 in all Chapters).

2.1.4 Cartograms presenting changes in land use

The aim of this analysis is to document long-term changes in the area of selected land use/cover categories within the wider area of interest. A database of the Land Use Land Cover Czechia Database (LUCC Czechia Database, https://www.lucccz.cz) was prepared at the Faculty of Science, Charles University. This database, which is based on cadastral data for the years 1845, 1948, 1990, 2000, and 2010. The database collects data on land use at the level of the Stable Territorial Units (STUs). STUs are units at the level of cadastre or units merged from several cadastres

(merged in the way that its area does not change by more than 2% during the whole monitored period). Areas of arable land, permanent grassland, permanent crops, forest areas, water areas, built-up areas and other areas are recorded for each STU and for every year. The methodology for creating and analysing of the database is described in detail in Bičík et al. (2015). Changes in arable land, permanent grassland and forest areas as a percentage for individual reporting periods are shown in Figures 6–8.

The Index of Change (IC) was calculated in the database from the area values of each category. This aggregate index indicates the intensity of land use changes over a certain period of time in the area of interest (STU in our case). The IC does not, however, assess the "quality" (structure) of such changes:

$$IC_{A-B} = 100 \cdot \frac{\sum_{i=1}^{n} |P_{iB} - P_{iA}|}{2}$$

where IC_{A-B} – index of change between year A and year B; n – the number of land use categories; P_{iA} – the proportion of relevant land use category at the beginning of the examined period; P_{iB} – the proportion of relevant land use category in the end of examined period.

The higher value of the Index of Change means more intensive land use change in the area. This index ranges from 0 to 100 and – put in a simple way – indicates the proportion of area where any land use change occurred, based on the comparison of beginning and end of the evaluated period. Changes that may have occurred during the examined period are not reflected (Bičík et al. 2015).

2.2 Regional and local symbols

Local symbols, often also symbols of a larger region, are often depicted on municipality emblems. Each emblem represents the municipality, but it is also its "chronicle". Using various graphic elements, the emblems tell of the past, monuments, traditions or legends, as well as of the economic and cultural activities of former inhabitants of municipality, or also of the present or/and past (extinct) landscape. If the municipality emblem is processed according to heraldic principles and if its iconography does not distort or shift reality, it is a valuable source of local or/and regional historical-geographical information. The aim of this analysis is to find references to the landscape and its changes within the symbols used in the emblems of municipalities in the area of interest (Figures 10 and 11 in all Chapters).

For the analysis of the form and content of the municipality emblem, content analysis has been chosen as an analytical method (Krippendorff 2004; Rose 2007). Content analysis was originally introduced in many fields for text analysis (linguistics, sociology, anthropology, political science, etc.). However, its principals can be used very well also in the analysis of visual materials (Rose 2007). The emblems of all municipalities in the area of interest (as of 20 August 2020) are shown in the map. But not all of the municipalities have an emblem. Cities and towns traditionally have their emblem (given the historical right of cities and towns to "own" an emblem). Other municipalities could not start to "create" its emblems until 1990 (Šifta 2016). It is not the duty of municipalities to have a municipality emblem. Thus, the areas of municipalities that do not have the emblem remain empty in the maps.

The first step of the content analysis is to select the type of materials examined, followed by its collection. On the example of the content analysis of municipality emblems in Czechia, the source of data is the Registr komunálních symbolů (Register of Municipal Symbols; https://rekos.psp.cz). In the second step, the set of emblems is subjected to analysis ("reading", deciphering its content) with the result of identifying certain symbols pictured in the emblem (it can contain, and usually contains, more symbols) and interpret their meaning. In the third step, the set of identified symbols is then divided into predetermined categories. Only those emblems, that contain the references to the history of the landscape and reflect its changes, are included in the analysis. These symbols are divided into following landscape-related categories: agriculture, water course/body, location of the municipality (e.g. symbol of the location of the settlement on a hill, in a valley, etc.), landscape/natural element (presence of rock formation, memorial tree, etc.), forest (occurrence of forest in the surrounding of the settlement), economic tradition, and other symbols. The "other" category includes all other types of symbols depicted in the municipality emblems (historical, church, cultural, administrative). In the next step, the results are quantified (using simple descriptive statistics, the frequencies of symbol use are analysed and the differences between categories are compared). The portion of the types of symbols in the emblems of municipalities in the area of interest is shown in the form of a thematic map with charts (diagrams). Subsequently, spatial patterns in the use of the same or similar symbols in the emblems of municipalities in the area of interest are identified. Symbols used in more places (in more emblems) thus often reflect the history, development and changes of the landscape in the wider area.

2.3 Heritage sites

Cultural monuments comprise a complex of heritage, representing values and meanings related to the past which should be protected and preserved for future generations. Preservation of monuments focuses on the research of monuments, their identification, protection, documentation or administration (Harvey 2001; Smith 2006). Internationally, UNESCO is dedicated to the protection of monuments, in Czechia, the National Heritage Institute (*Národní památkový ústav, NPÚ*) is a professional organization of the state monument care established by the Ministry of Culture of the Czech Republic (*Ministerstvo kultury ČR*). The aim is to get acquainted with the monuments and monument areas which are related to the monitored landscape transformation in the core (or in some cases in the wider area of interest), and which are registered in the National Heritage Monument Catalogue (*Památkový katalog NPÚ*).

The list of cultural monuments was created on the basis of a detailed research of the resources of the National Heritage Institute. This institution creates and manages above-mentioned National Heritage Monument Catalogue (www.pamatkovykatalog.cz). The catalogue contains basic descriptive information about monuments, including photographs and references to the location of monuments in the cadastral map.

The Ministry of Culture of the Czech Republic declares as cultural monuments under the Act of the Czech National Council on the Care of Monuments no. 20/1987 Coll. (*Zákon České národní rady o památkové péči č. 20/1987 Sb.*) immovable or movable property (or a set thereof), which is a significant proof of the historical development, way of life of the society from the oldest times to the present. Also, the creative abilities and the work of man from various fields of human activity are defined as cultural monuments, because of its historical, artistic, scientific and technical values. Monuments can also have a direct relationship to significant personalities or historical events.

For the purposes of the analysis of the area of interest, only those monuments that are directly related to the characterized landscape changes, i.e. refer to the specific historical development

of society or values and remind meanings connected to a specific human activity in the landscape, were purposefully selected from the National Heritage Monument Catalogue. In the catalogue, each monument is introduced in text and its "description of the monument value" is described. The monuments shown on the map (Figure 12 in all Chapters) are selected based on the data contained in this description.

The selection of monuments was performed mainly for the purpose of the best representation of the character of the examined landscape, because the National Heritage Monument Catalogue contains a large number of records that represent different historical periods or heritage values. In some core areas, however, monuments documenting the monitored landscape change did not occur, and therefore the search was extended to all cadastral areas in the area of interest (thus to the wider area of interest).

Features registered for each monument:
- catalogue number,
- name of the monument,
- cadastral area in which the monument is located,
- category of monument (small object, object, compound, area),
- date of obtaining the status of monument and monument protection,
- date of loss of the monument protection,
- type of monument protection (cultural monument, national cultural monument, heritage),
- annotation (brief description),
- location (GPS coordinates),
- data source.

2.4 Places and institutions of memory

Memory institutions preserve and transmit the information about the past and the changes of landscape in the area. Memory institutions are primarily museums or independent exhibitions, and also archives and collections that contain and manage related archival documents (Matero 2008). The aim of the analysis (using examples of museum expositions) is to create a basic overview and typology of memory institutions that are located in the wider area of interest or those institutions in whose exposures are related to the examined area of interest (Figure 13 in all Chapters).

The list of memory institutions was created mainly on the basis of research of electronic information sources. For this reason, it cannot be considered absolutely complete (there are many private collections, which are not represented on the Internet), but can be sufficiently valid with respect to the project objectives.

In the first step, a database of local exhibitions was created based on information about Czech museums provided by the *Asociace muzeí a galerií České republiky* (Czech Association of Museums and Galleries). The obtained data were further supplemented with information available from popularizing web projects the *Do muzea* ("To Museum") and the Muzeum.cz. In the second phase the expositions were searched according to the main localities in the areas of interest, i.e. larger cities with more than a thousand inhabitants. The resulting database contains detailed information about individual memory institutions (address, GPS coordinates, link to the institution's website).

The memory institutions (museums and individual expositions) were then analysed with regard to the focus of the expositions and collections. The expositions are divided according to:

a) their relation to the transformation of the landscape in the area of interest (expressed in the map by the inclination of the map sign):
   - exhibitions which are directly related to the area of interest and present the past and changes of the local landscape in the area of interest;
   - exhibitions which indirectly, respectively only partially, present the past and changes of the landscape in the area of interest (e.g. city museums, or those exhibitions which do not present a specific transformation of the landscape).
b) scale (expressed in the map by size of the map sign) on those representing:
   - institutions of local importance;
   - institutions of regional importance.

In the last step, the collections and exhibitions are described in terms of its content and focus. Colour of map signs symbolizes a maximum of three of the most typical themes of the exhibitions.

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CHAPTER 2

Jistebnicko: A defunct landscape of (sub)mountain agriculture in Česká Sibiř

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1. Introduction

Česká Sibiř is the name on an elevated landscape on the boundary of central and southern Bohemia, roughly between Votice, Sedlec-Prčice and Tábor. The name Česká Sibiř was probably coined and first used by the writer Jan Herben, who came here from Prague to his summer residence in Hostišov. The location of Česká Sibiř has long been distinctly peripheral, at the border of higher-order administrative units at the regional level, from where it is far from any major centres. The core area of the cadastral units of Cunkov and Ounuz occupies the highest ever position in Česká Sibiř on a flat watershed ridge, which includes the highest point of the Javorová Skála (723 m). The village of Ounuz (710 m above sea level) is the highest settlement in Česká Sibiř.

The traditional rural landscape of Česká Sibiř was a mosaic of forests, fields, meadows and small ponds, with a strong productive function of subsistence agriculture. Subsistence agriculture on poor acid soils and in a harsh climate was no longer profitable from the late 19th century onwards. Since then, the number of permanent residents in the small villages has steadily declined. This process accelerated and became more pronounced after the establishment of the JZDs (agricultural cooperatives) under the Communist regime, when arable land was declining and many agricultural plots were covered with grass. The area of forest cover was also gradually expanding at the expense of agricultural land. The depopulation of rural settlements is linked with the strengthening of their recreational function; many houses changed ownership and began to be used as individual recreational facilities (cottages) under the Communist regime.

After 1990, this trend became even stronger. There is currently no arable land in the vicinity of the highest settlements of Ounuz, Cunkov, Javoří and Alenina Lhota. The agricultural land on the watershed plateaus is completely grassed over and used as extensive grazing land for cattle, but also for horses. Exotic animals such as bison and donkeys can also be found here. The construction of the well-equipped Monínec ski resort with a chairlift, two surface lifts, a hotel and artificial snowmaking has contributed to enhancing the sport and recreational function of the area. To the south of Cunkov, an 18-hole golf course with accompanying accommodation and catering facilities was built on agricultural land. The area is interwoven with a dense network of marked hiking trails for hikers and cyclists. Unlike the past, horses are no longer raised for work, but for recreational horseback riding, which contributes to the development of new forms of eco-tourism and horse trail riding. In winter, cross-country skiing trails are maintained for cross-country skiers, for whom only the gently undulating grassy terrain provides ideal conditions. In order to protect the characteristic landscape of the traditional rural cultural landscape, a large natural park, the Jistebnická vrchovina, has been declared. It also includes the area under consideration. A village conservation zone of folk architecture has been declared in Ounuz (710 m above sea level), the highest settlement in Česká Sibiř.

Despite these efforts, it is clear that in the top region of Česká Sibiř one can observe the disappearance of traditional agricultural landscape and its subsistence function as well as a significant and quite obvious shift from the agricultural production function of the landscape to non-productive functions – sports and recreational, nature conservation, aesthetic ones.

For the purposes of this project, the "core area" was delineated and most analyses are carried out in it (Figure 1). It includes the municipal area of Cunkov. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

Česká Sibiř lies on the border of central and southern Bohemia in the geomorphological region of the Central Bohemian Uplands (České Středohoří; Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The geological subsoil consists of Variscan granitoids and granodiorites of the Central Bohemian pluton of the Čertovo břemeno type. The Quaternary cover is weak and insignificant, consisting of weathered rocks and slopes.

The core area of the cadastres of Cunkov and Ounuz occupies the highest positions of the Jistebnice Uplands. It is a flat, arched watershed between central and southern Bohemia, between the basins of the middle Vltava and Lužnice rivers. The relief of this summit area at the altitude of 600–720 m is very flat, with a level surface or gentle slopes with an inclination of up to 5°. The highest point is the Javorová skála (723 m), which is also the summit of the Jistebnická pahorkatina uplands and the entire Vlašimská vrchovina hilly area. To the north and northeast, the surface slopes down into the Sedlec basin through a significant terrain gradient with an elevation of 150–250 m, while on the southern side towards Jistebnice the elevation differences reach only a few tens of metres.

The relief on the northern slope typologically corresponds to a rugged upland, while the top positions and the entire southern side are flat undulating hills. Small rock formations and numerous granite boulders and their clusters stand out on the surface of the granite vault. The most famous rock shape is the Čertovo břemeno (Devil's Burden), a tor-type rock carved in the main watershed ridge between Cunkov and Ounuzí. On the northern side, a small boulder stone sea stretches below it. The anthropogenic landforms are mainly represented by numerous stone walls and long rows of accumulated granite stones and

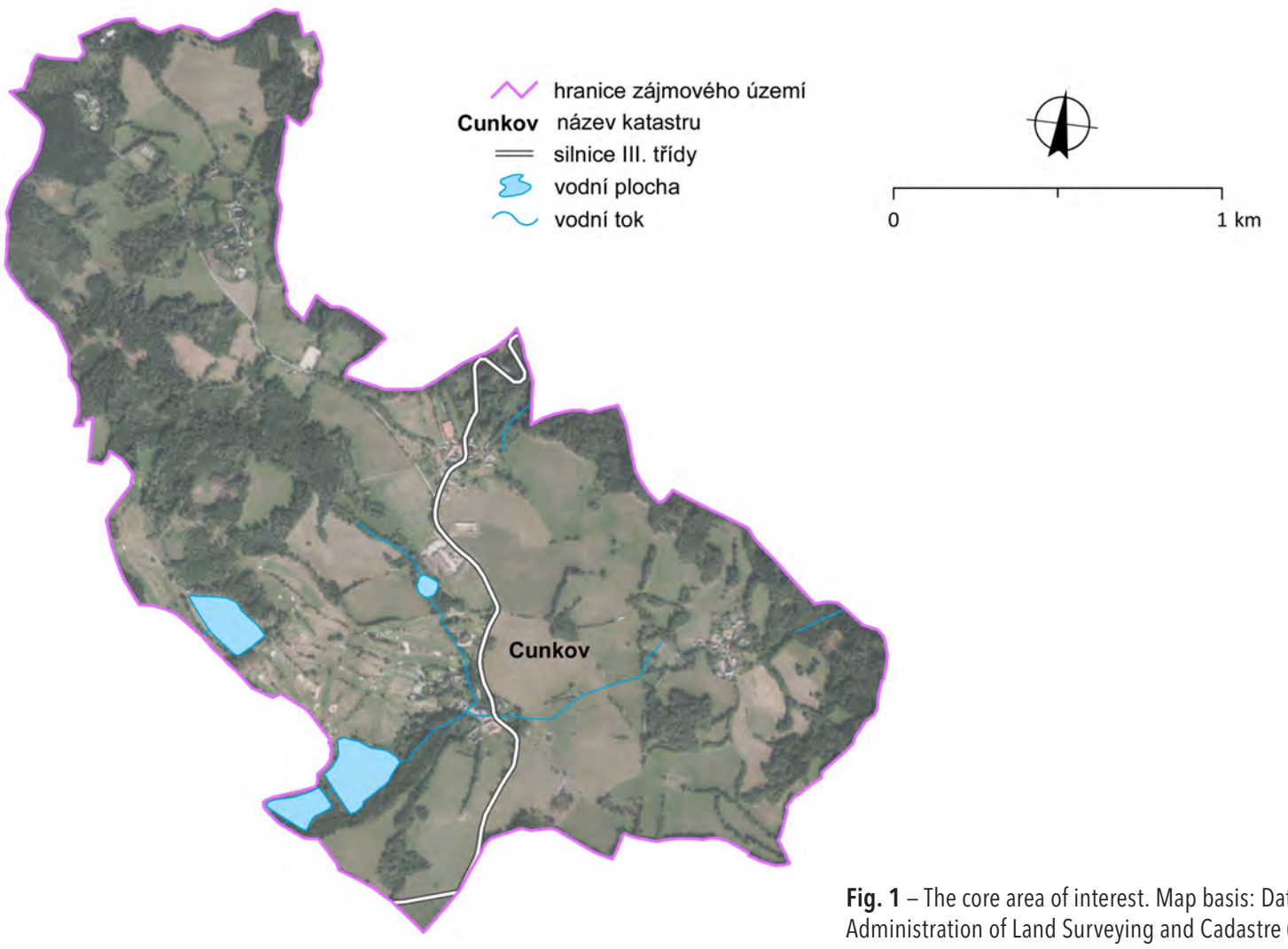


Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre (2019).

boulders. They are often found in the forest and testify to the former agricultural cultivation of the now wooded parts of the landscape.

According to traditional knowledge, Česká Sibiř has a cold climate. This was also reflected in the older climatic classification by Quitt, which classified the top region of Česká Sibiř (where the core area lies) as a cold climate region. However, more recent climate data, which already reflect the global climate change towards warming (Quitt 2009), classify the entire area of Česká Sibiř, including its highest elevations, as only moderately warm. The average annual temperature is around 6 °C and the average annual precipitation is 650–700 mm. The Sedlec basin is significantly warmer and drier. In winter, a snow cover forms, but due to frequent floods it does not last the whole winter and often melts.

The soil cover throughout the area consists of modal or dystric cambisols formed on the weathered rocks of deep granite-type igneous rocks. The soils are acidic, often skeletal, in depressional positions at spring areas and along streams, and generally rather infertile.

According to the phytogeographical division, Česká Sibiř lies in the Czech-Moravian mesophytic phytogeographical district, the Votická vrchovina phytogeographical district and the Čertovo břemeno subdistrict (according to Skalický et al. 2009). The forest vegetation stage is predominantly beech or fir-beech (beech with a mixture of fir), the natural forest area of the Bohemian-Moravian Uplands. According to Neuhäuslová, Moravec (eds. et al. 1997), the potential natural vegetation would consist of acidic beech with fir in places, and flowery beech with lime on marginal slopes. In the Sedlec basin, it is acidic beech and oak with fir in places.

The current use of the landscape in the core area alternates between forests and extensively used grasslands – mainly pastures. The flat relief of the summit ridge is dominated by pasture, while the steeper northern to north-eastern slope is covered by continuous forest cover. The forests are predominantly spruce and mixed, with occasional small stands of beech on the slopes and of scrub forest. Beech is the predominant deciduous species, while maple, sycamore, lime, elm and oak also grow on the rocks and scree. There are many linear structures of scattered greenery in the landscape as well as numerous solitary trees. In the pastures, especially on rows and piles of stones accumulated in the past, the photophilic hazel tree is the most frequent and dominant species. The scattered greenery is also made up of sycamore, less frequently of Norway maple, ash, elm, willow, aspen and numerous shrubs.

Shrub willows cover the waterlogged areas of the springs and alders grow along the streams. There is only rarely abandoned farmland, which is overgrown with tall grassland vegetation, dominated by reed canary grass and gradually by shrubs. A significant part of the land use is created by a golf course near the settlement of Alenina Lhota, south of Cunkov. Its structure, made up of permanent grassland with a number of point and linear structures of scattered tree vegetation, is not disturbing and is in keeping with the existing landscape character of Česká Sibiř.

The core area is part of the larger Jistebnická vrchovina nature park, which was designated to protect the landscape character of the mosaic hilly landscape of Česká Sibiř. The aim is to preserve the landscape character of the traditional rural cultural landscape with a harmonious arrangement of forests, farmland, ponds and small rural settlements.

In the highest settlement of Česká Sibiř, Ounuz (710 m above sea level), a village conservation zone has been declared. There is a complex of folk architecture with timbered buildings, some of which have thatched roofs. The territory of Česká Sibiř is popular for year-round recreation and tourism.

The area of interest is situated on the southern slope of the Javoří skála (723 m above sea level), which lies about 5 km south of the smaller twin town of Sedlec-Prčice. The area is influenced by the "Čertovo břemeno", which stands out in the landscape as a wooded ridge that is part of the Vlašimská hilly area. The location of the model area is significantly peripheral, situated on the border of the long, stable regional boundary between the Central and South Bohemia regions and at a relatively high

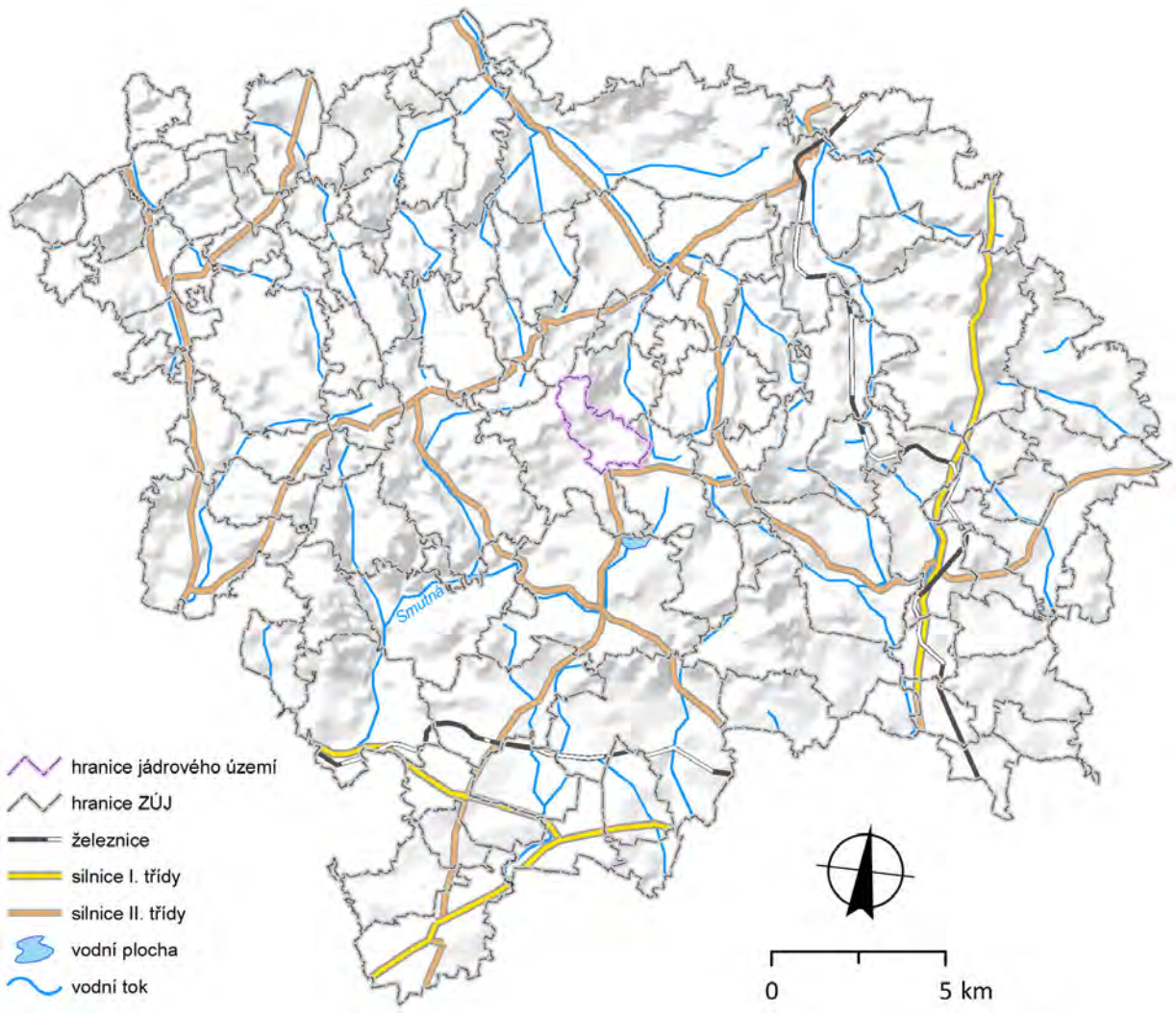


Fig. 2 – The wider area of interest.
Map basis: Data50.

altitude. This was also one of the reasons for the relatively late settlement and agricultural use of most of the model area. The gradually declining subsistence farming was transformed into an agricultural cooperative after 1948 and after 1990 it was returned to the descendants of the original owners. The peripheral nature of the location is reflected both in the very small number of permanent residents, mostly elderly, and in the fact that the abandoned houses were converted into holiday cottages after the Second World War. In this area, with a very interesting wildlife, there is a high proportion of recreational buildings in the total number of local buildings. The economic attractiveness of the model area lies in the almost undisturbed natural environment used for summer and winter tourism (walking, cycling, skiing), as well as the use of the golf course and the ski slope with two surface lifts, which are widely used by the inhabitants of Prague and other nearby centres. The model area consists of the following settlements: Ounuz, Cunkov, Javoří.

Ounuz is a local part of the village of Jistebnice, about 6 km north of Jistebnice. The settlement has been a village conservation area since 1956. Four buildings are listed and have been used in the past for filming several movies.

The settlement Cunkov (formerly Žunkov), too, is first mentioned as part of the Jetřichovice estate in 1547. Today it is part of the village of Jistebnice (about 5 km south). The peripherality of the location has been reflected in several changes in the affiliation to individual manors or municipal authorities. Similar to Ounuz, this settlement had the maximum population by 1880. Today, there are fewer than 10 permanent residents, which is about 10% of the 1869 population. The settlement has several well-preserved folk buildings from the end of the 19th and start of the 20th centuries. In addition, there is a small chapel in the village and several valuable crosses in the hinterland.

The third settlement of the model area, Javoří, about one kilometre away, is also an administrative part of Jistebnice. Like Cunkov, Javoří is characterised by its location at a relatively high altitude (650 m above sea level). Probably due to the greater proximity to Jistebnice, the population decline is less pronounced compared to the previous settlements. Today, there are about 8 permanent residents, which is less than 30% of the population in 1869.

Overall, the area can be characterised as an agricultural to post-agricultural landscape, the main use of which, apart from agriculture, is tourism in summer and winter and cottage farming. Both are supported by the beautiful natural environment and the south-west-facing slopes terminating on the ridge of the Čertovo břemeno with forestland, as well as the ski area on the north side of the ridge and the golf course in Alenina Lhota.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). The use of the landscape in the Cunkov area (part of the village of Jistebnice) has undergone significant changes in the period under review. A significant trend of extensification – a decline in intensive arable farming – can be observed. Forests have remained in the original location from 1840, but their extent has grown considerably over the period under consideration to almost 38% of the area. This is above average for Czechia. Water bodies have also remained in their original locations, but their overall area has slightly decreased. The most significant change in the territory is an extremely high loss of arable land. It covered almost half of the territory by 1840 and by today its area has diminished to all but nothing. It has been replaced mainly by permanent grassland (meadows and pastures), which is now the dominant use in the area, covering almost a half of it.

An interesting phenomenon is the development of leisure activities, such as golf courses, which have increased the size of other areas (to which the grass areas are classified in terms of use) – see other areas in the southwestern part of the territory. The construction of the golf course area in the 1990s was

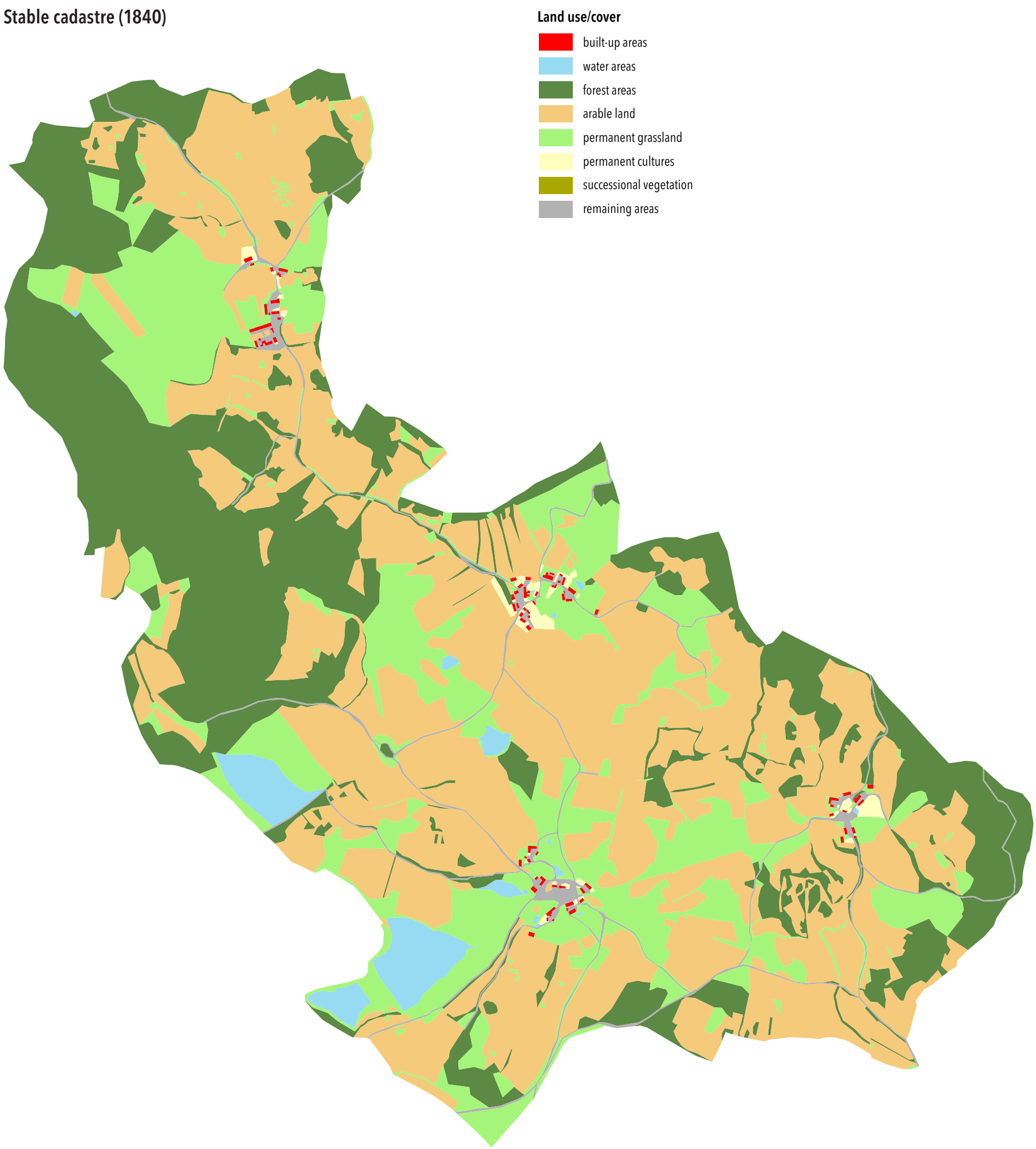
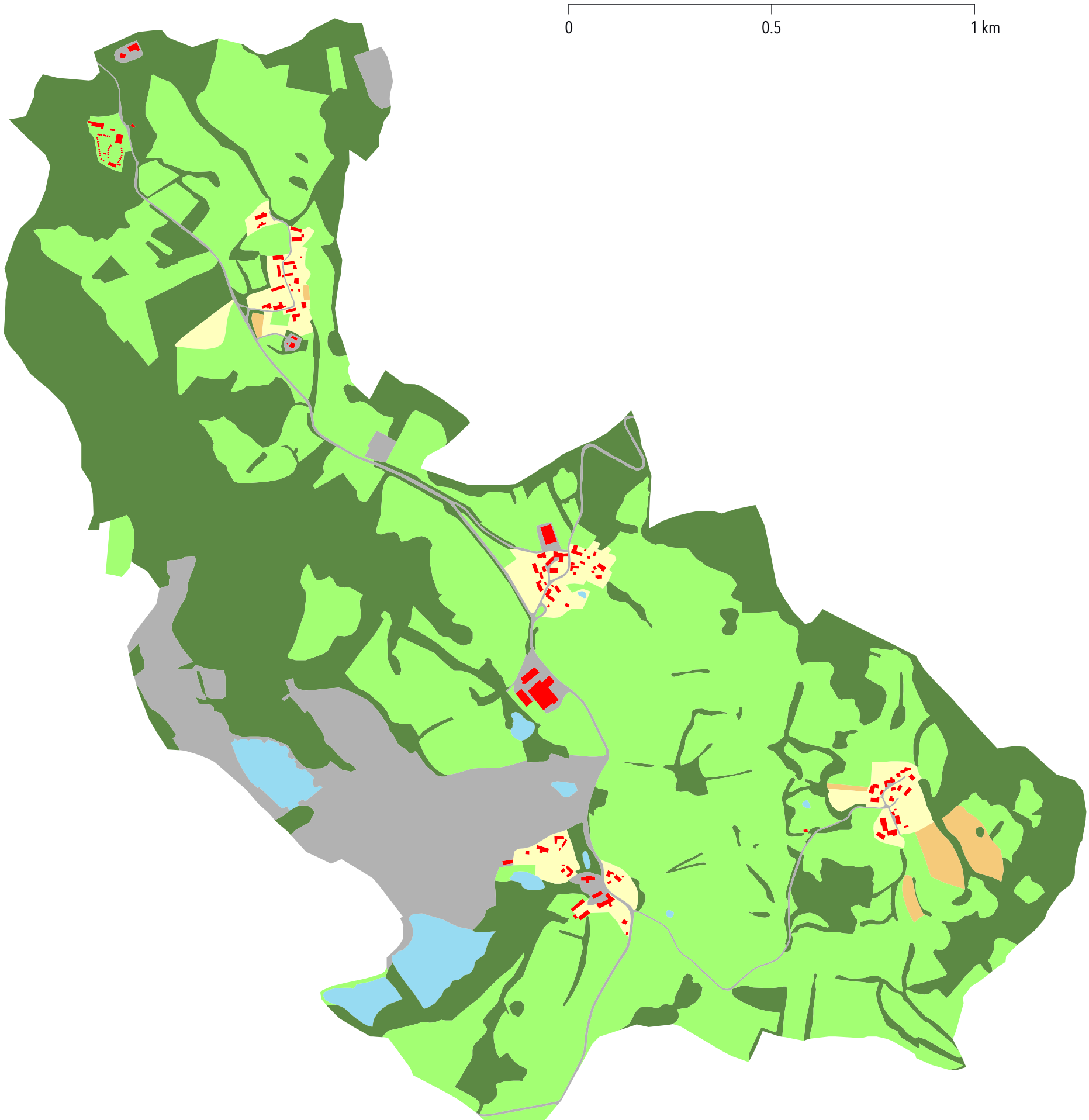


Fig. 3 – Land use/cover in cadaster Cunkov in 1840 and 2020. Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

Current state (2020)



Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.28	0.73	0.45
water areas	2.35	2.17	–0.18
forest areas	28.75	37.92	9.17
arable land	45.78	0.90	–44.88
permanent cultures	0.47	2.96	2.49
remaining areas	2.01	10.43	8.42
permanent grassland	20.36	44.89	24.53

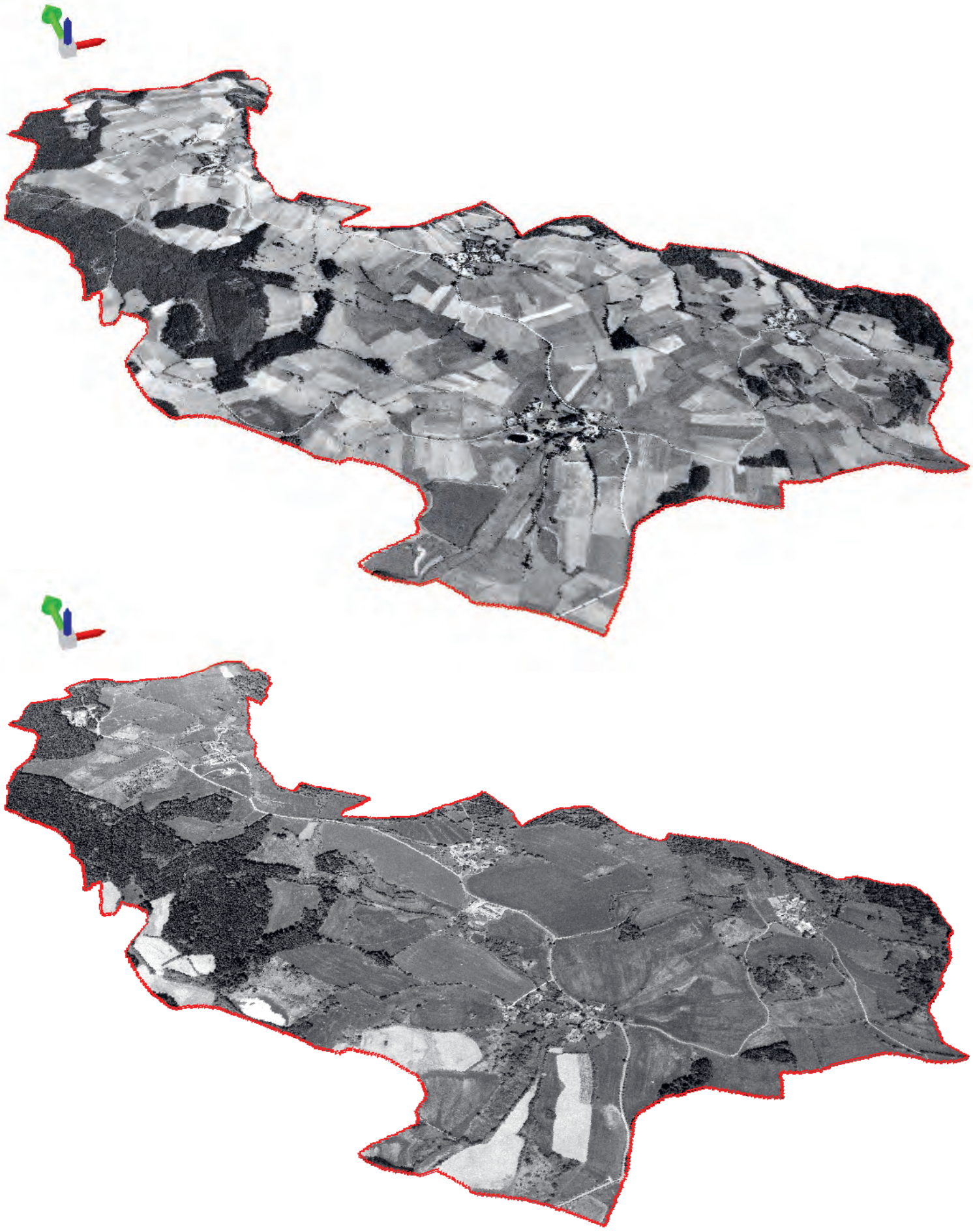


Fig. 4a – Models of landscape – Cunkov landscape in 1953, 1984, 1995 and 2017. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5a – The view of Miličín from south. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

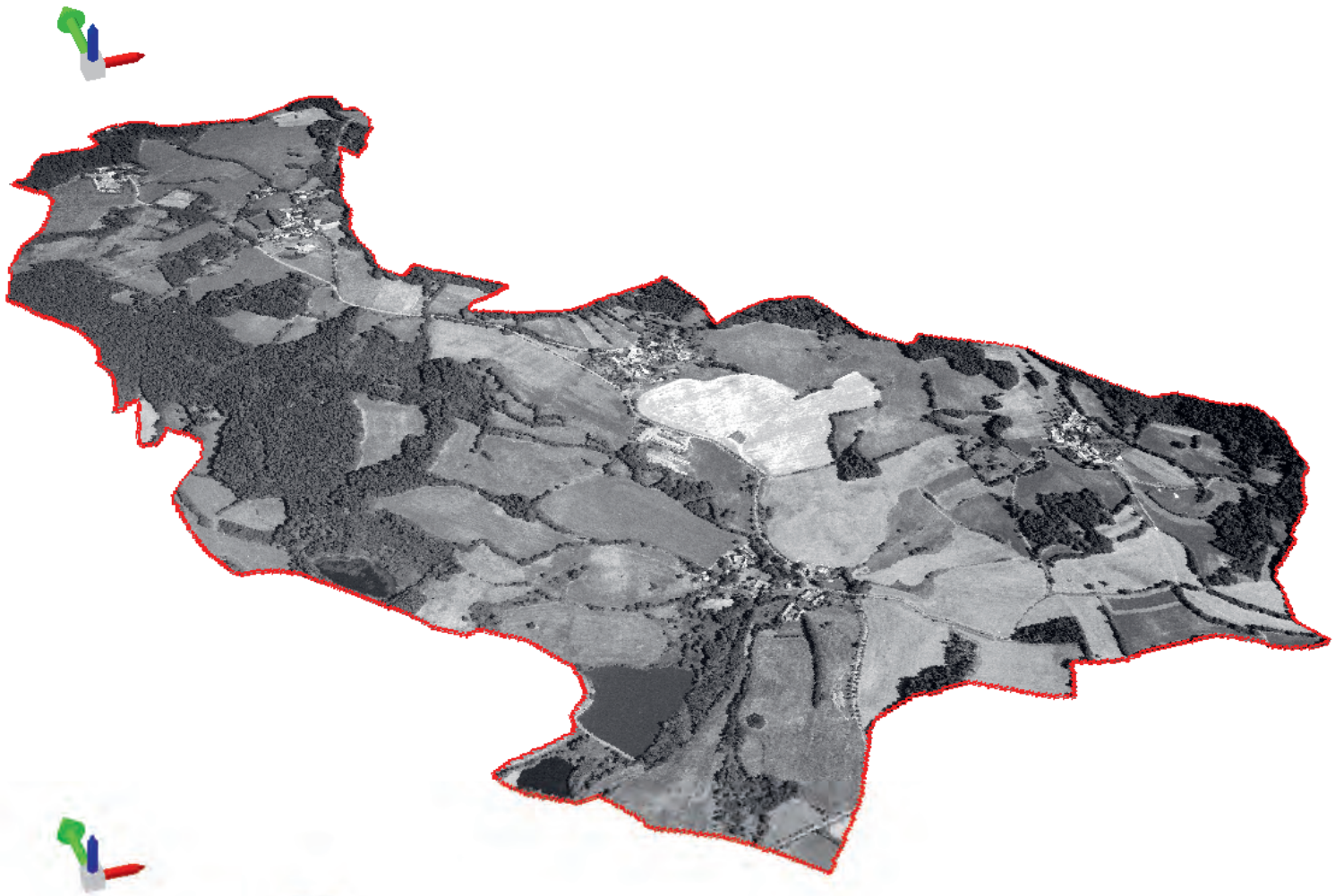


Fig. 4b – Models of landscape – Cunkov landscape in 1953, 1984, 1995 and 2017. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5b – The view of Chotoviny. Source: left: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

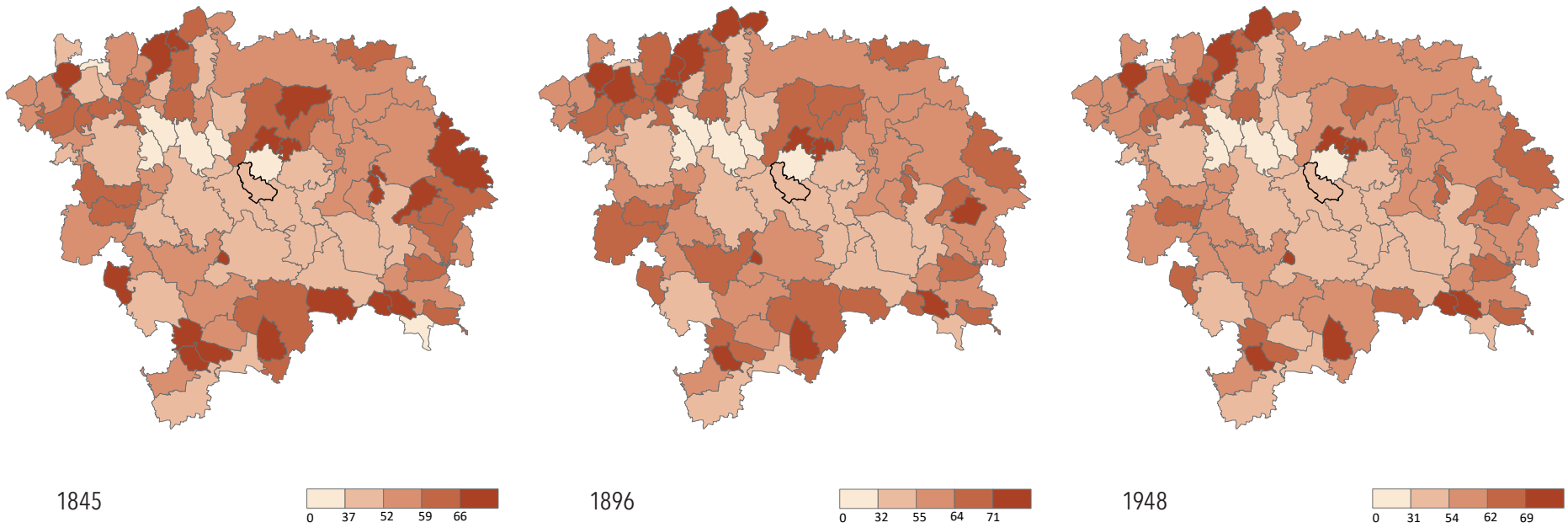


Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

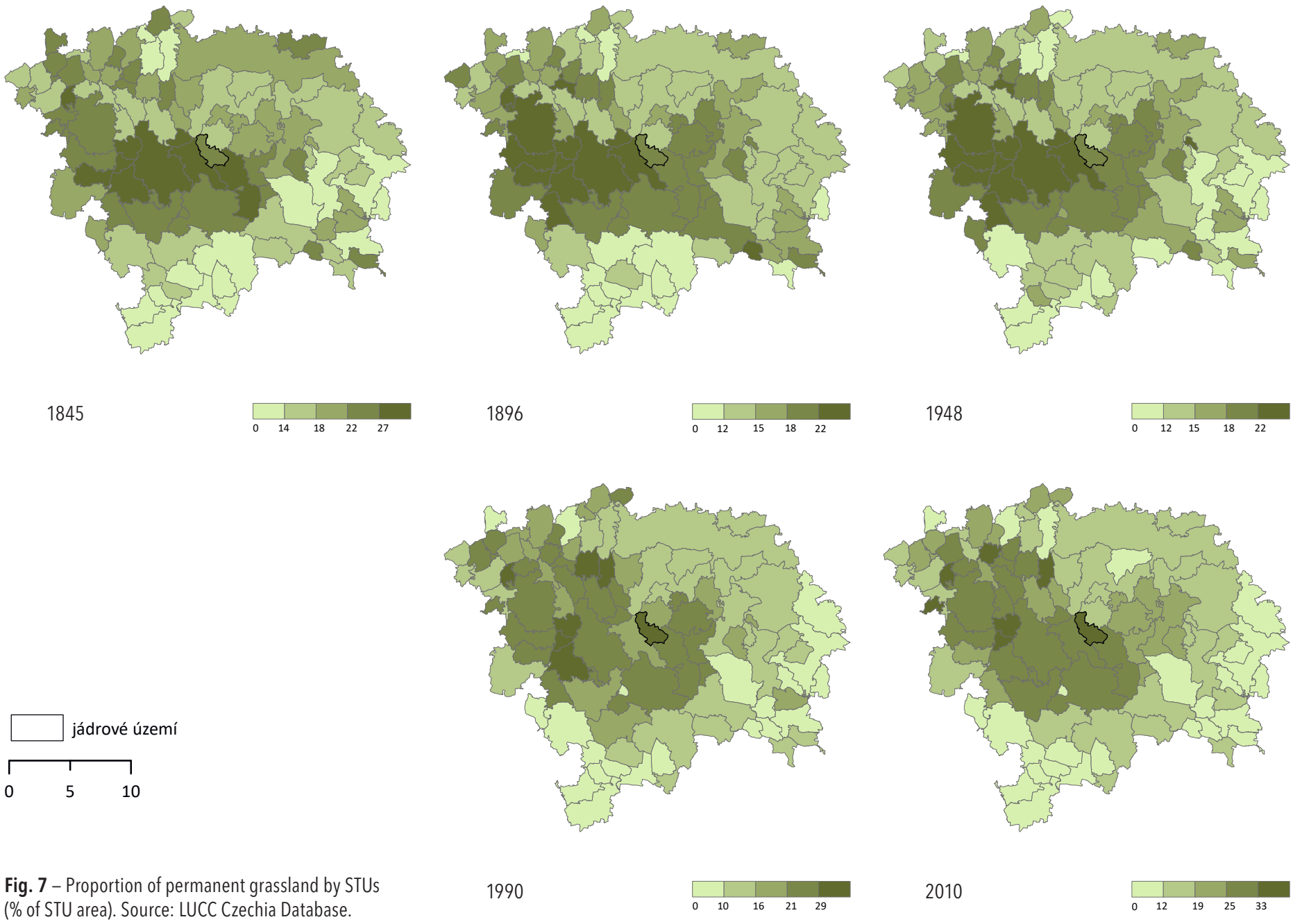


Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

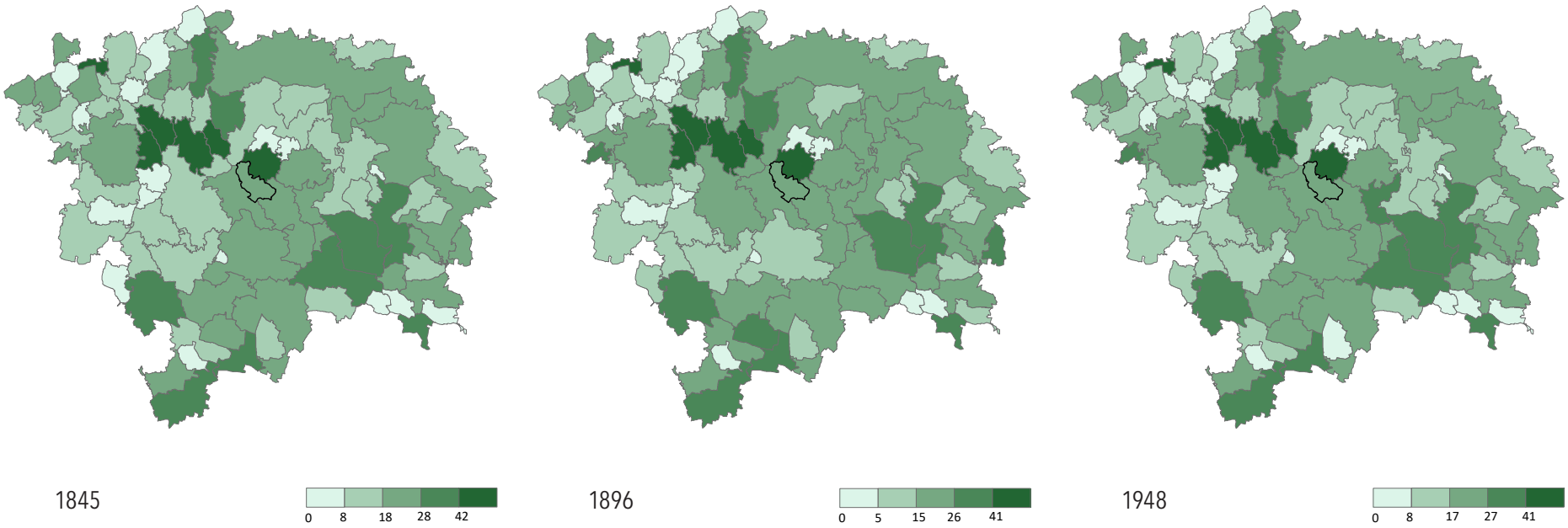


Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

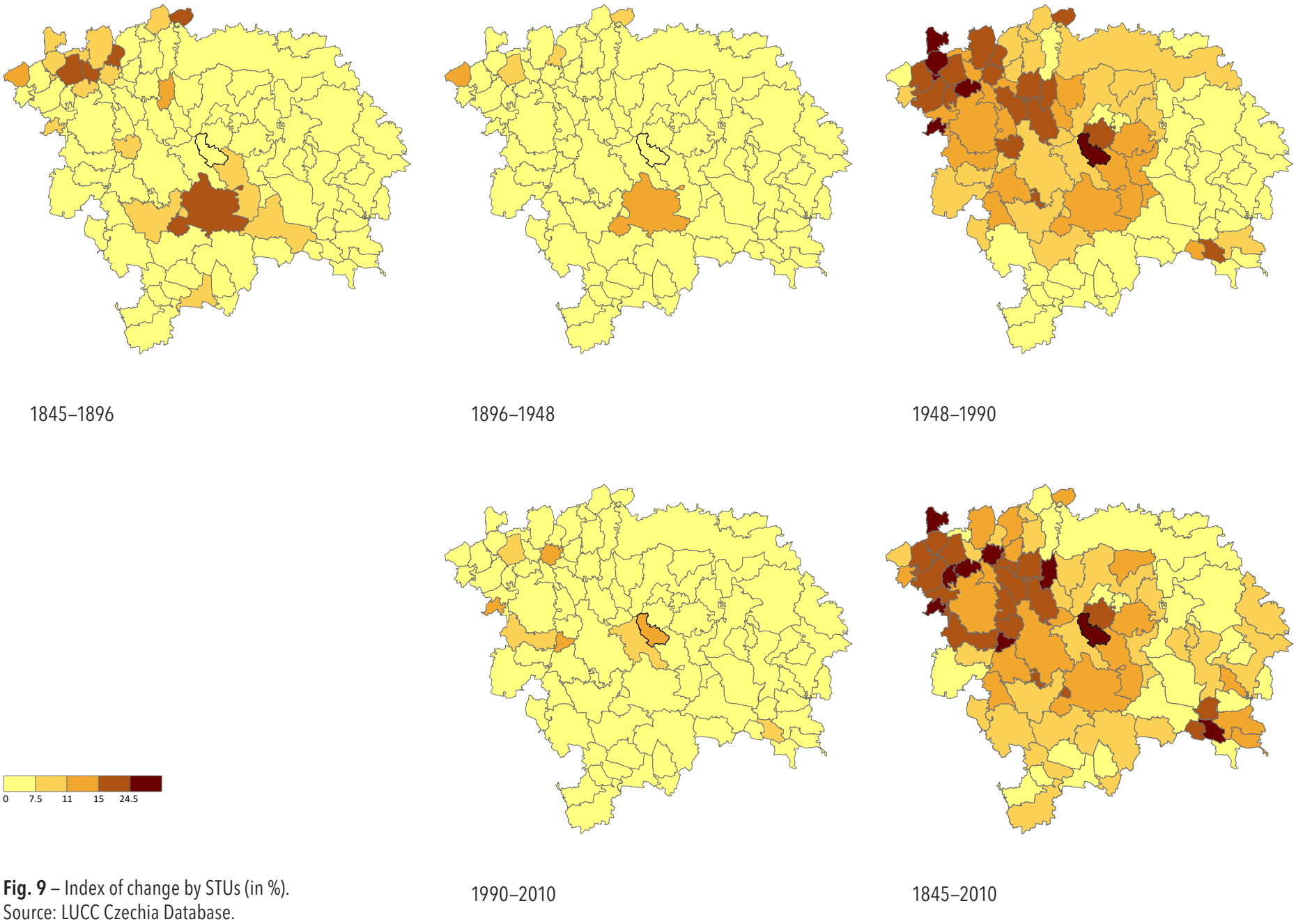


Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

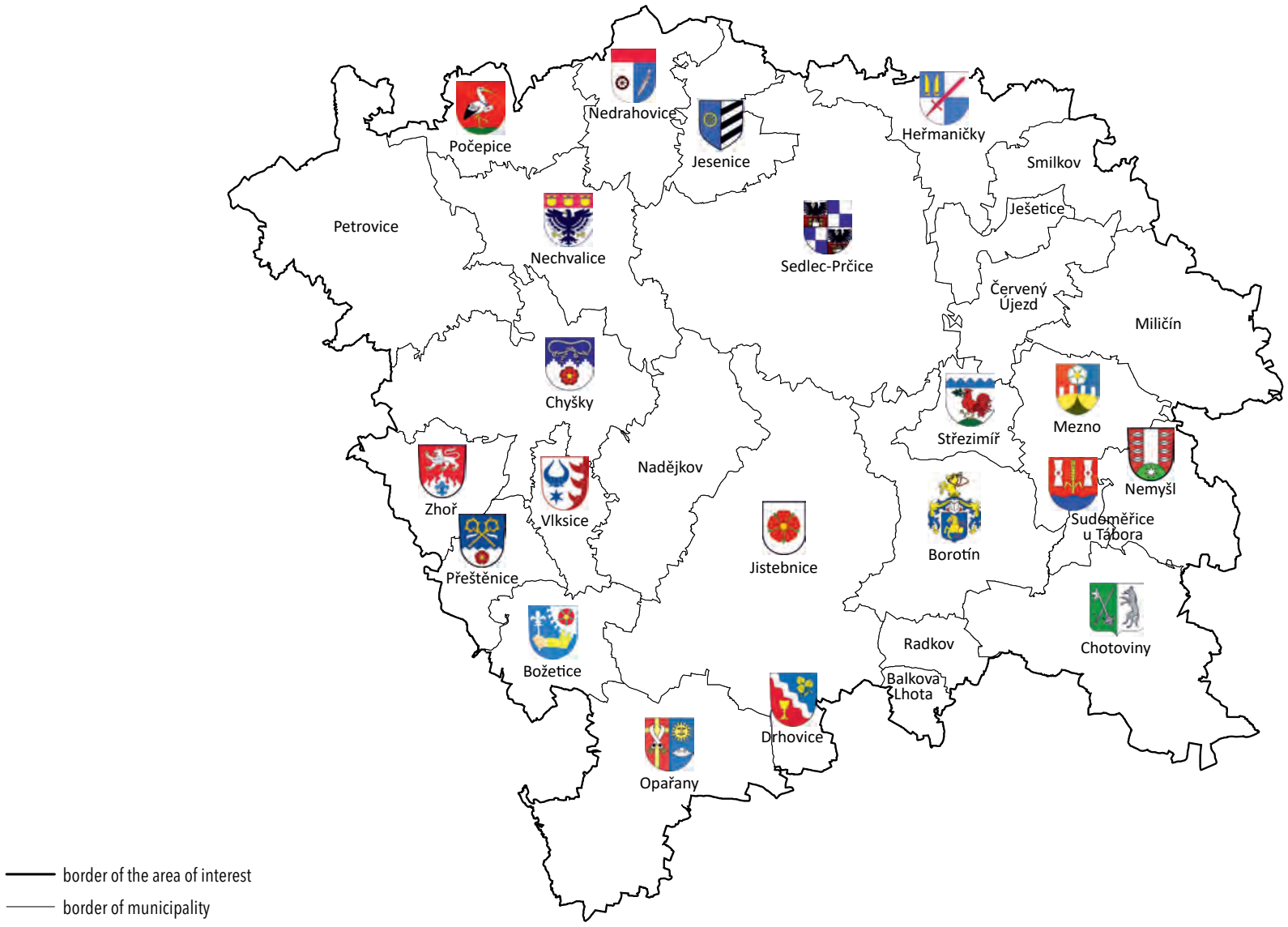


Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

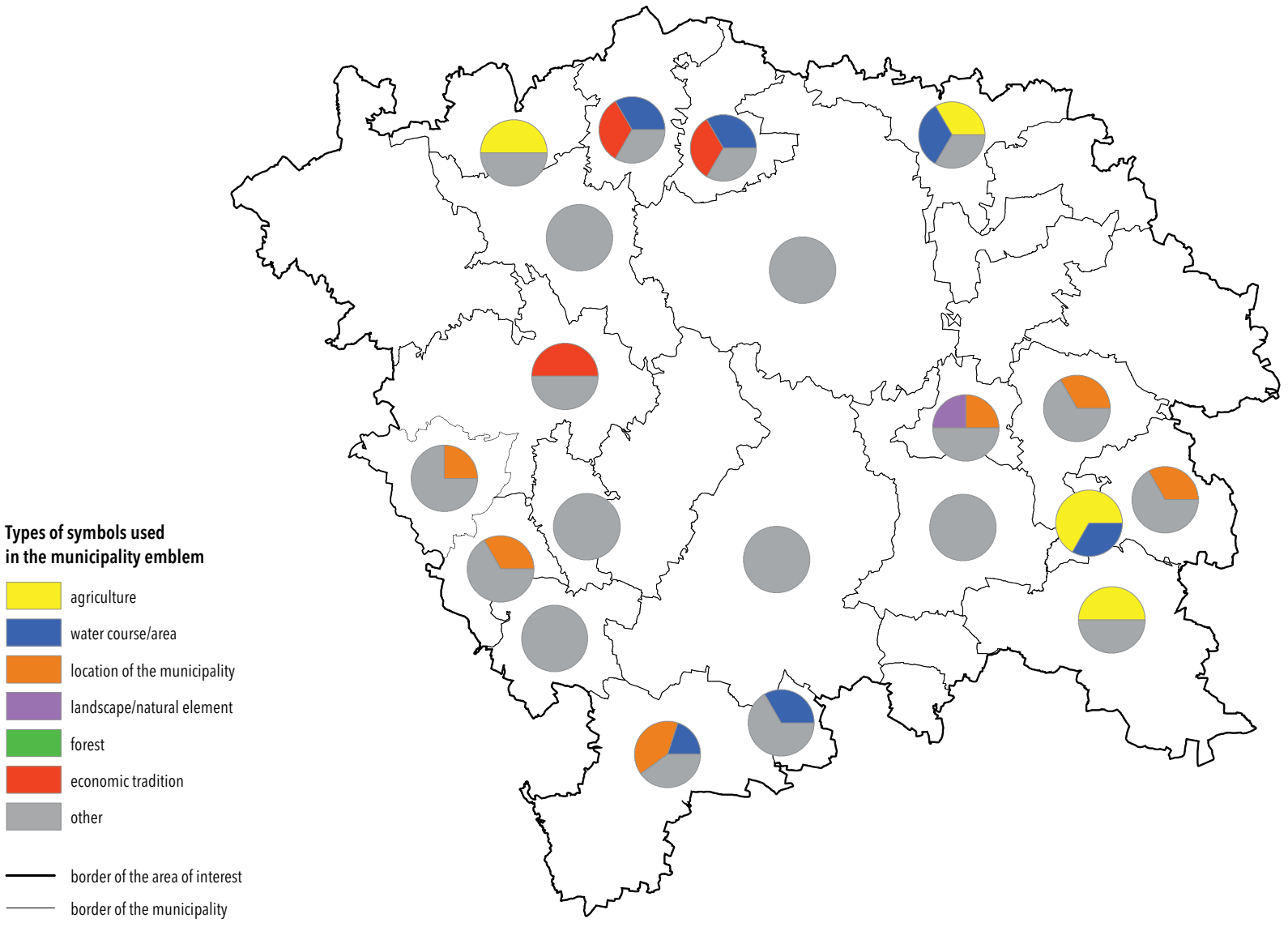


Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

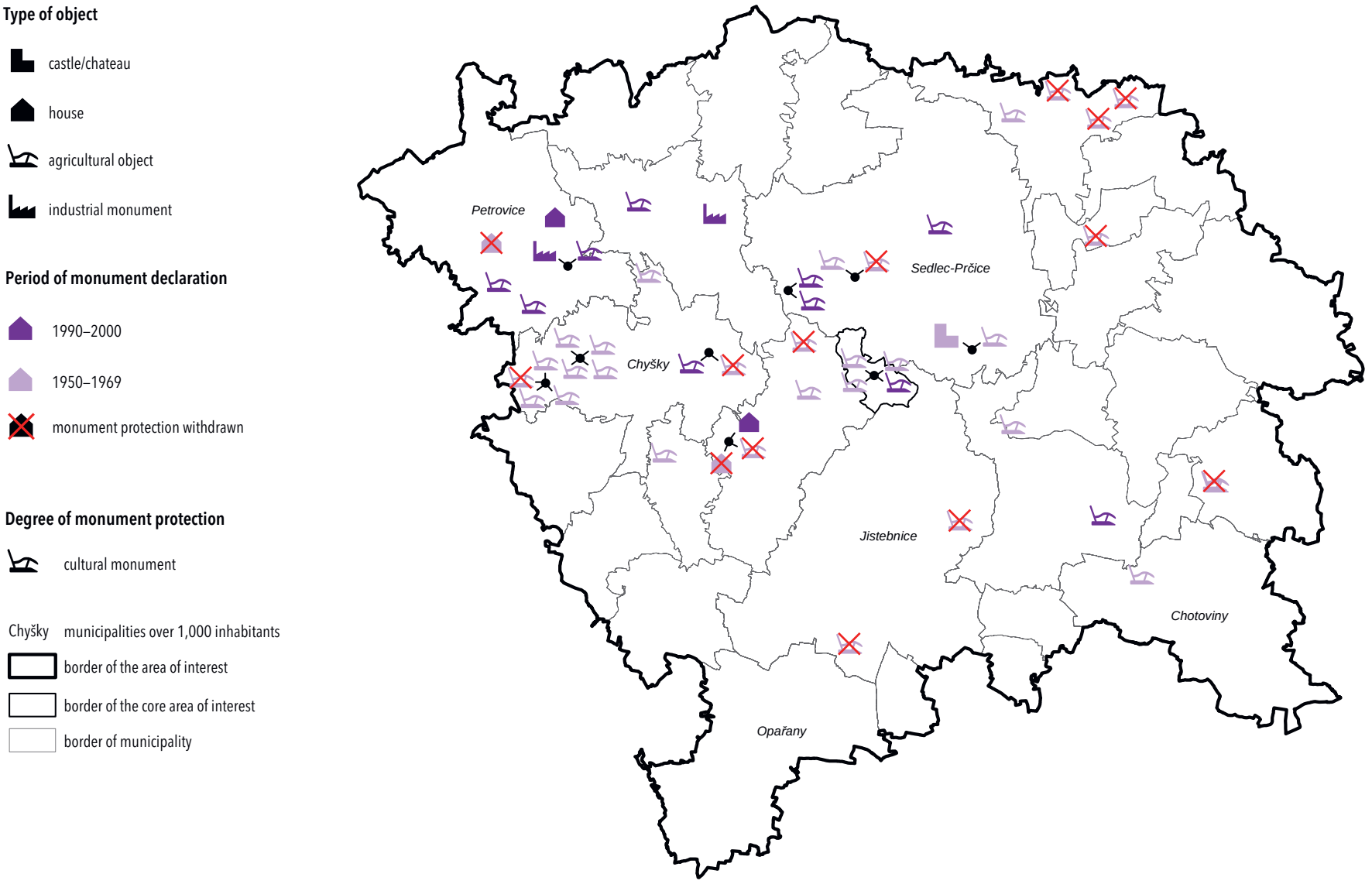


Fig. 12 – Cultural monuments and heritage areas.
Data source: National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

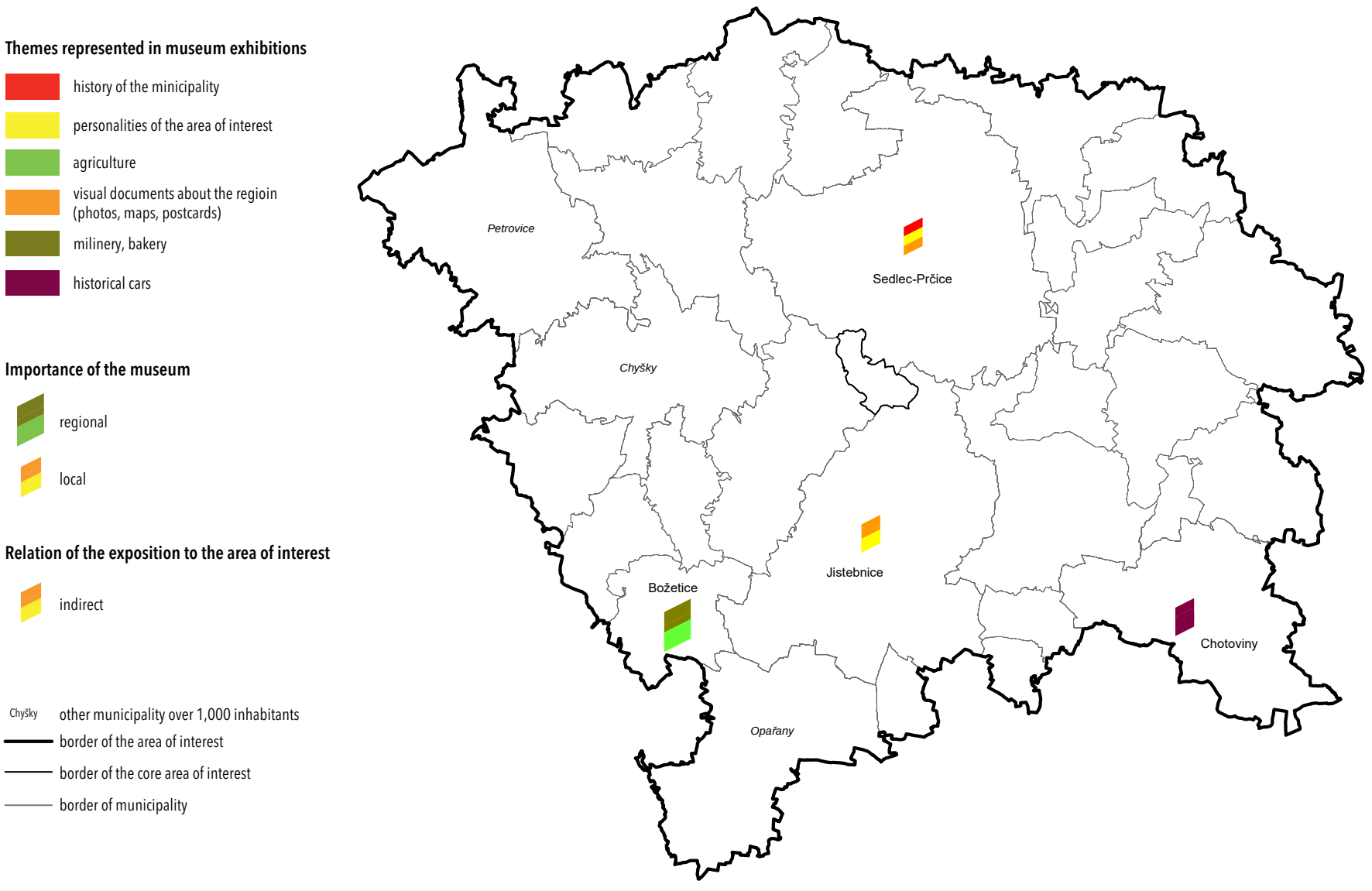


Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

a major intervention in the landscape character. The Čertovo břemeno golf course occupies an area of 0.32 square kilometres and accounts for the largest share of the increase in the extent of other areas. It takes its name from a rock formation located north of the village of Cunkov.

The patterns of the area of interest from the 1950s to the present day (Figure 4) show the basic trends in the development of this mountain landscape. Between the 1950s and the 1970s, large land units were created for agricultural cultivation, which are, however, currently covered with grass and partly used as pastures (horse and bison breeding). There has been a slight increase in forest areas. The recreational function is supported by natural conditions (forests, an undulating landscape suitable for hiking and cycling, interesting wildlife sites – the Čertovo břemeno, the Javořická rock, ponds, the Ounuz village conservation area, the nearby Monínec ski area). A golf course has been built at the western edge of Alenina Lhota. The proportion of built-up area has remained virtually unchanged. Residential buildings in the villages falling within the area of interest are used for individual recreational housing. In addition, there are a number of accommodation facilities (Alenina Lhota, Kroužky nad Moníncem).

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in STUs and describe changes over time by comparing the years 1845, 1896, 1948, 1990, and 2010. Due to the higher altitude (500–700 m above sea level), sloping and stony and poorly fertile soils (values of around 3.60 CZK/m², which are average values within Czechia) and also a higher proportion of forest areas, permanent grassland dominates. The overall intensity of changes in the structure of the area, expressed by the index of change (its values range from 0 to 100), was ranging between 30–40 from 1845 to 2010. In a predominantly rural landscape, this represents a relatively high value of landscape change in this model area.

The recent post-1990 period is characterised by the abandonment of arable land, with heavy grassing, but the intensity is smaller than in the period 1948–1990. It was only prior to the First World War that the area of permanent grassland declined, with inhabitants ploughing up meadows and pastures in an attempt to secure their livelihood through the hard work of largely subsistence agriculture. Between 1845 and 1920, the area of arable land increased slightly in order to provide enough food for relatively large families.

From the 1920s onwards, the area of permanent grassland began to increase. This trend has essentially continued to the present day, as has the long-term decline in arable land in most of the model area. After 1990, there was also a decline in arable land, only part of which was captured by the Cadastral Office records. This was land left fallow for more than four years. This situation changed with the accession of Czechia to the EU, when most of the temporarily fallow land started to be cultivated again.

The major changes in land use shown by the index of change (Bičík et al. 2010, 2015; Figure 9) were implemented between 1948 and 1990.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in the following sections 3.2.1–3.2.3 (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

There are three traditional institutions of memory in the Jistebník area of interest with exhibitions focusing on different themes. The Museum of Milling, Baking and Agriculture in Božetice, which is based on the history of the Božetice mill, is the closest to the transformation of the landscape of mountain agriculture under study. In the reconstructed building of the mill itself, which was in operation from the 16th century until 1945, visitors will learn about the operation of the mill, the agricultural machinery and tools needed to harvest grain and other crops from the surrounding fields, the bakery, and the period furnishings of the individual employees' dwellings (maids, countrymen, coachmen, etc.).

The Chotoviny Museum presents examples of vintage cars, while the Sedlec Museum and the memorial in Jistebnice reveal the lives of the personalities who worked in this region.

The Museum of Česká Sibiř is also worth mentioning, as it is linked to the entire Jistebnice region. It is not shown on the map because it is only an online museum, or library, digital archive or databank, which mainly includes visual documents of the whole region. According to the local index, it is possible to find scanned old postcards, photographs and old maps as well as references to individual localities in the topographical, local history and travel publications, mainly from the first half of the 20th century.

Archival materials for the territory of Jistebník are available, for example, in the State District Archive in Tábor.

3.2.2. Regional and local symbols

In the analysis of the Vanished Landscapes project, the Jistebnice region represents an area where the landscape has been transformed as a result of agricultural extensification. It is a peripheral area located in the Jistebnice Uplands. It is the representation of the location of the villages (orange category in Figure 11) that appears most frequently in their signs. The signs of Mezno, Nemyšl and Střezimíř depict hills (the green hill in the sign of Nemyšl is intended to symbolise the Mladovozice hills). The white (heraldically silver) sawtooth bottom of the coat of arms of Přeštěnice refers to the location of the village in the foothills of the Šumava Mountains. The emblem of the village of Zhoř (and its name – the "speaking sign") symbolises the way in which the local settlement was founded – the Žďár (Slash-and-burn) settlement. The figures of the Sun and the cloud in the coat of arms of Opařany (the climate of the village and also the symbol of the mist – thus also a speaking sign) are a reference to the location of the village.

Among the watercourses and areas (in blue in the chart), the ponds in the area of interest are mainly depicted by the blue tincture in the signs of the villages of Nedrahovice (the silver fish also refers to fishing as a traditional way of livelihood), Heřmaničky and Opařany (in addition to the local pond, the blue symbolizes two streams – Smutná and Oltyňský). In the coat of arms of the village of Sudoměřice u Tábora, the large Černý rybník (Black Pond) is represented by the blue wavy bottom of the coat of arms. The wavy bar in the coat of arms of Drhovice depicts the Pilský brook. In the coat of arms of Jesenice, the blue tincture is the symbol for the Sedlecký brook (the mill wheel in the coat of arms refers to the nearby Sovův mill). Other symbols of the traditional economy (in red in Figure 11), apart from the aforementioned fishery and mill, are the limestone quarries in the coat of arms of Chyšky (silver tincture and shields).

The symbolism of agricultural tradition (in yellow in the chart) is depicted in the signs of the municipalities of Chotoviny (the agricultural character of the municipality is symbolised by the green tincture), Sudoměřice u Tábora (grain cobs and

corncobs), Heřmaničky (scythes) and Počepice (the green lawn refers to the local meadows).

The symbols of flowers and trees are also depicted in the signs of the villages in the Jistebnicko area of interest. In the emblem of the village of Střezimíř, a lime branch symbolises the monumental lime tree in the village. The rose (the "Rožmberk rose"), which appears very frequently, is the symbol of the Rožmberks (or the Rosenbergs) – in the past important holders of local land (it is therefore a symbol of historical character, which is included in the category of others in this analysis).

As of 1 October 2020, 71.4% of the municipalities (20 out of 28 municipalities) in the Jistebnicko area of interest have a municipal emblem.

3.2.3. Heritage sites

In the area of interest of the Jistebnice Uplands, extinct landscapes of mountain farming are monitored. There are more than fifty exclusively cultural heritage sites in the area that received their heritage protection either between 1950–1969 or between 1990–2009. A number of these buildings have had their heritage protection withdrawn over the last twenty years, very often due to their poor structural and technical condition. In the area, mainly agricultural buildings (farmsteads, farmhouses, granaries, barns or granaries) are protected as heritage sites, as well as one fortress with a farmyard and one industrial monument – the site of a timbered mill from the early 19th century, which has been preserved with all its components (the dwelling, mill, gate, granary, granary with a wheelbarrow, barn) in its pure form without a later intervention. The interior of the mill still contains most of the original technological equipment.

4. Summary

The model area of Jistebnice is strongly influenced by its peripheral location both at the regional level (Prague, Pilsen, České Budějovice) and at the level of lower-order centres (Benešov, Votice, Tábor, Sedlčany). Population structures have been unfavourable for a long time and it is very unlikely that a major investment could be located in the area that would change the unfavourable trend of development. In our opinion, the area has a chance only in strengthening the attractiveness of tourism, while preserving the valuable landscape and architectural and cultural values of the landscape. Support for small farmers or basic services in the area should also help. Due to the position, this could, among other things, ensure a long-term trajectory of sustainable economic use of the area with an impact on the relative stability of the remaining rural population.

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Acknowlegment

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CHAPTER 3

Karviná Doly: Post-mining landscape of Czech-Polish borderland

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1. Introduction

Karviná and its surroundings can serve as a textbook example of an area that has repeatedly undergone very rapid and dramatic changes in its use, overall landscape structure and landscape functions associated first with a burgeoning development of coal mining and then with the decline and closure of mining. Until the mid-19th century, there was a rural agricultural landscape, used mainly for subsistence farming. The agricultural village of Karviná was known for its cattle breeding, especially sheep, which produced high-quality wool. Already in the 18th century, rich deposits of black coal were discovered below Karviná. The turbulent development of the area and the transformation of what was then farmland into a mining landscape began in the mid-19th century. After 1850, numerous underground mines started operating, which supplied the Ostrava steelworks with coal. Crowds of people flocked to Karviná, the number of mines increased rapidly, as did the population. This was matched by the chaotic development of mining buildings and colonies, service facilities and transport networks. In the interwar period, Karviná was already a populous and developing mining and industrial town. There were schools, a brewery, a hotel, taverns, numerous shops, salt and iodine baths, and the main station on the Bohumín – Košice railway. Most of the inhabitants were of Polish ethnic origin. In the 1930s, however, the first problems began with the cracking of houses and subsidence of the area, caused by extensive undermining.

After World War Two, Karviná, Fryštát, Darkov, Ráje and Staré Město were merged into one administrative unit under the name of Karviná. During the period of communist rule, when heavy industry became a priority, it was decided that the development of the old Karviná had to give way to mining and the population would be resettled. The newly created administrative city of Karviná, built mainly on the territory of Fryštát, was generously conceived as a metropolis with a planned population of 120,000. However, this was never achieved; after 1990, with the decline of coal mining and heavy industry throughout the Ostrava region, the population of Karviná diminished to the current 52,000. Although the present-day Karviná was actually built on the territory of Fryštát and adopted its historical core, the name Fryštát was to be forgotten for political reasons. Until 1945 Fryštát was a district town with a predominantly German population and its name historically derives from the German Freistadt. Between 1949 and 1971, the name Fryštát was erased from maps and its use was forbidden. Nowadays the name Fryštát is used again, but only as an administrative part of the town of Karviná.

The core area of Karviná-Doly is located on the territory of the original, old Karviná, and its administrative name unambiguously describes the fact that it was there that intensive coal mining was concentrated, while the original settlement had to completely give way. In 1950, more than 20 thousand inhabitants lived here. The mining colonies, streets, shops, schools, St. Henry's Church and the large Larisch castle with its family tomb, surrounded by a large English-style park, all disappeared in the following period. The only thing left standing from the original Karviná is the small church of Saint Peter of Alcántara, which has fallen due to undermining and has tilted almost 7 degrees from its vertical axis. Its present slanted building has become a memento of the demise and a symbol of old Karviná. A large cemetery remains near the church, where many victims of the Karviná mines are buried.

The landscape of the core area of Karviná-Doly is now a typical post-mining and post-industrial landscape. It is a plain with exclusively deciduous forests and bushes, tailings dumps, mining towers and large surface industrial objects of deep mines (the mines ČSA, ČSM, Gabriela, Darkov, Barbora, Jindřich and others), grasslands and numerous water bodies. The latter are increasing due to undermining and subsidence. A significant part of the area looks like a "no-man's land", without economic exploitation and with a proliferation of new wilderness areas. A smaller part of the area has a recreational and sporting function – the Karvinské moře lake and the Golf Resort Lipiny golf course on the site of the extinct settlement of the same name.

The Karviná region is a truly exceptional area in terms of landscape changes. In the second half of the 19th century, the rapid transformation of what had been a rural agricultural landscape with a primary subsistence production function into a mining landscape with a rapidly growing population was brought about by the rapid, spontaneous development of coal mining. This development, with a preference of the production function of coal mining, continued almost throughout the 20th century. After 1950, the whole of the old Karviná had to give way to mining, and its residential landscape was quickly and completely replaced by a mining and industrial landscape. After 1990, the decline in coal mining brought a further change in the landscape from a mining landscape to a post-mining and post-industrial landscape, associated with a change in landscape functions – the decline in the production function and the development of the recreational, sporting and landscape-forming functions that had not existed until then. A significant part of the area has the character of a spontaneously growing, new wilderness.

For the purposes of this project, the "core area" has been delimited and most analyses are carried out in it (Figure 1). It includes the municipal area of Karviná-Doly. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

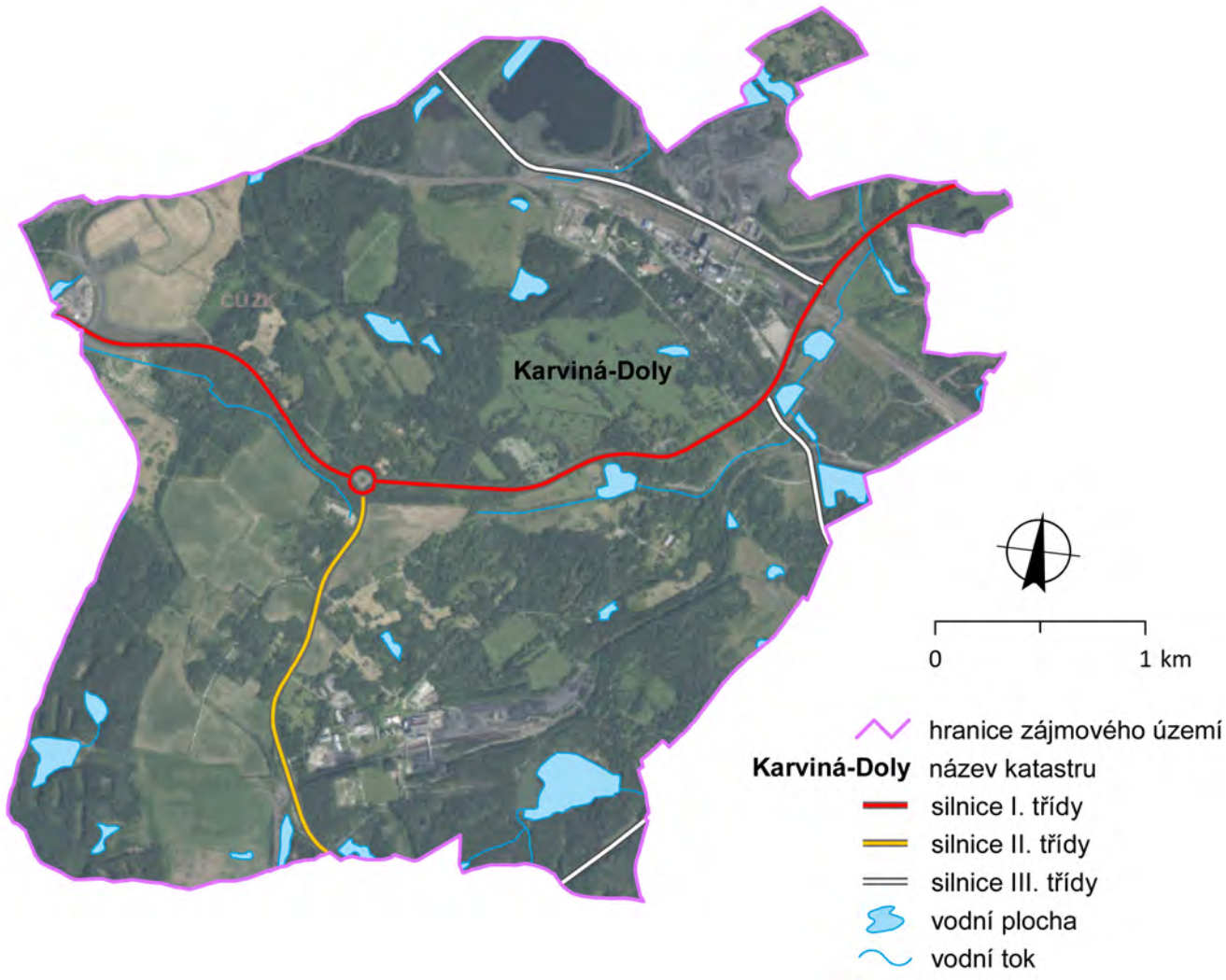


Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

2. Area of interest: main features

The model area Karviná-Doly is located in the geomorphological unit Ostravská pánev (Ostrava Basin), which is part of the Vněkarpatská sníženina lowlands (Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The geological subsoil of the Ostrava Basin consists of Tertiary marine sediments deposited on consolidated Carboniferous sediments containing coal seams. The overlying rock is comprised of variously strong series of strata of gravels, sands, loess and loess-loam of glacigenic, fluvial and eolian origin. The wide floodplain of the Olše River is filled with young Holocene gravel-sand alluvium. Numerous spoil tips, fills, backfills and other material of anthropogenic origin occur on the surface of the entire area.

The flat accumulation relief of the broad Ostrava Basin with height differences of up to 30 m is remodelled by anthropogenic activity. Anthropogenic landforms such as numerous flat spoil tips, anthropogenic industrial and settlement platforms, fills, ramparts, communication and littoral landforms predominate on the surface. The flat depressions created by subsidence of the subsoil are filled with numerous anthropogenic lakes. The Olše River is enclosed by massive flood defences.

According to the older Quitt classification, Ostrava is located in a climatic region of moderately warm climate. According to the climatic breakdown published in the Atlas of the Landscape of the Czech Republic (Quitt 2009), it is already in a warm area, relatively rich in precipitation. The average annual temperature is close to 9 °C and the average annual rainfall is almost 800 mm. Due to its basin position, numerous inversion situations occur, especially in the winter half of the year, with worsened dispersion conditions. In the past, the entire Ostrava region suffered from severe air pollution from heavy industry and energy production. The current situation is much more favourable, but with unfavourable dispersion conditions, and concentrations of dust in the air are occasionally above the limit.

The area of interest is drained by the Olše River and its tributary Stonávka. Both streams originate in the Beskid Mountains and deposit a lot of coarse-grained sandstone sediments in the Ostrava Basin. In the basin, which has been remodelled by anthropogenic, mainly mining activities, including massive undermining, the original water network, with the exception of these two main streams, has been completely wiped out and altered. On the surface, there are numerous water bodies created spontaneously in drainage depressions created by subsidence of the subsoil relief, as well as large areas of industrial tailings.

The original soil cover consisted predominantly of Luvisols and brown luvisols, in some places along with gleysol, formed on loess and polygenic clays. In the floodplain of the Olše and Stonávka rivers, the fluvisols are modal and mixed with gleysol, formed on alluvial deposits. In the current soil cover, a significant share of anthroposols is found in places remodelled by anthropogenic activity, such as spoil tips, backfills, dump piles, extinct tailings ponds and other anthropogenically created areas.

According to the phytogeographical division, the entire area of interest lies within the Carpathian Mesophytic phytogeographical district and the Ostrava Basin phytogeographical district (Skalický et al. 2009). The forest vegetation stage is oak-beech, natural forest area Podbeskydská pahorkatina hills. According to Neuhäuslová, Moravec (eds. et al 1997), the potential natural vegetation would consist of acidic wet oak-beech forest in most of the area, and in the floodplain of the Olše and Stonávka riparian forest vegetation of the bird cherry-ash type in complex with wetland alder forests.

The current landscape cover of the core area is dominated by green forest areas of second-growth, exclusively deciduous forests and scrub without any economic use. In part of the area, dense scrubby stands of new wilderness have spontaneously expanded into woodland and act as a no-man's land. New wilderness of the wet wilderness type, reedbeds, waterlogged willows and alders have also spread around water bodies in waterlogged depressions. The forests contain a variety of deciduous trees, with oak, poplar, hornbeam, birch and aspen in the pioneer stages of succession, and willow and alder in wet habitats. Birch is frequent in soil tips. The invasive Robinia pseudoacacia is

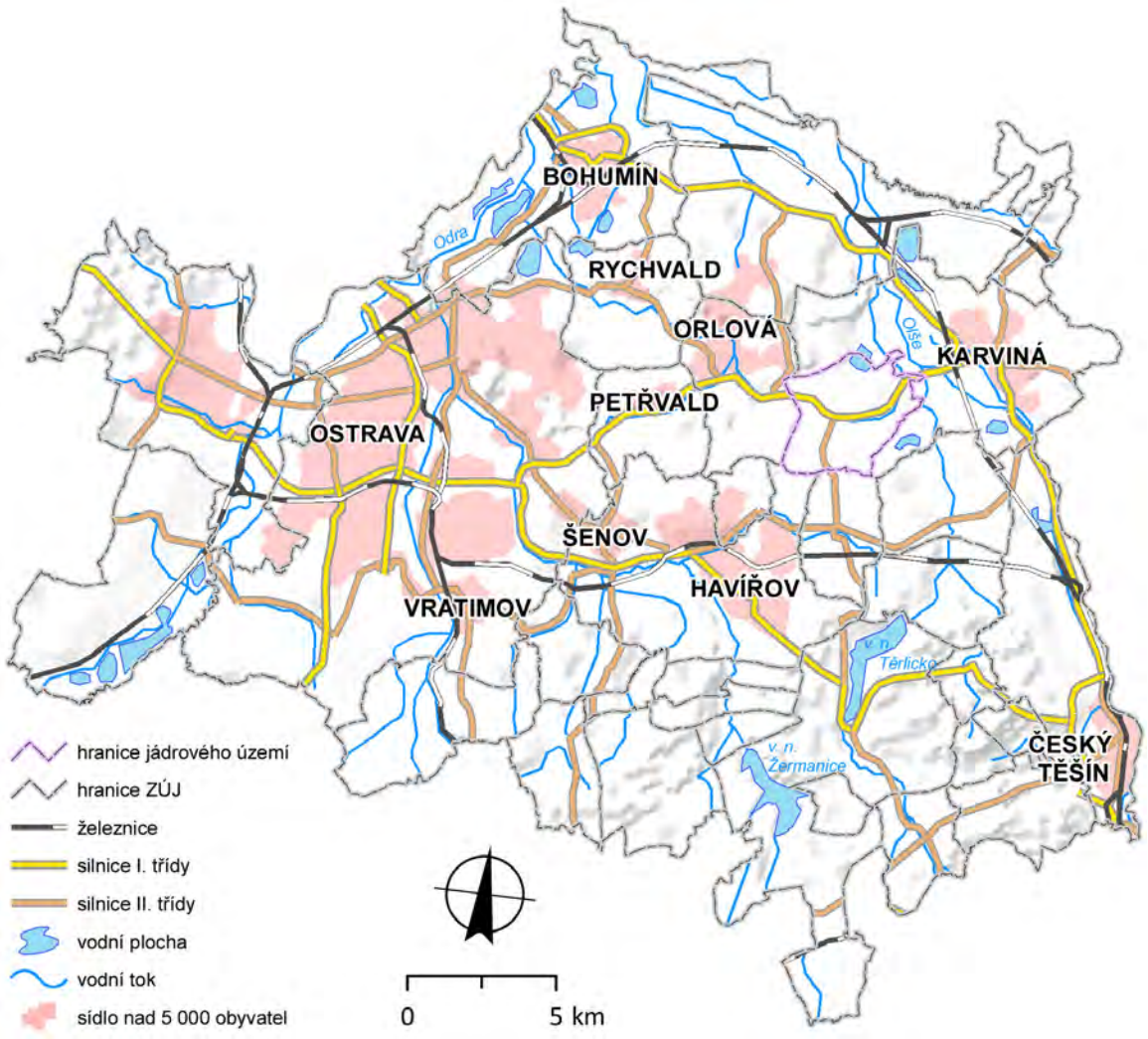


Fig. 2 – The wider area of interest.
Map basis: Data50.

also abundant, and in places there is ash-leaved maple. Of the invasive plants, the most widespread, and in places massive, are reynoutria and goldenrod.

The parasitic white mistletoe is extremely widespread in deciduous, especially floodplain forest stands. In addition to the unique new wilderness-type forest stands, which form the green heart and lungs of the post-mining and post-industrial landscape, there are occasional areas of extensively mown grassland. Agricultural use is practically absent in the core area of Karviná-Doly. Part of the area along the Olše River has the recreational and sporting use – a boathouse, cycle paths, a beach, the Karvinské moře water body. On the left bank of the Olše River on the territory of the defunct settlement of Lipiny, a large OKD golf course (Golf Resort Lipiny) was built in 2012 on reclaimed land between shafts, but the economic losses of its operation have run into millions annually. A significant part of the area is still covered by the former mine sites and other artefacts that accompany them.

Nature conservation has no special interests in the area. It has been completely altered by anthropogenic activity in the past and no original wildlife has been preserved, which would lead to a proposal for the designation of specially protected areas. However, forests and water bodies act as natural eco-stabilising segments of the landscape and should become the cornerstones of the ecological network.

Karviná is the statutory town of the Moravia-Silesia Region and the natural centre of the historical Těšín Silesia. The city is interesting in many ways. First of all, as a historic centre on the Olše River and the old road between Hungary and the Baltic. The Olše divides the Beskids arch into the Moravian-Silesian Beskides and the Polish Bieszczady across the border. It has a specific feature: the local castle was for almost three centuries (until 1572) the seat of the Silesian dukes of the Piast royal family and subsequently the seat of the Silesian and German aristocracy. The third specificity is its location on the edge of the Ostrava industrial conurbation based on coal mining and industrial development, which was the main reason for its rapid development in the 20th century. The fourth important feature of Karviná is its location on the border with Poland and now Slovakia on one of the important railway lines connecting Czechia and Slovakia. Despite its border location, Karviná can be described as a core area, due to its interconnectedness with the Ostrava agglomeration and, in a broader sense, as part of the Upper Silesian industrial agglomeration. This was one of the most important nuclei of industrial development in Europe and the former Austro-Hungarian Empire.

Karviná currently has about 53,000 inhabitants, about a fifth of whom are ethnic Poles and Slovaks. The model area of Karviná is specific in that its landscape is heavily marked by the activities of society and is even devastated in places. This fact has become the reason for several movements of the city core in the study area. The current town was created by the administrative merger of the town of Fryštát (the old historic centre of the area with a designated urban conservation area), the old Karvinná, completely destroyed by mining activities and their consequences, as well as Darkov, Ráj and Staré Město. New Karviná was built on the former upper suburbs of Fryštát, which had been growing intensively since the end of the 19th century, when Fryštát was connected to the railway network (Emperor Ferdinand's Northern Railway). At the time of the communist rule in the then Czechoslovakia, the newly administratively created town had all the prerequisites for growth (coal mining, heavy industry, location on the border between Czechia and Slovakia, ethnic mixture of population, etc.) and was conceived on a large scale as the next big city of the state with a planned population of up to 120,000. This was not achieved on account of the diminishing importance of coal mining (at the peak in the late 1980s, it was just under 90,000).

The impulse for the development of Karviná was the discovery of coal deposits in the second half of the 18th century. Until the mid-19th century, the traditional way of life based on subsistence farming and the market economy of the estate of the Larisch-Mönnich family, which was centred on pastoral breeding of merino sheep, renowned for high quality of its shearling wool (up to 40,000 heads by 1840), was maintained.

Stable cadastre (1836)

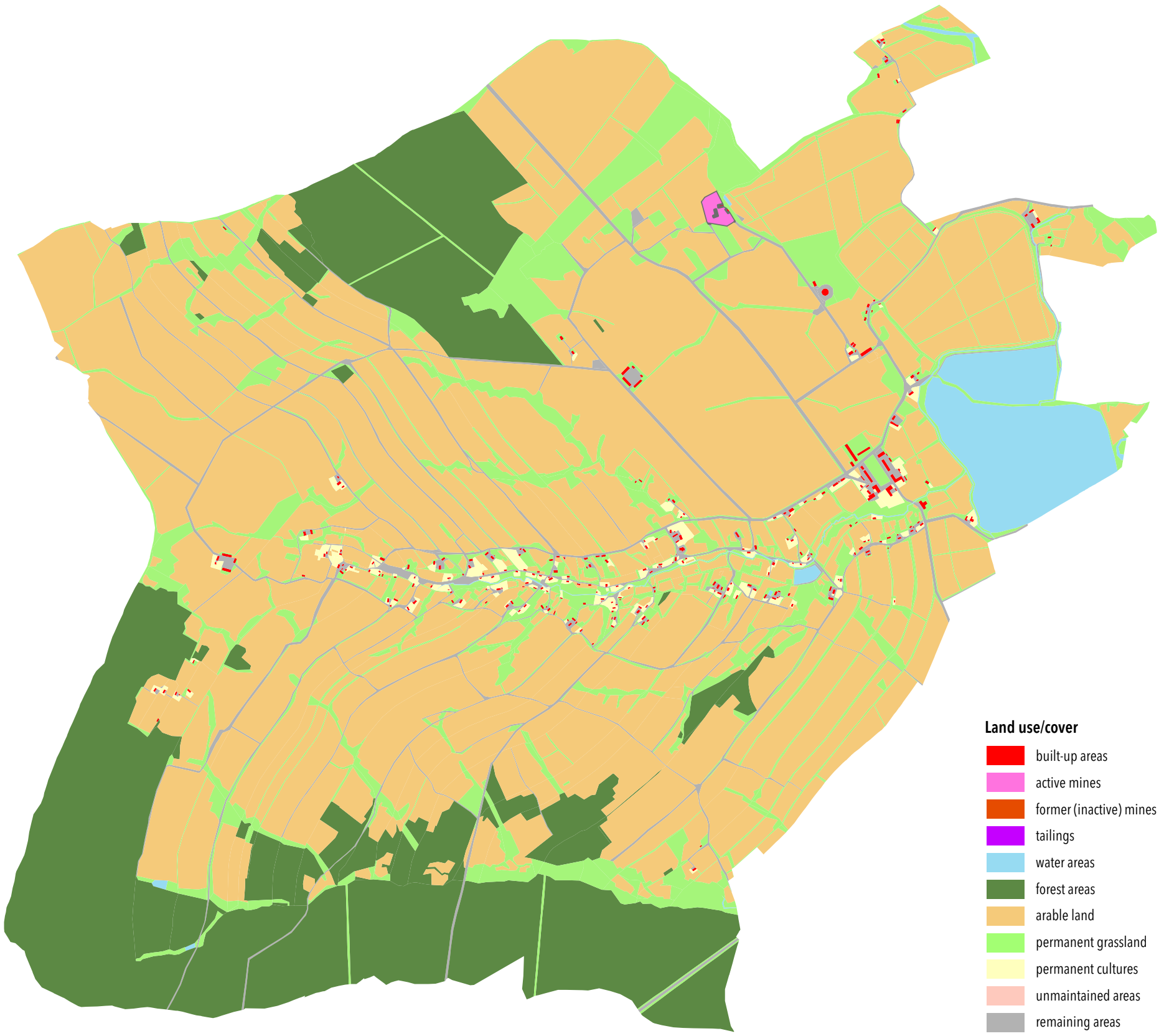
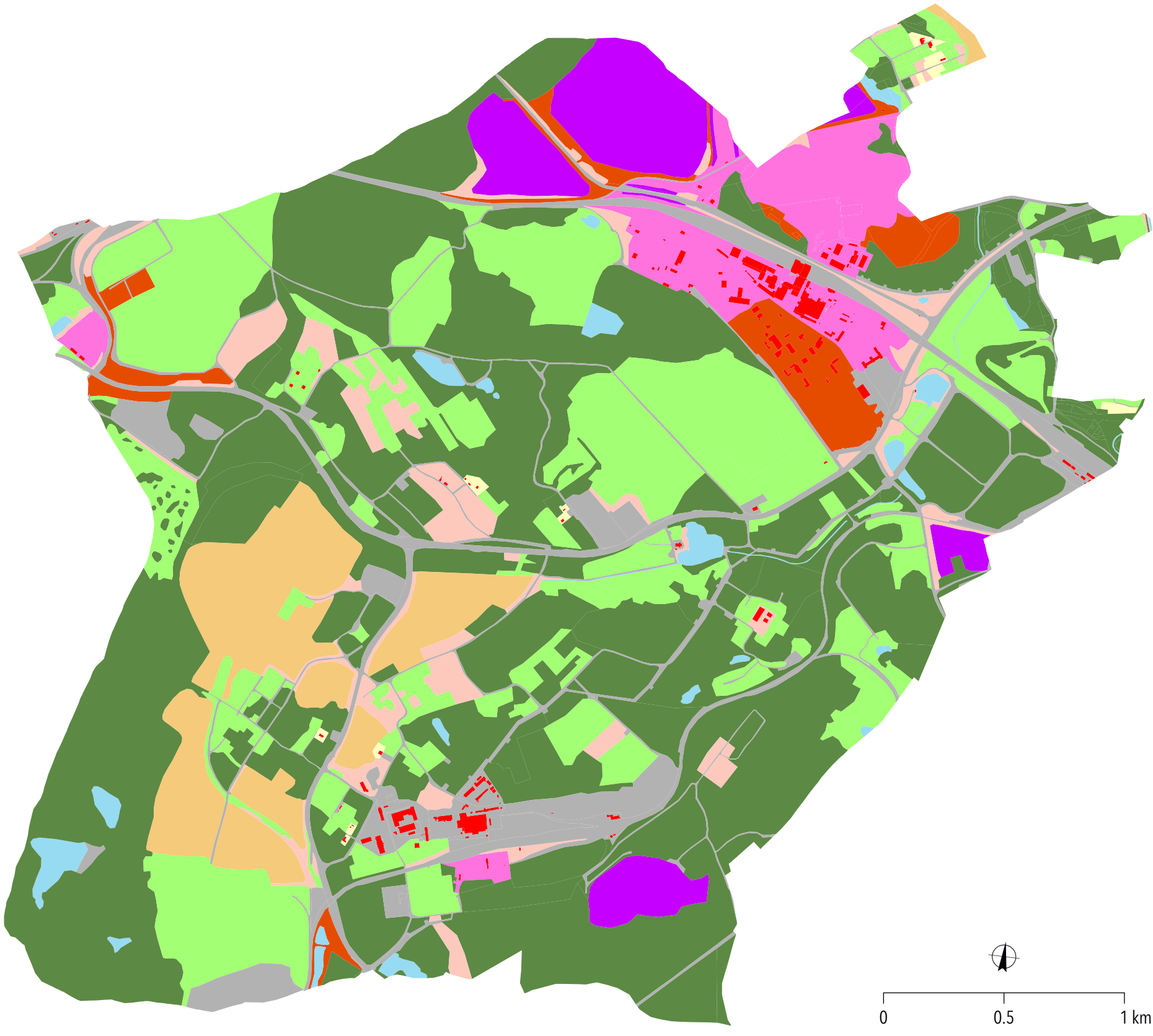


Fig. 3 – Land use/cover in cadaster Karviná-Doly in 1836 and 2018.
Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

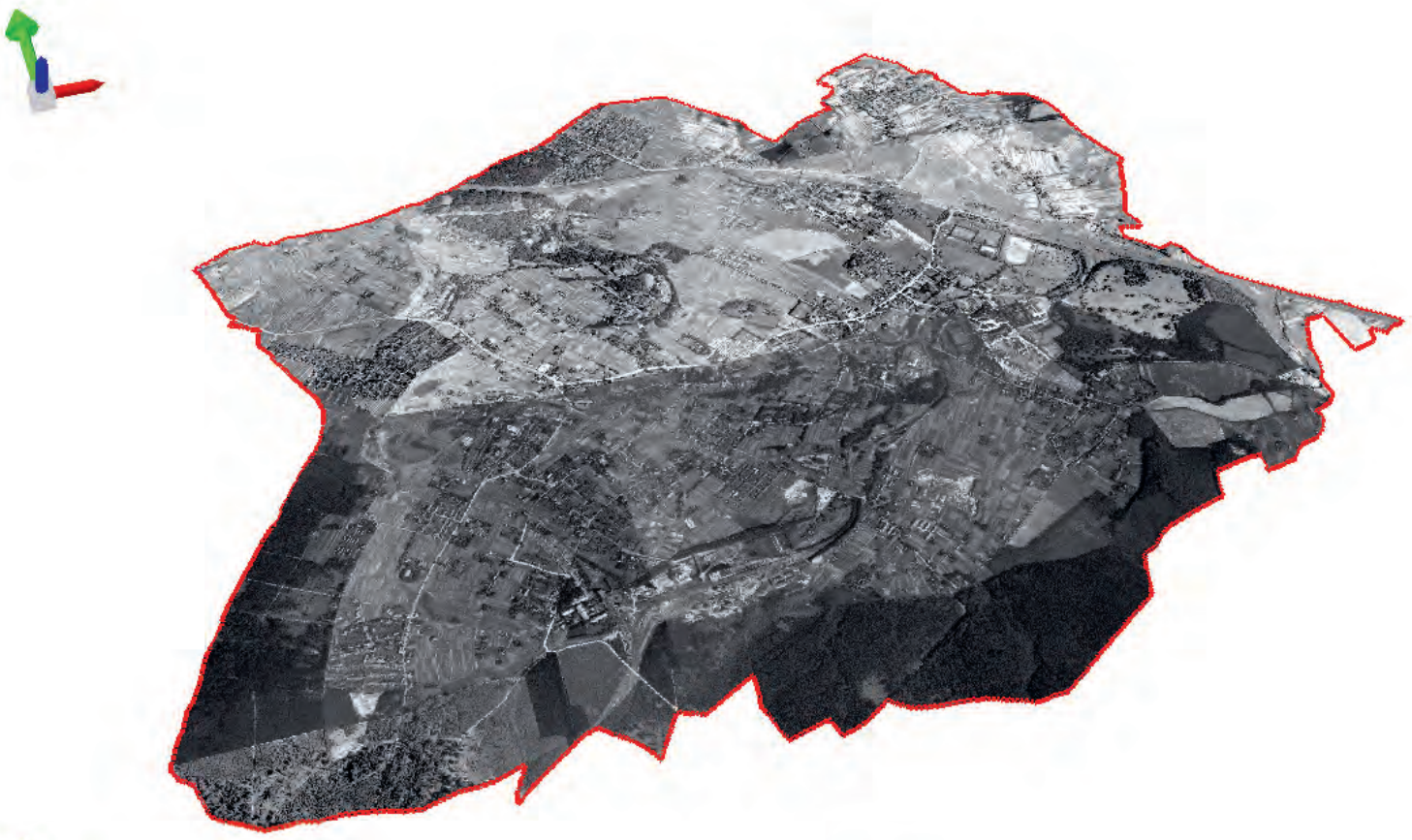
Current state (2018)



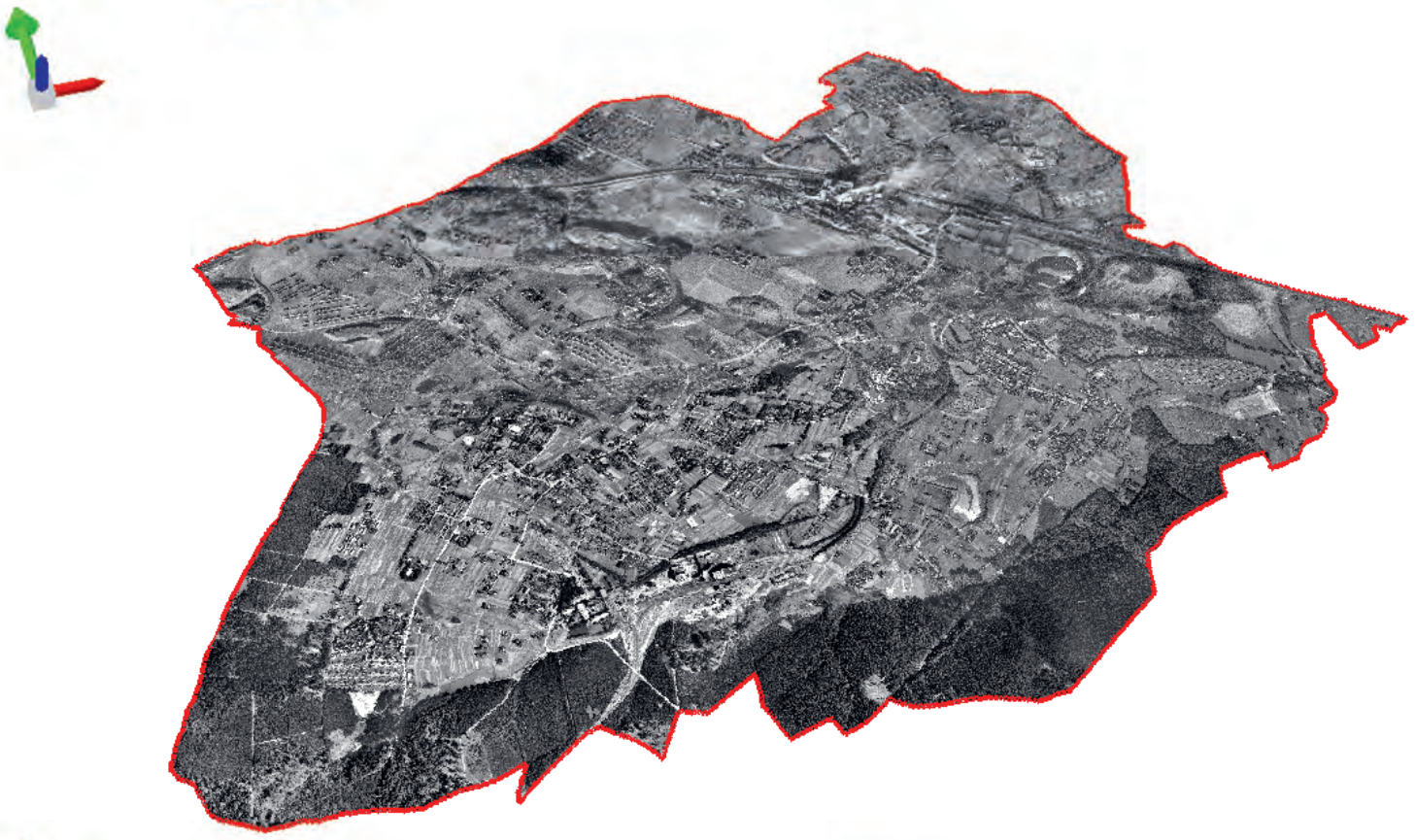
Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.32	0.82	0.50
remaining areas	3.47	10.15	6.68
active mines	0.09	4.66	4.57
former (inactive) mines	0.00	3.01	3.01
water areas	3.24	1.54	–1.70
tailings	0.00	4.35	4.35
forest areas	21.25	43.31	22.06
arable land	58.50	6.54	–51.96
permanent grassland	12.31	20.94	8.62
permanent cultures	0.82	0.23	–0.59
unmaintained areas	0.00	4.46	4.46

1947



1954



2020

Fig. 4 – Models of landscape – Karviná-Doly landscape in 1947, 1954 and 2018. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

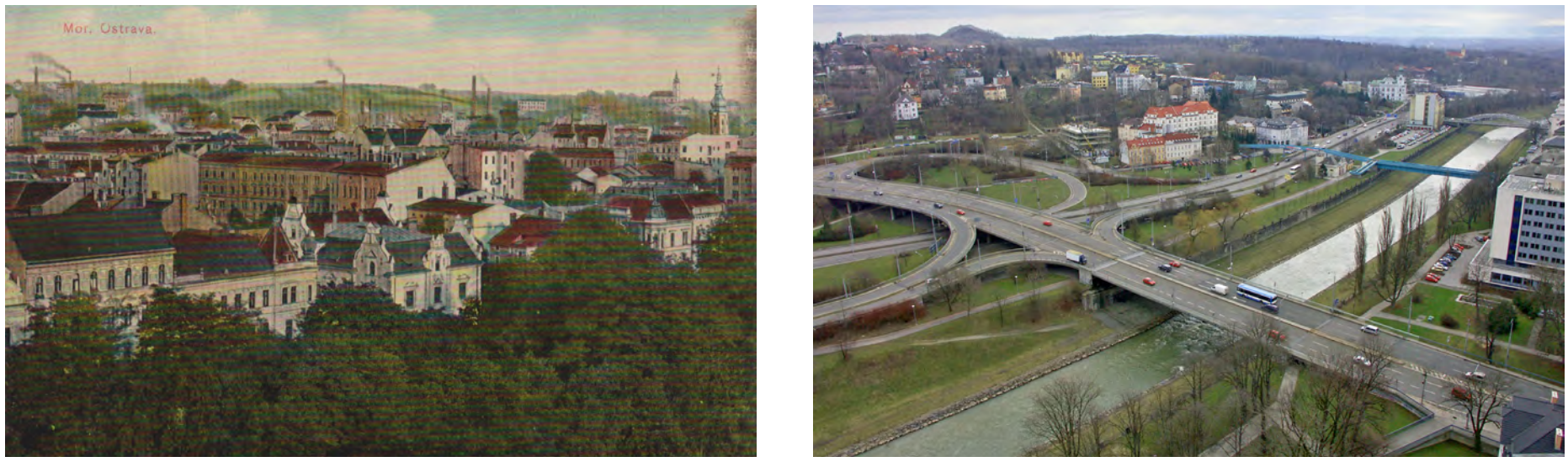


Fig. 5a – The view of Ostrava from the town hall tower. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): S. R. Kučerová.

Fig. 5b – The view of Ostrava, Jáma Karolína. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): S. R. Kučerová.

The Larisch-Mönnich family held high offices at the imperial court in Vienna, and this was to some extent the reason for the problems with the later delineation of the border between Poland and Czechoslovakia after the First and Second World Wars. The development of the area was influenced by the coal deposits and their gradually increasing production. After 1850, the mines of the Larisch-Mönnich and Těšín chambers (the František, Gabriel, Jindřich, Jan Karel and other mines) began mining. Deposits were located at the depths of 300–500 m and the extracted coal was transported to the ironworks and other factories in Ostrava. The development of mining and related industry and services led to a significant population growth in the area, with Karviná increasing fivefold in 40 years, from 7,746 by 1890 up to 21,000 by 1930. After 1870 this population growth was influenced by large-scale immigration from more distant areas of Austrian Silesia, Galicia and Moravia. This population boom and intensive transformation of the industrial landscape also influenced the variation of the town's name, with up to seven different names being used at different times (Karwin, Karvinná, Karviná, Karvín, Karviná-Doly, Karviná 2-Doly, Doly).

In terms of population development, the high population density in the model area as early as 1869 is characteristic. Most of the villages in that year had a population density of over 120 inhabitants/km², which then amounted to the average population density of Czechia. In 1950, the population density was above 225 inhabitants/km² in most of the model area (except for the southern mountainous part), which was roughly twice the Czech average. The situation was similar in 2011, when municipalities located in the Beskides valleys were at the same level of population density. The employment of the population in the primary sector is almost negligible in this area as in most of the territory agriculture has completely lost its function (under 1% of economically active population). Perhaps somewhat surprising is the finding that "only" 29–40% of the economically active population is employed in the secondary sector, and employment in the tertiary sector (from 30–50%) is much more significant in most villages. This documents a situation in which this "steel heart of the country", like the whole Czechia, is in the post-industrial period.

In the pre-1989 era, mining in the area was consolidated and today there are three large mines called Důl ČSA, Darkov and Důl ČSM. At present, they are the last ones that still mine black coal in the Ostrava agglomeration. Karviná was the main supplier of housing cores and fibreglass materials in the former Czechoslovakia. After 2000, an industrial zone was established, where there are buildings of a number of companies mainly in the engineering industry (Sejong, Shimano, Gates, Robe Lighting, etc.). There are plans to build a large-capacity waste incinerator (Karviná-Doly), which is opposed by civic groups, as Karviná is one of the cities in Czechia most affected by air pollution. The spa function of the city is vital and it will be probably even more important in the future, as the iodine-bromine water sources used in the Lázně Darkov spa and Karviná-Hranice have been drilled.

The Karviná region, with its long history and turbulent development in the industrial period, represents a landscape in Czechia where repeated changes in function have occurred, resulting in profound and irreversible impacts on the original landscape. These include large-scale development, undermining, the location of tailings dumps and the subsequent abandonment of intensively used and, in several places, devastated land, which has been transformed into a new wilderness.

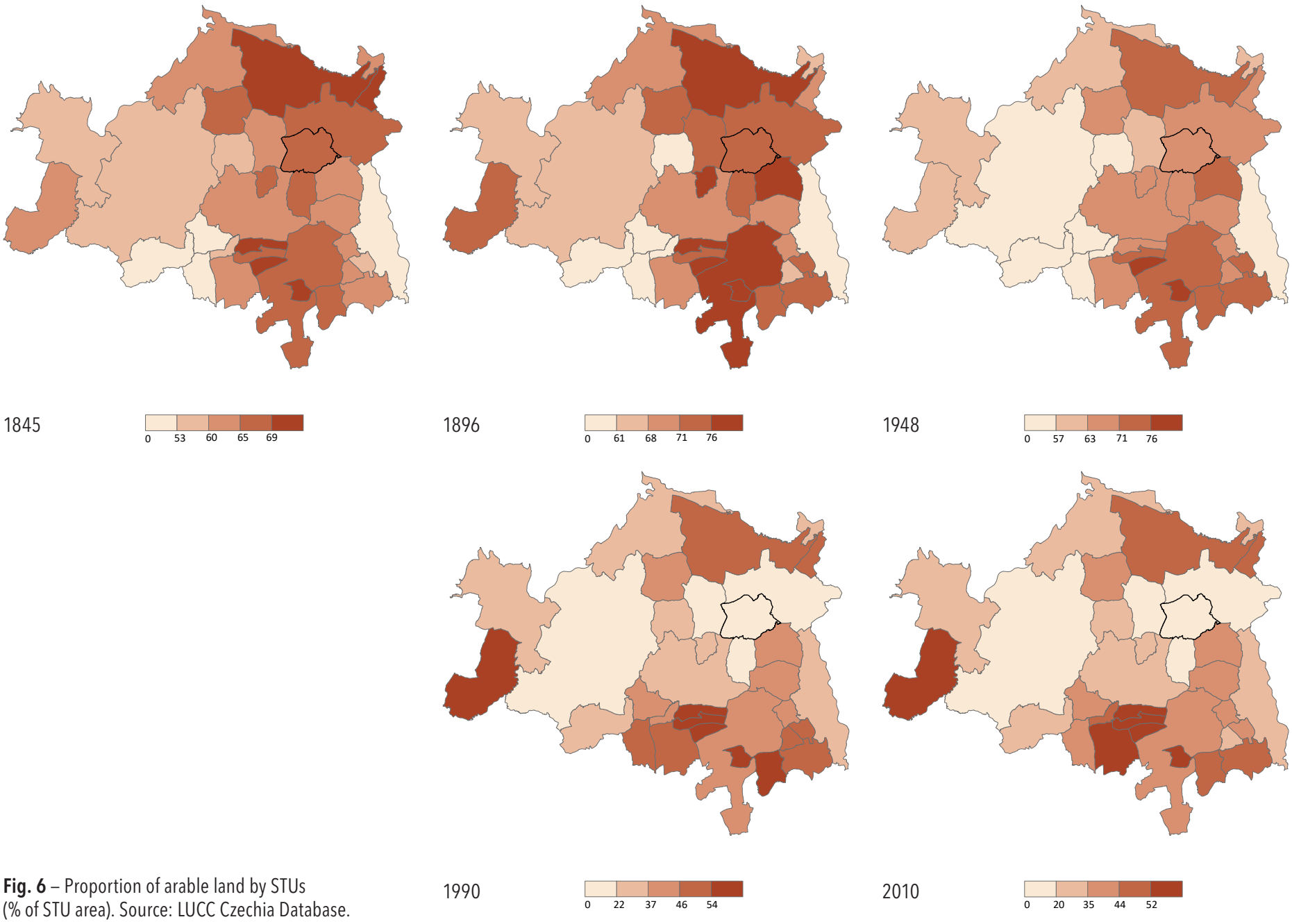


Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

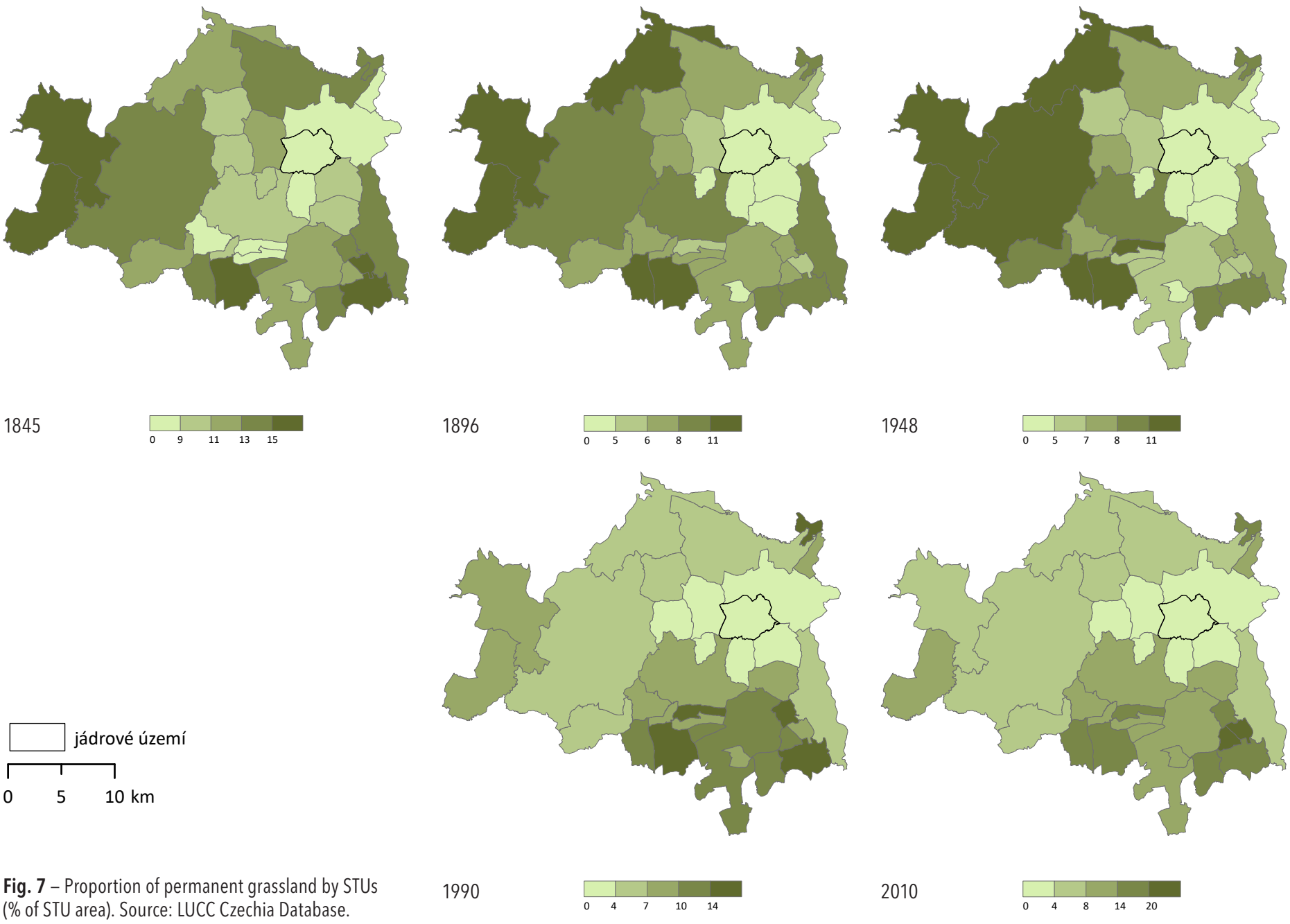


Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

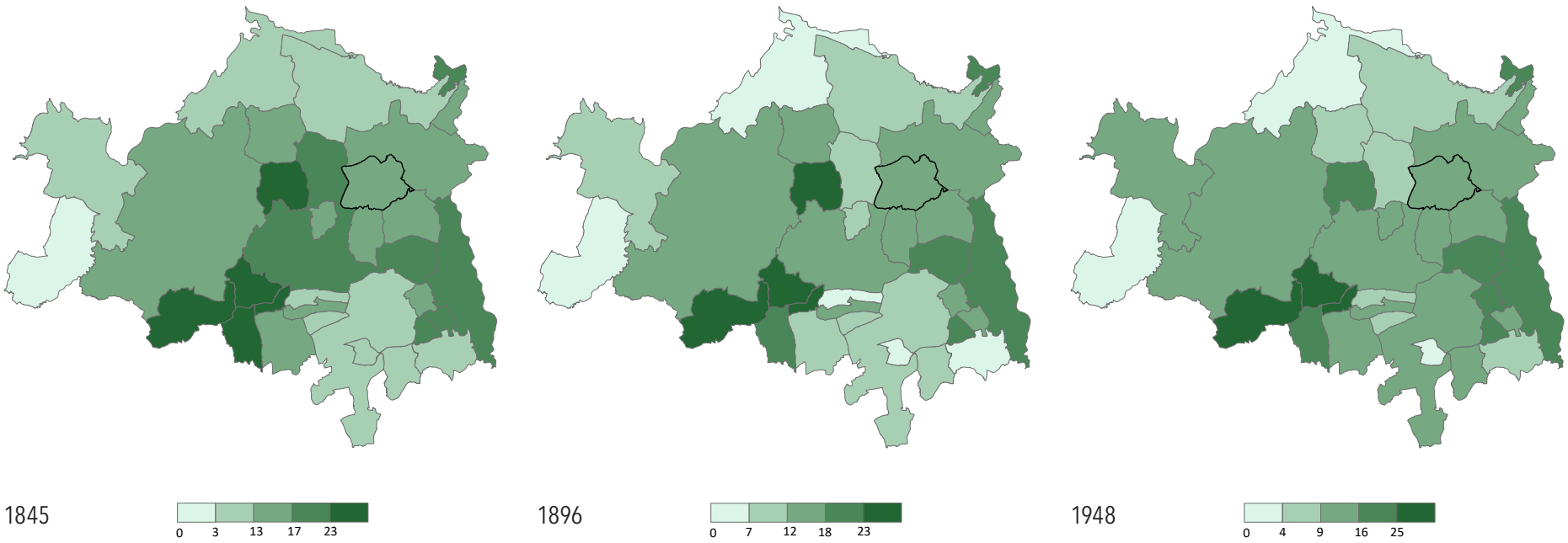


Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

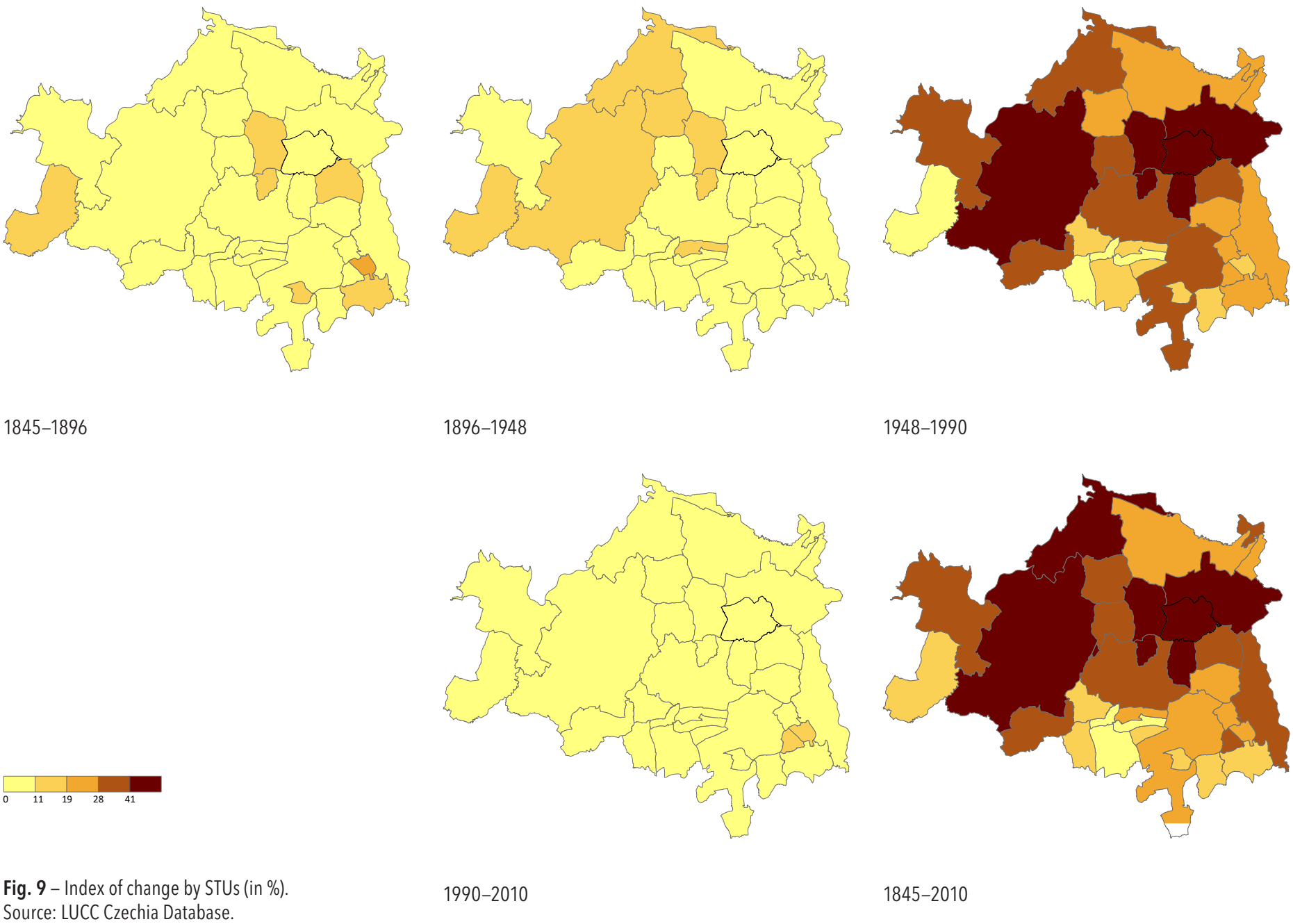


Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

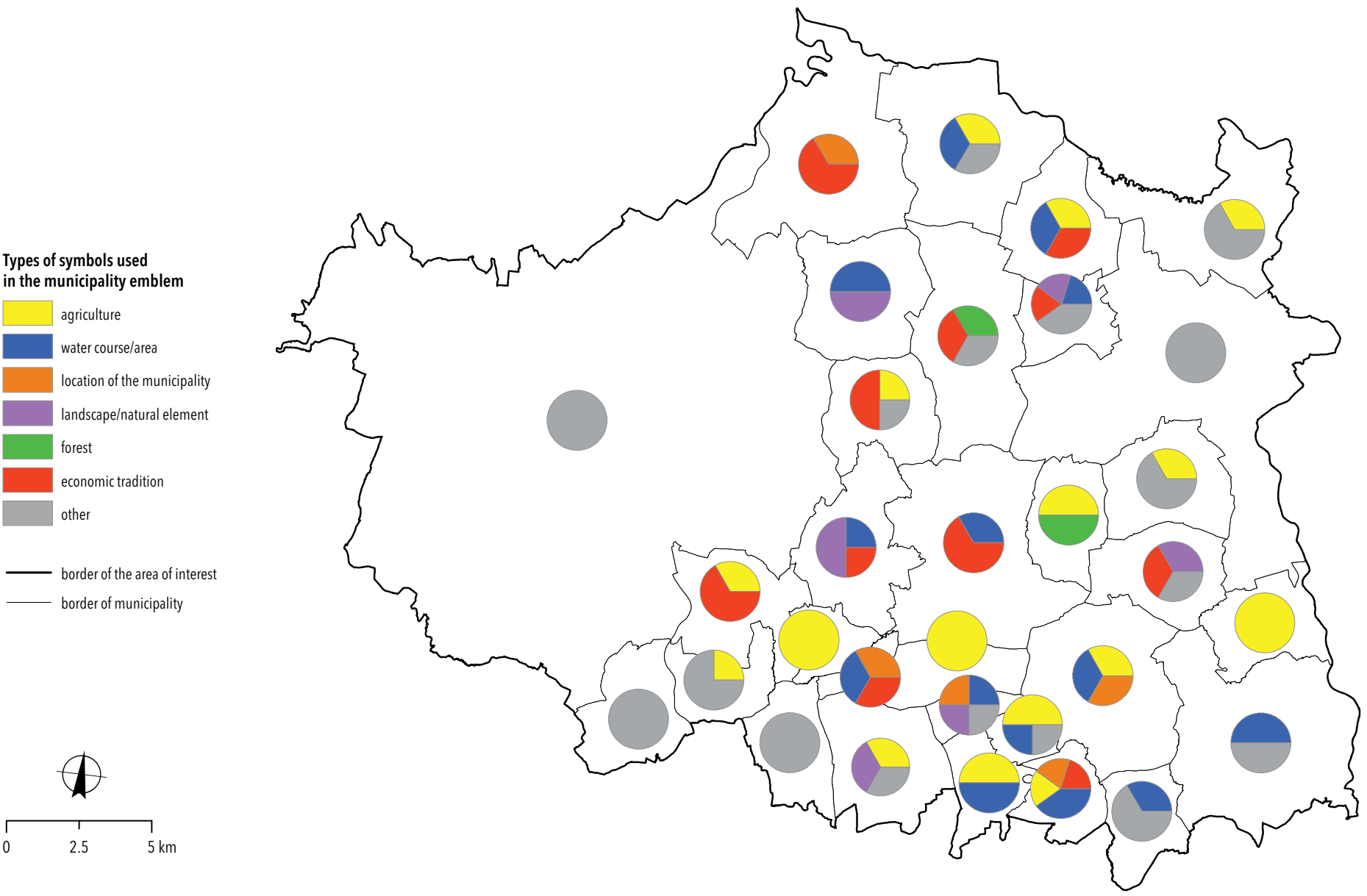


Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

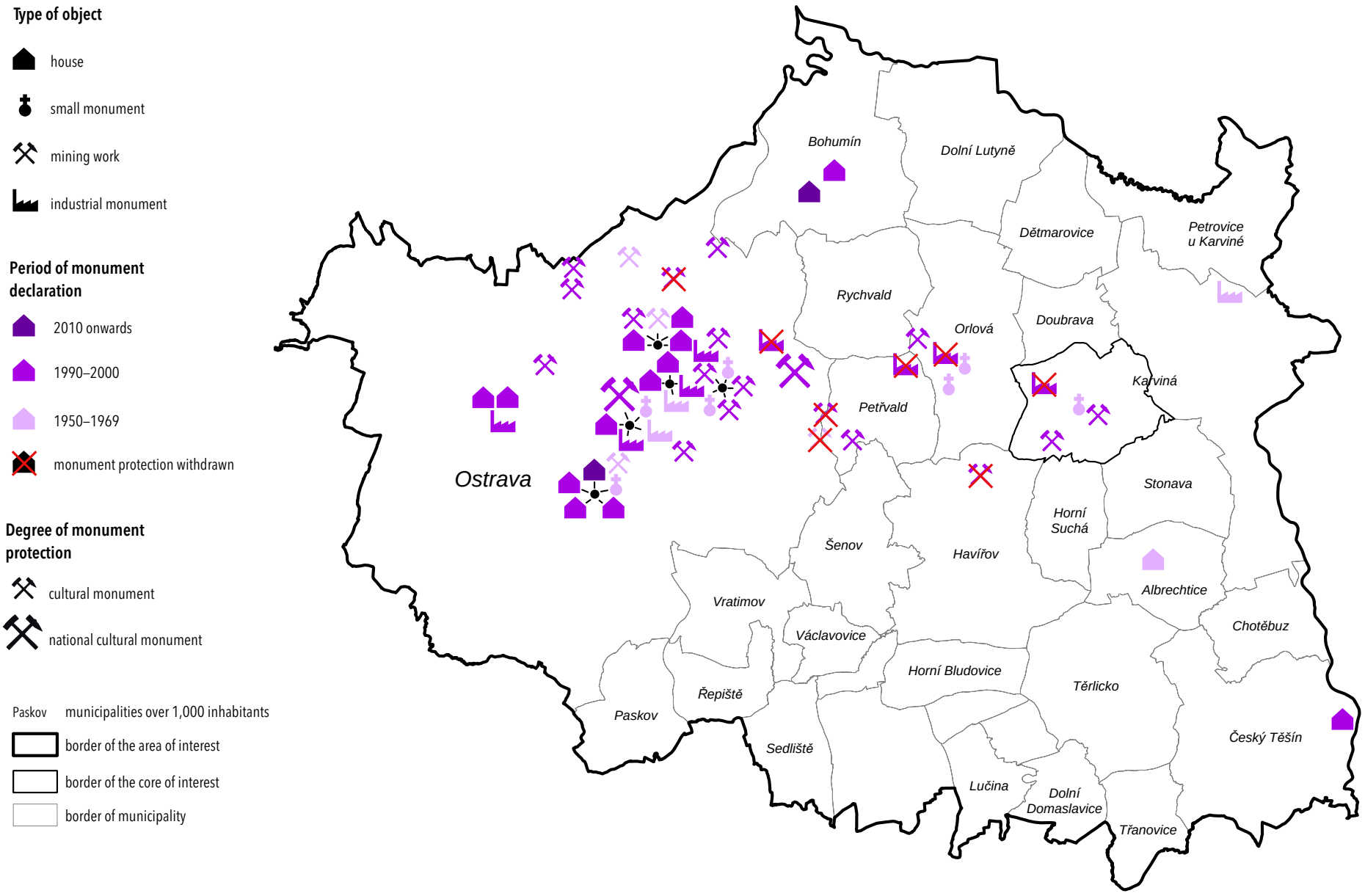


Fig. 12 – Cultural monuments and heritage areas.
Data source: National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

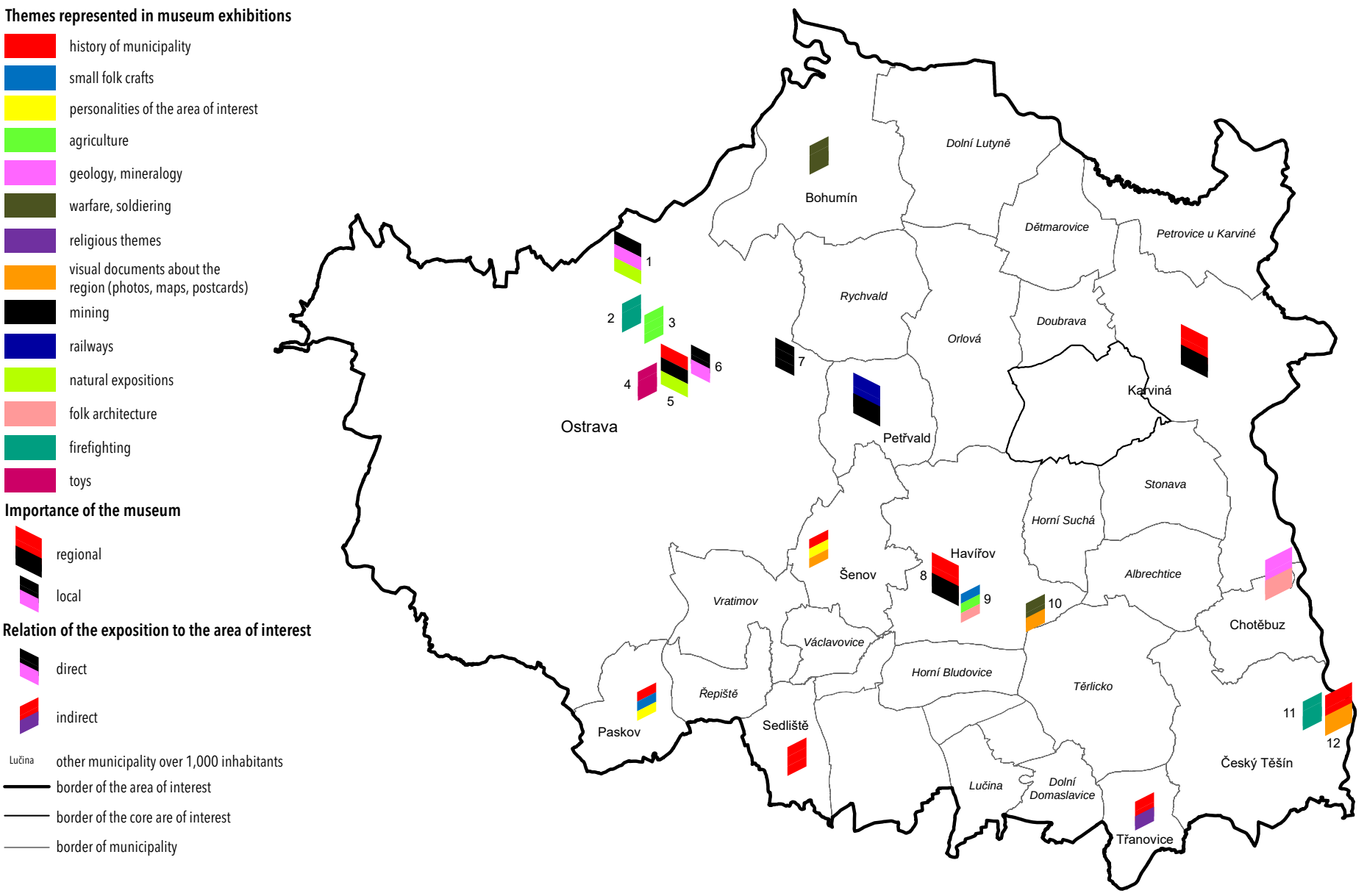


Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

One of the last areas of raw material extraction in Czechia is the Ostrava-Karviná Basin in the Moravian-Silesian Region. In recent times, there has been a significant decline in coal mining and related activities. These economic activities are being replaced mainly by enterprises in the automotive, electrical and mechanical engineering and plastics industries. They were partly created on the basis of greenfield projects (the bicycle and bicycle component manufacturer Shimano) and partly as a continuation of the existing industry, which served as a service industry for coal mining. The economic structure is completed by services (transport, wholesaling, logistics) and construction (often specialised in mining construction), complemented by urban services. In total, only 61 businesses with more than 10 employees are represented in Karviná. This number is just one half of that in the comparable towns Kladno (121 entities) and Most (105 entities). As a result, the transformation of the economy is lagging behind these areas, originally with a similar economic structure influenced by coal mining. The largest employer in the Karviná region is still OKD, now owned by the state, with more than eight thousand employees, despite its decline. The concentration of mining is also evidenced by the fact that only three entities from this sector are represented. Other industry is represented by 25 companies (8 engineering and automotive, 7 other and undifferentiated, 6 chemical and plastics, 2 metallurgical, 1 woodworking and only the Karviná brewery represents the food industry). A total of 13 are in the construction industry, 11 in wholesale trade and 6 in transport and logistics. Mining and the associated heavy industry have significantly influenced the landscape of Karviná and its surroundings, where extensive reclamation and consolidation activities are underway. One exception to the economic structure is the Lázně Darkov spa, one of the largest employers in the Karviná region.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). Karviná-Doly was a typical Czech rural landscape in 1836, dominated by arable land, with forests and permanent grassland occupying a significant proportion of the area. There were also water bodies and rural buildings and a fairly dense network of roads. In 2020, the landscape is very different. The areas resulting from mining activities (active and inactive mines, tailings, unmaintained and other areas) play a major role (although not dominant in terms of area). Paradoxically, there has been a significant increase in forest areas (by 22 percentage points) and also in permanent grassland.

Virtually all the changes that have occurred have been at the expense of arable land. Today, less than 7% of the area is comprised of it. The area is now very fragmented and strongly differs from that 180 years ago. The agricultural landscape has become a mining and industrial landscape, but with a significant proportion of woodland and grassed areas.

Images from 1947 and 1954 (Figure 4) show the original Karviná with its numerous residential buildings and the mining areas of the former Barbora mine in the southern part, the present-day ČSA mine in the northern part and the Gabriela mine in the eastern part of the area. The images further illustrate the agricultural use of the landscape. The original Karviná gave way completely to mining in the second half of the 20th century. The area is now dominated by forests and scrub vegetation, and new water bodies have been created as a result of undermining and local subsidence. Mining areas and mining-related features such as tailings ponds remain important features. The cemetery and the church of St Peter of Alcántara have been preserved from the old Karviná, which can be found in the present image virtually in the centre of the area of interest in the vicinity of the Pod farou pond.

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in STUs and describe changes over the time by comparing the years 1845, 1896, 1948, 1990, and 2010.

The land use evolution of the model area corresponds to the transition from a traditional rural society with predominantly subsistence small farmers over a relatively short period of time to intensive mining, industrial, residential, and transportation development, complicated by all but uncontrolled development planning for both the town and hinterland. The situation has been compounded by spoil tips from older deep mining and frequent subsidence of undermined areas. There are also old pinges retaining rainwater. The suggested trends are captured in the years under review. Arable land had increased by about 10% in the period before 1948, and there was a need to feed a much larger number of people living in the area. In the period of development of Karviná (1948–1990), on the other hand, arable land decreased by about a third, which was reflected, among other things, in a threefold increase in built-up and other areas. By 1948, 20–60% of permanent grassland had been lost, and after 1948 another 10–20%.

The woodland area was diminishing until 1990, by 10% until 1948 and less afterwards. The development of the macro-structure up to 1990 was clear, with a predominant type characterised by a decline in the area of agricultural land and woodland and an increase in other areas. After 1948, more than 500 ha of arable land were lost in several municipalities. Before 1990, very strong urbanisation was the dominant process of landscape change.

Figure 9 shows the index of change (Bičík et al. 2010, 2015). Karviná is an exceptional area in terms of landscape change. Between 1948 and 1990, the Karviná district showed the area with the highest index of change (13). This means that from the viewpoint of the district as a whole (i.e., if a summary is made), the land use category changed between these two years on 13% of its territory. In fact, when looking at the area in detail, the change was much greater (the development in many parts was contradictory). It can be estimated that if the detailed maps of 1948 and today were overlaid, one would find 50-percent changes in the use of individual categories in at least one half of the cadastres in the area of interest.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in following sections 3.2.1–3.2.3 (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

In the area of interest Karviná, it is possible to visit a total of twenty museums. Most of them are devoted to the post-mining and post-industrial landscape of the Czech-Polish borderland. Mining is still one of the typical economic sectors of this area. In addition to the Ostrava museums, the Těšínsko Museum is of key importance there. Its headquarters are in Český Těšín, but it has several other branches throughout the region.

The museum building in Český Těšín presents the history of the region in a broader context, taking into account the landscape, material culture and traditions of the area. Other branches of the regional museum include the Archaeopark Chotěbuz, which describes the prehistoric and early medieval period of Těšín Silesia. Then there is the Kotulova dřevěnka log building in Havířov, where visitors can learn about folk architecture (timbered buildings) and the everyday life of the inhabitants of Těšín at the end of the 19th and beginning of the 20th centuries. Traditional activities included especially agriculture, which is represented by examples of tools, utensils and other equipment.

Another branch of the Těšín Region Museum, the Memorial to Životice Tragedy, presents completely different exhibitions. It is dedicated to the Nazi annihilation operation in which many of the inhabitants of Životice perished. Until the beginning of 2020, the Těšín Museum also had other branches – Musaion and the Technical Museum in Petřvald – which are now managed by individual municipalities.

In addition to the mining museums, there are also two firefighting museums in Ostrava and Český Těšín, giving an account of the history of firefighting not only in this area. They present examples of historical firefighting equipment and vehicles and use models to illustrate firefighters' interventions in individual types of accidents.

Archival documents for the Karviná region can be obtained directly from the state district archive in Karviná or from specialised mining archives.

3.2.2. Regional and local symbols

The Karviná region is an example of post-mining and post-industrial landscape. The industrial tradition (the symbols of traditional industry are shown in red in Figure 11) is evident in the symbolism of the villages in Karviná. However, elements referring to agricultural tradition (yellow) and water bodies and streams (blue) also appear frequently, as this is generally a symbolism that is perceived in a predominantly positive way. Given that municipal signs are intended to represent the municipality externally and as an element that binds the local community together, references to industry in the area are contradictory. The public often associates such references with the degradation of the landscape and the structural problems of the region; on the other hand, they are a symbol of the tradition and success of local industry in the past.

Mining hammers are a traditional symbol of mining. They are depicted in the coat of arms of the municipalities of Albrechtice, Doubrava, Havířov, Orlová and Petřvald (whose coat of arms depicts black coal mining with a black foot in addition to the hammers). The black bar in the coat of arms of Šenov refers to the local coal stores. There are also other symbols of heavy industry in the emblems of municipalities in the Karviná region. In the coat of arms of Vratimov, cogwheel is the general industrial symbol. In the same coat of arms, a white square (a sheet of paper) symbolizes the local paper mills. Unique in the symbolism of municipal emblems is the inclusion of the figure of a turbine in the emblem of Dětmarovice, where it is a reference to the local power plant. The coat of arms of Bohumín is interesting, with a yellow (golden in heraldry) winged railway wheel and a silver fork, in the centre of which is a black, cogged wheel with eight spokes and eight teeth, representing the location of the industrial town on a trio of railway lines (it is therefore also a symbol for the location of the town – in the cartodiagram in orange). In the coat of arms of Havířov, apart from the aforementioned mining hammers, the rose is also surprisingly the symbol of the traditional economy as it represents the local important horticulture and floriculture.

The agricultural tradition of the municipalities in the Karviná region is symbolised in heraldry in the usual ways, such as the green tincture (colour) in the emblems of the municipalities of Petřvald, Horní Suchá (green foot of the emblem), Petrovice u Karviné, Stonava, Horní Bludovice (together with the figures of sheaves and sickles), Soběšovice (together with ears of wheat) and Chotěbuz (where the green tincture together with the symbols of sickles and scythes refer to the historical large estate). Other traditional agricultural symbols include a plough in the coat of arms of Vratimov, a flail in the coat of arms of Dolní Domaslavice, a bound sheaf in the coat of arms of Dolní Lutyně and a plough in the coat of arms of Těrlicko. The emblem of Václavovice depicts ears of wheat and the sun as symbols of the fertile area. The harrow in the coat of arms of Bruzovice also refers to the agricultural tradition (specifically to the fact that Bruzovice was a colonisation village based on large tracts of land). In the coat of arms of Dětmarovice, the corn cockle is both a "speaking sign" (the name of a part of the village) and a symbol of the agricultural tradition in the village. Similarly, there beet in the emblem of Řepiště and the meadow flower in the emblem of Lučina.

Elements depicting watercourses in the emblems of municipalities in the Karviná region include an undulating crossbar and blue tincture in that of Dětmarovice (a reference to the Olše River), the blue tincture in the emblems of Dolní Lutyně, Český Těšín (in both cases also a symbol of the Olše River) and Doubrava (the confluence of the Olše and Stonávka rivers), and the blue foot of that of Třanovice (the Stonávka River). The water reservoir Žermanice is also symbolised – silver bars and a blue shield in the coat of arms of Dolní Domaslavice, blue tincture and a wavy fesse of the shield of the coat of arms of Žermanice, wavy bars in the coat of arms of Lučina and Soběšovice (in both cases they are also a symbol for the Lučina River). Another dam depicted in the symbolism of municipalities in the Karviná region is the Těrlicko reservoir (blue tincture in the eponymous municipality of Těrlicko and the wavy foot of the emblem of Havířov). The emblems of the municipalities of Žermanice and Těrlicko also include symbols of the sun, which represent the location of the municipalities at the reservoirs and thus their function as recreational areas. The silver foot of the coat of arms of Kaňovice depicts the Kamenec pond, the blue-silver shield in the coat of arms of Rychvald refers to local streams and ponds (Nový stav and Skučák, around which there is a nature reserve). Bulrush in the coat of arms of Šenov is a symbol for local ponds (Košťálovský and Volenský) and also for the Lučina River and its meanders. In the coat of arms of Šenov, but also in that of the municipality of Žermanice, the bulrush also appears as an example of a typical plant, i.e., as a landscape element (in purple in Figure 11). A typical flora is the Hacquetia epipactis (the "Těšín plant" – symbolic for the whole of Těšín) in the coat of arms of Albrechtice. The linden trees in the emblems of Bruzovice and Rychvald symbolise the memorial linden trees in both villages, as does the oak tree in the emblem of Doubrava (two memorial oaks in the village, at the same time a speaking sign). The pine tree in the emblem of Horní Suchá refers to the pine forests in the municipality, the deciduous tree in the emblem of Orlová to the original floodplain forest. The axes in the emblems of Dolní Domaslavice and Kaňovice also refer to forestry, and hence to lumbering. In both cases, the figures of axes could also be a symbol for the way the first settlements were established, which was the clearing of the places in question.

3.2.3. Heritage sites

The post-mining and post-industrial landscape of the Czech-Polish border, represented by the area of interest Karviná and its surroundings, contains a large number of monuments referring to the local mining industry. The greatest concentration of listed buildings is, of course, in the cadastral area of the city of Ostrava. However, throughout the region, it is possible to find monuments relating directly to the extraction of mineral resources (mines, mining towers or mining complexes) as well as technical monuments of an accompanying nature (transport structures, electricity substations, water tanks, workshops) and, last but not least, monuments relating to the lives of miners (mining colonies, dwelling houses, miners' houses).

It is also worth mentioning the small monuments or memorials dedicated to the victims of mining disasters (e.g., the monument and grave of the victims of the 1924 mining disaster in Karviná) as well as to the victims of mining unrest (e.g., the monument to the workers' strike of the 1920s in Orlová or the grave and monument to the miners shot during the 1894 miners' strike in Ostrava). A large part of the elements have the status of cultural monuments, but it is also possible to find national cultural monuments, which are the Hlubina coal mine and the Michal coal mine in Ostrava. Heritage protection was granted to the local objects throughout the second half of the 20th century and some even after 2000. Several heritage sites have been withdrawn from protection for various reasons, mainly due to inappropriate structural and technical modifications or, on the contrary, due to dilapidation and subsequent demolition of the buildings.

4. Summary

The Karviná region is an extraordinary area in terms of landscape changes. Due to the total transformation, sometimes even devastation, of the landscape of Karviná, it is necessary to protect the remaining artefacts of the natural environment from the times of traditional society as well as the cultural and technical monuments of the area, and to support such areas in their protection. However, it is questionable whether such protection and support will be sufficient. For the future of the city, the spa and tourism areas on the tripoint of three neighbouring Central European countries should be one of the stabilising elements of the economy of the city and the whole area.

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CHAPTER 4

Kladensko: Hnidousy, Dubí u Kladna

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1. Introduction

Kladno is a typical example of an industrial and post-industrial landscape in combination with a mining and post-mining landscape, in which coal mining ceased and which was subsequently affected by the decline in heavy industry. The originally medieval village of Kladno, first recorded in writing at the beginning of the 14th century, was upgraded to a township in 1561. Until the end of the 18th century, the landscape had a typical agricultural character, with two manorial courts and a rich network of ponds, typical of the time.

At the end of the 18th century, the first coal mines were discovered and opened for mining, and mining developed rapidly from the beginning of the 19th century. The horse-drawn railway from Prague to Lány, which transported Kladno coal to Prague, also contributed to this. The turning point and the greatest boom in coal mining occurred in the middle of the 19th century. In 1846, the main Kladno coal seam was discovered and further discoveries followed after 1850. In 1854, the Kladno Ironworks was established and it became the most important industrial complex of the 19th century in the whole of Bohemia. At that time Kladno was called the Czech California or also the Czech Manchester. This had a far-reaching influence on the transformation of rural agricultural landscape. The development of coal mining and the influx of labour was followed by the establishment of workers' and miners' colonies near the shafts. The town of Kladno itself (promoted to the town status in 1870) was surrounded by mining enterprises and colonies, e.g., in Hnidousy near the Ronna mine, in Čabárna and in Pchery near the Theodor mine. Other colonies were established in Dubí, Dříně and Buštěhrad. North of the town (Hnidousy), large tailings heaps were created.

With the exhaustion of some important mines and the decline of mining by the end of the 19th century, the ironworks became the main economic force of Kladno. The system of mines thinned out, while industrial complexes expanded. The population of Kladno and its parts (Dubí, Hnidousy – today Švermov) increased significantly.

This growth and industrial boom of Kladno, interrupted by a crisis, continued into the 20th century. In the Communist era, heavy industry was initially supported. While coal mining was curtailed when resources were depleted, Kladno remained the steel heart of Bohemia. Modern metallurgical and foundry plants (the Dříň steelworks) were established here. After 1990, there was a dramatic decline in metallurgical production and the abandonment of a number of Kladno production sites. A typical post-industrial landscape emerged in Kladno with many abandoned factory halls, typical brownfields, overgrown handling areas, abandoned blind asphalt and concrete roads, etc. The abandoned yards and areas are covered with ruderal vegetation dominated by the invasive Canadian goldenrod.

For the purposes of this project, the "core area" was delineated and most analyses are carried out in it (Figure 1). It includes the municipal areas of Hnidousy and Dubí near Kladno. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

The model area of Kladno lies on the western edge of the large geomorphological unit of the Prague Plateau (Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The underlying geology consists of Permian and Carboniferous sandstones, arkoses and claystones, overlain in the northern part by Upper Cretaceous (Cenomanian and Turonian) siltstones, claystones and sandstones. Occasional intersections of non-volcanic bodies, formed by Myocene nephelites and pyroclastics (Vinařická hora and Slánská hora) occur. The younger mantle rocks mainly consist of loess sheets and drifts on plateaus and gentle slopes. In the valley floodplains, the youngest alluvial sediments are not very powerful.

The relief at the prevailing altitude of 300–360 m is a flat hilly plateau or tableland which slopes gently north-eastwards towards the Vltava River. The original sedimentary table is slightly broken up by shallow, wide valleys of streams which also head northeast to the Vltava (the Dřetovický Brook, the Týnecký Brook, the Knovízský Brook, the Zákolanský Brook). There are only major differences in the altitude of over 100 m at the western edge of the area near Vinařice, caused by the nepheline knob of the Vinařická Mountain (413 m) and a downward cutting of the Knovízský Brook. Otherwise, the relief is dominated by plateaus (level surfaces) and gently sloping slopes with a gradient of 2–5°. The (post-)industrial and post-montane landscape of Kladno is also characterised by anthropogenic landforms, primarily the abundance of industrial-levelled surfaces and industrial-paved terraces with artificial surfaces, abandoned mining and industrial complexes with heaps and other montane landforms after coal mining.

Kladno and the Kladno region are situated at a transition between the warm and temperate warm climate zones (Quitt 2009). The average annual temperature is around 8 °C and the average annual precipitation is low and only slightly above 500 mm. Winters are mild and inconsistent, with no long-lasting snow cover. Summers tend to be warm, often with a prolonged dry season.

The soil cover alternates between brown modal soils formed on loess and modal cambisol on weathered rocks, with occasional pararendzinas formed on outcrops of clay rocks. Anthroposols

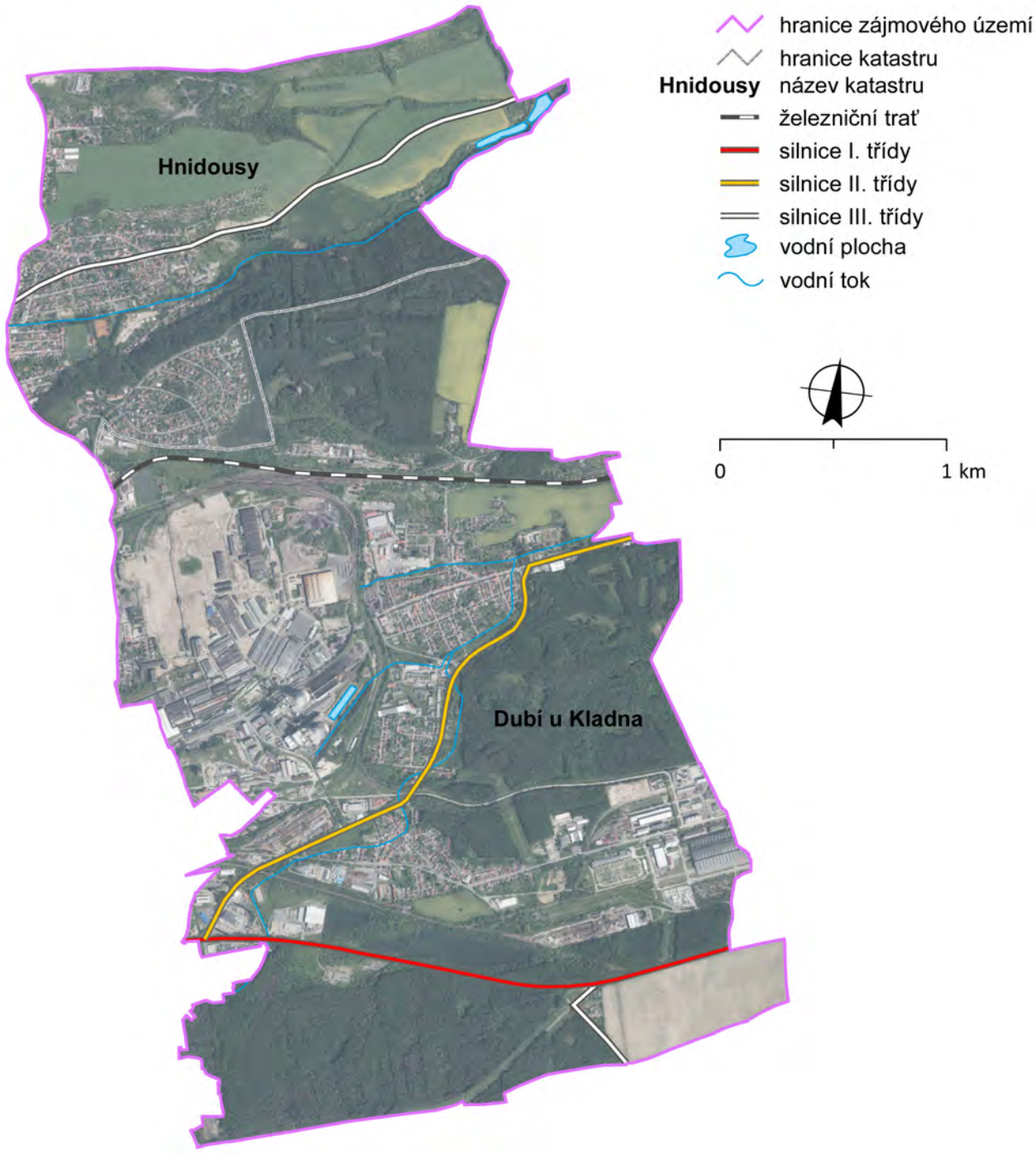

Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

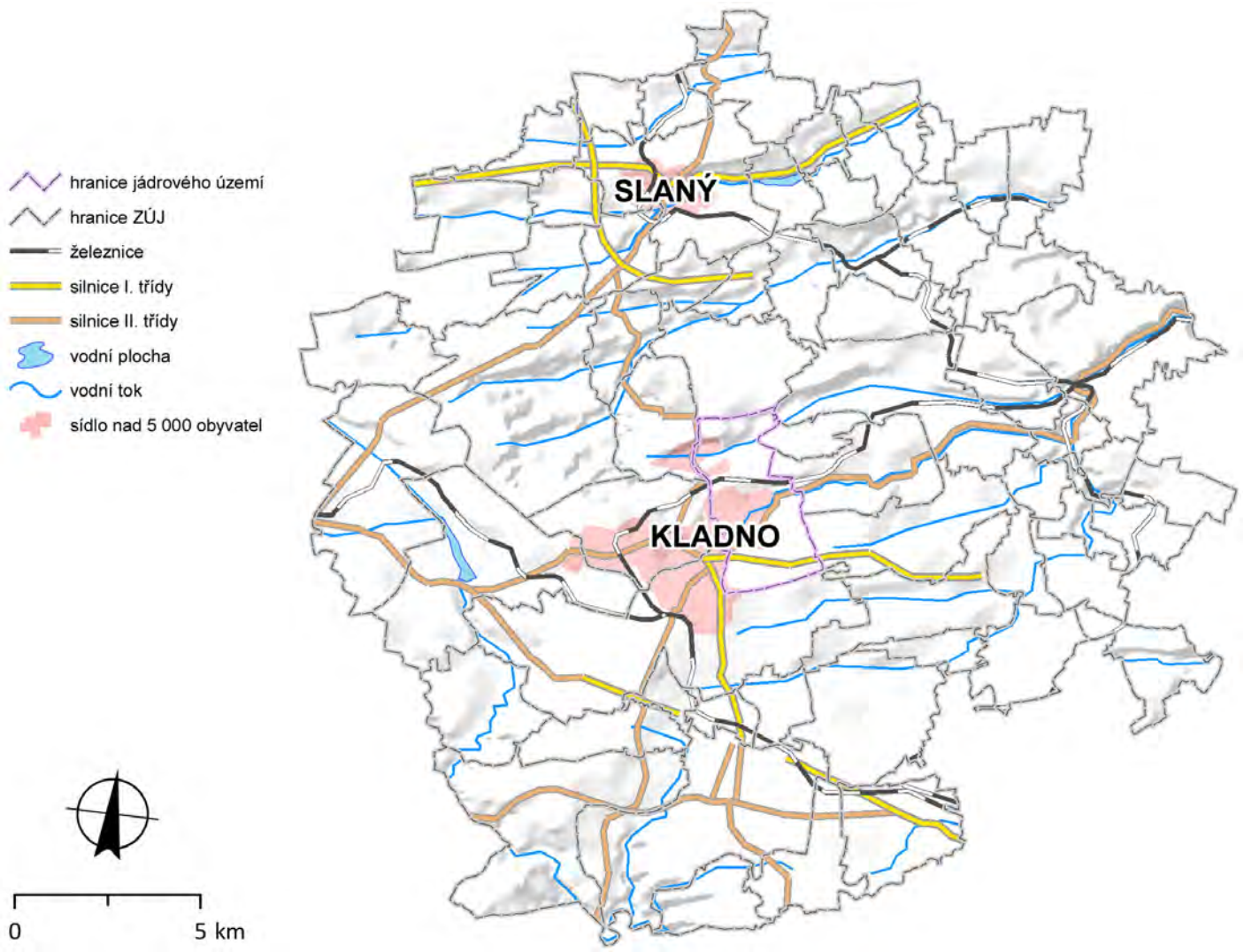

Fig. 2 – The wider area of interest. Map basis: Data50.

formed on anthropic and relocated substrates also have a significant share in current and extinct industrial areas and in mining sites, landfills and heaps.

Kladno is located in the Czech Thermophyticum phytogeographical district, on the eastern edge of the Džbán phytogeographical district, at the transition to the Central Bohemian Plateau phytogeographical district and the Slánská Plateau phytogeographical subdistrict (Skalický et al. 2009). The forests make part of the natural forest area of the Kladensko-rakovnická pahorkatina upland, the oak-beech vegetation stage. Potential natural vegetation would consist of the Melampyrum oak-hornbeam woodland in most of the area, only on the upland dry slopes in the north (outside the core area) of thermophilous moss oak, on the other hand, on the wetter and cooler northern slopes, of sporadically flowery lime beech (Neuhäuslová, Moravec, eds. et al 1997).

The current land use and landscape cover in the core area is dominated by urban residential and industrial development, interspersed with gaps, abandoned farm yards and typical post-industrial areas with ruderal herbaceous and scrub vegetation. The core area of Kladno-Dubí is dominated by large industrial and post-industrial areas, abandoned large halls and production facilities. The open areas between them are overgrown with ruderal vegetation with invasive plant species, the most abundant of which is the giant goldenrod. Clematis is very frequent. The forests are predominantly deciduous, with a relatively varied species composition: oak, hornbeam, lime, maple, beech, elm, and on the edges of the stands the invasive thorn tree. Conifers (pine, larch, spruce) are planted in places, mostly withering in poor health, while broadleaf trees are thriving.

On the northern side, adjacent to Švermov, Hnidousy and Vinařice, there are extensive field meadows on the Prague Plateau. Nature conservation has no special interests in this area, which has been intensively used and transformed by man for a long time. There are small specially protected areas on the edge of the area of interest in the valley of the Knovízský Brook, outside the Kladno core area.

The model area of Kladno (the villages of Hnidousy and Dubí) was selected as a characteristic post-industrial landscape. It is located in the close vicinity of a large city and along with it, it is now part of the Prague metropolitan area. Until the middle of the 19th century, these villages were part of the political district of Unhošť and it was only after the development of coal mining (1854) and the construction of smelters (Vojtěšská 1854, Poldina 1889) that Kladno began to grow in importance. This was undoubtedly related to the rapid onset of industrialisation as a fundamental process of modernisation of the traditional economy of the model area. The development of mining, metallurgical and engineering production influenced the growth of the population not only of Kladno, but also of many villages in its hinterland (Hnidousy, Motyčín, Dubí, Brandýsek, etc.). In the second half of the 19th century, several railway lines were built in the area to provide sales of coal, metallurgical and engineering products to Prague and other areas of the Austro-Hungarian Empire and later to Czechoslovakia and abroad. The inhabitants of the area were very politically active, and the Communist Party of Czechoslovakia had a significant position here in the interwar period already. After the Second World War and especially after 1948, the influence of the Communist Party continued to grow, which was reflected in the construction of some more plants (Dubí Steelworks, Kablo, etc.), as well as the construction of residential and service buildings and the position of Kladno as a preferred area of the previous regime. Some villages became part of the territory administered by the Kladno Municipal National Committee (Dubí, Kročehlavy, etc.). While Hnidousy acquired a primarily residential function and it was administratively merged with Motyčín under the name of Švermov, Dubí became part of Kladno with a distinctly industrial function.

As early as 1869, the first real census showed that Kladno, Hnidousy and Dubí (and some other villages) had a population density of over 250 inhabitants/km², which was more than double the average for Czechia. This situation documents the rapid development of a new industrial centre, sprawling between Kladno, Hnidousy and Dubí. The overall development of Kladno is also documented in the cartograms, where the population density (254 inhabitants/km²) is already shown by a quarter of the hinterland municipalities. The eastern part of the hinterland has a population density of under 100 inhabitants/km² and some municipalities even below 70. Kladno and its hinterland has always been considered a hub of industry and mining, which is no longer the case. In line with the trends influencing the whole society, the tertiary sector dominates, with more than 50% of the economically active population in the south-eastern hinterland, and in some municipalities more than 60%. It is in this part of the hinterland that employment in the secondary sector is the lowest, mostly below 20%. The commuting rate is relatively very high, above 32% in the model area, while in the municipalities in the south-east and east of the hinterland the commuting rate of the economically active population is well above 40%.

It is a model area on the outskirts of the Kladno agglomeration and with it, it has also undergone a transformation from one of the centres of mainly heavy industry into a zone that is used more as a service area of Prague with a significant housing function. The economic structure of the model area is quite varied, with a predominance of the tertiary sector, mainly logistics, warehousing, wholesale trade and transport services (almost half of them are mainly engaged in passenger transport).

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). In the middle of the 19th century, Kladno was an intensive agricultural area with a fairly high proportion of woodland. There were also several large ponds in the model area. The area has undergone an incredible transformation over the 180 years under study, mainly due to coal mining, industrialisation and, after 1990, a significant decline in mining and industrial activity. At present, the effects of mining and its decline are reflected in the extremely high proportion of other and built-up areas in the model area. In the typical post-mining and post-industrial landscape one can find abandoned factory halls – industrial brownfields, ruderal vegetated courtyards, handling areas, roads and yards.

Especially in Dubí, other areas cover almost one half of the cadastral unit, while its remaining part is mostly covered by forests. Hnidousy has a somewhat different character and there is a significant development of residential housing, while in the north agricultural areas, especially arable land, still predominate. Interestingly, forests have remained virtually untouched by logging throughout the area and their extent has even slightly increased.

The presented landscape models (Figure 4) document the expansion of the industrial estate and its adjacent service areas. This is also linked to the increase in residential development

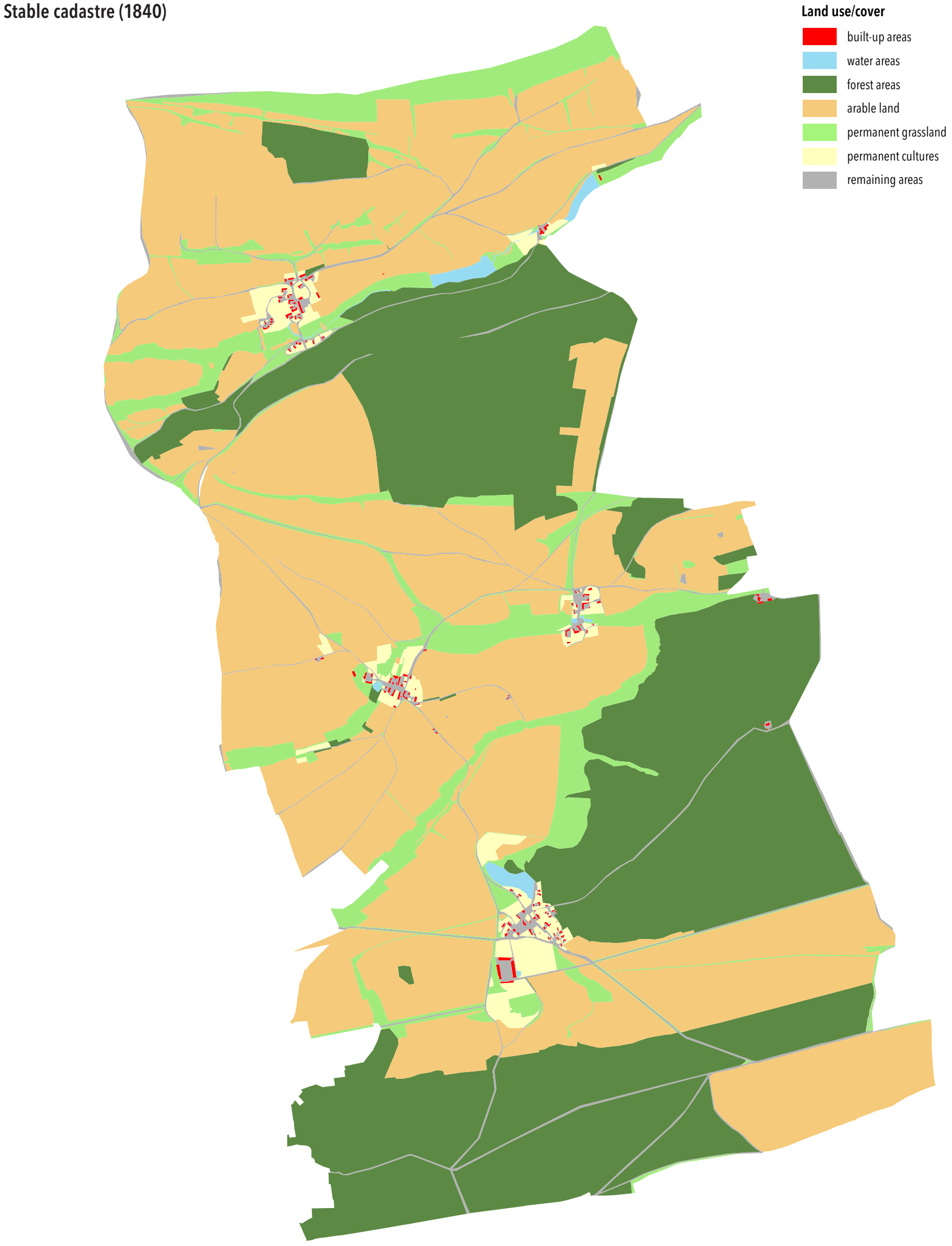

Fig. 3 – Land use/cover in cadasters Hnidousy and Dubí in 1840 and 2019.
Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

Current state (2019)

Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.20	8.38	8.18
remaining areas	2.37	29.54	27.16
water areas	0.43	0.13	–0.30
forest areas	35.21	36.38	1.17
arable land	50.40	14.71	–35.69
permanent grassland	9.51	4.15	–5.36
permanent cultures	1.89	6.74	4.65

1938

1953

2018

Fig. 4 – Models of landscape – Dubí u Kladna and Hnidousy landscape in 1938, 1953 and 2018. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5a – The view of Kladno from Podprůhon 1901 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2019): S. R. Kučerová.

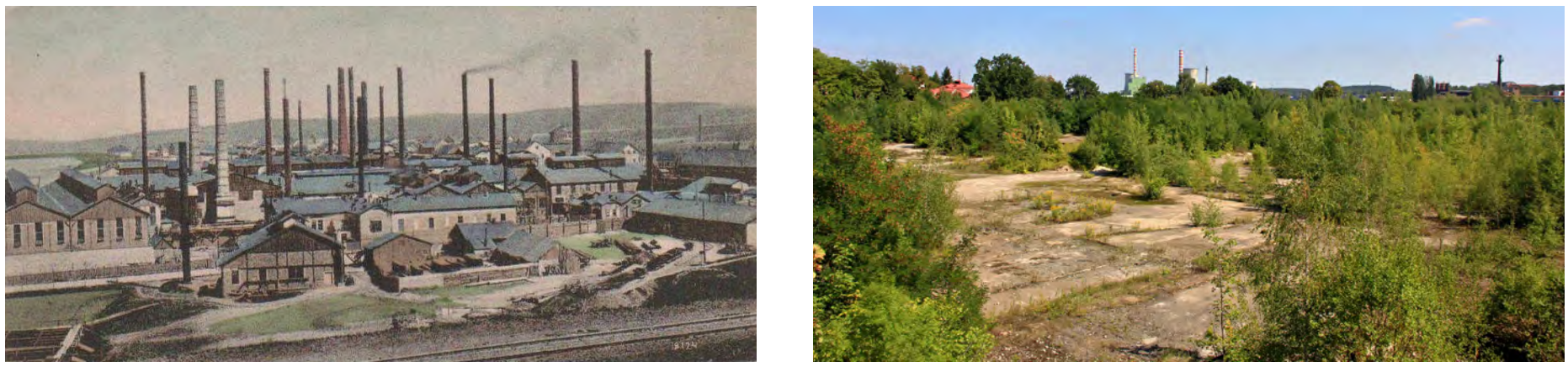

Fig. 5b – The view of Kladno, Vojtěšská huť 1910 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2019): S. R. Kučerová.

(e.g., the southern tip of the Hnidousy district – see the 1930s and 1950s). The structure of agricultural areas between the 1930s and the present shows the merging of the original smaller mosaic into larger units. After 1990, there was a dramatic decline in metallurgical production in Kladno and the abandonment of a number of production sites. A typical post-industrial landscape was created with a number of abandoned factory halls, typical brownfields, overgrown handling areas, abandoned blind asphalt and panel roads, etc. Ruderal vegetation is spreading in abandoned yards and areas.

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a broader perspective of land use/cover changes in STUs and describe changes over time by comparing the years 1845, 1896, 1948, 1990, and 2010. The extent of arable land increased/decreased by 5% across the different stages under study. In contrast, the area of permanent grassland has been declining in the long run and in recent years after 2000 there has been a clear difference between the reported area of permanent grassland and the real state of affairs in the terrain (unconverted arable land or fallow land to permanent grassland). Due to the proximity to Prague and the function of Kladno within the metropolitan area built-up areas have increased two to four times. This increase is likely to continue in the near future, but part of the required areas will be obtained by the redevelopment of existing built-up areas.

The index of change (Bičík et al. 2010, 2015; Figure 9) has been ranging from 10 to 20 since 1845, and only down to 4 in the period 1990–2010. This represents a relatively stable landscape with quite an intensive farming.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) and described in the following sections 3.2.1.–3.2.3. (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

The area of interest in Kladno represents a typical example of vanished industrial landscape – the space of large-scale industrial areas and a mining region. This type of landscape transformation and the activities associated with it are presented to visitors in many museum exhibitions in Kladno and its surroundings. Kladno's past is directly addressed by the Sládeček Museum of Local History, which depicts the entire history of Kladno from prehistory to the 20th century and the discovery of black coal. Other exhibitions, including the museum branch of the Mayrau Mining Museum in Vinařice, focus on the presentation of mining activities in this area – the life and work of miners and the places where they worked.

Several other exhibitions are devoted to the military and the Second World War in Kladno. In general terms, it is presented in the exhibition in the museum in Slaný. Specific examples of this period are the light fortification installations or the Lidice Memorial, which introduces visitors to the well-known tragedy of the annihilation of this village. Nearby museums in Buštěhrad and Unhošť then put on display other collection artefacts dealing with the history of the region, personalities and small local crafts.

The archival materials of Kladno are mainly stored in the State District Archive in Kladno or the State Regional Archive in Prague.

3.2.2. Regional and local symbols

As expected, the symbols of the municipalities in the Kladno area of interest often refer to the industrial tradition of the region (the "red" category of economic tradition in the cartogram, Figure 11). Mining and coal mining traditions are most frequently represented in the signs (Figure 10). The well-known symbol (figure) of crossed mining hammers (and its various types) appears in the emblems of the municipalities of Brandýsek (where it refers to the Michael Mine), Jemníky, Libušín, Otvovice (where the emblem also includes the symbol of a glassmaker's blowpipe – a reference to other traditional economic activities in the locality),

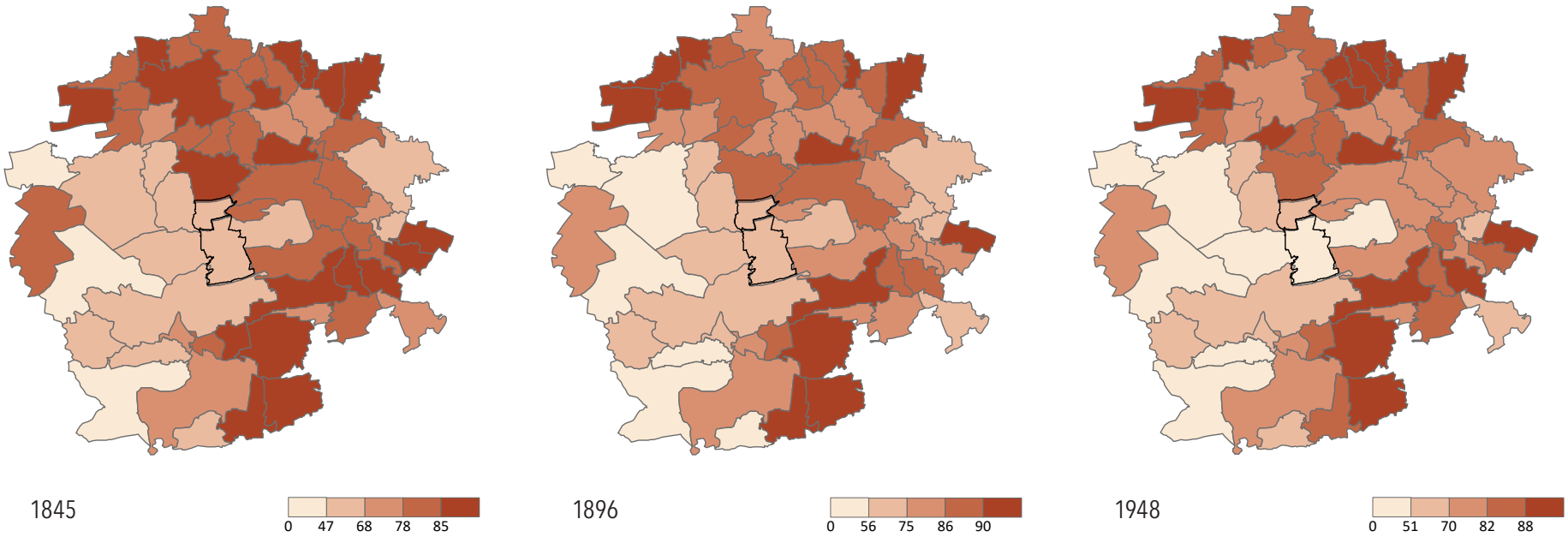

Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

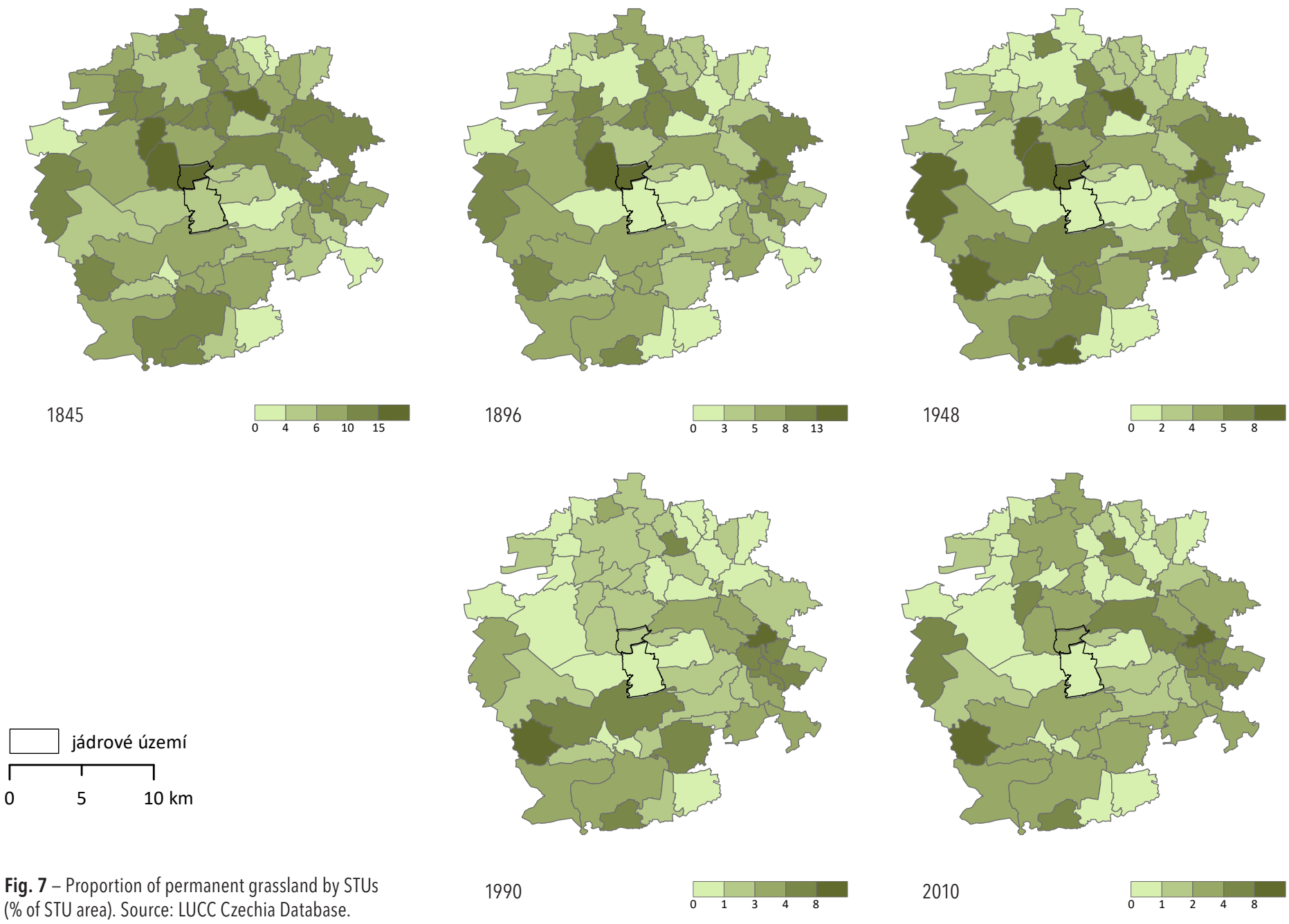

Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

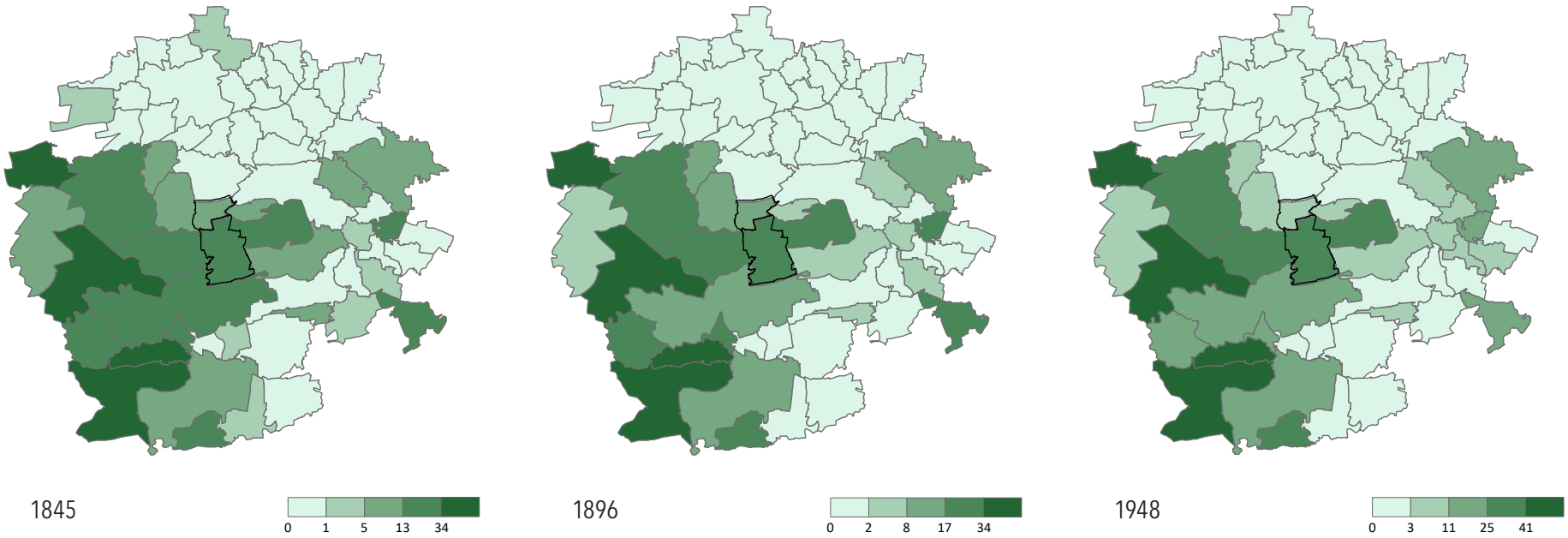

Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

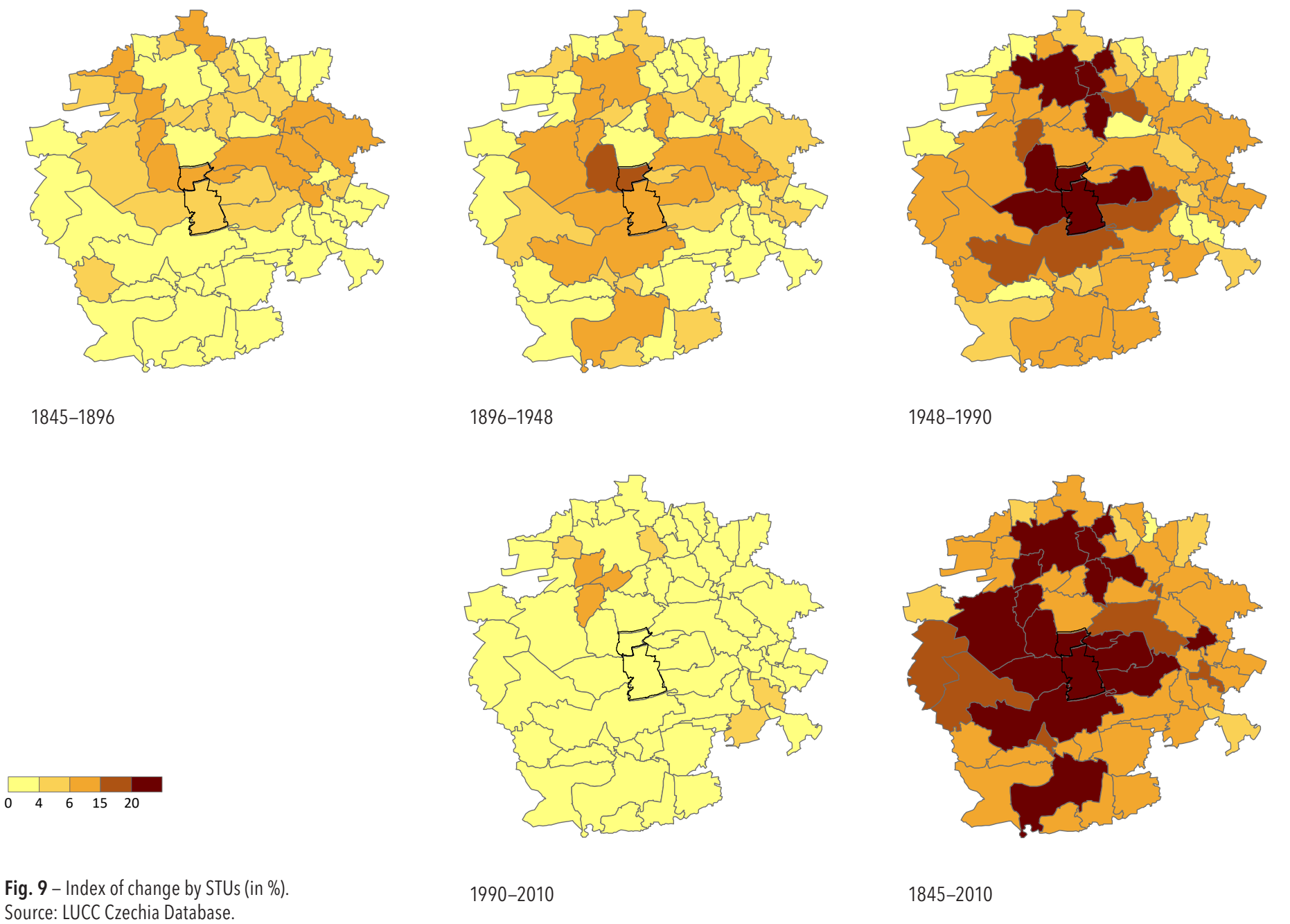

Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

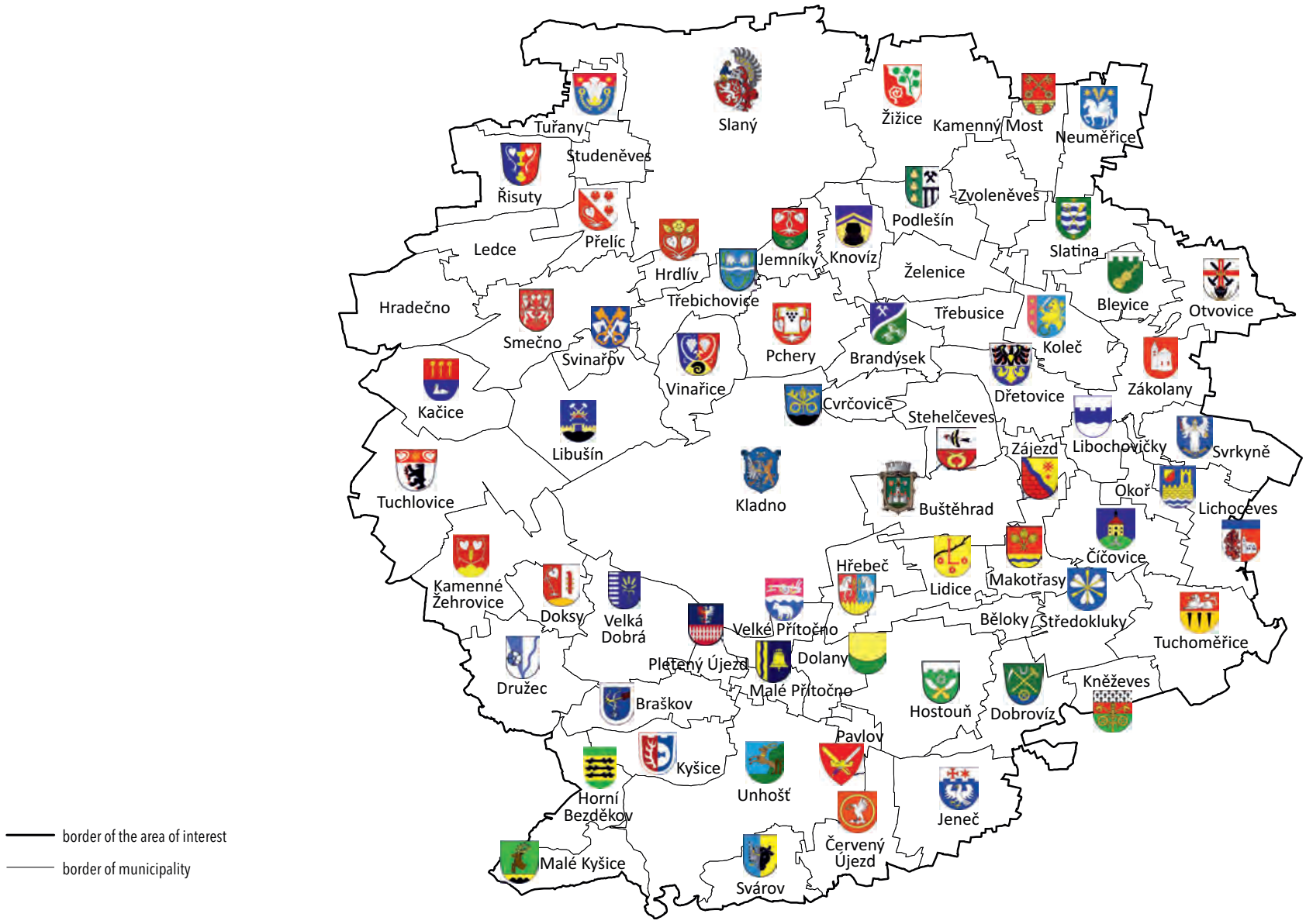

Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

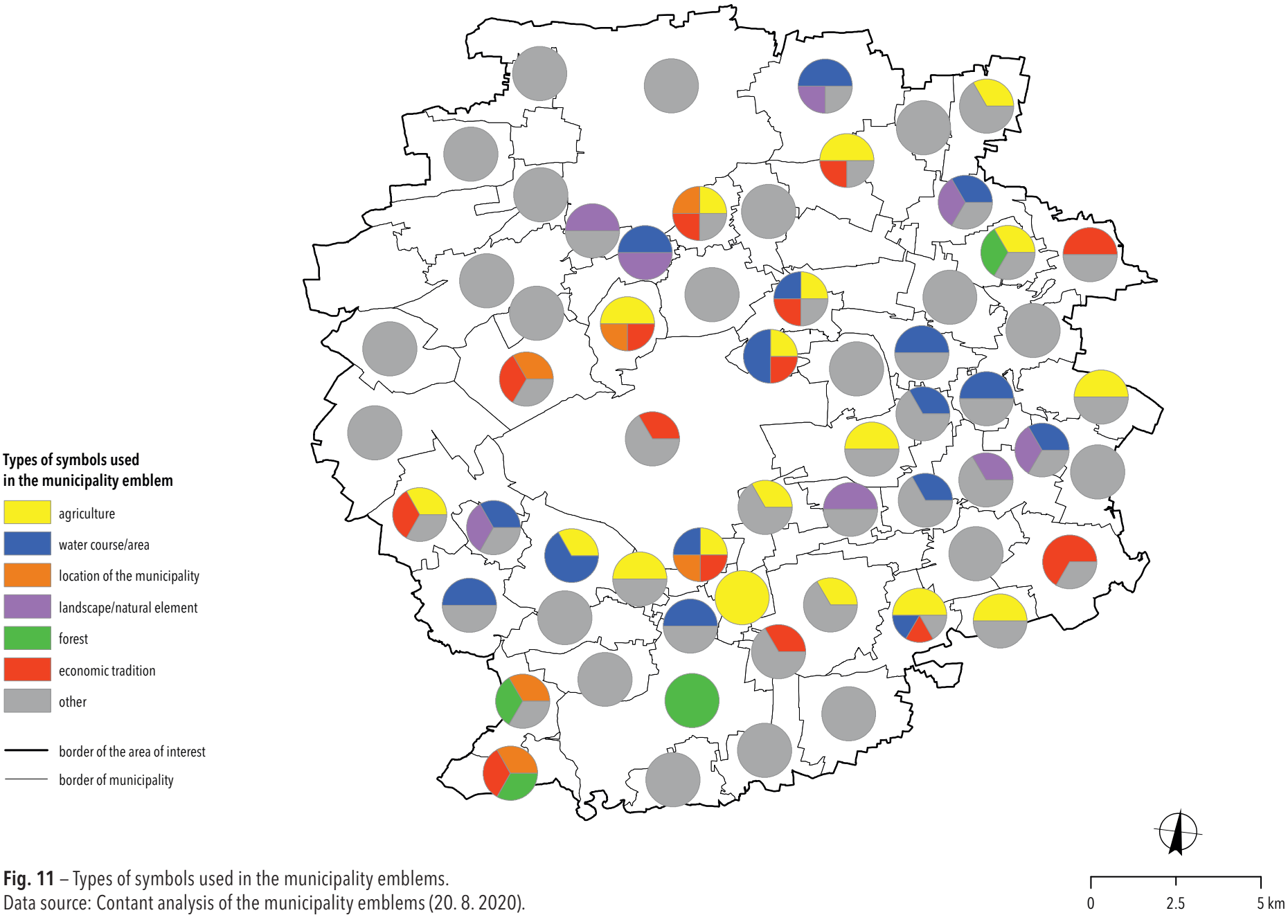

Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

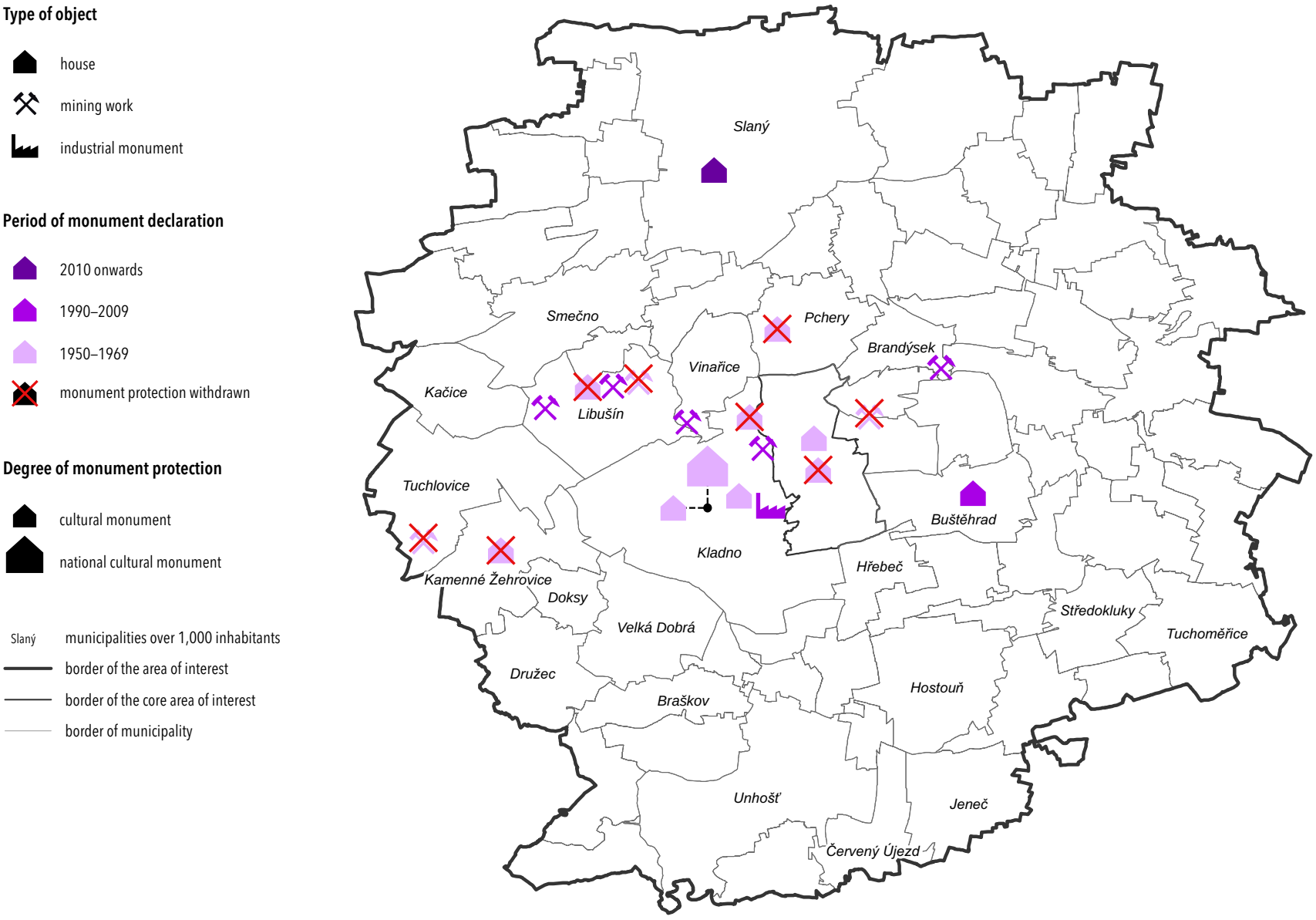

Fig. 12 – Cultural monuments and heritage areas.
Data source: National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

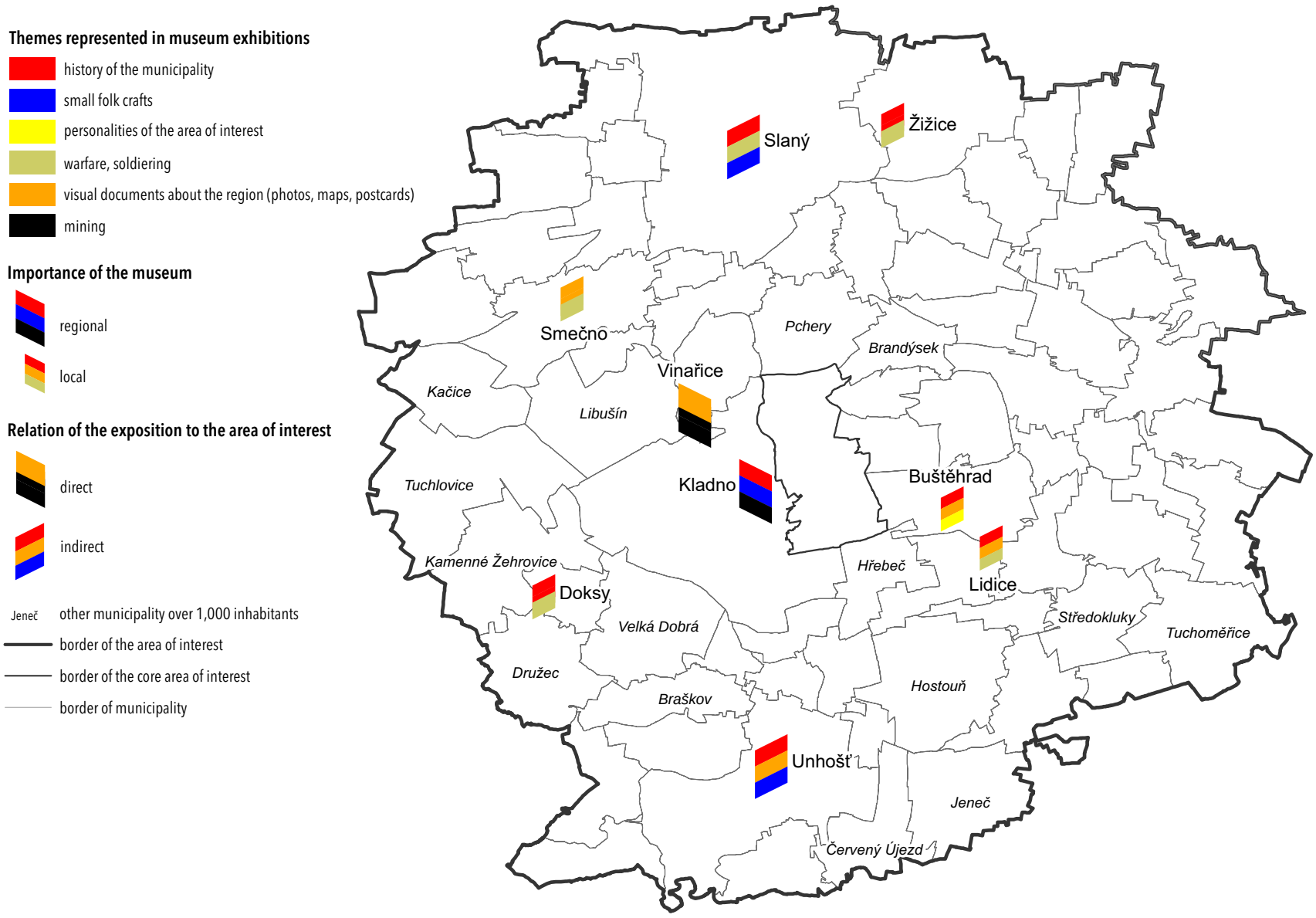

Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

Podlešín, Vinařice (where the hammers are a symbol specifically for the Mayrau coal mine), as well as the municipal emblem of Kladno. In addition to the hammers, the coat of arms of Libušín also features a black triple-peak (the symbol of mine heaps). The black trefoil also appears in the coat of arms of Malé Kyšice. Another symbol for coal mining is the black tincture (colour) at the bottom of the coat of arms of the municipality of Cvrčovice. In the coat of arms of Tuchoměřice, black quarryman's wedges appear, which refer to the local mining of marlite; in addition, the yellow (golden) field symbolises the colouring of marlite. The name and the symbol of the yellow (golden) triple peak in the coat of arms of Kamenné Žehrovice refer to the local sandstone mining.

Agriculture is abundantly depicted in the graphic symbolism of the villages in Kladno ("yellow" category, Fig. 11). Several symbols depicting the figure of a grain ear refer to the agricultural tradition (Cvrčovice, Hřebeč, Kamenné Žehrovice, Kněževes, Neuměřice, Svrkyně, Velká Dobrá). The emblem of Dobrovíz symbolises the agricultural character of the village with figures of agricultural tools, a mill wheel and green tincture (colour). The green and golden (yellow) tincture refers to agriculture in the coat of arms of Dolany, the green shield in the coat of arms of Hostouň and the green bulging foot in the coat of arms of Jemníky (the fertile valley of the Knovízský Brook) have a similar function. The green tincture together with the pear figures in the coat of arms of Podlešín represent the local orchard tradition. The fence in the emblem of Pletený Újezd is an interesting symbol for agriculture – the fence is also a "talking sign" (a knitted/fenced-in hut). The emblem of Velké Přítočno depicts agriculture with a plough and a lamb – a symbol of sheep breeding in the sheep yard.

Watercourses and water bodies are very often symbolised in municipal signs ("blue" category, Fig. 11). This is also the case in the villages of Kladno. However, these are often references to streams or ponds of local importance. For example, the oblique wavy bar in the emblem of Brandýsko represents the Týnecký Brook, and the emblem of Družka similarly symbolises the Loděnice River. The blue tincture at the foot of the shield of the Dřetovice municipality emblem points to the Dřetovický Brook. The wavy bottom and blue tincture in the coat of arms of Libochovice are symbols for the Buštěhradský Brook and the pond located in the village. The Buštěhradský Brook is also depicted in the coat of arms of Zájezd (a wavy, oblique blue crossbar). The emblem of the village Velká Dobrá contains several symbols connected with water – white (silver) and blue logs refer to the springs of good water in the village (they are also a speaking sign), while the blue field reminds of the ponds and the Rozdělovský Brook. In the coat of arms of Okoř, the white (silver)-blue wavy bar symbolizes the Zákolanský Brook and the pond in the foothills. The red stream flowing through the municipality of Žižice is symbolised in its coat of arms by a wave partition line and a red tincture corresponding to the name of the watercourse.

In the large area of interest in Kladno, there are also several interesting local landscape elements that have found a place in the graphic symbols of the villages in the area. The figure of the Okoř Castle is depicted in the emblem of the eponymous village. The emblems of the municipalities of Malé Kyšice (the protected landscape area is symbolised by a green tincture and the figure of a deer) and Unhošť (also a deer leaping out of the Křivoklát forests) are connected with the Křivoklátsko Protected Landscape Area. Unique symbols in the emblems of the municipalities in Kladno are the red roses in the emblem of Lidice (referring to the rose orchard in the Lidice Memorial), the figure of the spring mallow in the emblem of Třebichovice (a protected plant in the local nature reserve), or the golden (yellow) rose in the emblem of Hrdlív (a rare colour mutation of the wild rose growing in the vicinity of the municipality). An unusual but clear symbol appears in the emblem of the municipality of Knovíz – the figure of an amphora symbolises a well-known archaeological find in the municipality. The symbol of water lily also appears frequently in the emblems of municipalities in Kladno. In all cases, however, it is a symbol belonging to the category of others ("grey", Fig. 11), as it refers to the Martinic family, who owned extensive land in the area.

As of 1 October 2019, 89.7% of municipalities in the Kladno area of interest have a municipal emblem (61 out of 68 municipalities).

3.2.3. Heritage sites

The post-industrial landscape and its changes are monitored in the area of interest of Kladno. The whole area is important especially for the coal mining, which had a tradition lasting several centuries and was finally terminated in 2002.

The territory of Kladno was home to dozens of mines, industrial complexes and accompanying operations, many of which were abandoned or demolished after the end of their activities. Currently, the following have been declared cultural monuments: the site of a mining tower in the former 19th century Michael-Layer Mine in Brandýsek, the Schoeller/Nejedlý deep coal mine in Libušín, which was in operation between 1899 and 2002, the Kübeck deep coal mine, active between 1858 and 1997, and the Mayrau deep coal mine from 1874 to 1987 (both in Kladno). The latter site is now used as a mining museum for the public. There are also sites or buildings in the area that were designated as cultural monuments in the past, but this protection was withdrawn for various reasons. These include, for example, the mining tower of the Jan 2 Mine in Libušín, which collapsed in 1982, or the Ludmila coal mine, whose mining tower from the 1840s was significantly modified in 1988 and lost its monumental value.

In addition to the mines themselves, there are also several other buildings associated with mining in the area, including the Hornický – Lidový and Poldi SONP community centres. Both of these buildings are located in Kladno and were built in the first half of the 20th century. There is also the cultural monument of the Old Kladno Freight Station (probably the second oldest railway station in Kladno, dating from the mid-19th century) and the national cultural monument of the Workers House with a richly decorated neo-Renaissance façade from 1907, which was created by combining three buildings. It is largely preserved in its authentic form.

Other buildings that have lost their status as cultural monuments include the community and workers houses in the villages of Libušín, Pchery, Kamenné Žehrovice, Motyčín and Dubí near Kladno. All of these houses have in common that they were built in the first half of the 20th century and were not characterised by any architectural or town-planning values. They were designated as cultural monuments in 1958 for political reasons and had their heritage protection withdrawn during the 1990s.

The landscape of Kladno is strongly influenced by its industrial history, which is reflected in its present form, and therefore a diverse collection of mine workings or other buildings can be found here, referring to and recalling the recent mining and industrial past.

4. Summary

The discovery and extraction of coal in the area changed the agricultural and residential function of the microregion and gradually formed an industrial, residential and service function not only for the inhabitants of the rapidly growing Kladno but also for the numerous villages with a large population in the hinterland. Kladno gradually adopted the administrative functions of the older core of the region, which was the small town of Unhošť. Since the 1980s, there was a gradual phase-out of coal mining; after 1990, the unsuccessful privatisation of Poldovka led to the reduction and disappearance of the ironworks and only the power plant in Dubí survived. The loss of numerous jobs in mining and metallurgical production brought about their phase-out and the transition of workers to the rapidly growing service sector. Kladno partly lost its function as a centre of labour commuting and a strong stream of labour commuters emerged from the city and the hinterland villages to Prague as the core of the metropolitan area. In it, they were mainly employed in the rapidly growing service sector from the mid-1990s onwards. As a part of the metropolitan area, Kladno can gain certain advantages (the fast railway Prague – airport – Kladno; relocation of some industries and warehouses from the core of the metropolitan area) associated with the growing number and structure of job opportunities.

The landscape here is heavily built-up. It is the target of many investments and it has a high population density. As this is one of the cores of the Czech Industrial Revolution, it would be appropriate to ensure the maintenance and protection of some of the buildings for future generations. They could become an interesting destination of specific tourism for the inhabitants of the metropolitan area as well as visitors from other areas and abroad.

Acknowledgement

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CHAPTER 5

Transformed cityscape (Libeň, Karlín)

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1. Introduction

The districts and cadastral areas of Libeň and Karlín are municipal districts of Prague 8. Their example well illustrates several transformations of the formerly rural agricultural landscape into the current urban or metropolitan landscape and at the same time several transformations of its main landscape functions.

Libeň was originally an agricultural village whose history is documented from the Middle Ages. Before industrialisation, it was one of the most romantic Prague suburbs due to its rugged relief. Among the numerous vineyards and fields, there were individual farmhouses and vineyard estates. These include well-known names such as Balabenka, Bulovka, Hercovka, Kotlaska, Palmovka, Pekařka, Rokoska, Truhlářka or Vlachovka, which today have a completely different function and meaning. After the construction of the railway line from Vienna to Prague in 1845, Libeň was transformed into an industrial centre to the northeast of Prague. Further development was supported by the construction of a second railway line to Nymburk, which from 1873 crossed the most industrial part of Libeň. Libeň had two railway stations and a harbour on the Vltava River. In 1901 Libeň was annexed to Prague and its growth continued throughout the 20th century. Blocks of tenement houses were built here and the number of inhabitants increased. A further change in the function and appearance of the district was observed after 1989, when most of the local factories were closed and were replaced by office and residential buildings. Large-scale construction is being prepared in the area of Palmovka, Rohanský ostrov and Libeňský ostrov islands. Important transport constructions such as the north-eastern part of the City Ring Road and the Libeňská spojka road tunnel complex are in the project phase.

Karlín, unlike Libeň, was founded in 1817 as an official Prague suburb on the former Špitálské pole plain, where the massive Baroque building of the Invalidovna imperial complex for disabled soldiers had stood since the 18th century. After the dismantling of the Prague walls in the second half of the 19th century, a number of industrial plants and residential buildings were built in Karlín, with new factories on the Rohanský ostrov and residential buildings closer to Vítkov. Between 1903 and 1921, Karlín was an independent town and from 1 January 1922 it became part of Greater Prague. In the 1960s, one of the first Prague prefabricated housing estates was built in the neighbourhood of the Baroque Invalidovna. In 2002, Karlín was completely inundated and devastated by a Vltava River flood, which caused the collapse of several houses. In spring 2006, the flood protection of Karlín and Libeň was completed. At the beginning of the 21st century, intensive new construction is taking place in Karlín near the Vltava River, where the River City Prague project of modern buildings is being implemented. A new urban centre is to be built on the Rohanský ostrov. Old factory buildings are being rebuilt in old Karlín.

In the transformation of the urban landscape of Libeň and Karlín, one can therefore identify the following stages of significant changes in the character of the cultural landscape and its functions:

1. The conversion of the rural, agricultural landscape behind the Prague walls into industrial Prague suburbs with manufacturing, industrial and residential functions in the second half of the 19th century.
2. Further densification of the built-up area with a continued, primary industrial and residential, function of the urban districts throughout most of the 20th century.
3. The demise of factories and the decline in the manufacturing function, and the strengthening of the residential, service and cultural functions associated with the construction of new modern buildings in the early 21st century.

For the purposes of this project, the "core area" has been delimited and most analyses are carried out in it (Figure 1). It includes the municipal areas of Libeň and Karlín. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

The Prague districts of Libeň and Karlín are located in the geomorphological unit of the Pražská plošina plateau, but due to the low terrain on the right bank of the Vltava River, the name of the geomorphological district of the Pražská kotlina basin is more appropriate in this case (Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The geological subsoil consists of Old Palaeozoic shales, graywacke, sandstones and quartzites, overlain by fluvial Vltava sediments from the Middle and Younger Pleistocene and Holocene alluvial sediments of the Vltava and Rokytka rivers. The natural geological structure is, however, covered by anthropogenic layers in the majority of the urban area – by backfill and housing projects. The natural geological subsoil is only present in undeveloped areas – e.g., alluvial flood sediments on the Vltava islands or rock outcrops of hard Ordovician sediments with fossils on the right bank of the Vltava below Bulovka (the Bílá skála site), where there are also abandoned quarries.

The relief is typically basin-like. The bottom of the Pražská kotlina is a plain along the Vltava at the altitude of 180–200 m, stretching eastwards along the Rokytka River to Vysočany and Hloubětín. The basin is limited on the northern and southern sides by steep slopes which could not be built up continuously. On the southern side, the Vítkov hill rises with a steep wooded slope with an elevation of 50–60 m above Karlín, while in the

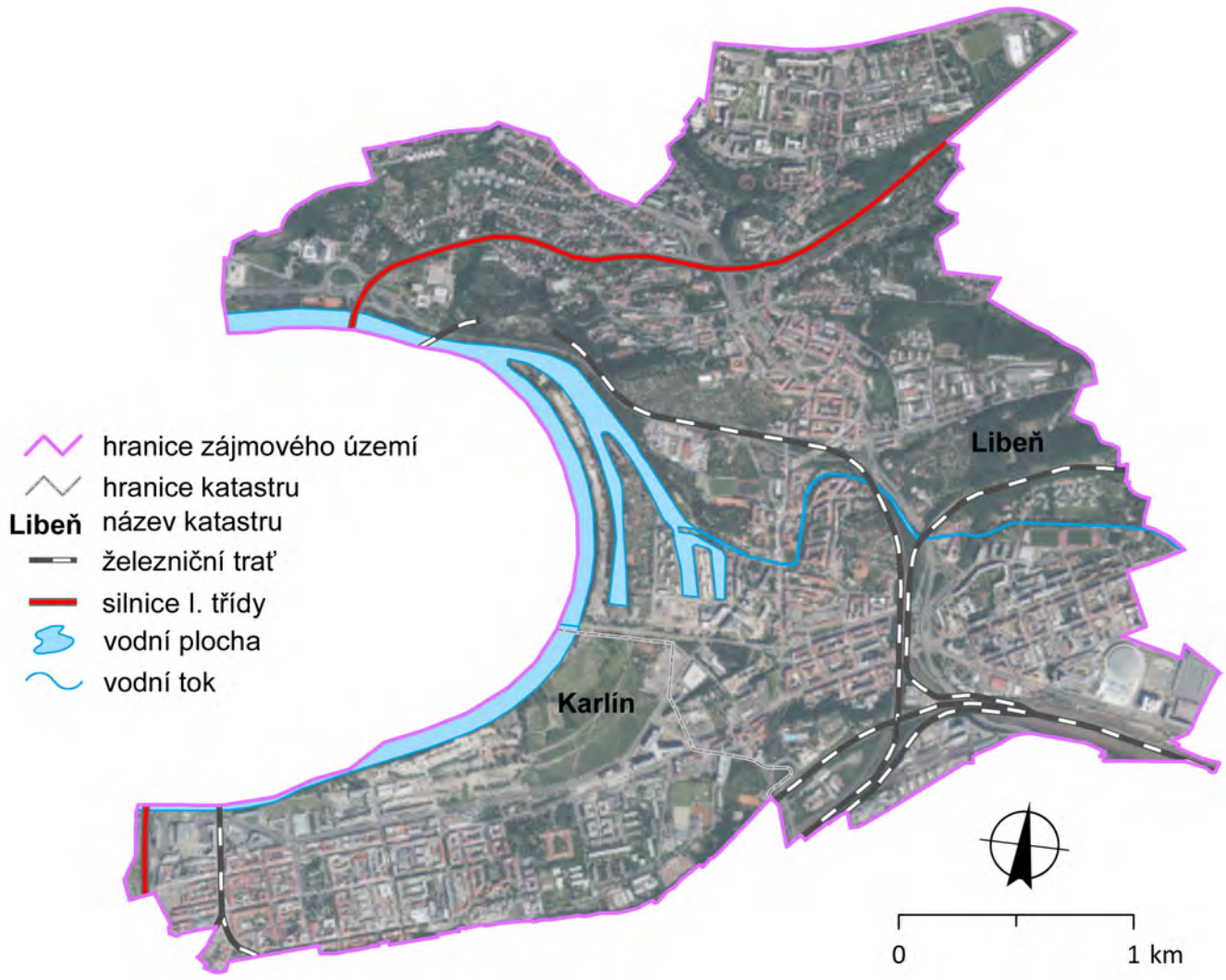


Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

north, above Libeň and Troja, it reaches the elevation of 70–100 m (e.g., Prosecké skály, Bílá skála, Velká skála, Rokoska). The dense urban development is of course dominated by anthropogenic landforms, such as artificially levelled urban surfaces, industrial platforms, artificially levelled surfaces of buildings and roads, littoral landforms along the Vltava River (dykes, paved banks and quays, especially in the artificially excavated Holešovice harbour), communication embankments and cuts, including railway tunnels, and abandoned quarries.

The axis of the Pražská kotlina is formed by the Vltava River, which still plays an important role in the life of the city. The average flow of the river in Prague reaches 150 m^3/s and the flow of the century water 4,020 m^3/s. The core areas of Karlín and Libeň are within the reach of flooding by the 100-year and higher water, as shown by the last major flood on the Vltava in August 2002. The flow of the Vltava reached 5,160 m^3/s, which corresponds to the level of 500-year water. Most of Karlín was inundated then and the flood brought catastrophic damage.

The climate of the Pražská kotlina is warm (Quitt 2009), in terms of topoclimate influenced by the location of the basin and dense urban development with a predominance of artificial surfaces. The average annual temperature is 10 °C, the average winter temperature is around 0 °C and the average summer temperature oscillates around 20 °C. Average annual rainfall is about 500 mm. Winters are very mild with erratic and very low snow cover, and summers are long, warm and dry. Due to its basin-like location, short-term inversions are frequent in autumn and longer in winter, with increased concentrations of air pollutants.

The original natural soil cover consisted of modal cambisols, and in the floodplain along the Vltava and Rokytka rivers of modal fluvisols. However, the natural soils have been transformed and covered by sedimentation and development in most of the area, so that atroposols (anthroposols) on anthropogenic substrates predominate today.

The natural vegetation cover is similarly transformed and suppressed by development. The Pražská kotlina lies within the phytogeographical district of the Bohemian Thermophytic, the phytogeographical district of the Pražská plošina, the phytogeographical subdistrict of the Pražská kotlina basin. The affiliation of the forests to the Polabí natural forest area is irrelevant, as larger forest units do not occur here (Skalický et al. 2009). Potential natural forest vegetation according to Neuhäuslová, Moravec (eds. et al. 1997) would consist of floodplain forests in the low position of the Vltava floodplain as well as cow wheat and oak-hornbeam or lime-oak woodland in the remaining area outside the floodplain.

The current use of the landscape and landscape cover is dominated by urban development, both residential and commercial, with a significant proportion of factory buildings (partly abandoned brownfields), warehouses and transport areas (the harbour area and the extensive track of the Libeň railway station). Areas close to nature, consisting of forest and scrub vegetation, only occur in a scattered way in small areas on steep slopes unsuitable for other uses – e.g., the northern steep slope of Vítkov, Prosecké skály or Bílá skála above the Vltava River. Fragmented communities of acid rock steppe and small heaths have been preserved on these sites, which are of interest for nature conservation. Otherwise, the area of Karlín and Libeň is of no importance for nature conservation due to long-term and intensive anthropogenic transformation.

Since the time of Charles IV, Prague has been defined quite narrowly within the four historical districts of Lesser Town, Old Town, Hradčany and New Town and due its being enclosed by walls. Prague developed as a specific city whose inhabitants used at least three languages – German, Czech and Yiddish. Beyond the walls, the former rural villages formed gradually sprawling suburbs inhabited mainly by Czechs, which were strongly influenced by the metropolis in their functions. The low-lying position of both areas, enclosed by the Vltava River on one side and the Vítkov hill on the other, provided good conditions for agricultural production and the construction of residential houses, workshops and, in the second half of the 19th century, factories. After the walls were town down, Karlín was connected to Prague by tram, and thanks to cheap land there was a booming

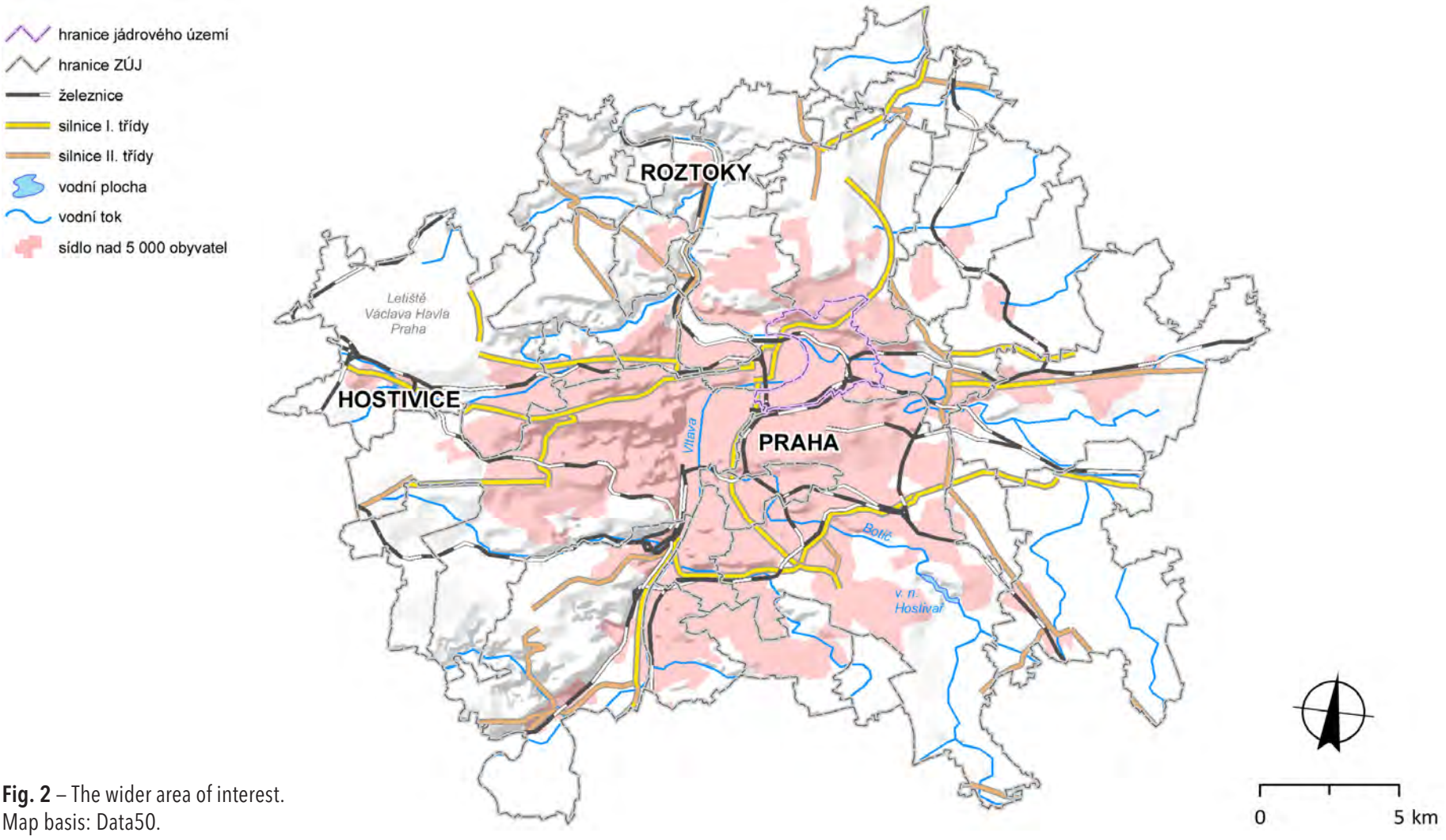


Fig. 2 – The wider area of interest.
Map basis: Data50.

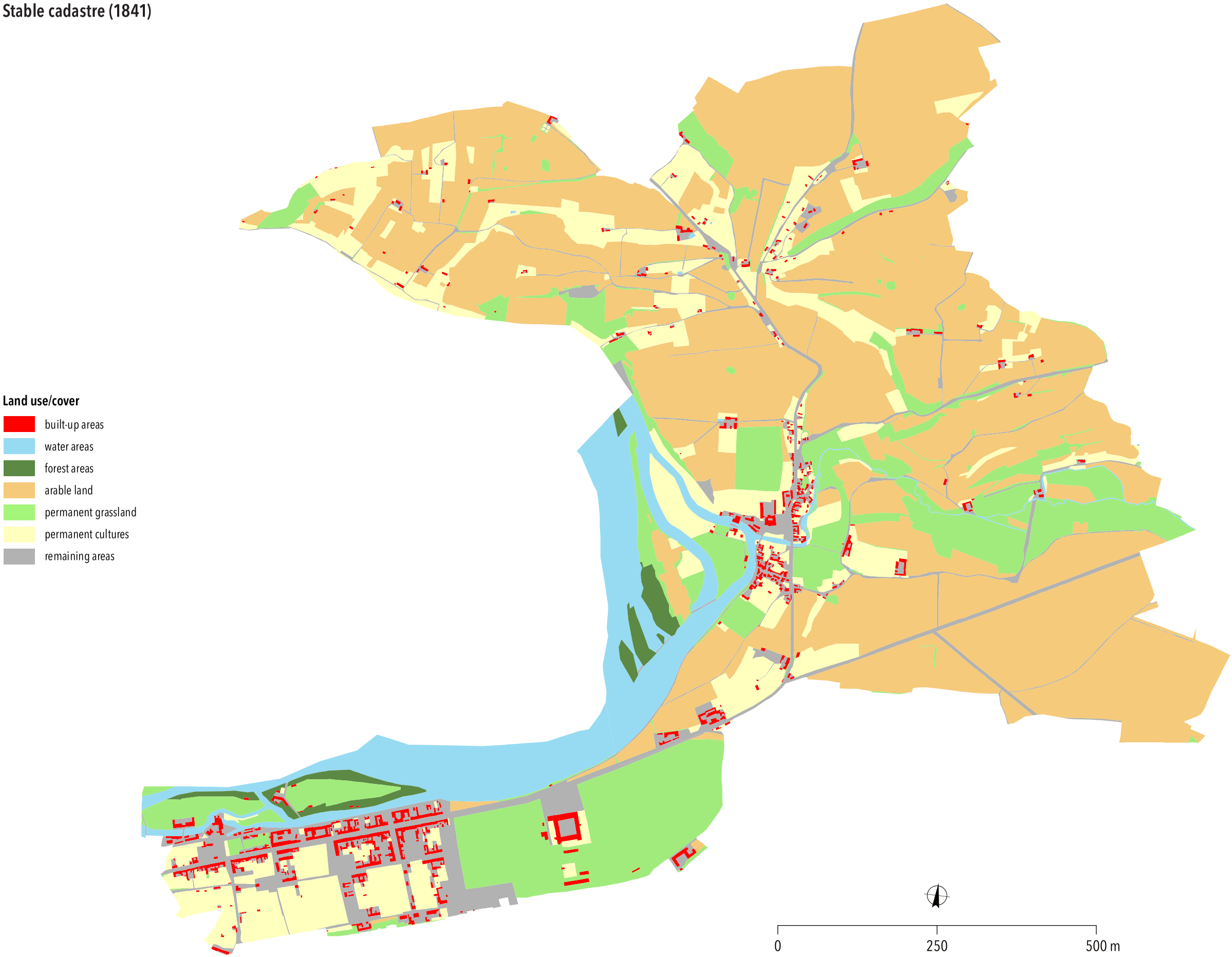
development of the suburb, which became part of the newly defined Prague in 1922. The adjacent Libeň district is spread out in the Rokytka valley and on the surrounding slopes, and at the end of the 19th century it was an independent, predominantly Czech town with a strong Jewish minority, connected to Prague by tram from 1896. In 1869, its population was 5,845, by the end of the century it was over 17,000 and Libeň was declared a city. The turbulent economic development of both Karlín and Libeň was influenced by its location and connection to Prague, as well as the efforts of politicians to create a strong centre of the Czech nation, as Czechia (the Czech Lands) represented the most important economic base in the then Austro-Hungarian Empire.

From the beginning of the 19th century, and especially after the annexation to Prague, the development of the two new parts of Prague became increasingly dense, with the construction and expansion of factories as well as housing and transport (trams, railways, the bridge to Holešovice, etc.). In 2002, the low location proved to be a disadvantage, as a significant part of the area was inundated by a devastating flood of the Vltava River. Significant resources were required to repair the transport networks and to renovate the residential buildings and factories. Some houses were demolished, but on the other hand, the flood significantly contributed to the redevelopment of Karlín, which became a popular residential area, especially for foreigners. The demise of factories in Karlín and the conversion of buildings into cultural centres, residential buildings and service facilities also played a role in this. In both areas of these formerly separate villages (residential-agricultural function), the residential-industrial function was transformed in less than two centuries, and the residential and cultural function was enhanced after 2000. Despite the apparently intensive development of multi-storey houses, the number of inhabitants per house declined between 1845 and 2010. In 1845, the whole of Prague had 6–10 residents in the scale of zoning units, but by 2010 virtually all zoning units had 3–4 residents on the per house scale. In terms of employment, the whole territory is dominated by the tertiary sector (mostly more than 60% of the economically active). The share of the secondary sector above 20% of the economically active was only in the peripheral parts near the administrative boundary of Prague.

In the past, the territory of Karlín and Libeň, which are part of Prague 8, was one of the most industrial areas of the Prague agglomeration with the location of mainly mechanical and electrical engineering industry since the first half of the 19th century. This state of affairs lasted, with minor changes, until 1989, and the emphasis on developing heavy industry after 1948 contributed to this preservation of the industrial landscape. This condition, which was captured in part of the territory by the Historical Atlas of Towns – Karlín, ended with the beginning of the transformation of society and economy after 1990. It was reinforced by the location in the wider centre of the metropolis in a limited valley between the banks of the Vltava and Rokytka rivers and the Vítkov hill, the construction of transport networks (metro, a road through the town) and, last but not least, the floods in 2002. The industrial landscape was transformed into an urban residential and service landscape, of which only fragments are reminiscent of the past. The economic structure of the model area also bears witness to this transformation. Of all the model areas (including the urban areas), there are the most economic entities with more than 10 employees, which is mainly strengthened by the transformation of existing industrial areas and the construction of new office space (Rohanský ostrov project, Palmovka and others). The vast majority of them are part of the non-manufacturing sector, with a number of industrial sectors (mainly mechanical and automotive, electrical, food and chemical), represented according to the sectoral breakdown, but most of them are company boards or sales and logistics departments.

It is inappropriate to call the model area of Karlín and Libeň a suburban landscape today. However, one has to realise that by the mid-19th century, although it was located in the immediate vicinity of the centre of Bohemia, the local landscape of the time should be characterised as a landscape of intensive agriculture supplying nearby Prague. This location on the banks of the Vltava

Stable cadastre (1841)



Current state (2019)

Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	2.08	18.95	16.88
remaining areas	7.95	55.37	47.42
water areas	8.45	2.44	–6.01
forest areas	1.18	8.95	7.77
arable land	50.61	0.00	–50.61
permanent grassland	16.17	0.17	–15.99
permanent cultures	13.57	14.11	0.54

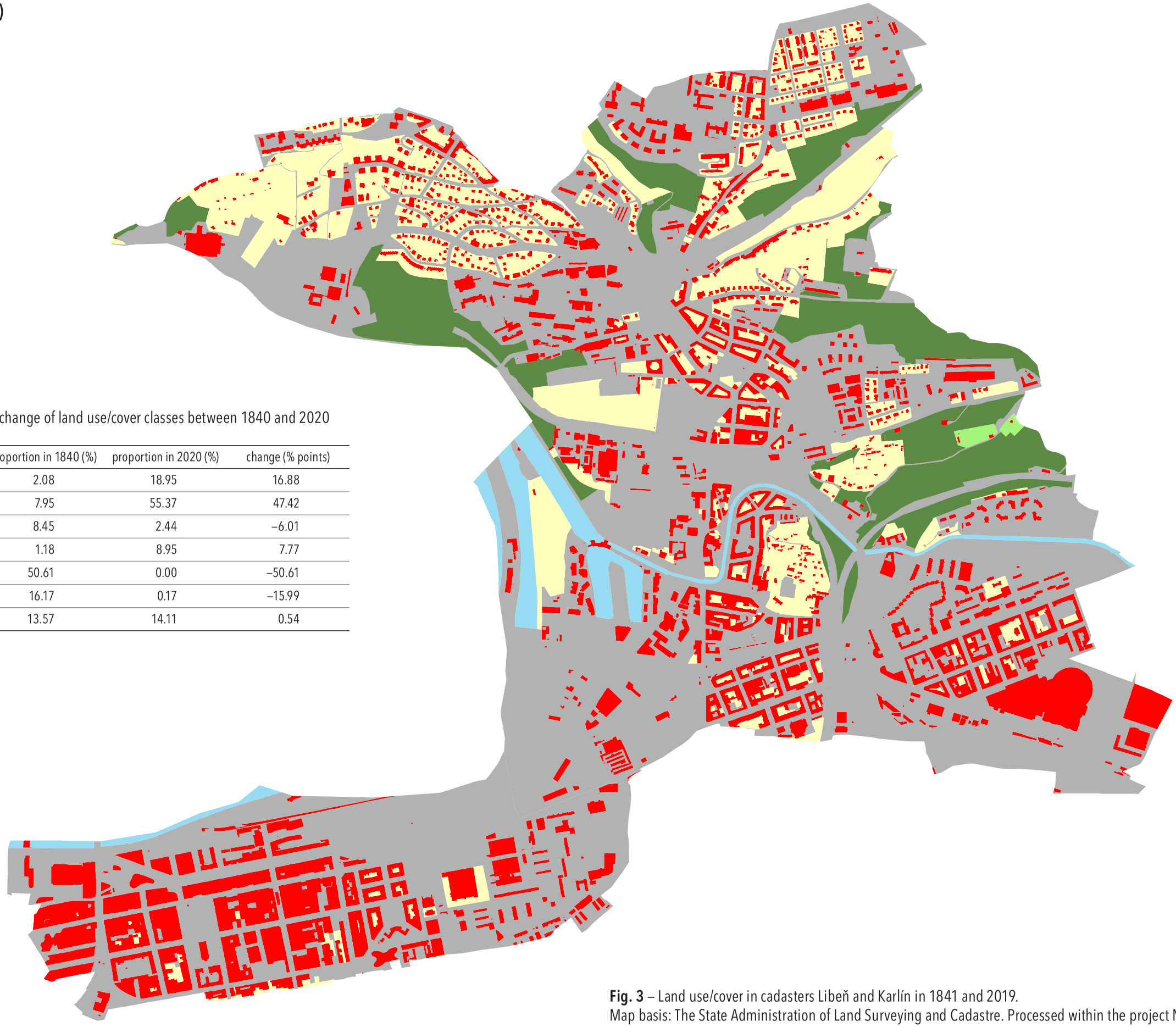


Fig. 3 – Land use/cover in cadasters Libeň and Karlín in 1841 and 2019.
Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

1938

1950

Fig. 4a – Models of landscape – Karlín and Libeň landscape in 1938, 1953, 2000/2001 and 2018. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5a – The view of Karlín from Vítkov 1910 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2019): Zdeněk Kučera.

2001

2019

Fig. 4b – Models of landscape – Karlín and Libeň landscape in 1938, 1953, 2000/2001 and 2018. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5b – The view of Smíchov 1915 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2019): Zdeněk Kučera.

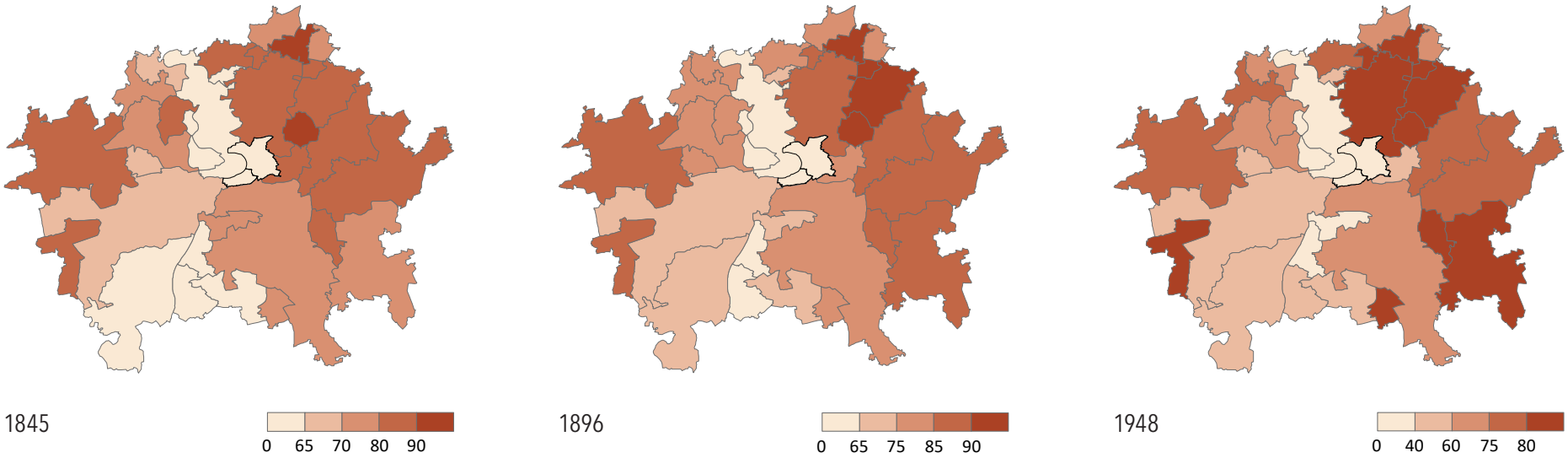


Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

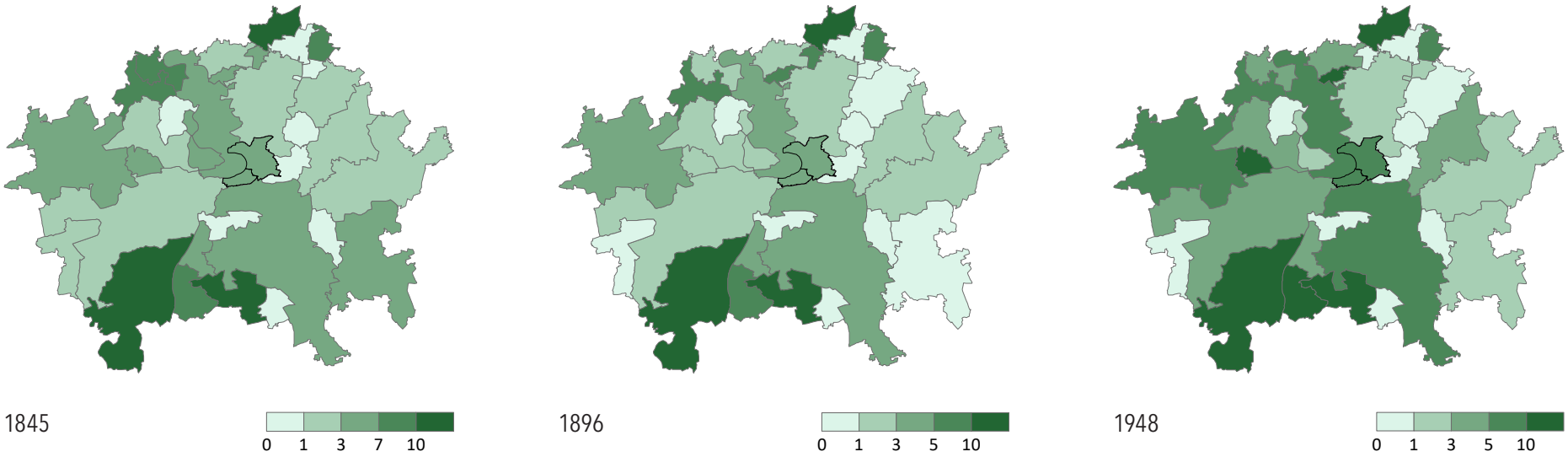


Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

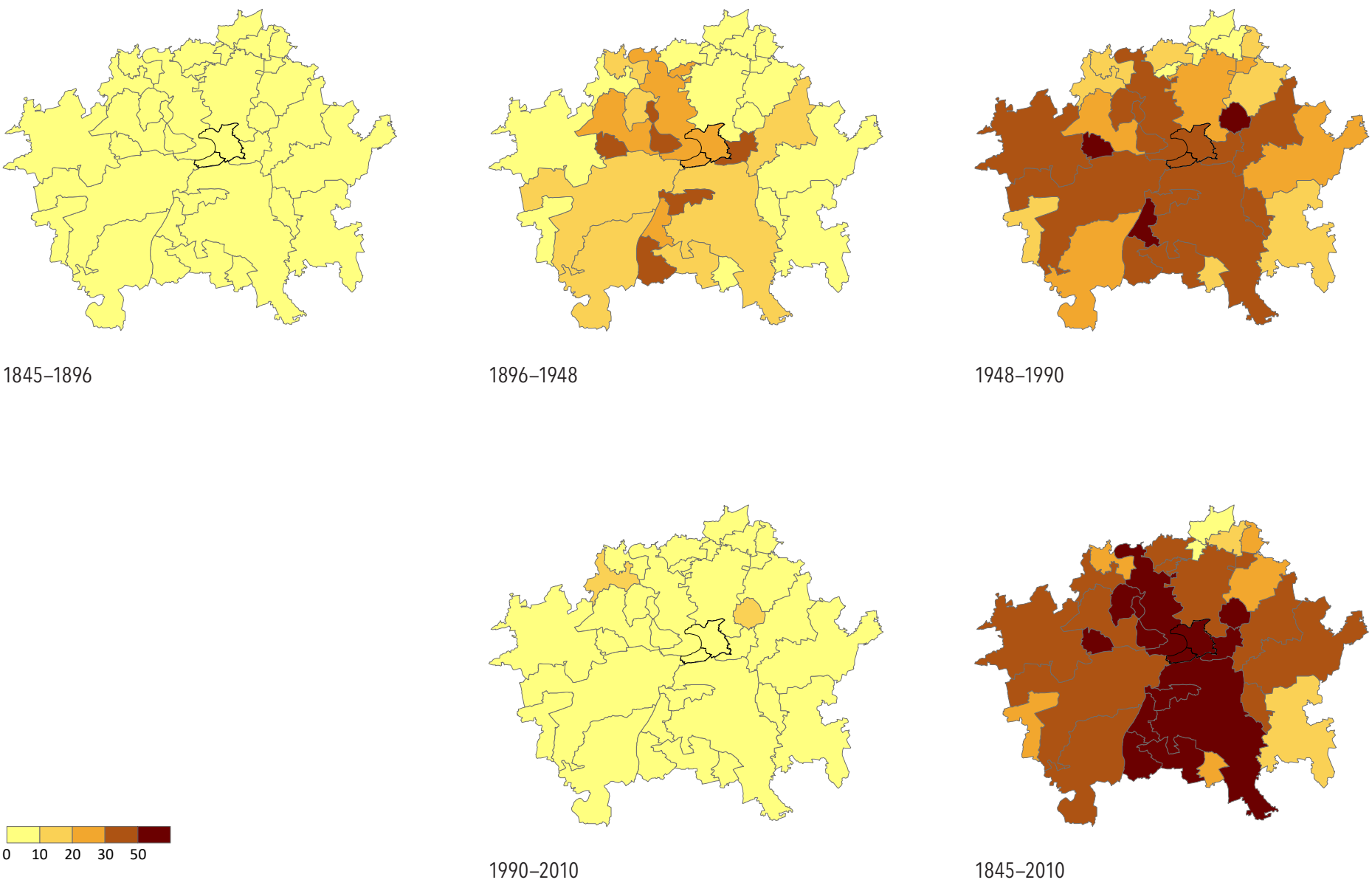
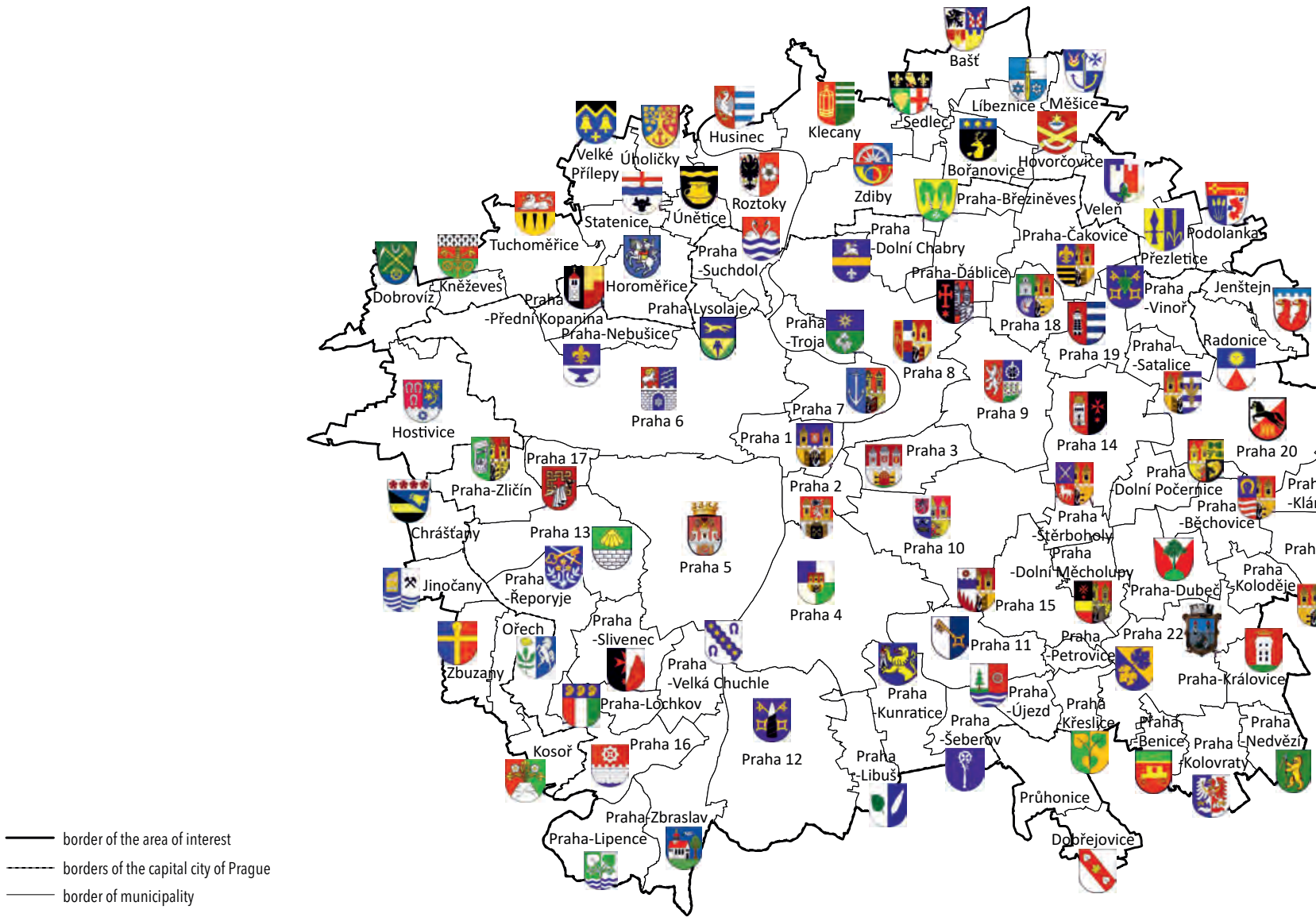


Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.



border of the area of interest
borders of the capital city of Prague
border of municipality

Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

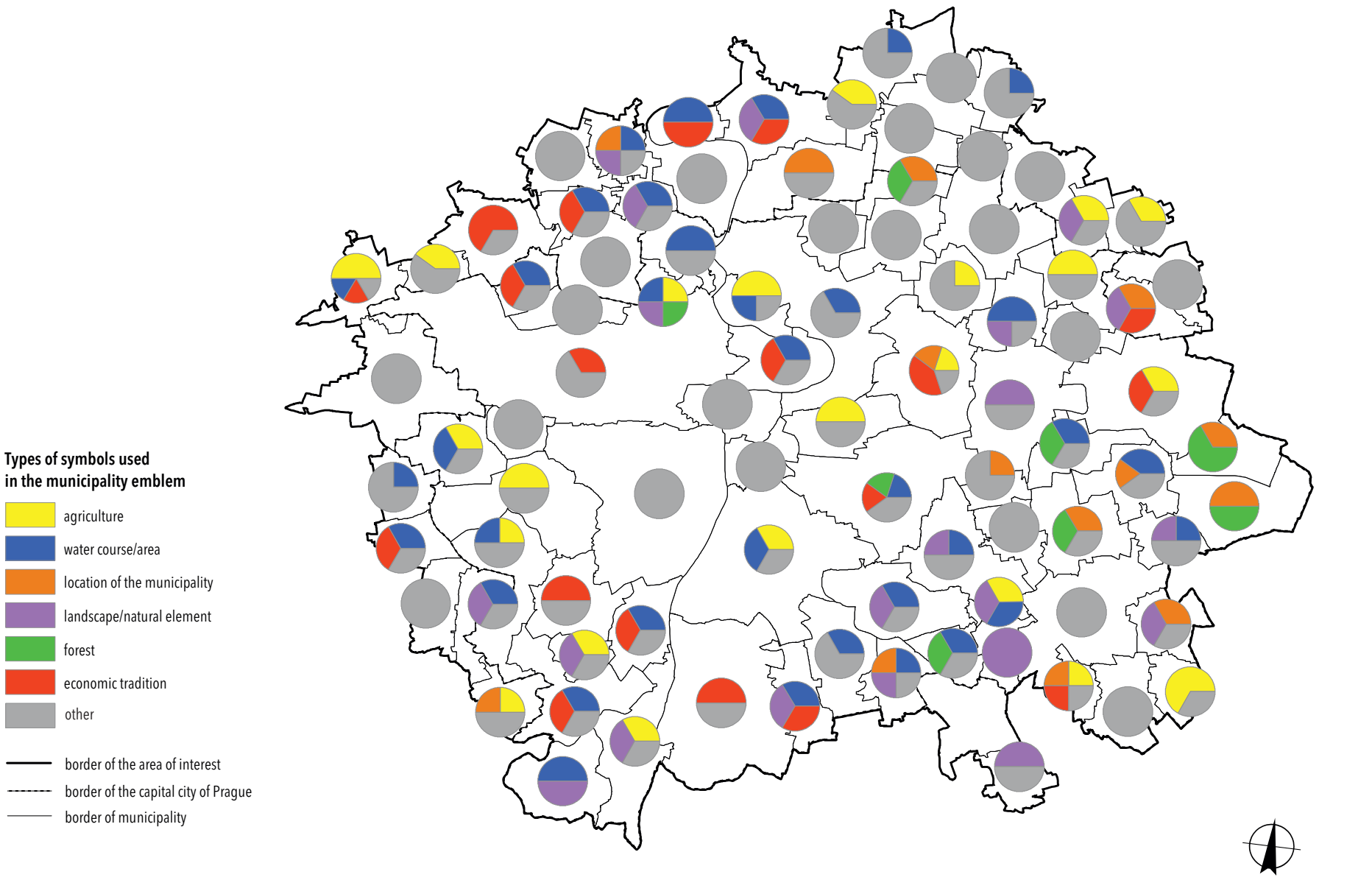


Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

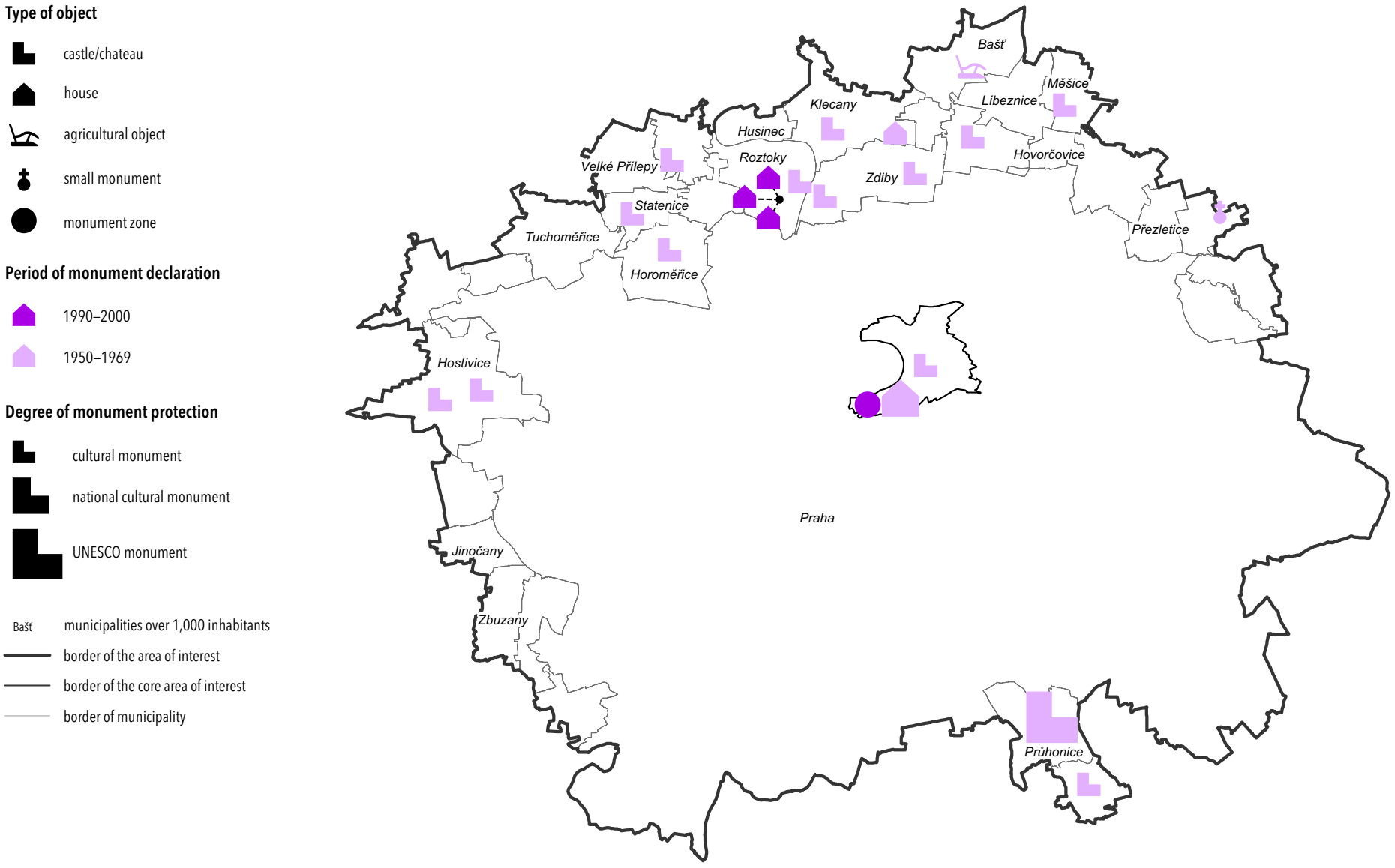


Fig. 12 – Cultural monuments and heritage areas.
Data source National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

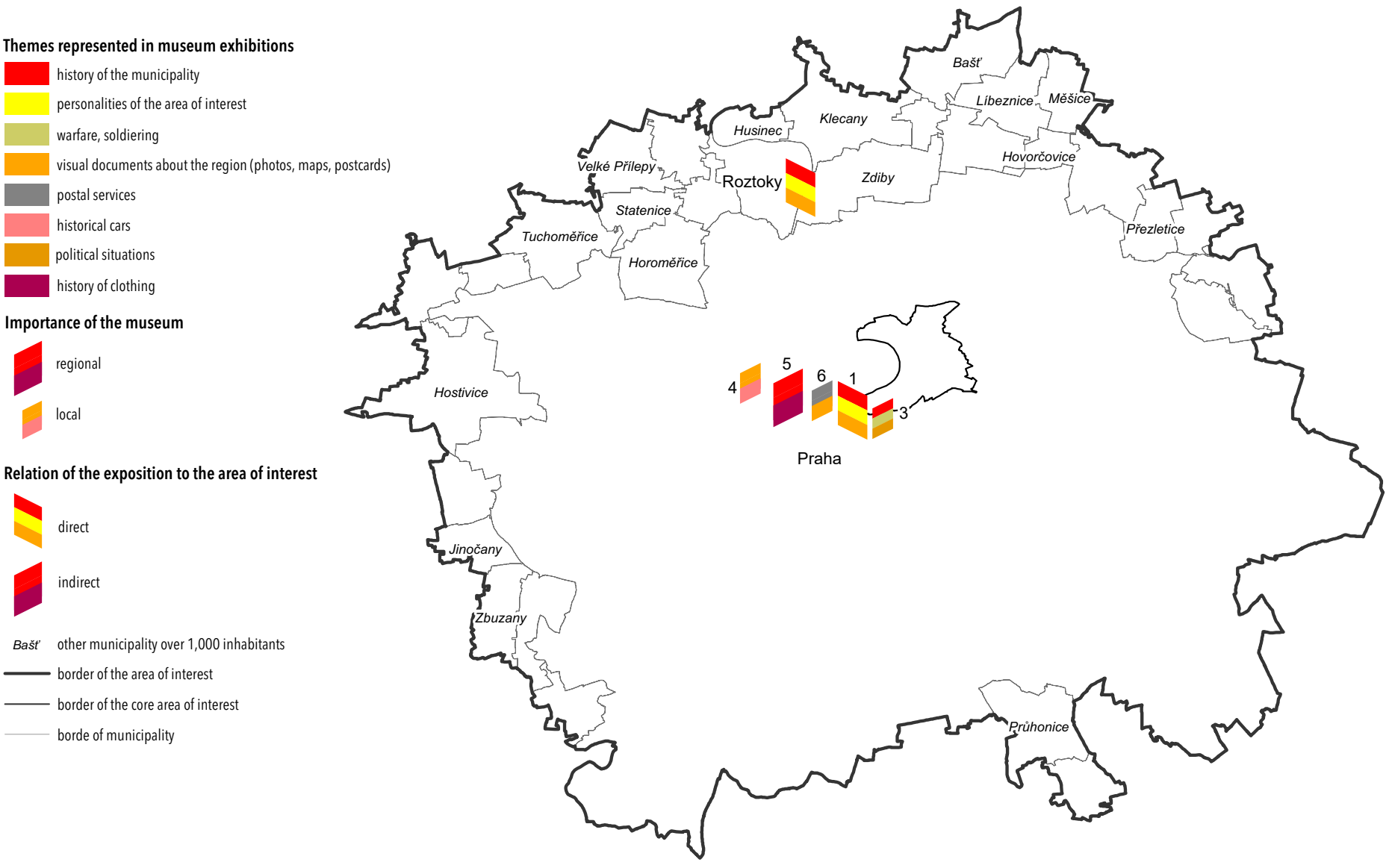


Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

River and the right-hand tributary of the Rokytka River provided ample flat land suitable for the development of workshops and factories, which were gradually connected by rail in the second half of the 19th century. With the development of employment opportunities, residential development grew, which was attractive for the new arrivals from the Czech countryside, where the increased birth rate in the last quarter of the 19th century could not support them. Gradually, therefore, over a period of about 40 years, the rural character of Karlín and Libeň changed into an urban landscape with industrial and residential functions, and the two formerly independent villages, later towns, were administratively annexed to Prague at the turn of the century. The period of more than a century without major flood promoted development, but in 2002 the low-lying location near the river proved to be a disadvantage as much of the landscape was inundated by a disastrous flood of the Vltava River. In the years that followed, large amounts of resources were required to repair transport networks and to renovate housing and factories, and some buildings were demolished. The flood contributed significantly to the redevelopment of Karlín in particular, which became an expensive residential area with a service function, and virtually all factory buildings were reconstructed for other functions or made way for new buildings. The disappearance of the factories in Karlín and the conversion of the buildings into cultural centres, residential houses and service facilities have strongly modified the functions of Karlín and partly Libeň. In both areas of these formerly separate villages (residential-agricultural function), the transformation to a residential-industrial function took place within less than a century. After 1989, and even more significantly after 2002, the residential-service function and the cultural function increased, as it is now practically a full-fledged landscape of a large urban character in the centre of the Prague metropolitan area. This dual transformation of the landscape of the model area over the course of about 150 years has brought about the disappearance of both the original farmsteads and the industrial buildings from the early days of industrialisation. Given the specific nature of the area, it would be advisable to ensure the preservation of the remains of these buildings representing the former functions of the two districts and documenting the stages of metropolitan development.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). The current image of the area is the result of several changes. In particular, the transformation of a rural agricultural landscape into an urban landscape with not only residential but also industrial functions. The current map then includes the result of the decline in the industrial production function of the territory at the beginning of the 21st century and the highlighting of the residential, service and cultural functions. These functions have spread to these places and are also associated with the demolition of some industrial sites and the construction of large modern service buildings and residential complexes in their place. At the time of the stable cadastre, arable land occupied over one half of the area, with permanent grassland and permanent crops also being important. The landscape was so agricultural that it was virtually impossible to find forests. Watercourses were also important. At that time, the Vltava riverbed greatly encroached on the area in question, while today it is relocated. Nowadays, the other areas are the dominant category, and today they cover more than one half of the area. The (very) urban character of the area is underlined by the high proportion of built-up areas. However, parks/forests/perennial crops are also present. The area does not yet have the typical character of a city centre, but is increasingly approaching it.

The created landscape models (Figure 4) document the development of the urban built-up area and changes in its structure. The urban area of the municipality has been transformed into the urban landscape. During the 20th century, industrial complexes and blocks of tenement houses expanded in the Libeň cadastral unit. After 1989, most of the local factories were closed and were replaced by office and residential buildings. In Karlín, one of Prague's first prefabricated housing estates was built in the 1960s in the neighbourhood of the baroque Invalidovna. During the floods of 2002, Karlín was completely inundated and as a result of the disaster, several houses had to be demolished. In spring 2006, the flood protection of Karlín and Libeň was completed. Since the beginning of the 21st century, intensive new construction has been taking place in Karlín near the Vltava River, where the River City Prague project of modern buildings is being implemented. Old factory buildings are being rebuilt in old Karlín. From the time series of photographs, the redevelopment of the dead-end of the Vltava River is clearly visible.

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in STUs and describe changes over time by comparing the years 1845, 1896, 1948, 1990, and 2010. The transformation of the dominant agricultural function of the Prague area (according to today's delineation) in 1845 (over 80% of it mainly in the east of the area) shows a relatively significant decrease in the share of arable land in most of Prague. The actual study area of Karlín and Libeň is now virtually in the middle of the big city. Of course, the share of arable land has decreased significantly, while the area of built-up and other areas has increased more than fivefold. The proportion of permanent grassland has shrunk to between a half and a third of its original area, due to population density and pressure on the area to be developed, and in most areas permanent grassland accounts for up to 3%. At the same time, the proportion of woodland has slightly increased despite the extreme exposure of the territory, and the western half of Prague shows woodland on more than 10% of the area, which is influenced by a different relief.

The landscape on the eastern edge of Prague, in the form of the two model areas of Karlín and Libeň, was a rural landscape with clear agricultural and residential functions in the mid-19th century, as evidenced by historical maps of the time and the Historical Dictionary of Municipalities. In the second half of the 19th century, the intensity of local investment increased considerably. The major changes in land use shown by the index of change (Bičík et al. 2010, 2015; Figure 9) were implemented between 1948 and 1990. Roughly one half of Prague's land use units showed the index of change of 30–50 between these years, and three land use units even showed a value over 50. In a long-term comparison between 1845 and 2010, land-use changes in more than one half of the area occurred in about 30 land-use units, stretching roughly from the north to the south, and almost all the others had the index of change between 30 and 50. This intensity of land-use change in the territory of Prague documents a quite fundamental change from the original, predominantly agricultural landscape to a landscape with a predominance of residential, industrial production and service functions.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in the following sections 3.2.1–3.2.3 (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

The area of interest of a typical transformed urban landscape is constituted by Prague and its parts Libeň and Karlín. Both urban districts used to be independent municipalities in the past, but at the beginning of the 20th century they were annexed to Prague as its industrial parts. Today, they form the wider centre of the capital, offering many opportunities for cultural and social life, space for living, but also the remains of industrial areas. Until now, no museum or separate exhibition have been created exclusively for these sites. However, documentation on the transformation of Prague's urban districts can undoubtedly be found in many institutions throughout Prague.

The Prague City Museum can be called the signpost of Prague's museum exhibitions. Under it one can find not only the main museum headquarters with basic expositions on the history of Prague, but many other branches dedicated to special topics. The second regional museum, which covers the transformation of Prague and Central Bohemia, is the Central Bohemian Museum in Roztoky near Prague. Among the interesting exhibitions located in the defined area of interest there are the Museum of Mass Transport, the Postal Museum, the themes of historical clothing in the private Museum of the Charm of Old Times or military themes in the National Memorial at Vítkov.

Specific themes can also be added by national museums also located in Prague – the National Museum, the National Technical Museum and the National Museum of Agriculture, or the Prague City Archives.

3.2.2. Regional and local symbols

Although the emblems of the municipalities and districts in Prague (Figure 10) do not speak about the current dynamic changes in the city and its landscape, they do capture many interesting elements depicting Prague's urban landscape and economic activities in the distant and relatively recent past. Of course, they also provide a testimony about changes in the use of the landscape – an analysis of the symbolism of the villages and districts shows the agricultural use of the landscape, which in many cases had to give way to expanding development.

The symbols of Prague's urban districts (Figure 10), as mentioned above, reveal many interesting facts about the landscape and its development in individual areas of the city. Despite the fact that this is an urban landscape or cityscape, there are also references to agriculture ("yellow" category, Fig. 11), even in the now central part of the city. The agricultural tradition is represented by the green grass at the foot of the emblem in the coat of arms of Prague 3. Agriculture is symbolised by the green field in the coat of arms of Prague 4. The green tincture (colour) is also indicative of the agricultural character of the settlements in the emblems of Prague 13, Prague 18, Lochkov, Nedvězí (together with the figure of a flail), Benice, Troja or Zličín. In the emblem of Lysolaje, the green tincture symbolises the orchards (but also the forested nature of the locality). The red tincture in the coat of arms of Přední Kopanina points to the local fertile soil. The three ears of wheat in the emblem of Prague 20 refer to the original agricultural character of the three local settlements. Prague 9 has hills with vines in its coat of arms, representing the Vysočany vineyard and partly also the elevated location of the district. Vines also appear in the signs of Petrovice (vine leaves), Troja (vines), and Vinoř (grapes, also a speaking sign). The talking sign and a reference to an interesting type of agricultural tradition is the sticklewort in the emblem of Řeporyje (the tradition of "extracting the root" of this medicinal plant from the ground).

In the territory of the capital city, there are of course also references to the Vltava River (the blue field in the emblems of Prague 4, Prague 7 and Řeporyje, the blue shield in the emblem of Troja), or to other watercourses, ponds and other water bodies (the "blue" category). In the emblem of Prague 8, blue stripes point to the Vltava and Rokytka (the latter is also depicted as a blue wavy crossbar in the emblem of Kolodějе). In the coat of arms of Suchdol, the Vltava River is shown with blue and silver (white) wavy bars (the swan figures in this coat of arms are the symbol of the letter S for Suchdol and Sedlec, while they do not live in the locality). In Petrovice and Prague 10, the blue field is a symbol for the Botič (and the figure of a tool for catching fish in the river, a keepnet, refers to the tradition of fishing on the Botič). The blue wavy foot in the emblem of Prague 16 depicts the Berounka River (which is symbolized by blue and silver – white – wavy crossbars together with the Lipenský potok stream in the emblem of Lipence). The blue tincture in the Libuš emblem represents the Libušský brook and the Obecňák pond. In the coat of arms of Běchovice, the silver (white) wavy crossbars symbolise the Říčanský, Rokytka and Blatovský streams; the blue field in this coat of arms refers to the Nohavička pond. The large Počernice pond (the largest pond in Prague) is symbolised by a golden carp in the coat of arms of Dolní Počernice. Furthermore, ponds are represented in the emblems of Kunratice (blue tincture), Šeberov (where the blue tincture also symbolizes a good climate), or Újezd (wavy crossbars). In the emblem of Velká Chuchle, the wavy blue stripe is a symbol for the spa of Malá Chuchle. In the coat of arms of Lysolaje, the blue spring is a reference to the local Zázračná studánka (Miraculous Spring). The well in the coat of arms of Zličín indicates that there are also rich water springs in its cadastre.

In the emblem of Prague 15, the blue wall symbolizes the Hostivař dam (which can also be considered a landscape element – the "purple" category). The original fortress in the territory of Prague 11 was also a distinctive element in the landscape; it is symbolised in the coat of arms by a blue field (also a symbol for the extensive moat around the fortress). In the coat of arms of Prague 19, the blue and silver (white) crossbars together with the figure of the water tower are a symbol for the local waterworks – the tower itself is also a distinctive landscape landmark. The emblem of the Královice district also depicts a dominant feature of the surrounding landscape – the Královická tvrz fortress situated on a green hill (which symbolizes the location of the municipality above the Rokytka River). The coat of arms of Prague 14 depicts another important local building – in the right part of the coat of arms there is a stylized view of the western facade of the tower of the Church of St. Bartholomew with a platform in Kyje. An interesting natural element is the figure of a shell pointing to a geological site in the coat of arms of Lochkov. In Kolodějе, the green tincture is a reference to the game preserve in its chateau. The Křeslice coat of arms similarly depicts (green tincture together with lime leaves) the Botič-Milíčov nature park. Linden leaves also appear in the Lipence and Libuš symbols – in both cases they symbolise the memorable lime trees. The clover leaf in the coat of arms of Šeberov is a reference to the Hrnčířsko-Šeberovské louky nature park. The emblem of the Lysolaje district even depicts a fox, which is still widespread here today.

In the text above, several elements in the coat of arms of Prague's districts have already been mentioned as symbols of their location ("orange-brown" category). The carriage in the emblem of Benice is a symbol of the newly reconstructed original imperial road Prague – Vienna. The horseshoe in the emblem of Běchovice (specifically a symbol for the inn and post office) represents its location on an important historical road. The blue tincture in the coat of arms of Štěrboholy points to the original, marshy terrain in the area. The green hill in the coat of arms of Dubeč is a reference to the higher location of the village. The coat of arms of Dubeč also depicts an oak tree, which is a speaking sign, but also a symbol of the typical vegetation in the area (e.g., in the Uhříněveská obora game preserve). In the emblems of Prague 21 and Březiněves, the hill also represents the high location of the municipal district. In the case of Prague 21, the colour of the hill (green) together with the figures of trees point to the forested nature of the municipality (Praha 21 – Újezd nad Lesy), specifically the symbol of the Klánovický les forest. This is of course depicted in the coat of arms of Klánovice, too (also with green tincture and silver rafters – these symbolize both the trees and the location of the municipality within the forest). Forests, woodland or greenery in general also have their place in the emblems of Prague 10 (the broad axes are a reference to the originally wooded area), Újezd (spruce and green tincture – the forested area of the cadastre), Dolní Počernice (lime branch – symbol of greenery), Březiněves (birches – a speaking sign, probably the original trees in the cadastre). The green tincture in the emblem of Lipence represents the meadows in the surroundings.

Many emblems of Prague's municipal districts also refer to their location in Prague from an administrative point of view. In the coat of arms, fragments of the municipal emblem of Prague are used for this purpose (most often one half of the shield). However, these cases are included in the analysis among the symbols of the category other ("grey").

Elements of an economic character are not unique in the urban landscape of Prague ("red" category). The above-mentioned symbols of watercourses, the Vltava in particular, are linked to the reference to a ferry (anchor in the emblem of Prague 7). The coat of arms of Přední Kopanina depicts the golden (yellow) tincture of the golden marlite. The red rock in the emblem of Slivenec refers to the tradition of marble mining. The golden (yellow) bar in the emblem of Benice is a symbol for gold mining in the Benice mines. In the emblems of Prague 9 and Prague 12 a sugar loaf is depicted – in the case of Prague 9 it refers to the Frey sugar refinery, in Prague 12 to the sugar refinery in Modřany. In addition to the sugar industry, the emblem of Prague 9 also includes a symbol of traditional engineering (a cogwheel). The cogwheel is also placed as a general symbol of industry in the emblem of Prague 16. Traditional sheep breeding is represented by a ram in the emblem of Prague 6. The goose neck in the emblem of Libuš refers to the tradition of goose breeding. The black horse on the Prague 20 emblem refers to the local traditional horse breeding (Horní Počernice – Xaverov). The horseshoes in the emblem of Velká Chuchle represent the sport of horse racing.

3.2.3. Heritage sites

In the area of interest of the capital city of Prague, the transformed urban landscape is examined. The Libeň and Karlín cadastres were selected as core areas. First of all, since it is necessary to mention that there is a large number of cultural monuments in the area, only the most representative elements were selected.

In the Karlín cadastre, the most important conservation zone is Karlín, whose specificities include the deliberately designed, regular pattern of buildings with a uniform scale and height level, the rectangular outline of streets, which is complemented by the composition of parks. The main dominant feature is the Church of St. Cyril and St. Methodius, the main axes are the Sokolovská, Křižíkova and Pernerova streets. The creation of this first Prague suburb outside the walls as a modern, residential and industrial, architecturally unified urban complex with a generous layout can be classified as one of the supreme manifestations of classical urbanism in Czechia.

In addition, it is necessary to mention the national cultural monument Invalidovna in this cadastre. This Baroque complex from 1731–1737, built according to a project of Kilian I. Dientzenhofer, is quite unique in Bohemia. Although unfinished, it is nevertheless a large-scale and monumental building designed for the care of war invalids thanks to the Peter Strozzi Foundation. In the core area there is also an important cultural monument, the Libeň Manor.

A number of cultural monuments, such as chateaux and villas, can be found in the wider area of interest. In the village of Průhonice there is a UNESCO monument – the Průhonice Castle. The core of the area, a large part of which is occupied by a large park with rare trees (founded by Count Silva-Tarouca), is a richly decorated castle building. Originally a Gothic fortress, it was extended in the Renaissance. The present-day Neo-Renaissance appearance was designed by Jiří Stibral in 1889–1894.

4. Summary

The development of both new parts of Prague has been getting thicker since the annexation, with the construction and expansion of factories as well as housing and transport (trams, railways, the bridge to Holešovice, etc.). In 2002, the low location proved to be a disadvantage, as a significant part of the area was inundated by a large flood of the Vltava River. Large resources were needed to repair the transport networks and to renovate the housing and factories. Some houses were demolished; on the other hand, the flood contributed significantly to the redevelopment of Karlín in particular, which became a popular residential area much sought after by foreigners. The demise of the factories in Karlín and the conversion of buildings into cultural centres, residential buildings and service facilities also contributed to this. Both areas of these formerly separate villages (residential-agricultural function) were transformed into a residential-industrial function in less than two centuries, and the residential and cultural function increased after 2000.

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CHAPTER 6

Nové Mlýny Reservoirs

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1. Introduction

The Nové Mlýny (New Mills) waterworks in South Moravia consists of a system of 3 large and relatively shallow reservoirs on the Dyje River: The Mušovská or Horní (Upper) Reservoir has the area of 528 ha and the maximum depth of 4.3 m, the Věstonická or Střední (Middle) Reservoir has the area of 1,031 ha and the maximum depth of 5.3 m and the Novomlýnská or Dolní (Lower) Reservoir has the area of 1688 ha and the maximum depth of 7.8 m. The Dolní Reservoir is the largest in Moravia as the entire cascade covers the area of 32.3 km². The average depth is small and often does not exceed two metres.

The entire waterworks were built between 1975 and 1989. The construction and filling of the reservoirs resulted in the flooding and irreversible destruction of the unique and unrepeatable alluvial landscape on the lower reaches of the Dyje River. The broad floodplain of the Dyje was a complex of valuable floodplain forests, alluvial meadows and riparian vegetation. Valuable floodplain wetland, meadow and forest ecosystems of supra-regional importance, which were home to many rare plant and animal species within the most endangered categories in the Red Data Book, have disappeared. Important archaeological sites and the village of Mušov, of which only one artefact remained above water – the Church of St. Linhart – are now under water.

A completely new type of waterscape, unknown in the region until then, was created here, where large artificial water bodies and their dams are the dominant landscape element. All three dykes are also used for transport since important roads run along them. Despite the undeniable and very noticeable loss of ecological values, the landscape has gained a new attractiveness, with interest for many visitors. The Nové Mlýny reservoirs has become an important tourism destination. The fundamental change in the use of the landscape and the landscape character has also brought new opportunities for economic development and for business for the inhabitants of the surrounding villages.

The Nové Mlýny reservoirs have become the most important fishing and ornithological site in South Moravia. Due to its area and location, the reservoir complex is today the most important wintering ground for some of the northern goose species, up to 30,000 of which can be observed here. There are also several dozen sea eagles that winter here. The small islands are also home to the annual breeding of mallard geese, mallard ducks, gadwalls, ruddy ducks and other duck species. There are colonies of many thousands of gulls, including terns, storm-petrels and black-headed gulls. In summer, many species of waders and elegant white and red herons can be seen. In winter, one can see northern ducks, great and white guillemots, northern goshawks, northern field and white-fronted geese. This variety of bird species is, however, a mere substitute for the original unique floodplain forests, which can be only seen today at the confluence of the Jihlava and Svratka rivers. Here is the Dolní Mušovský luh nature monument, which protects the remnants of the hard floodplain forest and the stands of the Scilla vindobonensis, which blooms here in early spring. Nearby is another natural monument, Betlém, which became an important refuge for numerous species of animals, especially amphibians that migrated from the floodplain during the filling of the middle reservoir. Over a quarter of a century, a unique set of xerophilous, hydrophilous and wetland biotopes has been created in Betlém by natural development, reminiscent in vitality and variety of species of the sites flooded by the Mušov reservoirs and thus serving as a model example of the remarkable self-renewal capacity of the floodplain landscape.

A significant recreational use of the reservoirs has been concentrated on the northern bank of the Mušovská reservoir, where the ATC Merkur Pasohlávky recreational complex was built. Recreational use also takes place on the Dolní (Novomlýnská) reservoir, where regular recreational boat transport is also operated. However, the heavily eutrophic reservoirs are unsuitable for bathing due to polluted water. A number of guesthouses and other recreational facilities have been built in the villages of Strachotín, Dolní Věstonice and Pasohlávky. The flat landscape is ideal for cycling, and cycle paths have been built on the banks of the reservoirs. Wine tourism associated with visits to wine cellars is also important, as this is a well-known wine-growing region and local winemakers have adapted themselves to this demand very flexibly.

In addition to recreational use, the landscape around the Nové Mlýny Reservoirs is primarily used for intensive agricultural exploitation of the favourable soil and climatic conditions, especially the cultivation of vines, apricots and peaches, as well as maize and other arable crops.

For the purposes of this project, the "core area" was delimited and most analyses are carried out in it (Figure 1). It includes the municipal areas of Mušov, Strachotín and Dolní Věstonice. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

According to geomorphological division, the western part of the examined area, the Horní nádrž and Střední nádrž reservoirs, is situated within the geomorphological system of the Vněkarpatská sníženina lowlands, the geomorphological unit VIIIA-1 Dyje-Svratecký úval and the subunit VIIIA-1C Dyje-Svratecká niva (Balatka, Kalvoda 2006; Demek, ed. et al. 1987).

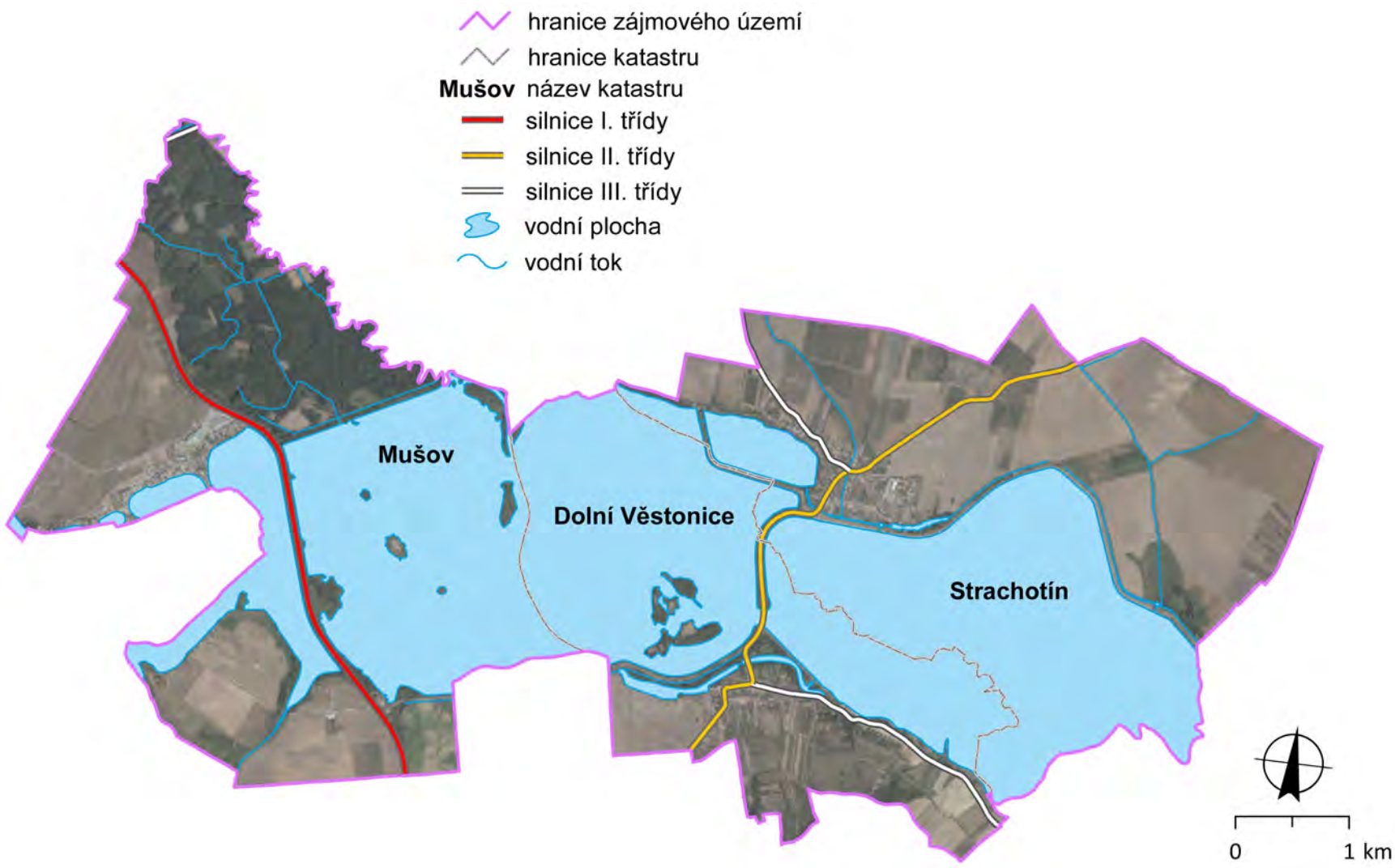


Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

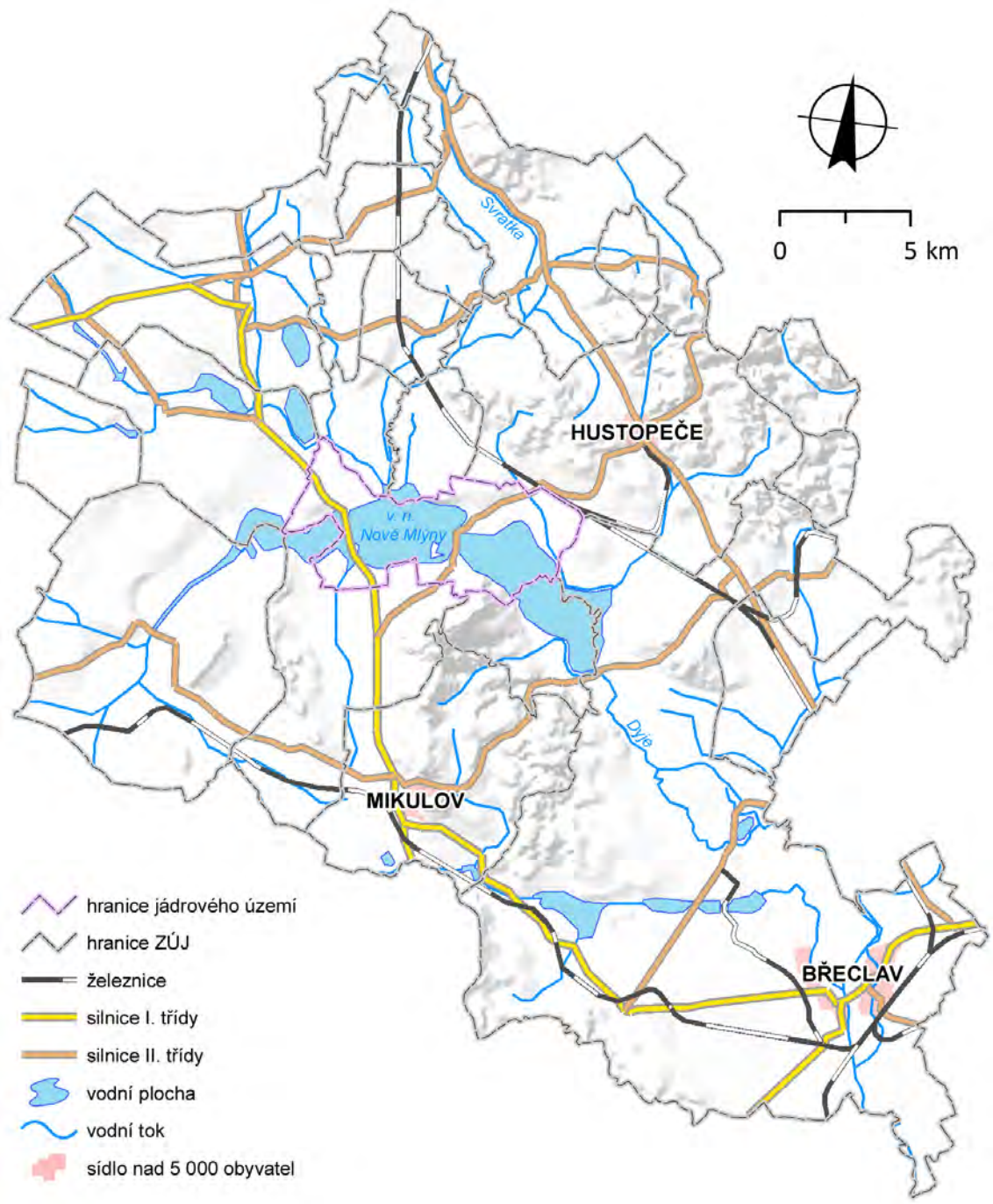


Fig. 2 – The wider area of interest.
Map basis: Data50.

The eastern part, i.e., the Dolní nádrž reservoir, is located in the geomorphological system Vienna Basin within the geomorphological unit Dolnomoravský úval (Lower Moravian Basin). However, the geomorphological parts are very similar in both parts; it is a wide alluvial plain, currently flooded by the water surface of the three reservoirs, at the altitude of 160–180 m. It is an accumulation plain along the Dyje River filled with Quaternary fluvial sediments. Numerous meanders were already crisscrossed by artificial channels in the past, before the reservoirs were built. The current relief of the flooded floodplain is dominated by anthropogenic littoral landforms, especially by massive dykes along which the roads run. In addition to the main dam, the reservoirs usually have lateral embankments. Only above the northern bank of the Střední nádrž reservoir, west of Strachotín, there is a steep terrain step up to 30 m high, the original bank of the Dyje, which contains wine cellars. Similarly, the northern slopes of the Pavlovské vrchy hills adjoin the southern bank of the Dolní nádrž reservoir in the section between Pavlov and Dolní Věstonice.

The surroundings of the reservoirs are therefore mostly flat, only in the south above Dolní Věstonice does the backdrop of the Pavlovské vrchy, which belong to the geomorphological province of the Outer Western Carpathians, rise up as a dominant terrain feature. South of the Horní nádrž reservoir, the lower and less distinctive Dunajovické vrchy hills rise. On the northern side, the low Strachotínský kopec hill, the Šakvický kopec hill and the Přítlucká hora mountain rise with very gentle slopes. Behind the Popická sníženina lowland there are the low slopes of the Hustopečská pahorkatina hill-plain rise, the lowest peripheral part of the geomorphological unit.

The geological subsoil of the Dyje floodplain consists of Quaternary sediments. In the original Dyje floodplain there are wide and massive Holocene fluvial deposits, which are now flooded by the waters of the Nové Mlýny reservoirs. The surrounding low slopes and the outskirts of the Ždánický les forest are composed of flysch Palaeogene sediments (Hustopeč marl), with occasional Neogene sediments, Quaternary loess and remnants of river terraces. The Pavlovské vrchy are built up of the felsic claystones and sandstones of the Ždáň escarpment, from which tectonically detached white Jurassic limestone crystals stand out prominently. They have been carved into the form of massive rock boulders.

The Nové Mlýny Reservoirs are located in southern Moravia in the lowest and warmest part of Czechia in a climatic region that is very warm and dry, with poor rainfall (Quitt 2009). The average annual temperature reaches 9 to 10 °C (in recent years over 10 °C due to the global warming) and the average annual rainfall is 450–500 mm. The average summer temperature is close to 20 °C, there is the highest number of summer days in Czechia (70–80) and the longest growing season, the duration of which is getting longer due to global warming. The vegetation suffers from frequent prolonged droughts during the growing season. Winters, especially in recent decades, are very mild and short, with inconsistent snow cover due to global warming. Frequent inversions and fogs occur in autumn and winter.

In the soil cover outside the floodplain, where the original fluvial soils are mostly flooded, the predominant soils are modal and carbonate chernozems, sometimes regosols or pararendzinas, and chernozems developed mainly on loess. On the gentle slopes built up by flysch rocks there are pelitic black earths, chernozems and peloids, developed on structurally heavier carbonate substrates (clays and marls). On the Pavlovské vrchy limestones, typical rendzinas and pararendzinas have formed.

The Nové Mlýny Reservoirs lie in the Pannonian thermophytic phytogeographical district. The core of the study area belongs to the phytogeographical district of the Jihomoravské úvaly, a subdistrict of the Dyjsko-Svratecký úval. The southern peripheral part belongs to the phytogeographical district Mikulovská pahorkatina hills, subdistrict Dunajovické kopce hills and Pavlovské kopce hills. The north-eastern part of the area of interest is covered by the phytogeographical district of the Jihomoravské úvaly, a subdistrict of the Hustopečská pahorkatina upland (Skalický et al. 2009). The entire area lies in the natural forest area of the Jihomoravské úvaly, with the exception of the Pavlovské vrchy in the lowest forest vegetation stage of oak. Potential natural vegetation would consist of Pannonian elm ash in a complex with poplar ash in the floodplain of the Dyje and the lower Svratka (Neuhäuslová, Moravec, eds. et al 1997). On the plateaus and gentle slopes outside the floodplain there is the Pannonian oak-hazel with loess oak and on the Pálava klippe, there are thermophilous mahaleb cherry and/or spruce oak.

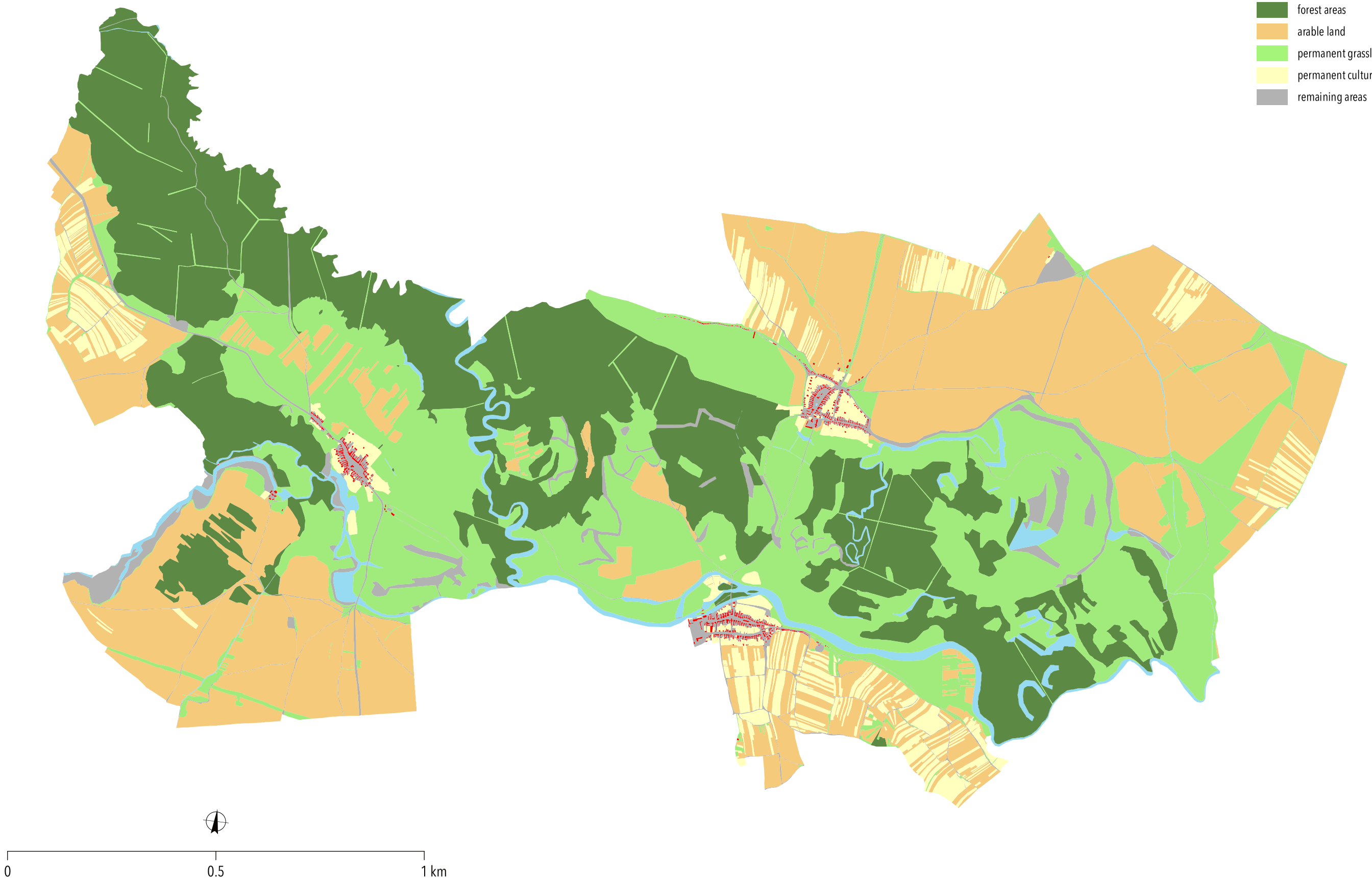
The current land use and landscape cover in the Dyje floodplain is dominated by the water surface of the three Nové Mlýny reservoirs. In their surroundings, intensively used arable land predominates, interspersed with vineyards and orchards on the gentle slopes. On the banks of the reservoirs, recreational areas have also expanded. Valuable remnants of floodplain forest have been only preserved at the confluence of the Svratka and Jihlava rivers (the Mušovský luh).

In the south, the Dolní Nové Mlýny Reservoir is adjacent to the Pálava protected landscape area. There are a number of important small-scale specially protected nature areas, primarily the large national nature reserve Děvín – Kotel – Soutěska with rock steppe communities on limestone cliffs. Below the dam of the Dolní Nové Mlýny Reservoir, the national nature reserve Křivé jezero (Crooked Lake) is situated in the Dyje floodplain, protecting the rest of the natural course of the Dyje with the surrounding river floodplain, floodplain vegetation and an important bird nesting area. The Věstonická (Central) Reservoir is a nature reserve to protect a newly created important aquatic and wetland ecosystem with the occurrence of specially protected species of plants and animals. The Dolní Mušovský luh nature monument protects the last remnants of floodplain forests in the lower Jihlava and Svratka river basins. The Betlém nature monument protects typical marsh plant communities in the lower Jihlava floodplain.

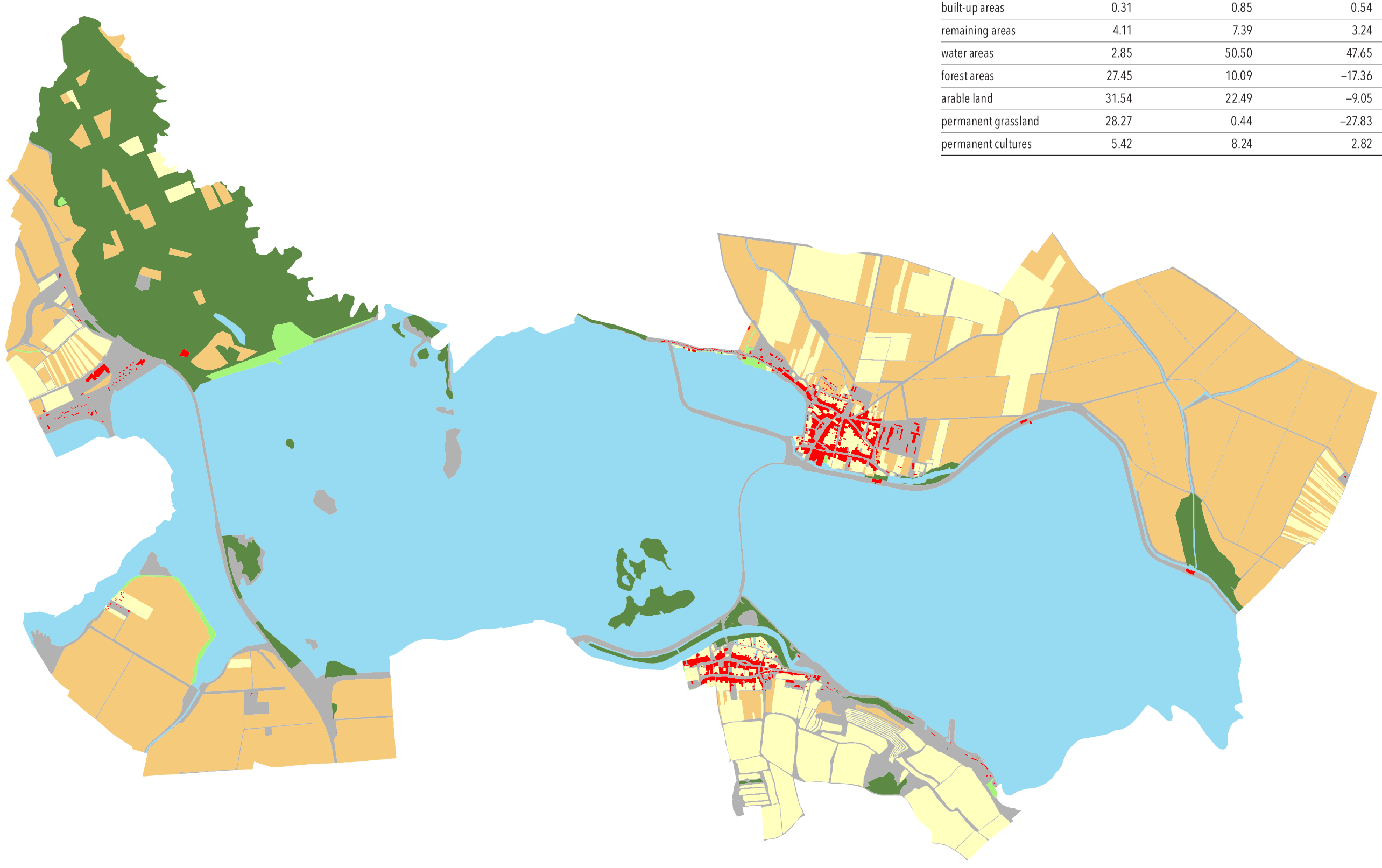
The Pálava bird area and the Nové Mlýny Reservoirs bird area have been designated in the area to protect populations of the white stork, sea eagle, osprey, great goose, field goose and other water birds, numbering more than 20,000. The Mušovský luh, which is of European importance, protects an ash and alder floodplain forest with summer oak, elm, hornbeam and ash.

The model area of the Nové Mlýny Reservoirs – a flooded landscape of river valleys (Mušov, Strachotín, Dolní Věstonice) is located in a good position on the historical road between Brno and Vienna near the state border with Austria. In the past, it was repeatedly affected by occasional flooding of the Dyje River and its tributaries. The area has been inhabited since ancient times, and in prehistoric times it was one of the most densely populated areas in Europe. The largest human intervention in the landscape of South Moravia was the construction of the Nové Mlýny Reservoirs in the 1970s. This highly debated and controversial project created a large reservoir (lower, middle and upper, separated by roads on bridges) at the mouth of the Svratka and Jihlava rivers, which inundated a large area of floodplain forests, farmland, meanders and pools of the rivers mentioned above, as well as one of the villages. Mušov (first written mention in 1276) disappeared in 1980 and was inundated in 1988. Only the Church of St. Linhart on a small island in the middle of the

Stable cadastre (1825)



Current state (2019)



Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.31	0.85	0.54
remaining areas	4.11	7.39	3.24
water areas	2.85	50.50	47.65
forest areas	27.45	10.09	–17.36
arable land	31.54	22.49	–9.05
permanent grassland	28.27	0.44	–27.83
permanent cultures	5.42	8.24	2.82

Fig. 3 – Land use/cover in cadasters Mušov, Strachotín and Dolní Věstonice in 1825 and 2019.
Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

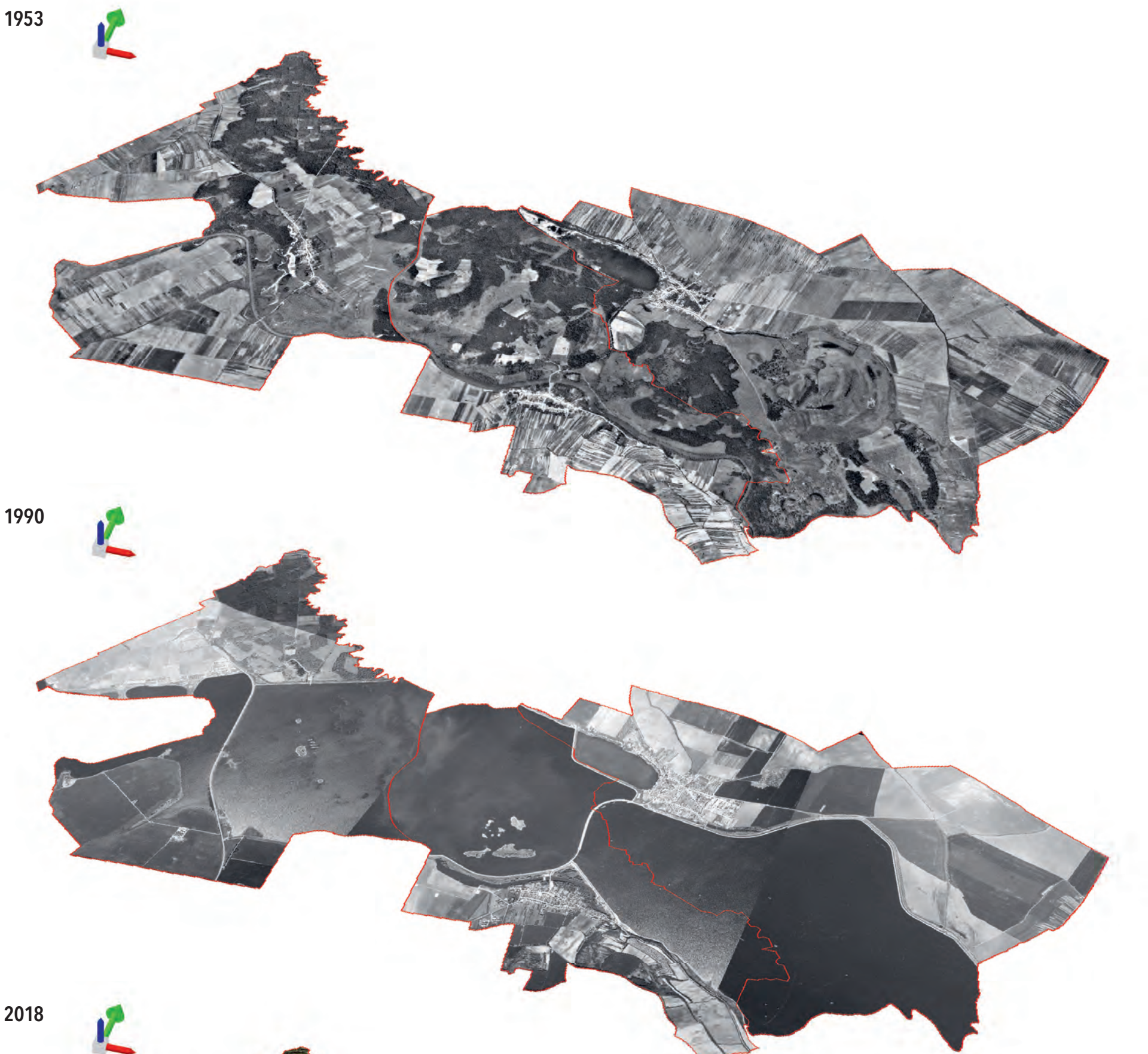


Fig. 4 – Models of landscape – Nové Mlýny Reservoirs in 1953, 1990 and 2018.
Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018);
Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5a – The view of Dolní Věstonice from the south in 1971 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

Fig. 5b – The view of Dolní Věstonice from the north in 1971 and 2019. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

reservoir and a few small buildings, statues and crosses, which were moved to the surrounding villages before the flooding, were saved. On the northern bank of the reservoir there is a valuable archaeological site documenting a Roman camp, and artefacts testifying to the settlement of the area at the end of the Ice Age. The unflooded part of the territory of Mušov was annexed to the municipality of Pasohlávky. Two other villages of the model area, Strachotín and Dolní Věstonice, also have part of their cadastre under water. The model area is characterised by very fertile and intensively used soils with a large proportion of vineyards and orchards. Traditional wine-growing, wine cellars and the whole culture associated with it have become a major attraction for domestic and foreign tourism. The significant elevation of the terrain, in the form of the Pavlovské vrchy with numerous views of the landscape of the model area, also contributes to this. The large water area allows for seasonal bird migration stops, water sports, fishing and swimming. This is, however, to a much lesser extent than envisaged by the Nové Mlýny Reservoirs project, due to the dirt and run-off from the intensively used land. The model area represents a very interesting landscape that has been cultivated by man for a long time. The former agricultural function has been somewhat weakened by the development of other functions related to tourism and nature conservation in part of the area.

There is the use of a number of inhabitants per house as one of the characteristics describing the environmental change in the model area. This ranged from 4–6 in 1869 to 2–4 in 2011. This documents a long-term increase in the quality of housing in the model area, influenced by the departure of some rural residents to towns, but also by the improvement in the standard of living in traditional houses. However, the indicator only shows the proportion of the population living in the area and, given that some of the buildings are used as guesthouses, the number of inhabitants living at least during the tourist or wine season is certainly higher. The population density was lower than the average of Czechia in all time horizons, which corresponds to the rural character of the territory. All municipalities show a higher proportion of economically active people in the primary sector than the national average, nine municipalities in the southern half of the hinterland had (according to the data from 2011) even more than 9% of the population in the primary sector. It is certainly influenced by the traditional character of the area with a high proportion of vine, fruit and vegetable growing. Most municipalities also have higher employment in the tertiary than in the secondary sector, which is more linked to municipalities with a higher proportion of commuting economically active residents.

The economic structure itself has shifted from concentrated agricultural production to smaller farms and given the recreational use of the reservoirs, to tourism. The fragmented economic structure is reflected in the fact that there are only four economic entities with more than 10 employees. There are two small agricultural enterprises as remnants of agricultural cooperatives with less than 100 employees and then 2 tourism facilities linked to the existence of the reservoirs.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). Mapping at the time of the stable cadastre

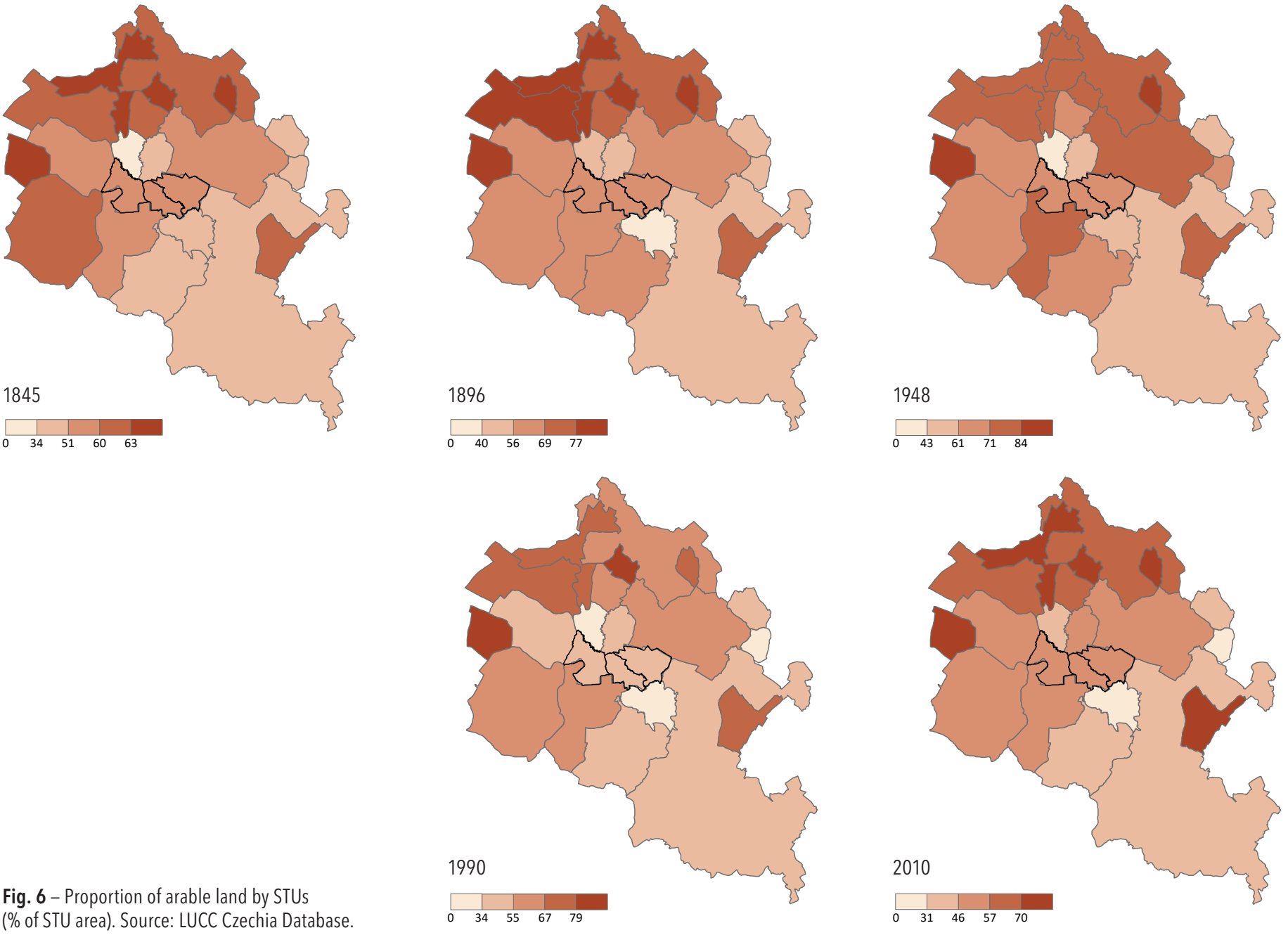


Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

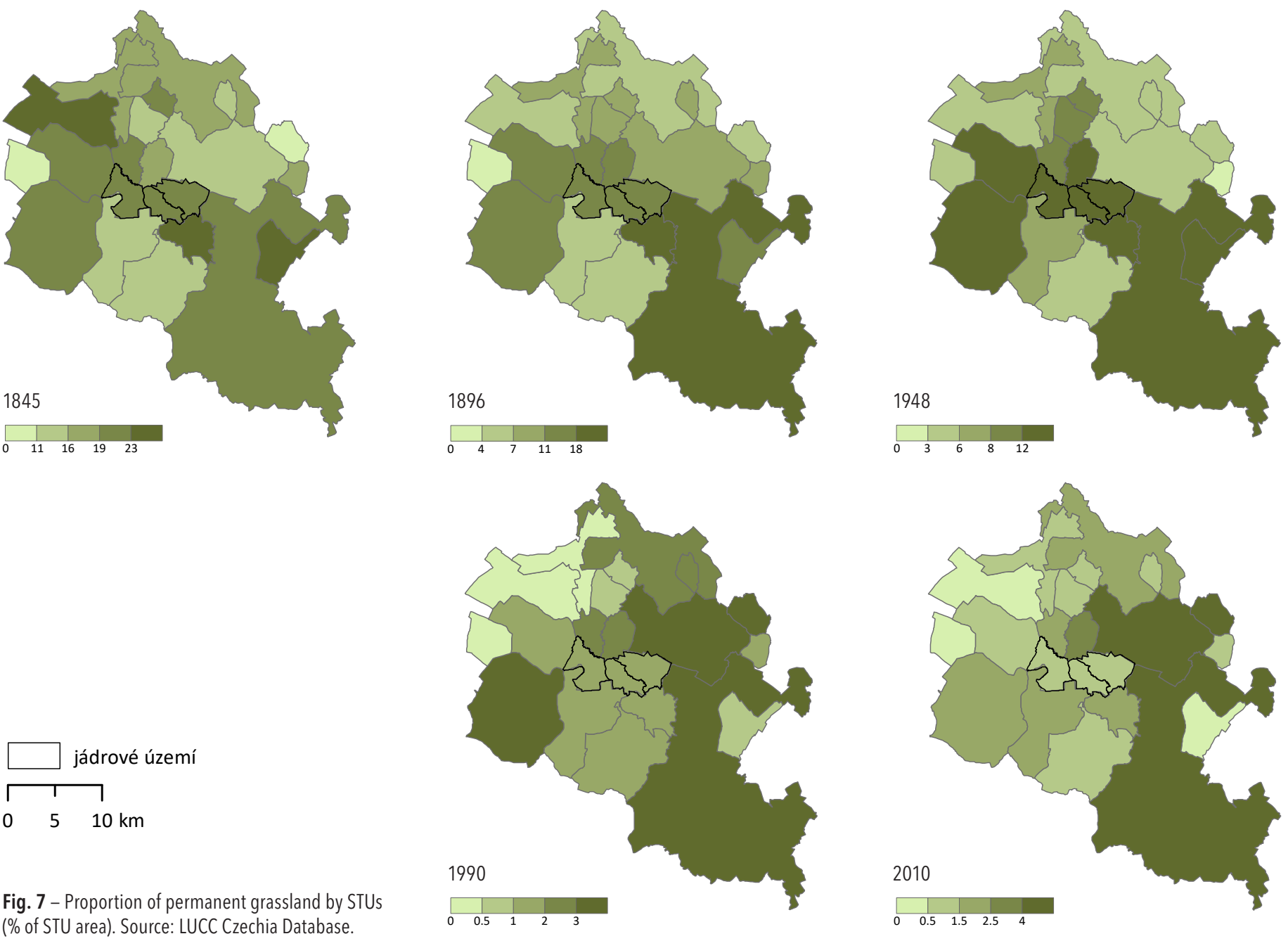
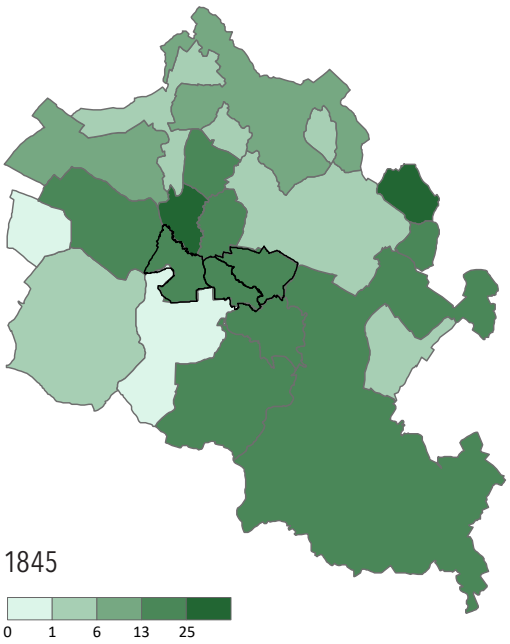
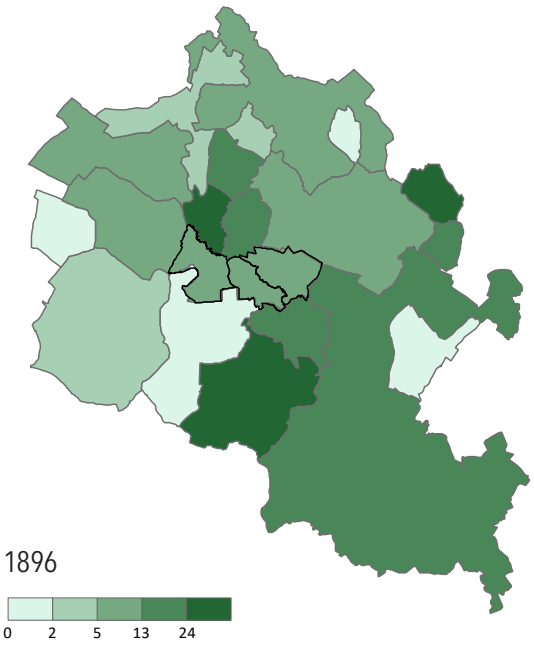
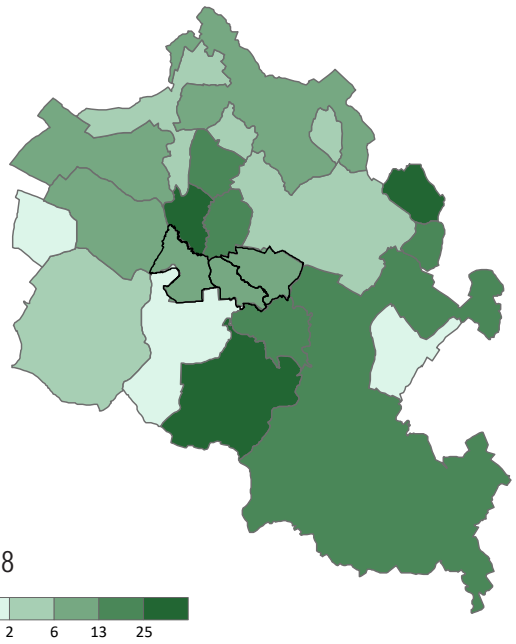
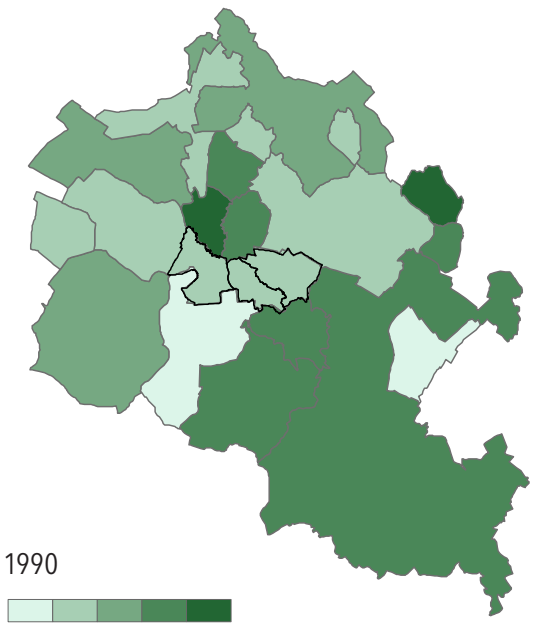


Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.









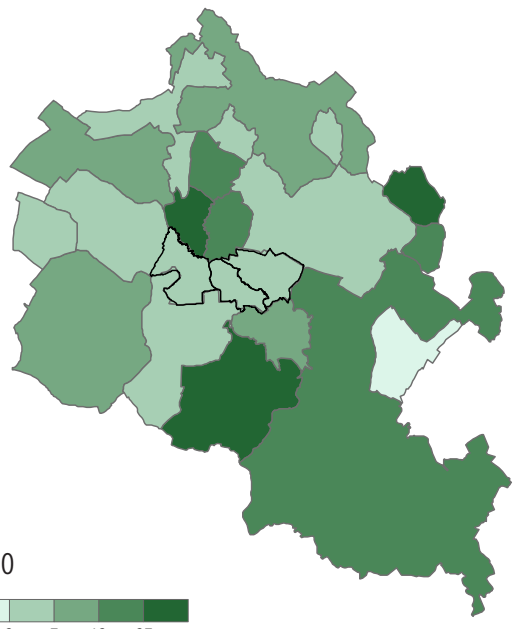
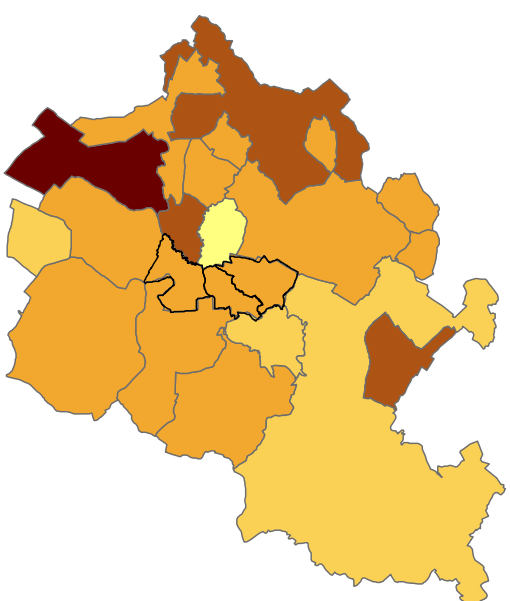
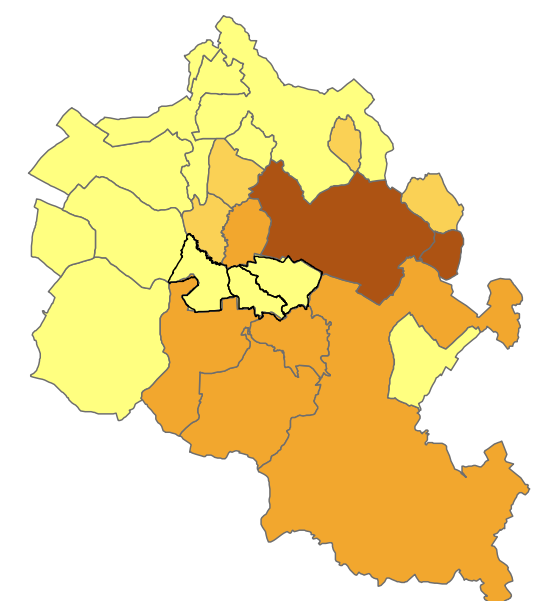
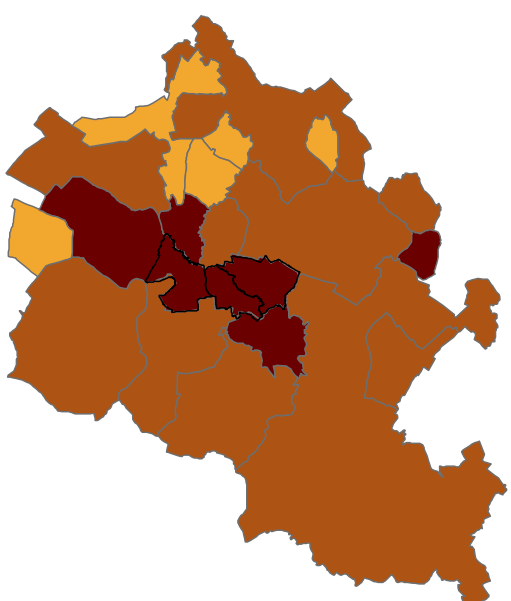
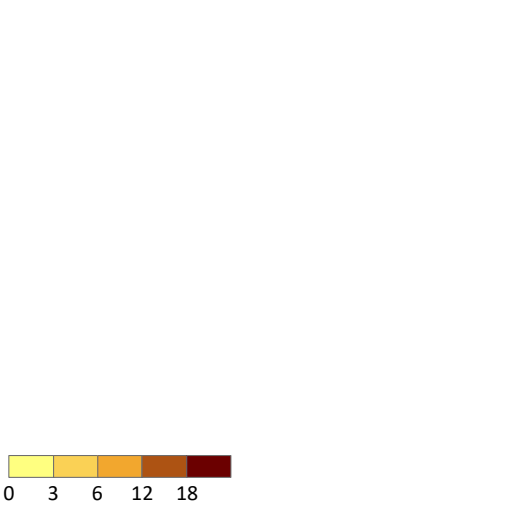


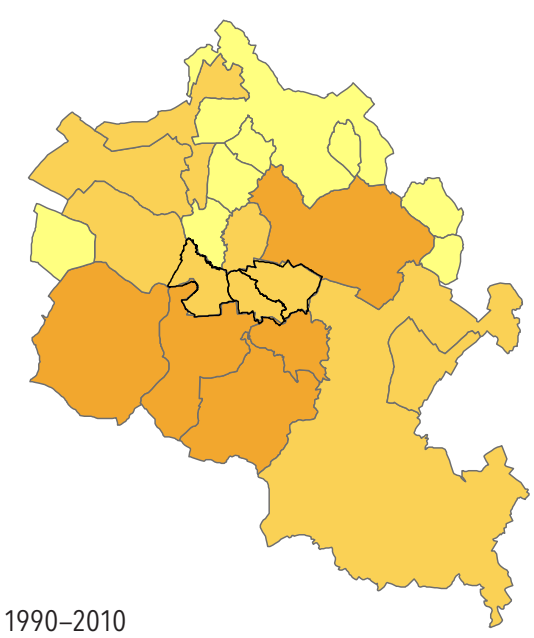
Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.











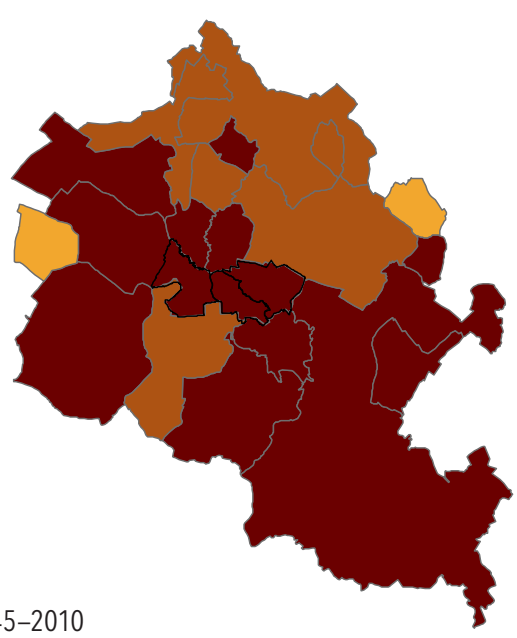


Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

Fig. 10 – Municipality emblems.
Data source Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

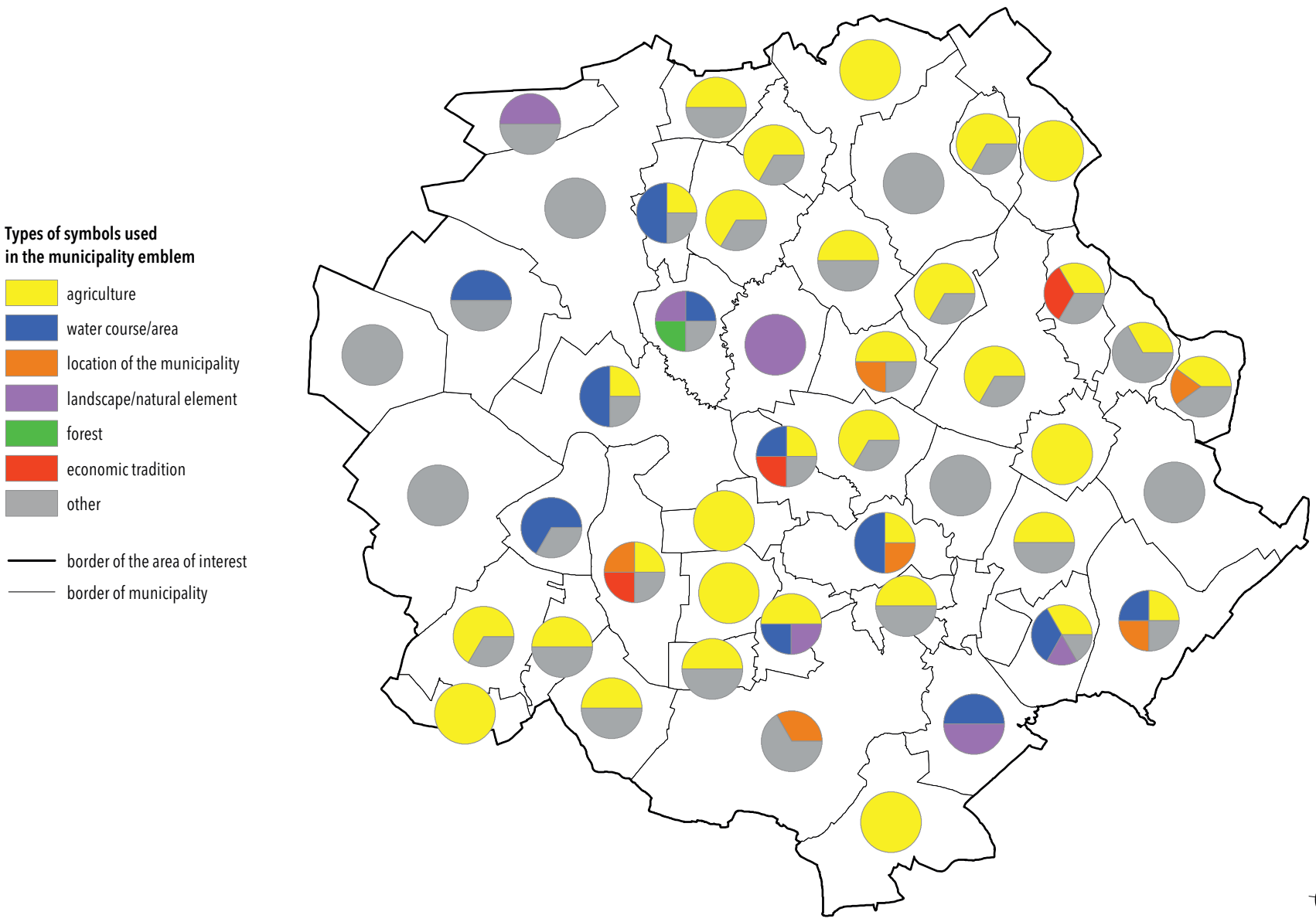


Fig. 11 – Types of symbols used in the municipality emblems.
Data source Data source: Contant analysis of the municipality emblems (20. 8. 2020).

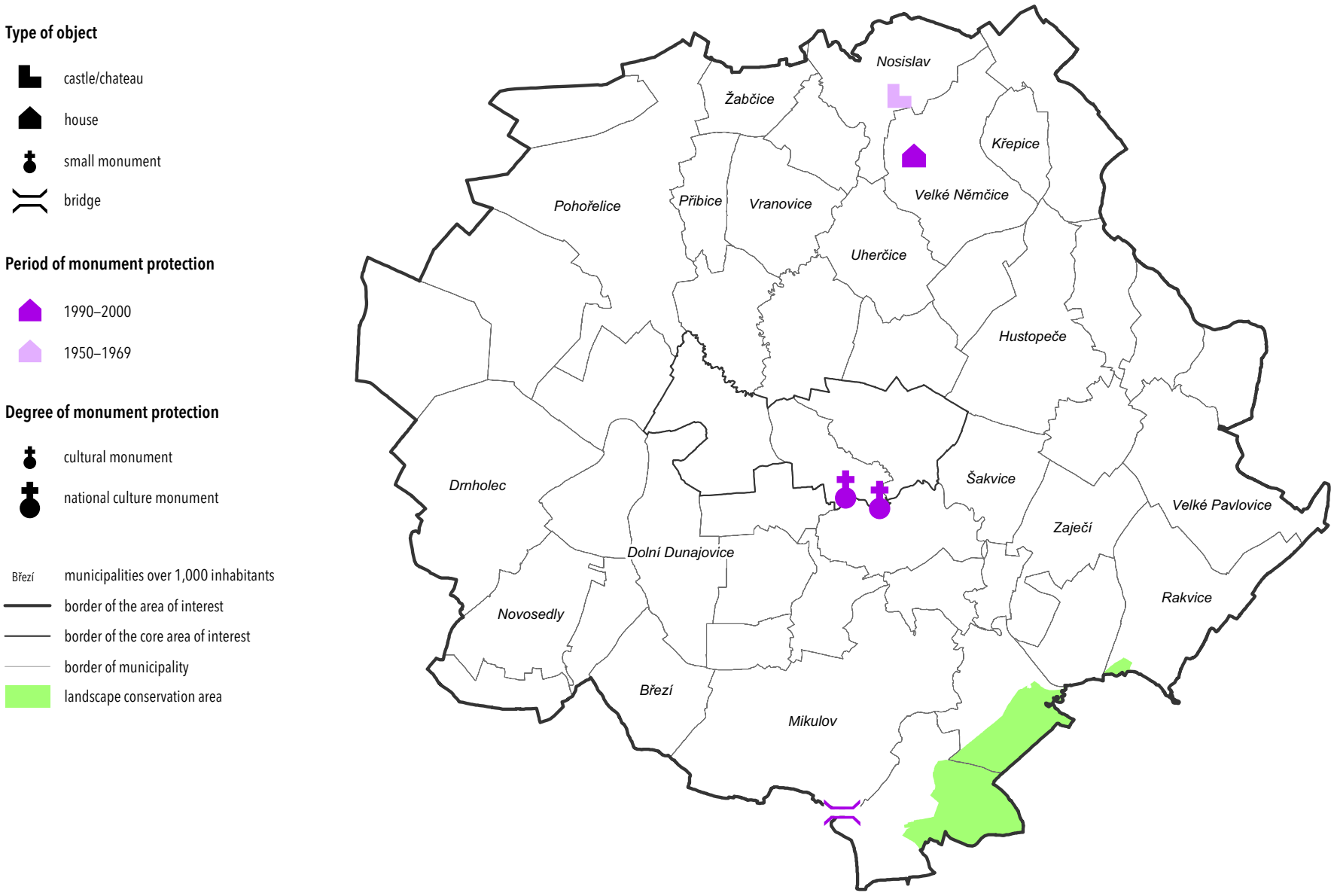


Fig. 12 – Cultural monuments and heritage areas.
Data source National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

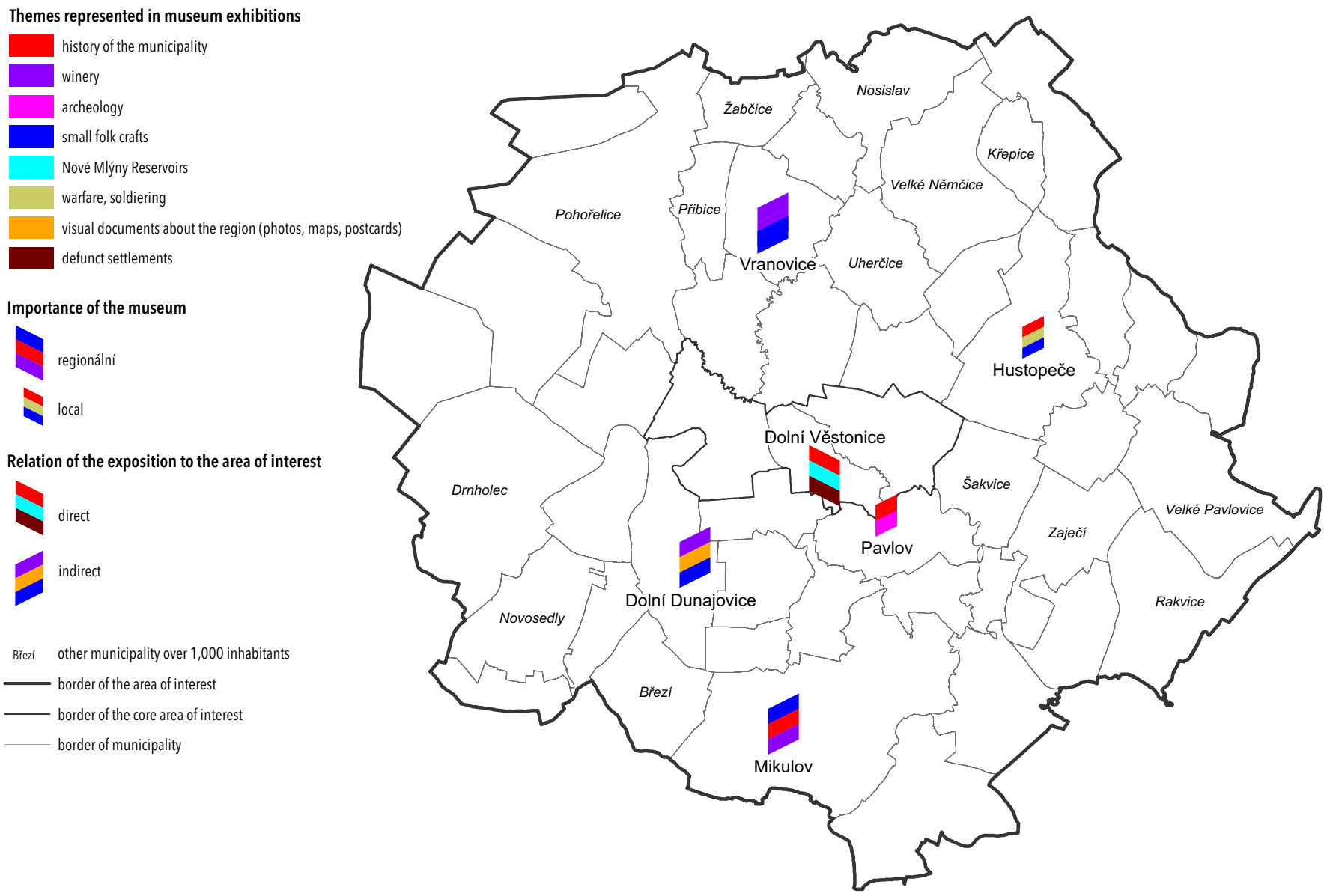


Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

captured the area of the current Nové Mlýny reservoirs at a time when there was a valuable alluvial landscape with a complex of floodplain forests, alluvial meadows and riparian vegetation on the lower reaches of the Dyje River. Almost a third of the area was covered by grassland, almost a third by valuable forestland and another third by a small mosaic of arable land in combination with areas of permanent crops. These valuable ecosystems were almost completely flooded as a result of the Nové Mlýny waterworks, which were built in the 1970s and 1980s.

Today, the Mušovská, Věstonická and Nové Mlýny reservoirs are covering exactly one half of the model area with water. The water surface has thus expanded by almost 48%. This was mainly at the expense of the aforementioned naturally valuable grasslands (the loss was practically zero), floodplain forests and arable land. Nevertheless, there has been a slight expansion of built-up and other areas, which now also offer a recreational function. Permanent crops have expanded, particularly as a result of the development of vineyards and orchards, which take advantage of the favourable climate and the quality of the soil in the area.

The created landscape models (Figure 4) document the flooding of the floodplain forests in the area of the present-day reservoirs and the disappearance of the village of Mušov, of which only the Church of St Linhart on the island in the middle of the central Nové Mlýny reservoir remains today. The dam separating the Horní and Střední reservoirs is the important road E461 connecting Brno with Vienna. In the northern area of the Horní reservoir, the development of the recreation centre Pasohlávky is visible. The 1950s image also shows the difference in ownership and management of agricultural land compared to the current situation – a mosaic of small, narrow fields vs. complete fields (with the exception of vineyards and orchards).

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in comparable territorial units (STUs) and describe changes over time by comparing the years 1845, 1896, 1948, 1990, and 2010. The structure of the land stock is specific due to the high productive capacity of soils with a high proportion of arable land. In the north of the hinterland, some land units had up to 80% of arable land, while in the south of the Nové Mlýny Reservoirs the share was in the range of 40–50%. The importance of permanent grassland was at its highest in the last decade of the 19th century and is now all but negligible (max. 5%). The areas with part of the cadastre in the floodplain and also those extending into the Pavlovské vrchy had a higher proportion of forest area (above 13%, exceptionally up to 25%).

The index of change (Bičík et al. 2010, 2015; Figure 9) was the highest in the period 1948–1990. It significantly influenced the overall magnitude of the change index between 1845 and 2010 (above 12 without two territorial units, even above 18 for half of them). These are relatively large changes in land use, influenced by a modified function of traditional, primarily subsistence agriculture. A fruit and wine-growing specialisation emerged. This happened after the railway network was built and the connection of the micro-region to the Austro-Hungarian and Czechoslovak markets improved (after 1918), and also due to the rise in the standard of living of the population in present-day Czechia.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in the following sections 3.2.1–3.2.3 (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

A total of six museums characterise the area of interest of the Nové Mlýny Reservoirs, one directly and five indirectly. The exhibitions in these museums focus on three major themes (flooded landscape, prehistory and viticulture) that are typical of the area. All information is provided to visitors mainly by the Regional Museum in Mikulov, which manages several branches. One of them is the exhibition in Dolní Věstonice, which describes life under the Pálava River. It focuses mainly on the transformation of the landscape as a result of the construction of the Nové Mlýny Reservoirs and provides a view of the now extinct villages and the life of their inhabitants.

Another key topic is archaeology, the archaeological sites of Pálava and, last but not least, the discovery of the "Venus of Věstonice". The second branch of the Mikulov Museum, the Archaeopark in Pavlov, is dedicated to this topic and presents the prehistoric period in a modern way in many interactive exhibitions.

The central office of the Mikulov Museum in the Mikulov Chateau and the museums in the wine-growing villages of Dolní Dunajovice and Vranovice focus on the issue of viticulture. Closely linked to these exhibitions is the subject of folk crafts, which developed in this area, particularly in connection with the cultivation and processing of wine. Folk crafts, albeit in a different context, are also the subject of the Hustopeče Municipal Museum. In the past, this town was famous for holding markets because of its location on the "Uherské stezka" (Hungarian Road). In the exhibitions, visitors can therefore learn about the market schedules, the sale of Hustopeče liquorice goods or painted furniture.

Archival materials for this area can be found mainly in the state district archive in Břeclav.

3.2.2. Regional and local symbols

The area of interest of the Nové Mlýny Reservoirs represents a type of area that has been significantly affected by the construction of the reservoir. The symbolism of the municipal emblems in the area (Figure 10) of the Nové Mlýny Reservoirs is partially captured, but as municipal emblems typically feature other elements (historically old events, positively perceived features and events, site-specific elements rather than those of the wider region), one should expect other symbols to predominate. The analysis of the symbolic content of the emblems of the villages in the region confirms this hypothesis – as expected, the territory is dominated by symbolism associated with viticulture (included in the "yellow" category – agriculture, Figure 11).

The winemaking tradition is depicted in the emblems of almost all the municipalities in the area of interest and is most often symbolized by the figure of a vine or grape (Bavory – vineyards under Pálava; Dolní Věstonice – also production of Pálava wine, Horní Bojanovice, Horní Věstonice, Klentnice, Křepice, Němčičky, Nikolčice, Nosislav, Novosedly, Hustopeče, Pavlov, Perná, Popice, Přibice, Přítluky, Rakvice, Sedlec, Starovičky, Uherčice, Vranovice). Other widely used symbols of winemaking depicted in municipal emblems in the area are winemaking knives and sickles (curved winemaking knives) – they appear in the emblems of the municipalities of Dolní Dunajovice, Hustopeče, Milovice, Nosislav (where there is also a hoe figure in the emblem), Pasohlávky, Přísnotice, Přítluky, Starovice, Starovičky, Strachotín (together with another typical winemaking tool – a cutlass), Vranovice, Žabčice. In the coat of arms of Dolní Dunajovice, the green hill symbolizes the fertility of the area in general, but also the local vineyard lines on the hills Ořechová hora, Pod Slunným vrchem, Dunajovský kopec, Kraví

hora, Mlýnská, Zimní vrch and Plotny. Agriculture and the fertility of the region are also symbolised in the territory by the green tincture (colour) in the emblems of the municipalities of Březí (green bordure of the emblem), Horní Věstonice (green foot of the emblem), Křepice, Němčičky, Nikolčice, Novosedly (green foot), Přísnotice, Starovice and Vlasatice. The golden (yellow) tincture represents the agricultural character of the village in the coat of arms of Kurdějov, Popice and Starovičky (where there is also the figure of a sickle). In the emblems of Klentnice, Nový Přerov, Perná, Přísnotice and Sedlec there is an element representing the agricultural tradition with the figure of a plough. The emblem of Nový Přerov also features flowers to represent the fertility of the area (as does the emblem of Dobré Pole).

Water bodies, especially water reservoirs, which are the main subject of the analysis in this area of interest, but also watercourses ("blue" category), are traditionally depicted in municipal emblems with blue tinctures, wavy crossbars, wavy feet, etc. The Nové Mlýny water reservoir is symbolised by a blue tincture in the coat of arms of Pavlov (together with a barbel) and Přítluky (with a figure of the mill wheel). In the coat of arms of Dolní Věstonice, Nové Mlýny is depicted as a water surface (also together with a figure of a fish symbolising the local fishing tradition). In the coat of arms of Brod nad Dyjí, the blue tincture represents the Dyje River, and the undulating golden (yellow) crossbars represent Nové Mlýny. Specifically, the Věstonice reservoir is depicted with a blue tincture in the coat of arms of the municipality of Vlasatice (blue here also symbolizes the Novoveský rybník pond and the Dyje). The Dyje and Nové Mlýny are symbolised by a blue wavy foot and the figure of a boat in the coat of arms of Pasohlávky. The Dyje River is also represented in the emblem of the village of Bulhary (blue tincture, the barbels symbolise typical game fish in the area). The Kurdějov emblem features the pike, which is its typical symbol on the one hand, but also evidence of fishing on the Dyje in the village, on the other.

The Jihlava River is also among the watercourses depicted (the wavy bar in the coat of arms of Přibice). The Jihlava, together with the Svratka River, is also symbolised by a wavy bar in the coat of arms of Ivana. In the coat of arms of the village Klentnice, the blue shield refers to the proximity of the Dyje River, Nové Mlýny as well as the Dolní Morava biosphere reserve (which can be classified in the "purple" category of landscape symbols). The figure of crayfish in the emblem of Rakvice (which is of course a talking sign, but also a reference to the rare crayfish that lives in the Dyje) can also be included in this category. In the coat of arms of the municipality of Ivaň, the leafless oak refers not only to the local floodplain forest, but also specifically to the Plačkův les nature reserve. The oak branches in the emblem of Pouzdřany symbolize the Pouzdřanská step-Kolby nature reserve (the downy oak grows in the forested part). The lily is a reference from the seal of Přítluky, but it also represents the occurrence of orange lily (Lilium bulbiferum) in the Čertoryje National Park.

Within the symbolism of the municipal emblems in the area of interest of the Nové Mlýny Reservoirs, there are also references to the location of the municipalities ("orange-brown" category). The rocks depicted in the emblem of Mikulov point to the location of the town. The green hill in the emblem of Němčičky symbolises the Kraví hora mountain, the three stones in the emblem of Pavlov represent the Děvínské skály rocks, the three hills in the emblem of Popice represent the Hustopečská pahorkatina and the silver (white) tincture in the emblem of Rakvice is a symbol for the local Pálavské vrchy limestone hills.

As of 1 October 2019, 100 % of the municipalities (a total of 46) in the area of interest of the Nové Mlýny Reservoirs have a municipal emblem.

3.2.3. Heritage sites

The flooded landscape of river valleys is monitored in the Nové Mlýny area of interest. The cultural monuments associated with the use of water can certainly include the water fortress in the Nosislav cadastre. It is a fortified, medieval village settlement in the form of a residential building with a two-storey granary, which is partially underground. It is a unique example of a gentry building whose history probably dates back to the 14th century. Another building is the former seigneurial mill in Velké Němčice, which was declared a cultural monument in 2006. Near the village of Sedlec there is a brick bridge which was built in the late 1730s. Its function was to span a newly built pond. However, in 1855 the pond was drained and dried up. Today, much of the bridge is covered with mud. Only the upper part and a few spans closest to the stream can be seen. Not far from here, there is the Lednicko-Valtický areál landscape conservation area.

A Paleolithic settlement, called Dolní Věstonice I, is a very important national cultural monument, which is not related to water management but is worth mentioning because it is evidence of the use of the landscape in the distant past. This is a unique archaeological site on the global level and a source of knowledge of the historical development, way of life and environment of human society in the Paleolithic Era.

There are no more significant cultural monuments in this area of interest that are related to water management.

4. Summary

Traditional wine-growing, wine cellars and the whole culture associated with it became an important attraction for domestic and foreign tourism in the territory of southeastern Moravia in the past already, but it gained much importance after 1990. The significant elevation of the terrain in the form of the Pavlovské vrchy hills with numerous views of the fertile landscape of the model area also contributes to tourism. The large water surface of the Nové Mlýny Reservoirs was built for somewhat different functions (recreation, irrigation, flood protection) than the landscape of the model area has today. The lakes provide staging areas for seasonal bird migrations as well as some water sports, but fishing and recreation are only on a much smaller scale than envisioned by the design of the Nové Mlýny Reservoirs. This is due to pollution from sewage and run-off from intensively used land (the catchment areas of the Dyje, Svratka, Jihlava rivers). The model area represents a very interesting landscape, cultivated for a long time by the work of generations, combined with the distinctive limestone block of the Pavlovské vrchy and wooded slopes. It is an area where one of the highest population densities in the whole of Europe was documented at the close of the Ice Age. A number of artefacts from this period have also been found here and are on display in the local museum (Velké Pavlovice). The former agricultural function has been preserved, but it is now competing with some other tourism-related functions (a water park, wine consumption, cycle paths) on the important road link between Brno and Austria.

In the model area, the environmental function has increased significantly due to the needs of nature protection in the Pavlovské vrchy protected landscape area and its small local reserves. The high number of visitors to the area is important for economic development, but from the point of view of nature preservation, especially in the summer period, numerous conflicts arise with the necessary conservation.

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CHAPTER 7

Defunct landscape of pond system in Pardubice region

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1. Introduction

At the end of the 15th and the beginning of the 16th centuries, an extensive pond system was built on the Pardubice estate. The largest ponds, including Velká Čeperka with a water surface of about 1,000 ha probably the largest Czech pond in history, were fed by the Opatovice Canal. The construction of the large ponds required the destruction or relocation of several villages. All the ponds are recorded on Vischer's detailed map of the Pardubice manor from 1688. In the late 18th and early 19th centuries, most of the ponds were rapidly abolished en masse. The reason for this was the intensification of agriculture.

In the fertile Polabí region, most of the ponds were converted into arable land. In the second half of the 19th century, the former pond landscape of Pardubice was thus without water bodies, transformed into a productive agricultural landscape. Only the names of some of the ponds on cadastral maps reminded of the former ponds. In the 20th century, sandpits began to be established in the area, some of them on the place of former ponds.

After the end of mining, some of the mined sandpits were left to be spontaneously flooded by large anthropogenic lakes, especially on the site of the former largest ponds Čeperka and Oplatil. Water surfaces have thus partially returned to the landscape. Instead of the former large ponds, which dominated the landscape for about 300 years, they are now flooded sandpits. However, their water surface area is smaller than that of the ponds. Since the 20th century, there has also been an increase in the area of forest cover and a decrease in the area of agricultural land, which is in line with the overall trend in the development of the Czech cultural landscape.

The function of the landscape has also changed, at least in part. After the establishment of the fishpond system, the original production and settlement function shifted almost exclusively to a production function focused on fish breeding and production. The settlement function has been weakened by the displacement and disappearance of several villages. With the closure of the ponds, the fish-farming production function disappeared and the agricultural production function became the primary one in the 19th century. As the population of the settlements grew, the settlement function was also strengthened in the 19th and 20th centuries.

From the second half of the 20th century onwards, the creation of large anthropogenic lakes in mined sandpits brought about the emergence of a new landscape function, namely that of recreation. This trend has been slightly strengthening and continues after 2000. In this most recent period, there is also the new trend of emergence of industrial areas and the manufacturing industrial landscape function in the Čeperka industrial zone.

For the purposes of this project, the "core area" has been delimited and most analyses are carried out in it (Figure 1). It includes the municipal areas of Čeperka and Stéblová. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

The model area of former ponds in Pardubice lies in the geomorphological area of the Východočeská tabule (East Bohemian Tableland; Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The geological subsoil is composed of Upper Cretaceous sediments, mainly marlites and claystones of the Lower and Middle Turonian and Upper Turonian to the Coniacian age. The Cretaceous rocks are overlain by fluvial and eolian Quaternary sediments, mainly Pleistocene fluvial gravels and sands. The surface of the Middle Pleistocene and Early Pleistocene river terraces is overlain by loess covers and drifts, with occasional covers and overlays of weathered sands. The youngest terrace sands transition smoothly into Holocene alluvial sediments in the broad Elbe valley floodplain.

The relief of the core area is absolutely flat at an altitude of 220–230 m. Basically, the only differences in altitude of up to 10 m are caused by anthropogenic activity – gravel extraction – and are formed by the mining pits of abandoned and active sandpits, or piles and mounds of gravel and quarry material. Larger height differences are prevented by the immediate flooding of the excavated depressions. The anthropogenic mining (geometrically regular excavated areas of sandpits), littoral (dykes, ditches) and possibly communication (road embankments) landforms are also the most prominent, and in fact the only visible landforms apart from the plain. In the wider area of interest, the striking neo-volcanic peak of the Kunětická hora mountain (307 m) rises to the south-east, while the gentle slopes of the Chlumecká tabule rise very gently to 230–250 m above sea level on the north-western edge of the wider area of interest.

The model area is located in the Polabí region in a warm climate zone with an average annual temperature of around 9 °C and an average annual rainfall close to 600 mm (Quitt 2009). Winters are very mild and short, with inconsistent snow cover, especially in recent decades on account of global warming. Due to the location of the basin, frequent inversions occur in autumn and winter. High night-time humidity due to evaporation from water bodies causes frequent night and morning fogs. Summers tend to be relatively long and sunny.

The soil cover alternates between arenaceous and psephitic cambisols formed from the gravel sands of fluvial terraces, and sometimes even arenaceous podzols were created on watery or

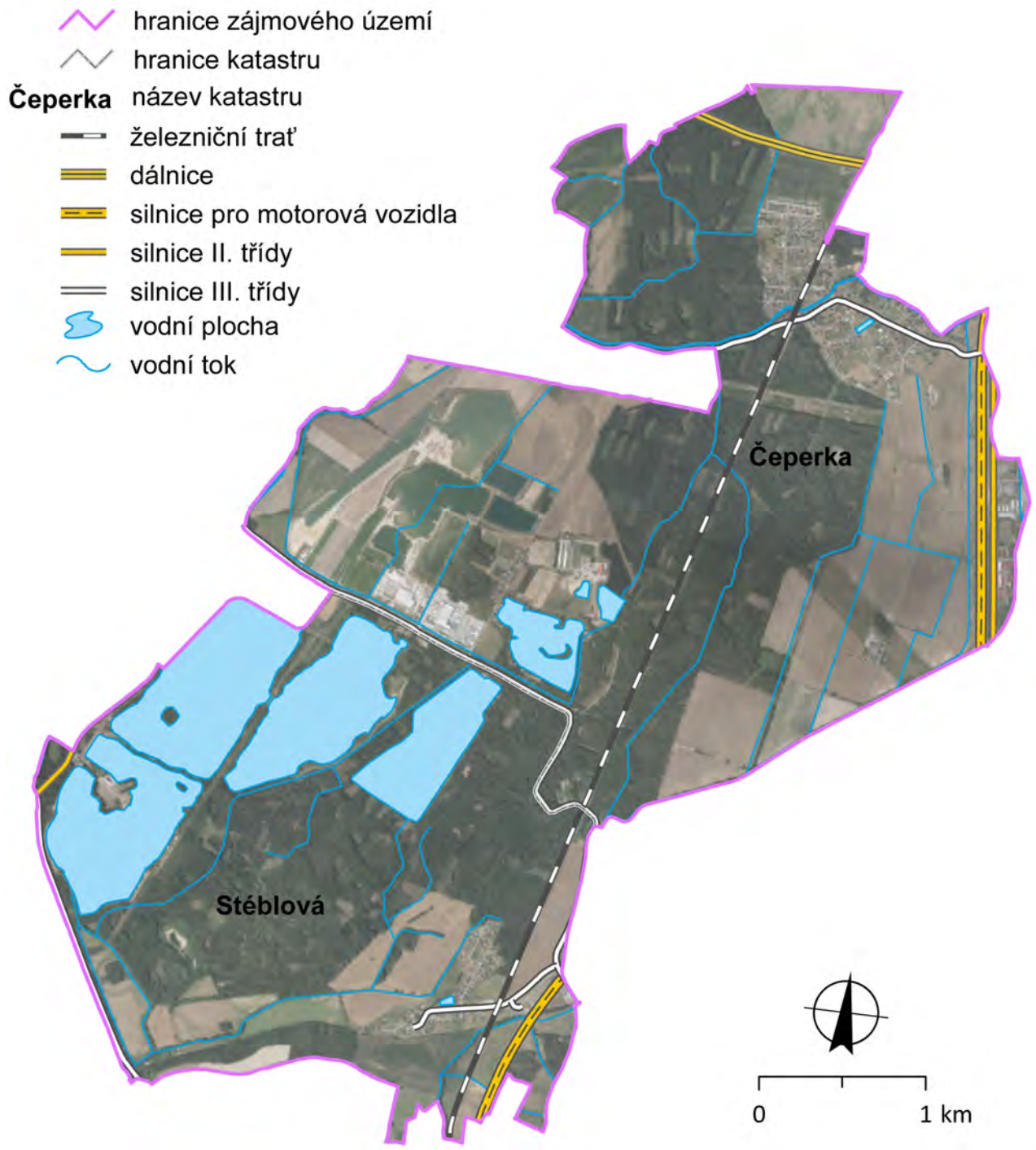

Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

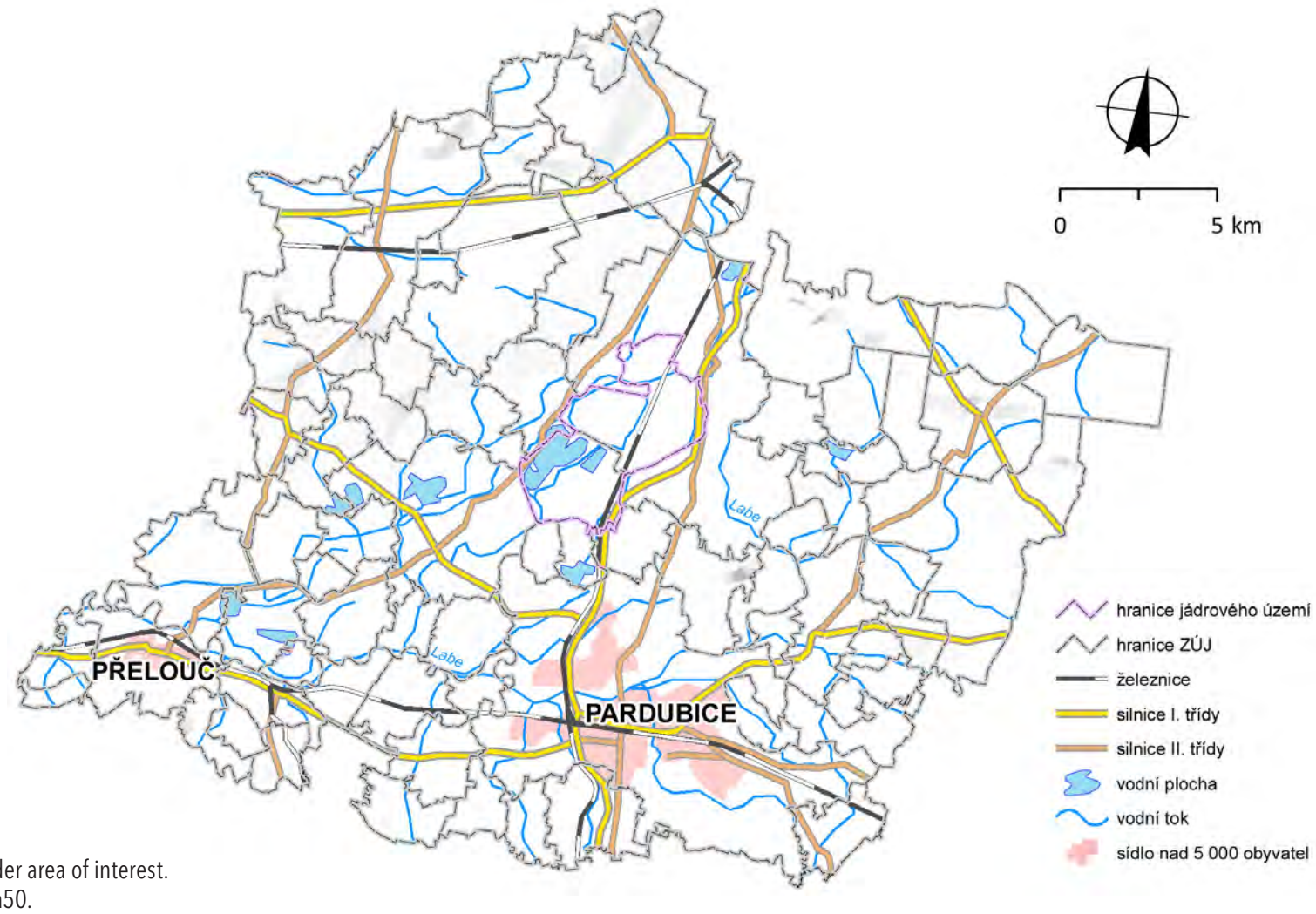

Fig. 2 – The wider area of interest. Map basis: Data50.

fluvial sands. The loess cover in the north-western part of the wider area of interest has formed fertile, brown modal soils, possibly even black modal soils. Fluvial soils occur in the Elbe valley floodplain. There is sufficient groundwater throughout the area of interest, which is continuously replenished by infiltration throughout the year.

The Pardubice region lies in the phytogeographical district of the Czech Thermophytic Region, the phytogeographical district of the Eastern Polabí, and the subdistrict of the Pardubice Polabí (according to Skalický et al. 2009). There is the natural forest area Polabí, with oak forest vegetation stage (linden-oak to oak-hazel, according to Neuhäuslová, Moravec, eds. et al. 1997). In the Elbe floodplain, elm-oak woodland is potential natural vegetation.

In the current land use and landscape cover, relatively large deciduous forests, mostly oak, occur on the site of the former large pond Oplatil and partly on the site of the former pond Čeperka to the west and north of Stéblová and to the south of Čeperka. The forests are occasionally mixed with pine, and pure pine stands can be found on the sandy soil. Outside these forest complexes and throughout the wider area of interest, arable land predominates. Permanent grassland in the form of alluvial meadows is very rare, only occurring in small areas in wetter positions at the forest edges or along watercourses. In the core area, on the site of the former Oplatil pond, there is a considerable area of water surface of flooded sandpits between Staré Ždánice and Stéblová. To the north of them, the new industrial zone of Čeperka was created next to a still active sandpit.

There is no specially protected nature area in the core area, as the landscape has been transformed by man several times and valuable natural ecosystems have not been preserved. In the wider area of interest there is the national nature reserve Bohdanečský rybník (Bohdaneč Pond) and the Matka pond near Lázně Bohdaneč. This is the only large preserved pond of the Pardubice-Bohdaneč pond system on the former Pernštejn estate, which is also one of the oldest – it was created in around 1480. The reserve protects water bodies with adjacent extensive reedbeds and marsh meadows as a breeding ground for waterfowl and habitat for rare marsh plant species. The watercourses have the character of artificial channels with a low wildlife value. An exception is the Opatovice Canal, which, in addition to being an important historic technical monument, has acquired a natural character over more than 500 years of existence in the landscape and is a valuable landscape feature with a high wildlife value.

The Pardubice model area is located north of the regional town in the fertile landscape of the Polabí region. In the past, it was a specific area both because of its high fertility and because the Opatovice Canal was built here, which diverted part of the Elbe flood waters and also served to feed and drain water from a system of large ponds. In the past, part of the area was occasionally inundated by the flood wave of the Elbe and its left-side tributary, the Orlice River. The abolition of a number of ponds expanded the extent of arable land, which in the second half of the 19th century was a greater source of income than pond farming, mainly due to the cultivation of sugar beet. The area covers six settlements: Čeperka, Hrobice, Stéblová, Srch, Pohranov and Hrádek.

At present, the area lies between two regional towns in an exposed position with a high population density and it is heavily trafficked. A motorway linking Prague, Hradec Králové and Náchod towards Poland passes through the area, and another motorway is under construction to replace the road No 35 (Liberec – Hradec Králové – Olomouc). The proximity of two major railway junctions also affects the level of exposure of the model area. It represents one of the nuclei of settlement in Bohemia with a significant administrative, production and service function, which also benefits the model area under study due to its location.

On account of the good fertility of the area, the model settlements had 7–9 inhabitants per house in 1869, whereas today there are 2–3 inhabitants per house. High commuting rates account for between a third and half of economically active residents across the wider hinterland, with the model settlements themselves having commuting rates in excess of 40% of active residents. Despite the good conditions for agriculture, less than 2% of the economically active population is engaged in agriculture in the two settlements studied. The secondary sector employs about 30% of the economically active population, while the tertiary sector, which is linked to commuting, employs less than half of the economically active population. In the model area there are a few small manufacturing services and farms.

Although the area is flat and intensively farmed, there are still some recreational facilities. This is largely due to the high population density of the area and the attractiveness of the two regional towns for the rural population as well as the desire of urban residents to own a recreational facility near their permanent residence. It is the number of original rural properties not allocated from the housing stock (41 in 1991) that represents the potential for the protection of cultural heritage and understanding of the development of the local landscape.

The area of interest in the Východolabská tabule below the Kunětická hora lies between Pardubice and Hradec Králové and is crossed by the Opatovice Canal, which has been feeding the local pond system since the 18th century, drained and converted to farmland and forest land. Instead of the ponds one can find sandpits with continued sand mining at present. They have often adopted the names of the ponds (Oplatil). The Gigant ("Giant") sandpit took its name from a closed pig farm (now a feed mill). Sand mining and processing are among major economic activities, the most important being Hans (formerly Prefa), a concrete construction company with more than 100 employees (headquarters in Prague), and Cemex, a manufacturer of concrete floors. Good transport accessibility (the D11 motorway, the R37 expressway and the main line between Pardubice and Hradec Králové) gave rise to a business zone near the Opatovice power plant (which partly extends into the Čeperka cadastre). Tourism is beginning to develop in the vicinity of the sands.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). At the end of the 18th and the beginning of the 19th century there was a rapid mass closure of most of the ponds established on the Pardubice estate in the 15th and 16th centuries. The reason was intensification of agriculture. In the fertile Polabí region, most of the ponds were converted into arable land. Instead of the former large ponds, which dominated the landscape for about 300 years, there are now flooded sandpits. In 1839, the local water bodies covered almost one third of the area of interest. Even today, their proportion is significant. The area has another specific feature. Between the period of the stable cadastre and the present day, there has been an increase in the area of arable land of more than 12%, largely at the expense of permanent grassland.

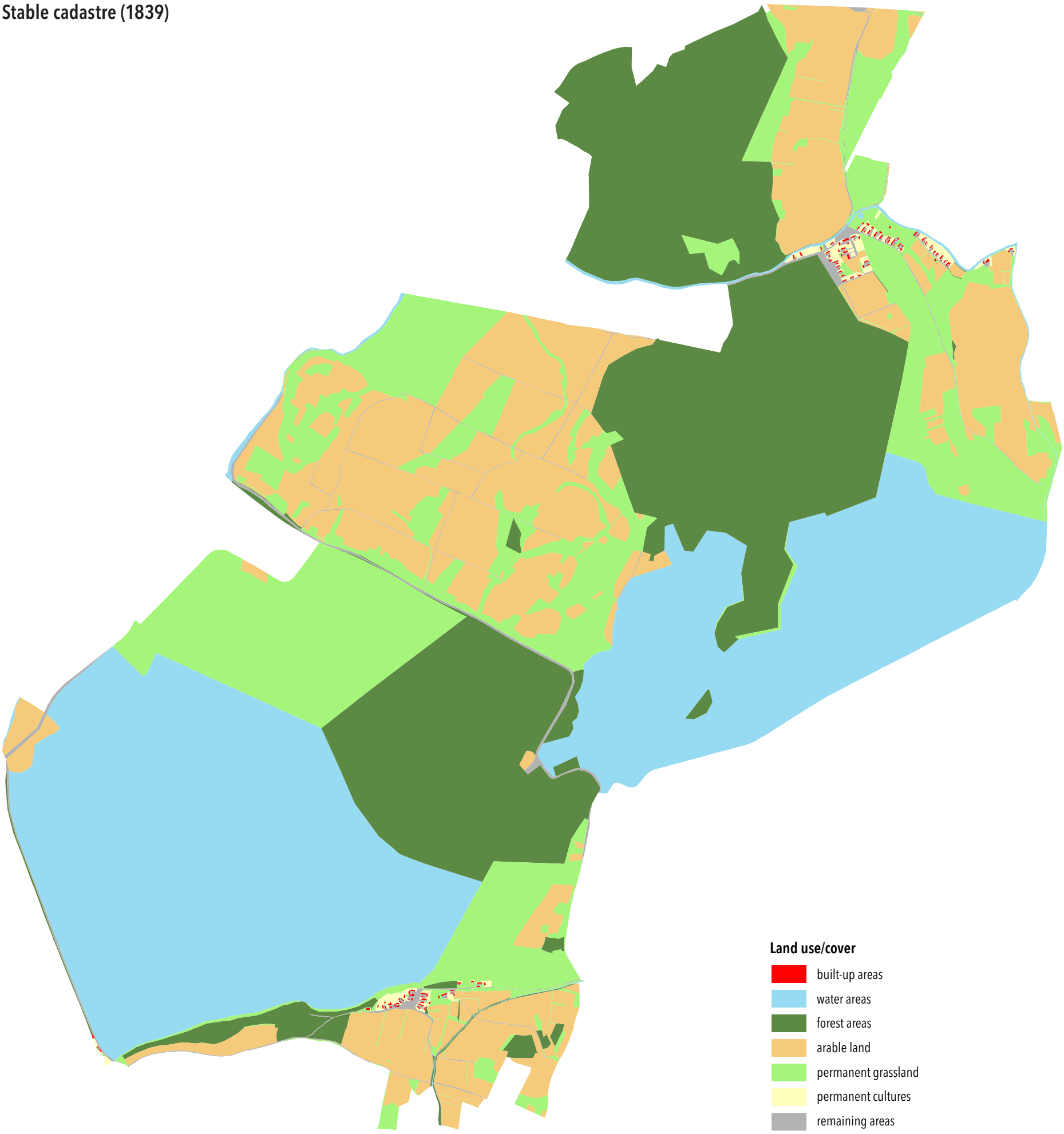

Fig. 3 – Land use/cover in cadasters Čeperka and Stéblová in 1839 and 2020 (current state).
Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

Current state (2020)

Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.09	0.98	0.88
water areas	32.25	14.42	–17.83
forest areas	27.20	34.60	7.40
arable land	19.64	32.08	12.45
permanent cultures	0.35	0.29	–0.05
remaining areas	1.05	10.59	9.54
permanent grassland	19.42	7.04	–12.39

1954

2018

Fig. 4 – Models of landscape – Čeperka and Stéblová landscape in 1954 and 2018. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

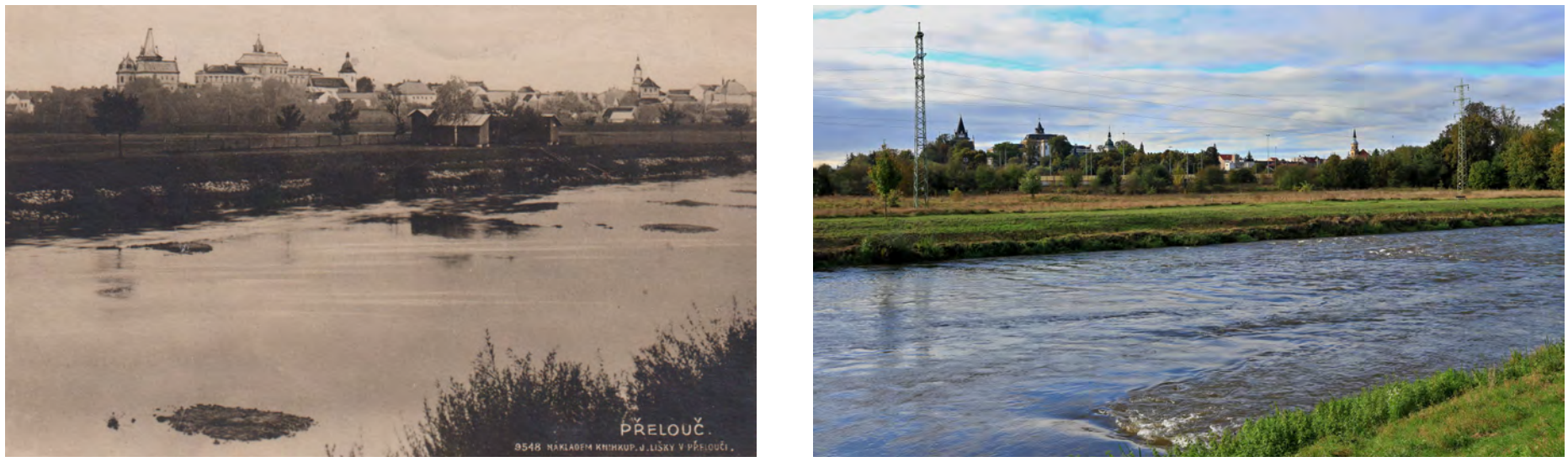

Fig. 5a – The view of Přelouč. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

Fig. 5b – The view of Lázně Bohdaneč, Pod Lipami Street. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

The decline in permanent grassland has been accompanied by an increase in woodland. Settlement areas (both built-up and other areas) have also expanded. Thus, agricultural use intensified in this area. The change was not very common in the Czech landscape in the period under review. This is due to the good natural conditions for agriculture (good quality soils and favourable climatic conditions).

A comparison of the images from the 1950s and the second decade of the 21st century (Figure 4) shows in particular an increase in the proportion of water bodies in the area of interest. This was largely due to the flooding of the sandpits in the second half of the 20th century. Newly created anthropogenic lakes are also found in the sites of the original Oplatil and Velká Čeperka ponds. There is also an increase in woodland. The presence of relatively large forest and water bodies strengthens the recreational use of the model area. During more than 60 years, the development of housing has taken place in both villages, which are conveniently located between Pardubice and Hradec Králové in terms of accessibility. Another important element is the establishment of the Malá Čeperka industrial complex with the production of precast concrete and concrete mixtures.

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in comparable territorial units and describe changes over time by comparing the years 1845, 1896, 1948, 1990, and 2010.

The long-term trend in the extent of arable land between 1845 and 1948 showed an increase in the range of 15–30%. Most of this can be attributed to the reclamation of the Elbe banks, which led to the removal of dead channels, pools and wetlands on the lowest river floodplain. After 1948, the extent of arable land varied from settlement to settlement within 3% to around a hundred. This development prompted the opposite changes in the extent of permanent grassland: the long-term trend was characterised by a decline in permanent grassland to a level of 70–80%, mainly due to the disappearance of pastures, as livestock was mainly transferred to stables. In the period before 1989, the decline in permanent grassland continued, albeit to a lesser extent (5–10%).

After 1990, when rural restitution and privatisation took place, the trend was almost the same. Due to the exposure of the model area, the extent of built-up areas has increased at least twofold in the long term, and when changes in the extent of other areas are taken into account, the total increase (built-up and other areas) is more than threefold. The small extent of floodplain forests on the banks of the Elbe has decreased by about 5–10% in the long run.

The overall intensity of changes in land use structure is expressed as an index of change (Bičík et al. 2010, 2015; Figure 9). This indicates major modifications in land use since 1845 for the model area, as it shows the values above 40 (on a scale of 0–100) in it. Crucially, most of the land-use change took place between 1948 and 1990 (at a level of around 20). The area was also characterised by a major change in the composition of agricultural landscape, as original small-scale plots were turned by ploughing into huge tracts of land of over 200 ha. This suggests that substantial changes can be expected in terms of the ecology and future of the landscape, as this situation continues after 1990.

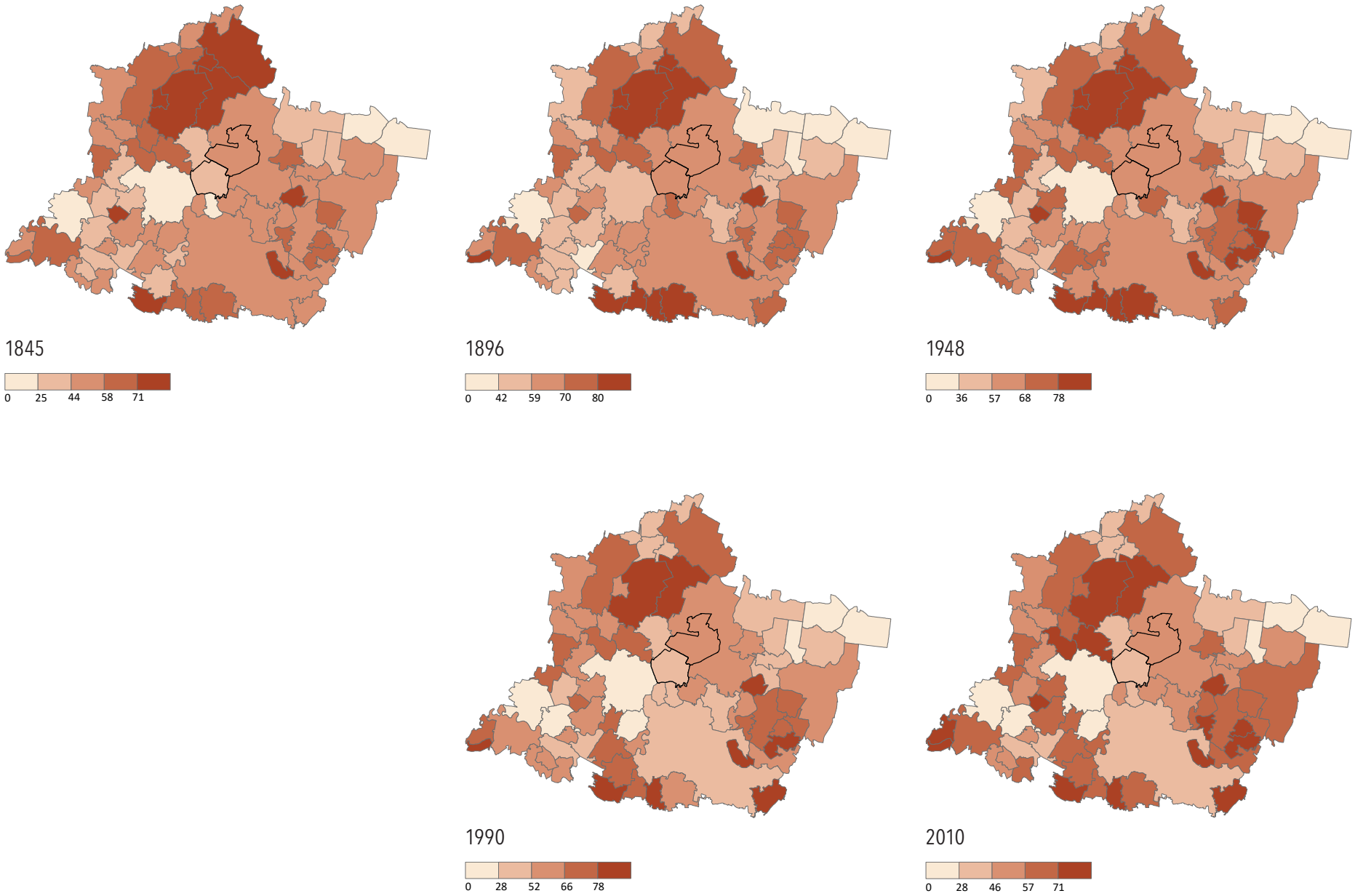

Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

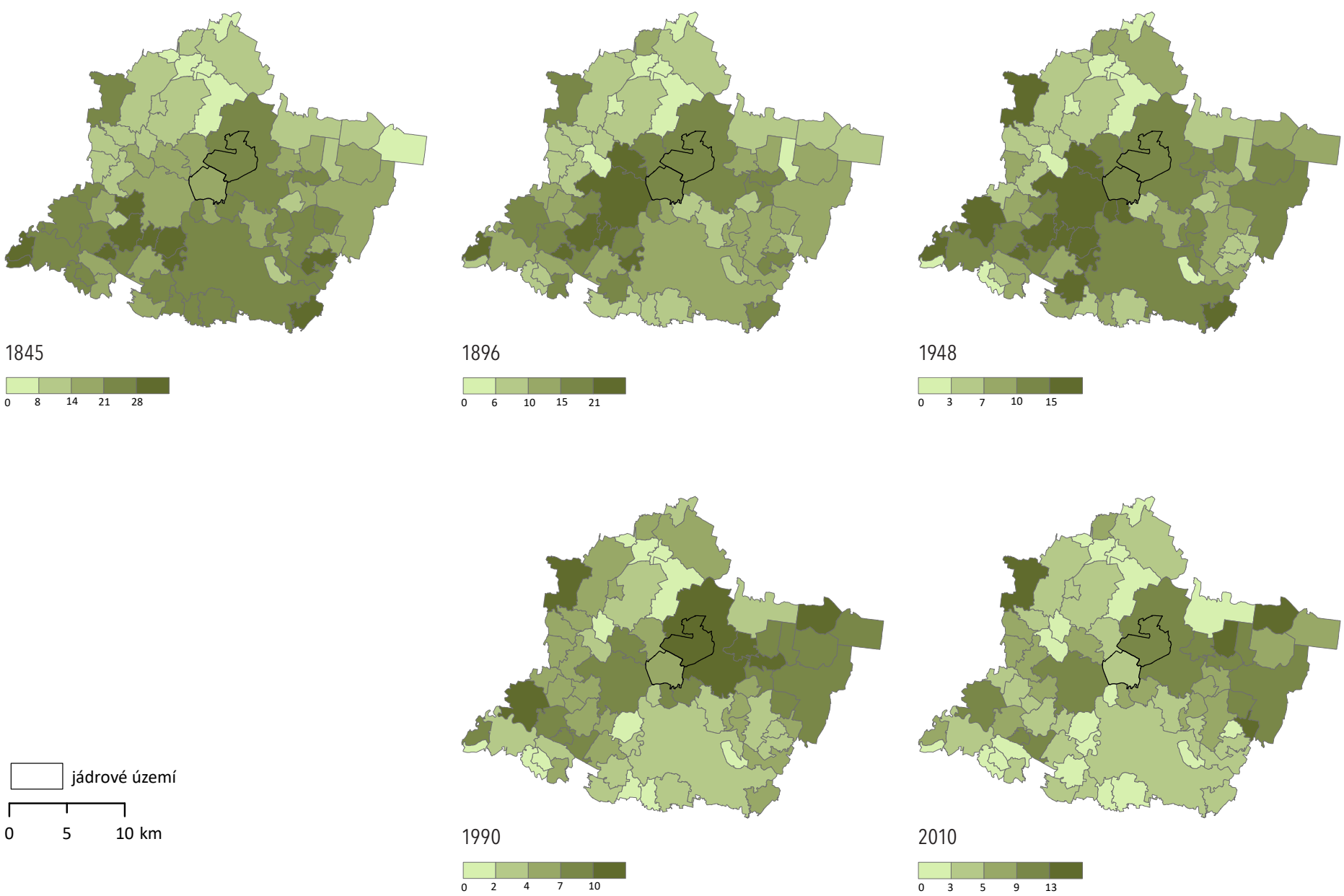

Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

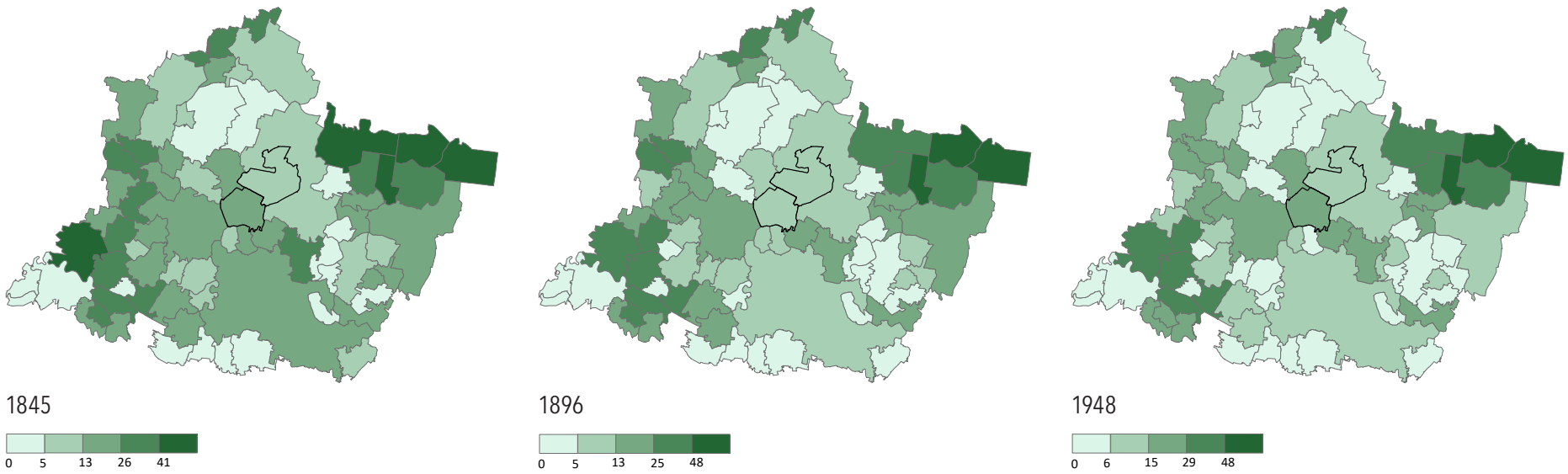

Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

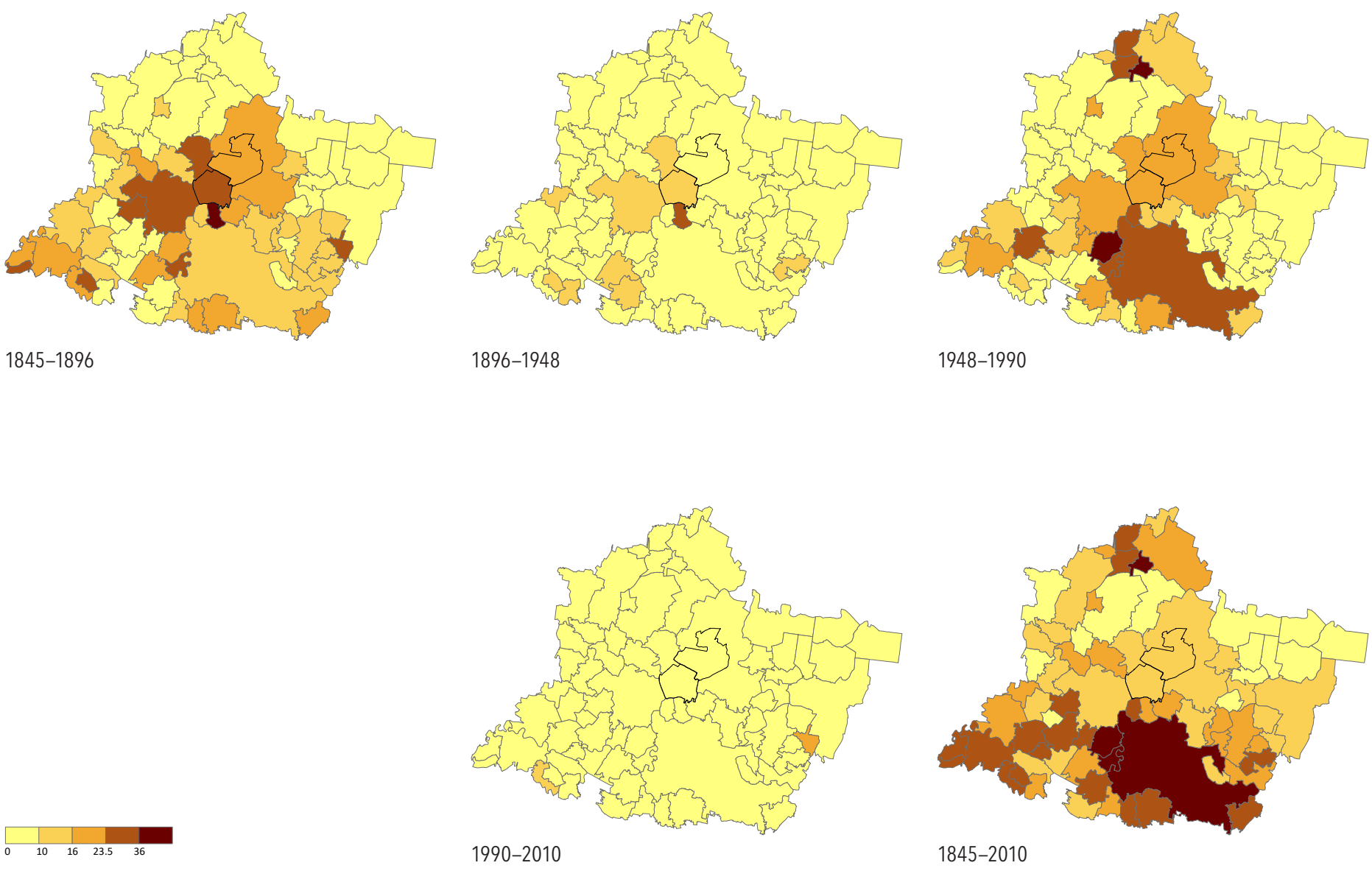

Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

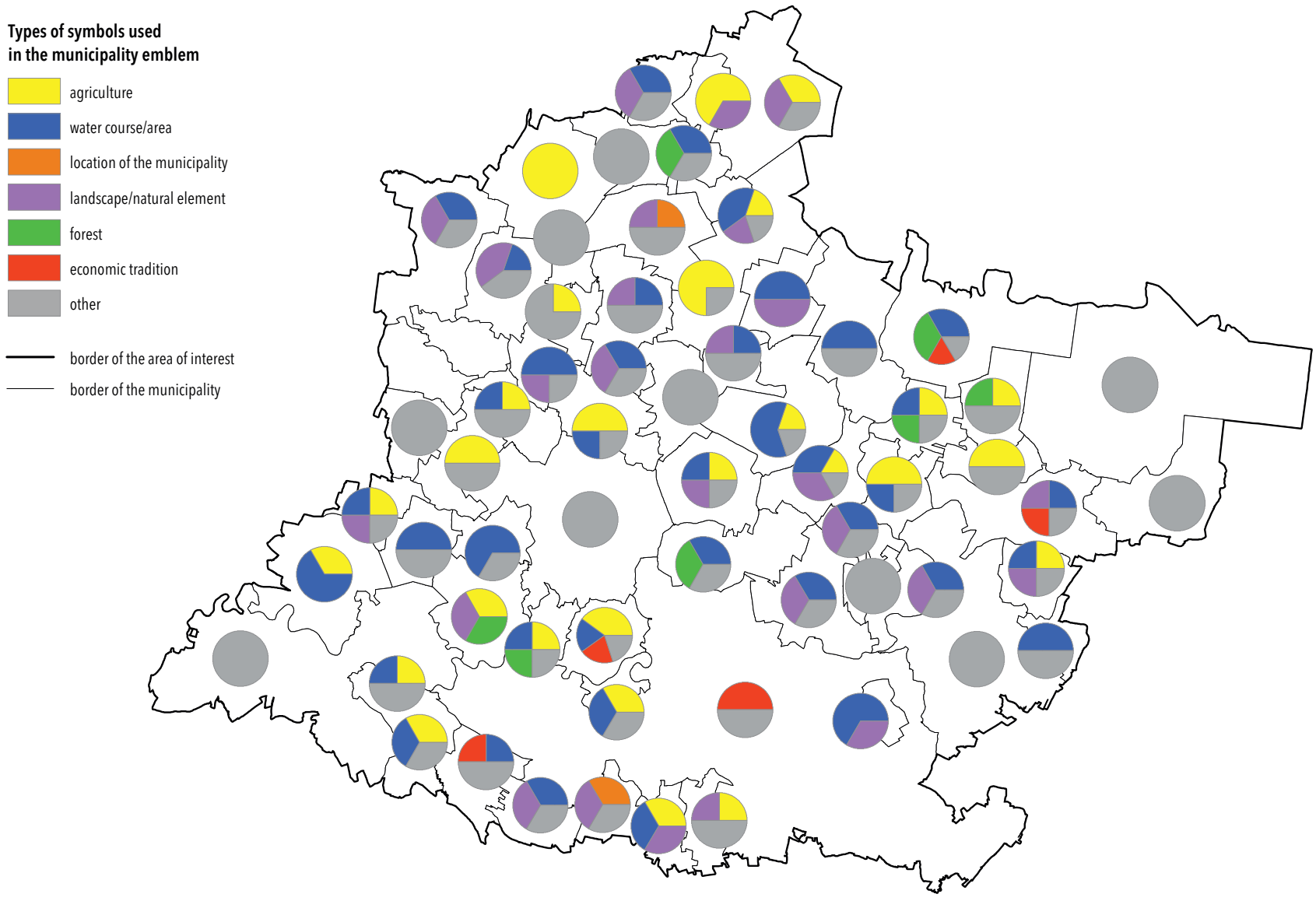

Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

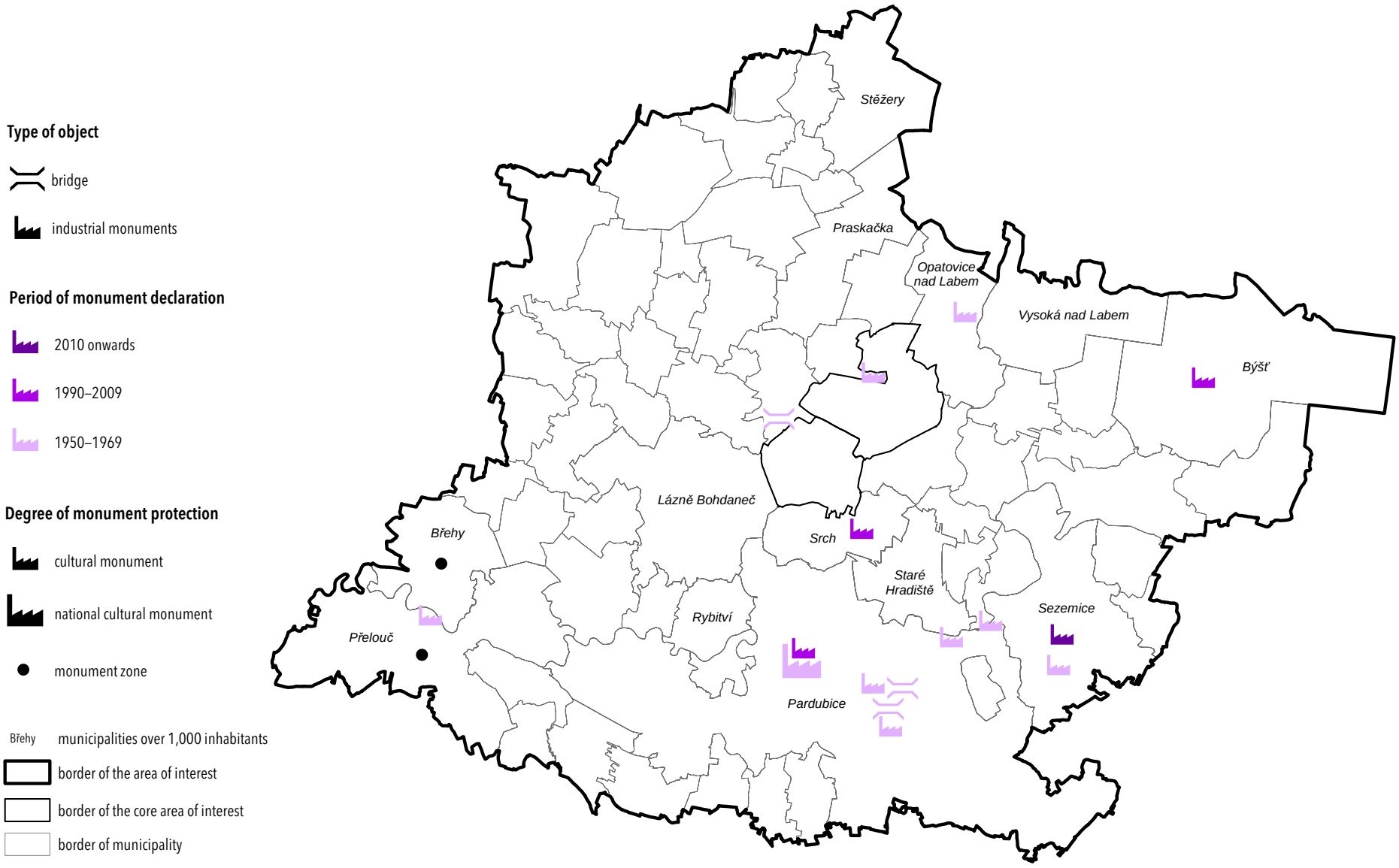

Fig. 12 – Cultural monuments and heritage areas.
Data source: National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

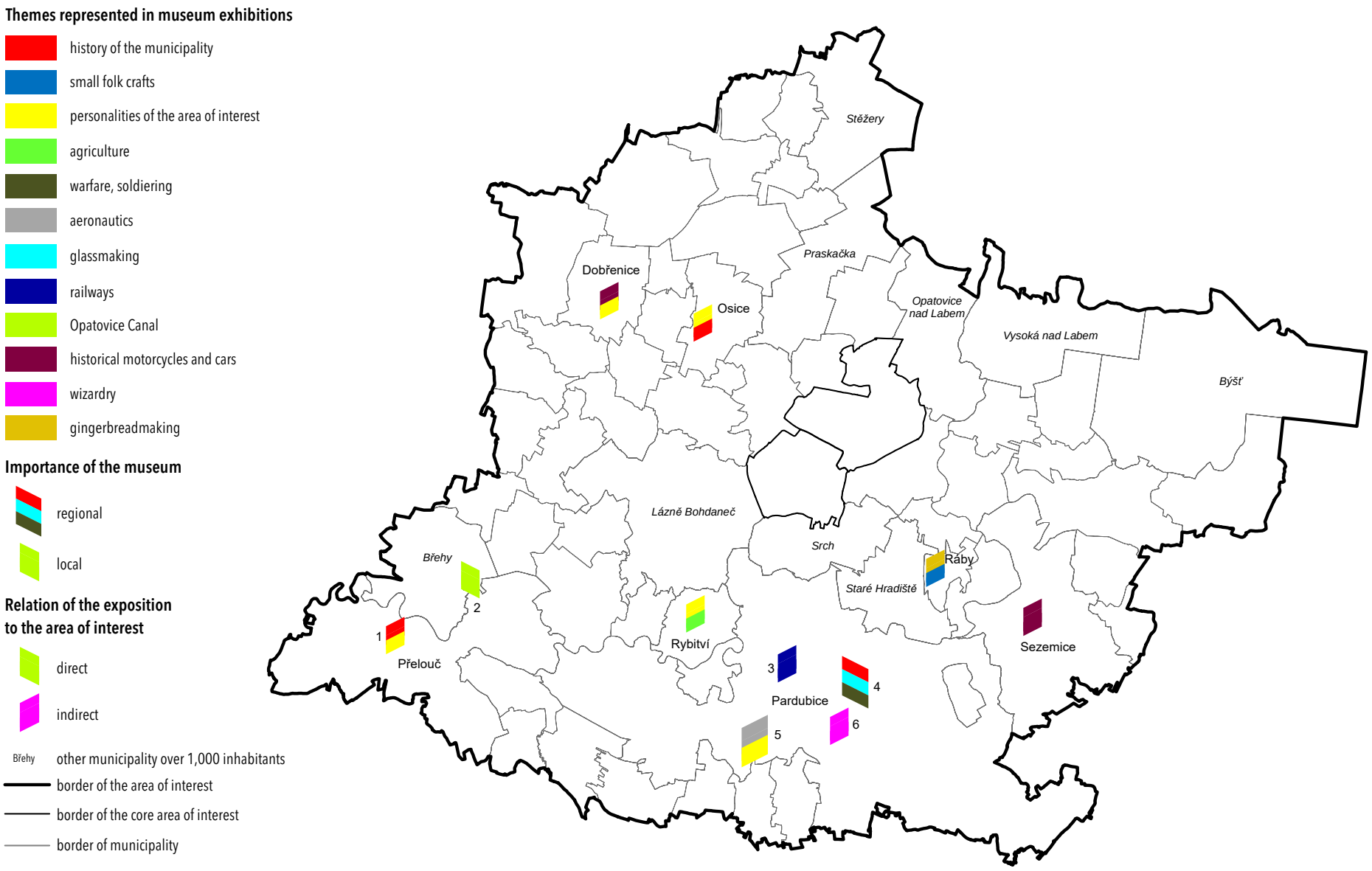

Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in following sections 3.2.1.–3.2.3. (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

The Pardubice region was home to one of the most important pond systems in Bohemia from the late 15th to the 18th century. However, unlike the South Bohemian areas, the ponds in Pardubice were gradually drained and only a fraction of them remain today. However, the memory institutions in this area do not devote much attention to the issue of fish farming in their exhibitions.

The only exhibition that is closely related to the transformation of the landscape as a result of the disappearance of the pond system is the Museum of the Opatovice Canal in Břehy. It presents the Opatovice Canal as a work created for the purpose of feeding the Pardubice ponds, which has been declared a cultural monument. The museum is housed in the building of the former mill in Výrovo. Since 2010, it has been undergoing a complete reconstruction and it is only accessible during important events, such as the celebration of 500 years of the Opatovice Canal.

The largest regional museum dedicated to Pardubice in a broader historical context is the East Bohemia Museum Pardubice. In the exhibitions of this region one can find interesting themes. They are undoubtedly from the sphere of the military and aviation, remembrances of local notable natives (e.g., the Veverka cousins, whose contribution to agricultural production was widely used in the territory of the Polabská nížina lowlands), or the production of Pardubice gingerbread. Today, the Museum of Gingerbread and Fairy Tales in Ráby is a great attraction not only for young children but also for adults.

As in other areas, some exhibitions are being built in Pardubice that have no connection with the history of the region and serve purely to increase the attractiveness of the site for different types of visitors (e.g., the Museum of Magic).

Archival documents for the Pardubice region can be found in the state regional archive in Zámrsko or directly in its branch, the state district archive in Pardubice.

3.2.2. Regional and local symbols

Ponds (as water bodies they are part of the blue category in the cartogram, Figure 10) are strongly reflected in the symbolism of municipalities in Pardubice. Ponds are symbolised in blue in the coat of arms of the municipalities of Břehy (the Buňkov pond), Časy (the blue foot of the sign refers to the Labská pond), Dobřenice, Křičeň, Neratov (together with a pike), Osice, Rohoznice (together with the wavy crossbar refer not only to the Klechtávecký and Starý ponds, but also to the Rohoznický potok brook), Rokytno (both the pond and the Bohumilečský potok brook, with carp as a symbol of traditional fishing), Spojil (together with the white crossbar, it refers to the Spojil and Strejček ponds), Urbanice (together with the figure of a perch) and Valy.

The wavy foot of the Stéblová coat of arms represents the ponds Oplatil, Hrádek, Jezero and others, which are located in the municipality. The Pohránovský pond is also symbolised in the coat of arms of Srch. The blue wedge in the emblem of Vlčí Habřiny refers to the Sopřečský pond. The wavy shield in the coat of arms of Čeperka refers to the ponds Oplatil, Čeperka and Machač. Moreover, it is also a symbol for the Opatovice Canal in this coat of arms. The Opatovice Canal is also expressed in the municipal emblems of Podůlšany (blue tincture), Přelovice (blue and the wavy bar). In the aforementioned emblem of Srch, besides the pond, the Velká strouha drain is also represented by a wavy foot. Velká strouha was built in the Middle Ages and was used to feed a system of ponds. The canal starts at Čeperka, where it separates from the Opatovice Canal, which brings water from the Elbe. The blue tincture in the coat of arms of the municipalities in the Pardubicko area of interest, often together with references to other watercourses and areas (especially the aforementioned ponds), of course symbolises the most important river flowing through the region – the Elbe. It is depicted in the emblems of the municipalities Bukovina nad Labem (blue), Černá u Bohdanče (the wavy bar is a symbol for the nearby Elbe River and also for the Rajská struha stream – which is also depicted in blue in the emblem of Bezděkov), Hvozdnice (blue – the proximity of the Elbe and the Pašát stream), Časy (blue foot and a boat – the proximity of the Elbe), Dříteč (blue), Choteč (blue), Kunětice (blue), Němčice (blue), Opatovice (blue and a silver crossbar), Plch (blue), Rybitví (blue), Srnojedy (blue), Staré Hradiště (a wavy crossbar), Urbanice (blue and perch), Valy (blue), Veselí (blue), Vysoká nad Labem (blue, the wavy crossbar in the same emblem symbolizes the Opatovice dam).

In the coat of arms of the municipality of Hrobice, the blue colour and the wavy crossbar also represent the Elbe River and three protected water features with rare flora and fauna that lie in the cadastre of the municipality – Baroch (a grounded pond with adjacent reedbeds, forest and meadow communities, an ornithological site), Tůň u Hrobic (a dead arm of the Elbe with riparian vegetation) and Labiště u Němčic. Other smaller watercourses are included in the coat of arms of the municipalities of Barchov (a blue wavy bank – Podolský brook), Dolany (a silver foot – Černská strouha, Ždánická stoka), Kratonohy (blue – several streams and wetlands), Libišany (blue – a local stream), Radíkovice (blue – the Radíkovický brook), Třebosice (a wavy bank – the Bylanka and Dubanka rivers).

The symbolism of the emblems of the municipalities in the Pardubice Region also reflects the landscape features (in purple in Figure 11) typical of the Polabská nížina lowland, the banks of numerous local watercourses, ponds and wetlands. Such features include the symbol of bulrush as a typical plant in these areas. The bulrush is found in the coat of arms of the municipalities of Hrobice (here, moreover, it underlines the reference of the above-mentioned protected areas), Plch, Spojil and Stéblová. In the emblem of the municipality of Rohoznice, a typical plant in the local wetlands is represented by the figure of a reed. In the emblems of Barchov and Rokytno, the abundance of willows is represented by willow rods. The alder tree in the emblem of Podůlšany is also a talking sign. The coat of arms of Vlčí Habřina depicts hornbeams (also a talking sign). The stork in the coat of arms of Dobřenice is an emblem element, but also a reminder that storks used to be abundant here.

In addition, symbols for memorial trees (lime leaves – linden trees in Dobřenice), Lhota pod Libčany (lime leaves), Starý Mateřov (linden tree), Stěžery (lime leaves), Urbanice (lime leaves – the memorial Švehlova linden tree), Staré Jesenčany (ash leaves – a talking sign, but also stands of ash trees in the vicinity of the village), Živanice (linden tree) appear in several municipal emblems in Pardubice. The category of landscape and natural features also includes landscape landmarks such as references to mountains, important buildings and other specific places. The emblem of Choteč depicts the Kunětická hora mountain as a blue spike. The coat of arms of Kunětice features the Kunětice castle. The depiction of the fortress in the coat

of arms of Staré Hradiště is based on the past when a fortress stood in Staré Hradiště. The coat of arms of Němčice depicts a bridge, the existence of which is mentioned in the oldest surviving land registry of the Pardubice manor, established and used after 1494. The scallop symbolizes the church of St. James in Kratonohy, the coat of arms of Libišany depicts the local chapel, the church as a dominant feature of the village is found in the coat of arms of Osice, and that of Radíkovice depicts the local bell tower.

The coat of arms of Těchlovice symbolically depicts the local chapel of the Virgin Mary (since the chapel was built on the highest point of the village, it used to be its dominant feature, but due to the later developments it is no longer there). The goat in the coat of arms of Třebosice is a reference to the archaeological discovery of a prehistoric statuette, which was made in 2013.

The agricultural tradition of the region is closely linked to the fertile Polabí region (in yellow in the cartogram). The "golden stripe" of the Polabí region is often depicted in the coat of arms of the villages in the area of interest (Břehy, Bukovina nad Labem, Černá u Bohdanče, Čeperka, Dříteč, Rybitví, Stěžery, Vlčí Habřina, Živanice). Fertile soil (specifically red earth) is also symbolised by red tincture in the coat of arms of the villages of Dříteč, Třebosice and Valy. Other elements symbolising agriculture are green (Borek, Osičky, Srnojedy, Staré Jesenčany, Těchlovice, Urbanice, Veselí). Green together with ears of wheat is found in the emblems of Dolany, Praskačka (with the figure of a chicory) and Újezd u Sezemic. Only ears of wheat are depicted in the municipal emblems of Choteč, Křičeň and Stéblová. The green, a sheaf and a ploughshare refer to the agricultural character of the municipality in the coat of arms of Roudnice. A ploughshare is also in the coat of arms of Bukovka. In the emblem of Hrobice the apple blossom symbolises orcharding, in the coat of arms of Těchlovice the cherry blossom has the same function.

The numerous ponds and rivers also include fishing (belonging to the category of economic tradition – in red in Figure 11). Fishing is represented by the figures of fish in the coat of arms of Bezděkov and Rybitví (in addition to the "talking sign"). Other symbols of traditional economy, which are unique in the symbolism of Pardubice municipalities, are the black tincture in the emblem of Vysoká nad Labem, where it represents the traditional production of charcoal. The horse in the coat of arms of Pardubice can also be considered partly a symbol of traditional economic activity. The horse in the coat of arms of the town is primarily a symbol of peace and resilience, but today it is also associated with the local racecourse and stud farm.

There are also a few elements symbolizing forests in the coat of arms of Pardubice municipalities. The pine cones in the emblem of Borek refer to the pine forest and this is also a talking sign. Similarly, there are the figure of a beech tree in the coat of arms of Bukovina nad Labem as well as the black oak tree in the coat of arms of Černá u Bohdanče, where deep oak forests were originally found. Oak leaves also represent local oaks in the municipal coat of arms of Hvozdnice and Srch. In the emblem of Živanice, the oak forests are symbolised by the figure of an acorn, in the coat of arms of Vysoká nad Labem by green. Very unique symbols are the green trefoil in the coat of arms of Starý Mateřov and the wedge in the coat of arms of Lhota pod Libčany, which refer to the location of the villages in a slightly undulating landscape, which is otherwise typically very flat in the Pardubice Region.

As of 1 October 2020, 96.9% of the municipalities in the Pardubicko area of interest (62 out of 64 municipalities) have a municipal emblem.

3.2.3. Heritage sites

In the area of interest of the Pardubice region, the extinct pond system is monitored. There are several industrial buildings connected with water management and construction (water mills, dams and canals, aqueducts, reservoirs or bridges). Most of the features have the cultural monument status, which they acquired between 1950–1969 or 1990–2009. However, two significant monuments are exceptional. The first is the Winternitz Automatic Mills national cultural monument, which is a monumental set of automatic mill buildings built in stages in the early 20th century in the Art Deco style according to an original design by Josef Gočár, a leading figure in Czech modern architecture. The second is the National Stud at Kladruby nad Labem UNESCO World Heritage Site, the core of which lies in the values of the cultural landscape adapted for horse breeding. In this landscape complex, however, many elements of water engineering can also be found.

4. Summary

The Pardubicko model area represents a specific landscape that has undergone major changes in the past with the construction of ponds and canals connecting them. This is a significant intervention in the traditional landscape and it would undoubtedly be worth preserving this heritage for the future. Another major change was the closure of a number of ponds in the second half of the 19th century, which is also a major intervention in the use of the landscape. Finally, a third intervention is the current trend towards suburbanisation and the search for sites for recreational use, which are also contributing to changes in landscape use. It can be summarised that Pardubice is an exposed landscape, which has led to several changes in functions in the past and this is likely to continue in the future. The original residential and agrarian function has been expanded to include water management and fish farming, followed by the agricultural production function. Today it is an area with residential, commuting and agricultural production functions in an exposed background of strong regional centres. In the future, residential, transport, manufacturing and warehousing suburbanisation can be expected to further modify this area. Therefore, it is necessary to protect some of the artifacts associated with the land use history of this area to help develop the leisure uses by the residents of the model area and the two regional cities.

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CHAPTER 8

Zahrádky u České Lípy: defunct feudal landscape

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1. Introduction

The Zahrádecko region represents a type of vanished feudal landscape, which was created here as a composed, purposefully aesthetically arranged landscape during a long period from the 17th to the 19th century. The landscaping was based on the representative manor house, the castle in Zahrádky, which is first mentioned in 1556. Originally a Renaissance chateau from the 16th century, it was owned by the Vartenberks, followed by Albrecht von Wallenstein and after his death by the Kounic family, who had the chateau heavily modified in the Baroque style. As early as the first half of the 17th century, a large park was established around the chateau, which was later modified in the Baroque style and enriched with a brick gloriette. The park lies mainly to the west and north-west of the chateau on a sandstone terrace above the incised valley of the Robečský potok brook. In the 18th and 19th centuries, the park landscaping extended from the castle far into the surrounding countryside. This included, for example, the extensive Novozámecký rybník pond, founded as early as the 14th century in the time of Charles IV, on which a fishing bastion, a music pavilion and a boat dock were built.

The flat landscape to the south of Zahrádky was intersected and aesthetically enriched by straight lines of trees. The most famous is the almost 2 km long, Valdštejnská alej linden avenue, which leads from the chateau in Zahrádky to the Novozámecká pheasantry and the Vřísek game preserve. The game preserve and the pheasantry are among the oldest in Bohemia, having been mentioned as early as the 16th century. The Vřísek game preserve included a Renaissance hunting lodge called Žižkův hrad, and the pheasantry was enriched by a circular summer house in the 19th century.

Apple tree avenues are a tradition and a particular feature of the garden landscaping. The oldest apple tree avenue was established in 1799 and led from Zahrádky to the secluded St. Barbara's Church. Since the early 19th century, landscaping has also included the romantic canyon-like Peklo (Hell Valley), carved in sandstone cliffs. A chestnut avenue connects it to the castle. In the early 19th century, the Peklo was landscaped in the romantic style that took advantage of the attractive natural scenery of the sandstone cliffs in contrast to the flowing water. An artificial cave, an inn and a summer house called Nový dvůr were built on the sandstone rock with a spectacular view of the valley. The Robečský potok brook was navigable throughout the valley and boating through the Peklo was a favourite pastime of the castle's gentry.

This long-established and aesthetically maintained landscape disappeared as a result of political and social changes after 1945. In addition to the nationalisation of the Zahrádky castle and other properties, Zahrádky was also affected by the removal of the German population. However, it was not an absolute devastation of the landscape and the disappearance of settlements as in the border areas, e.g., in the Bohemian Forest, because the German population was not as large and this was not a border area. The way the landscape was managed changed. On the flat areas in the southern surroundings of Zahrádky, the Communist collectivisation created large blocks of arable land, which were gradually cultivated with increasing intensity. On the other hand, on sloping, less fertile or waterlogged land, cultivation became more extensive and less intensive, and the proportion of woodland, scrub and reedbeds increased.

Maintenance of the elements of the feudal landscape created in past centuries was limited to the maintenance of the chateau park in the immediate vicinity of the chateau. Other elements of the feudal landscape have only survived in fragments. One of them is the valuable Valdštejn lime avenue, which was declared a NATURA 2000 site of European importance. On the other hand, both pheasant farms were abandoned and disappeared, and the circular summer palace is a bizarre ruin. The entire valley of Peklo was also abandoned and transformed and now it is densely overgrown and, with the exception of a marked hiking trail, impassable. The Robečský potok brook, once navigable, is completely silted up and overgrown with lush vegetation.

After 2000, with the help of subsidies under landscape programmes, the apple tree avenue from Zahrádky to St Barbara's Church was restored and another avenue of fruit trees was planted perpendicular to it. However, the feudal landscape of Zahrádky as a whole is irretrievably a matter of the past.

For the purposes of this project, a core area was delimited and most analyses are carried out in it (Figure 1). It includes the municipal areas of Zahrádky and Sosnová near Česká Lípa. The wider area of interest (see Chapter 1 of Atlas for more details) is shown in Figure 2.

2. Area of interest: main features

Zahrádecko in North Bohemia in the Českolipsko region is located in the north of the Bohemian Table (Česká tabule), in the geomorphological unit of the North Bohemian Table (Balatka, Kalvoda 2006; Demek, ed. et al. 1987). The geological subsoil is composed of Upper Cretaceous sediments of the Middle Turonian, mainly clastic sandstones, sometimes claystones and siltstones. The Cretaceous sediments are interspersed with pockets of Neogene volcanic bodies, which form striking monadnocks (Provodínské kameny, Lysá skála, Vlhošť). However, in the vicinity of Zahrádky, neovolcanites are almost absent. Instead, they can be seen in the view scenery on the horizon. The bottom of the Jestřebská kotlina basin is filled with the wide loess alluvium

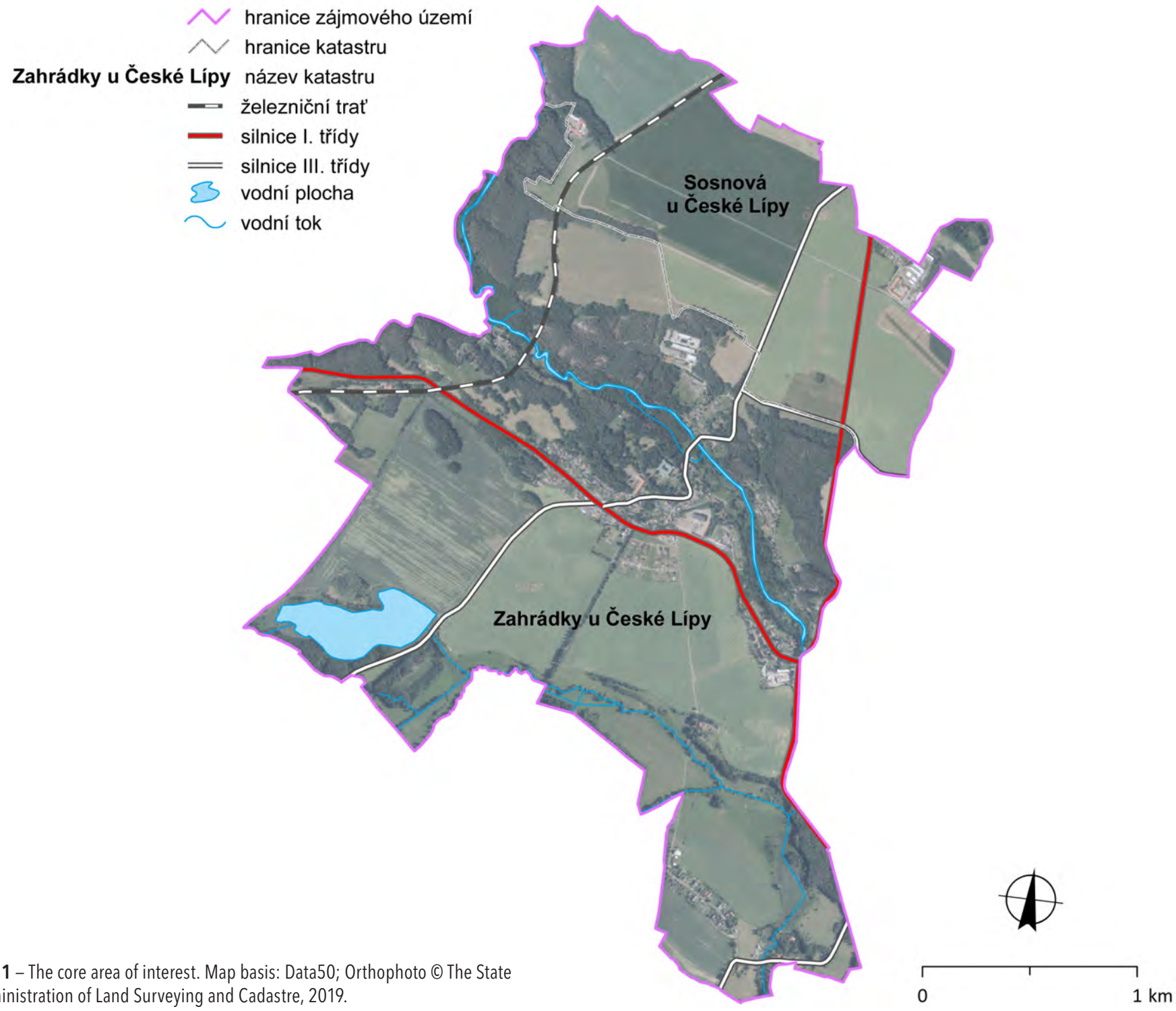

Fig. 1 – The core area of interest. Map basis: Data50; Orthophoto © The State Administration of Land Surveying and Cadastre, 2019.

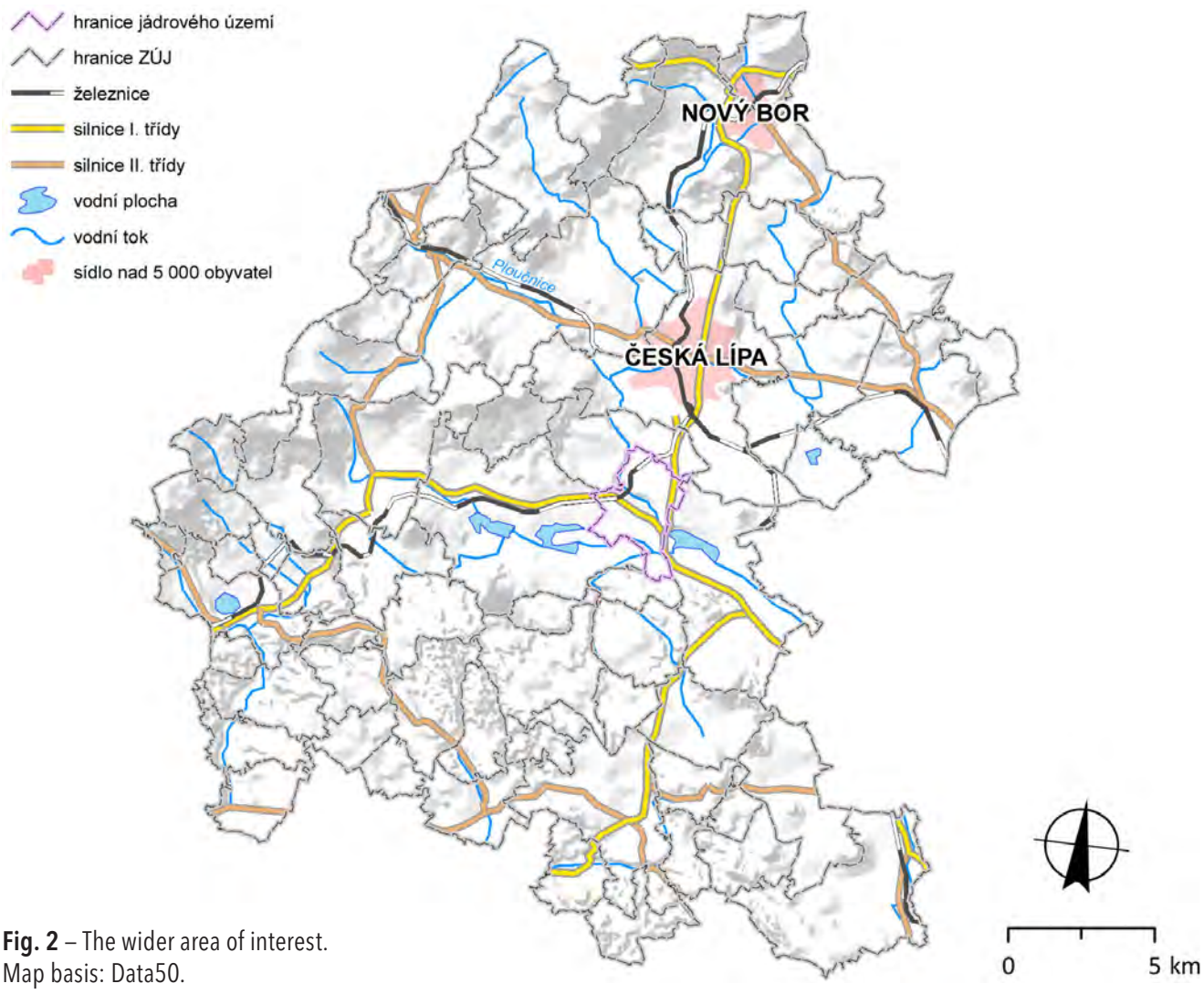

Fig. 2 – The wider area of interest.
Map basis: Data50.

of the Bobří and Robečský brooks, elsewhere the Quaternary sediments only have a small extent and low thickness (except for the loess that covers the Jestřebská kotlina outside the waterlogged floodplains).

Zahrádecko lies at the prevailing altitude of 250–300 m. Above 300 m above sea level, only the low-lying projections of the Polomené hory mountains in the south and individual neovolcanic monadnocks (e.g., Lysá skála or the more distant Provodínské kameny) rise. The surface in the southern surroundings of Zahrádky in the Jestřebská kotlina is flat or only slightly undulating, with wide floodplains of watercourses and height differences of 10–30 m. On the edge of the Polomené hory, the height differences reach 30–50 m, exceptionally even more (Pruský kámen). To the north of Zahrádky, the dominant macro-form of the relief is the canyon-like valley of the Robečský potok brook, called Peklo, cut into a sandstone plateau with an elevation of 30–50 m. On the slopes of the valley, typical sandstone rock formations are exposed, formed by cobble sandstones. The sandstone rocks extend into the village of Zahrádky in its lower part near the Robečský brook. Elsewhere, the sandstones rise to the surface only sporadically.

The area lies in a climatic region originally classified as moderately warm, but now the area of Zahrádecko and Českolipsko, namely the Jestřebská kotlina, is classified as a warm, reasonably humid climatic region with long summers and moderately cold winters due to the overall warming of the climate (Quitt 2009). The average annual air temperature ranges between 8 and 9 °C, and the average annual rainfall is slightly above 600 mm. However, longer dry periods can occur. Winters are mild with erratic snow cover and numerous inversion situations.

The soils are most fertile in the Jestřebská kotlina: brown soils on the loess south of Zahrádky, which are also used agriculturally as fields. At the edges of the basin, the brown earths give way to luvisols and arenaceous Cambysoils on weathered chalk sandstones. The sandstones themselves have then formed poorly fertile arenaceous podsols. Pseudogley soils occur on permanently waterlogged valley bottoms around the ponds.

Zahrádecko lies in the phytogeographical district of the Bohemian-Moravian Mesophytic, the phytogeographical district of Podještědí and the subdistrict of the Českolipská kotlina basin (according to Skalický et al. 2009). Natural forest area North Bohemian Sandstone Plateau, forest vegetation stage beech-oak. According to Neuhäuslová et al., the potential natural vegetation would consist of acid pine and oak forest, and in the broad floodplains on the floor of the basin, bird cherry and ash as well as bird cherry and oak forest in a complex with wetland alders.

The current land use in the flat landscape south of Zahrádky is characterised by large areas of arable land. In contrast, the rugged relief of the sandstone valley of Peklo north of Zahrádky is overgrown with dense, unmaintained forest. Pine trees grow on the sandstones, otherwise deciduous forests, mostly with oak (e.g., Bažantnice), predominate. Considerable areas in the Jestřebská kotlina are occupied by the water surface of several large ponds and in the vicinity of the Novozámecký rybník pond there are also waterlogged meadows and reedbeds.

The varied natural conditions around Zahrádky include two contrasting types of environment and communities: on the one hand, the rugged relief of sandstone cliffs with relict pine and xerophilous communities, on the other hand, wetland, aquatic and littoral communities on and around the large ponds. The most valuable in this respect, and also the largest, is the Novozámecký rybník national nature reserve, covering the area of 368 ha. There are up to 220 bird species, rare amphibians and endangered plant species. The next is the Peklo national nature monument, which protects the canyon-like valley of the Robečský potok north of Zahrádky on an area of 58 ha. The valley is famous for its mass occurrence of spring snowflake. The Zahrádky nature monument includes the castle park and the Valdštejn lime avenue and is also a site of European importance due to the presence of hermit beetle in old trees. The Kokořínsko – Máchův kraj protected landscape area does not extend directly into Zahrádky, but covers a wider area of interest.

Zahrádky is located about 6 km south of Česká Lípa, at the crossing of two first class roads from Prague and Litoměřice to Česká Lípa. Part of the village with about 700 inhabitants is formed by the local districts of Šváby and Borek, located south of here on the northern edge of the sandstone outcrops of the Kokořínsko protected landscape area. The location of the village and its two local parts is influenced by a large pond (Novozámecký) formed by the Dolský and Robečský brooks. The pond is a national natural monument and a bird sanctuary. In addition, the pond's water supply as well as water drainage is provided by artificially carved rock passages. After flowing through Zahrádky, the Robečský potok turns northwards and creates an interesting gorge in the sandstone rocks called Peklo, about 4 km long. It is a national natural monument with protected plant species, widely visited by tourists.

The dominant feature of the village of Zahrádky is a picturesque Renaissance chateau from the mid-16th century, which was rebuilt at the end of the 19th and start of the 20th centuries. Nowadays the castle is in a state of disrepair after a fire. It is surrounded by a large park. In the 19th century, it included the rock canyon of the Robečský potok called Peklo, now a national natural monument with a rich occurrence of spring snowflake, and the Valdštejn lime avenue (300 years old), leading to one of the oldest pheasantries in Bohemia. At present, it houses breeding of the wild goat and mouflon.

In the village of Karba, a 209 m long railway viaduct built at the end of the 19th century (1898) crosses the valley of the Robečský potok. The park is surrounded by a stone wall. As the village has preserved its distinctive timbered folk buildings and an interesting railway viaduct in the local part of Karba, the whole area was declared a village heritage site.

In addition to the village itself, the model area of Zahrádecko also includes the hinterland, which is strongly diversified, especially from the natural point of view. From the south, the wider hinterland of the model area is formed by the rugged landscape, which passes into the wider valley of the Ploučnice River and the Robečský potok. From the north, the model area is encroached by the remnants of sandstone cliffs and the eastern edge of the Bohemian Central Highlands with a number of peaks of former volcanic activity. In the middle, the whole area has a lowland stretching from the east to the west, which forms a natural link between Děčín via Česká Lípa and Liberec, and to the south, a road connection to Mělník and Prague "forces its way" through the rugged terrain of the Kokořínsko protected landscape area towards Mělník. This area has a slightly higher population density, as it was possible to develop agriculture successfully here. In the Middle Ages, a network of ponds and special facilities was built here to provide water management and fish farming.

In other parts of the model area, agriculture was mainly traditional, primarily subsistence farming. This corresponded to the relatively populous settlement of a predominantly German population in the past, which also extended into the model area of Zahrádky near Česká Lípa. Due to the location of the area outside major development centres, neither in the past nor today, it is possible to assess the model area as a sort of borderline between semi-periphery and periphery. From the economic

Stable cadastre (1843)

Land use/cover

- built-up areas
- water areas
- forest areas
- arable land
- permanent grassland
- permanent cultures
- abandoned land, scrubby vegetation
- remaining areas

Fig. 3 – Land use/cover in cadaster Zahrádky u Čerské Lípy in 1843 and 2020. Map basis: The State Administration of Land Surveying and Cadastre. Processed within the project NAKI II – DG18P020VV008.

Current state (2020)

0 0.5 1 km

Tab. 1 – Proportion and change of land use/cover classes between 1840 and 2020

Land use/cover class	proportion in 1840 (%)	proportion in 2020 (%)	change (% points)
built-up areas	0.64	1.07	0.43
remaining areas	7.65	7.74	0.10
water areas	2.65	3.06	0.41
forest areas	9.06	19.09	10.04
arable land	61.09	39.55	–21.54
permanent grassland	16.76	21.48	4.72
successional vegetation	0.00	3.14	3.14
permanent cultures	2.15	4.86	2.71

Fig. 4 – Models of landscape – Zahrádky u České Lípy in 1954 and 2019. Source: Aerial photos © Military Geographical and Hydrometeorological Office in Dobruška, Ministry of Defence (2018); Orthophoto © The State Administration of Land Surveying and Cadastre, 2018.

Fig. 5a – The view of Zákupy. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

Fig. 5b – The view of Česká Lípa. Source: Archive of the NAKI project No. DG18P02OVV008. Photo (2020): Zdeněk Kučera.

point of view, it can be argued that uranium ore mining developed on the outskirts of the model area (Hamr na Jezeře) in the post-war period, which led to a strong labour migration to Česká Lípa in the 1970s and 1980s. The mining and the basic processing of the extracted ore severely damaged the landscape, but the Communist government had to pursue the extraction and everything was exported to the USSR. There are documents showing that deep fissure pollution from the extraction of thin uranium seams deep below the surface reached as far as the Polabí region through the underground. The gradual decommissioning of uranium mining was desirable from the point of view of nature conservation, but it also led to the necessary securing and disposal of the remnants of mining for at least another twenty years (the DIAMO enterprise) and to the construction of further manufacturing facilities (mainly in Česká Lípa and Nový Bor).

The area of interest of the Zahrádky composite landscape lies south of Česká Lípa, northeast of the Máchovo jezero lake. Long-term care of the landscape has also been reflected in a large concentration of farm buildings used for agriculture, forestry, animal husbandry and fish farming, a number of technical monuments (artificial ditches for watercourses) and other buildings that have animated the landscape and at the same time promoted its use since the 17th century. Today it forms the Zahrádecko landscape conservation area. The village has mainly small businesses in the service sector, primarily catering and retail. In the past, the local Nový zámek manor was used as a training centre for Charles University and also provided employment for a number of local residents, but it burnt down in 2003 and reconstruction is proceeding very slowly. Most of the economically active people commute either to Česká Lípa or to the somewhat more distant, but more attractive Mladá Boleslav.

3. Results

3.1. Landscape and land use/cover changes

Figure 3 and Table 1 show how the landscape looked like in the 1st half of the 19th century (1825) and compare it with the present state (2020). In the area of Zahrádky, the feudal composite landscape around the 16th-century Renaissance castle, whose aesthetic and landscaping and maintenance were cared for from the 17th to the 19th century, has now virtually disappeared. Its decline began with the political and social changes after 1945. The castle was nationalised, and the German population in the area was expelled. Collectivisation brought new farming methods and a change in the landscape, and elements of the composed landscape were not maintained.

At the time of the stable cadastre, Zahrádky was part of the agricultural landscape, where arable land predominated in almost a third of the area, supplemented by permanent grassland. The proportion of woodland in the area was very small (less than 10%). Even as a result of the degradation of the composed feudal landscape, forest areas have expanded to the present day, although their current share (around 20%) is below the Czech average. The proportion of permanent grassland has increased slightly, and with the development of (rural) housing there has been an increase in permanent crops around houses. Successional vegetation is spreading on some uncultivated areas.

Comparing the 1954 and 2019 images (Figure 4), one can document in particular the change in ownership and cultivation of farmland, with even greater consolidation of smaller blocks into large land units. The proportion of forest areas has increased, particularly in the northern half of the area. The images show preserved elements of landscaping, such as the

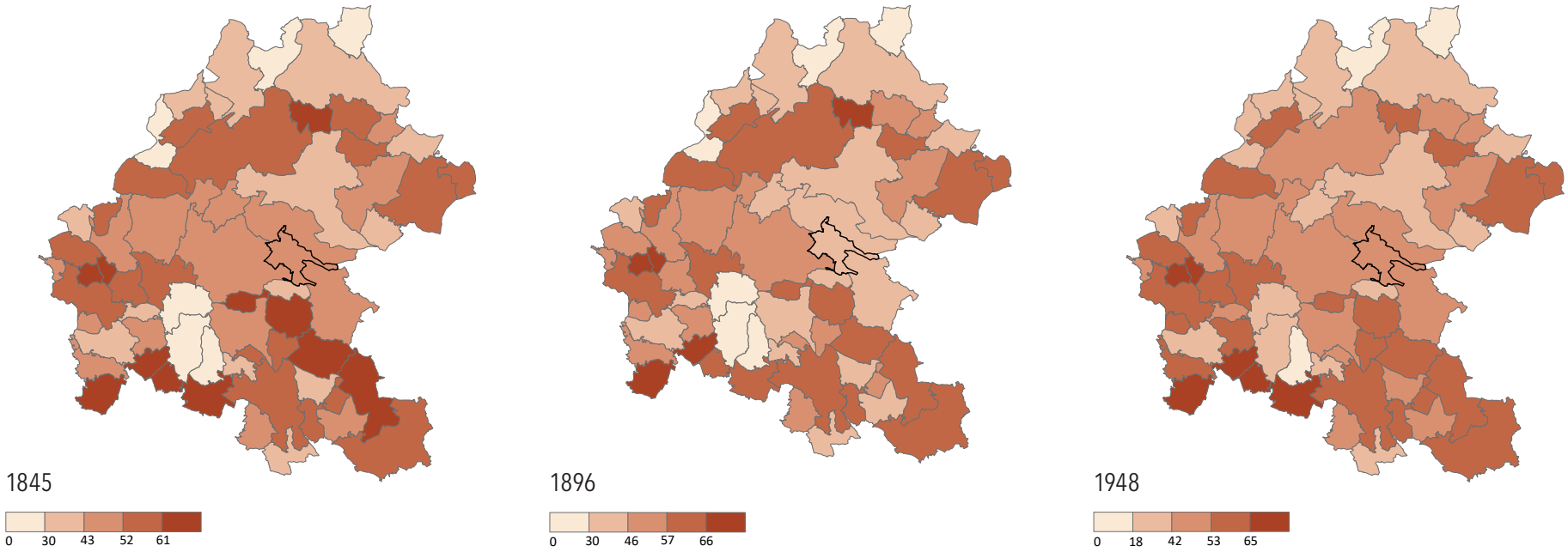

Fig. 6 – Proportion of arable land by STUs (% of STU area). Source: LUCC Czechia Database.

Fig. 7 – Proportion of permanent grassland by STUs (% of STU area). Source: LUCC Czechia Database.

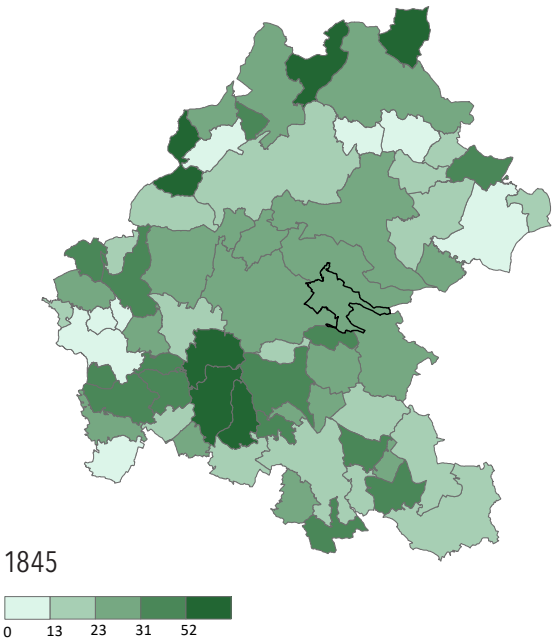

Fig. 8 – Proportion of forest areas by STUs (% of STU area). Source: LUCC Czechia Database.

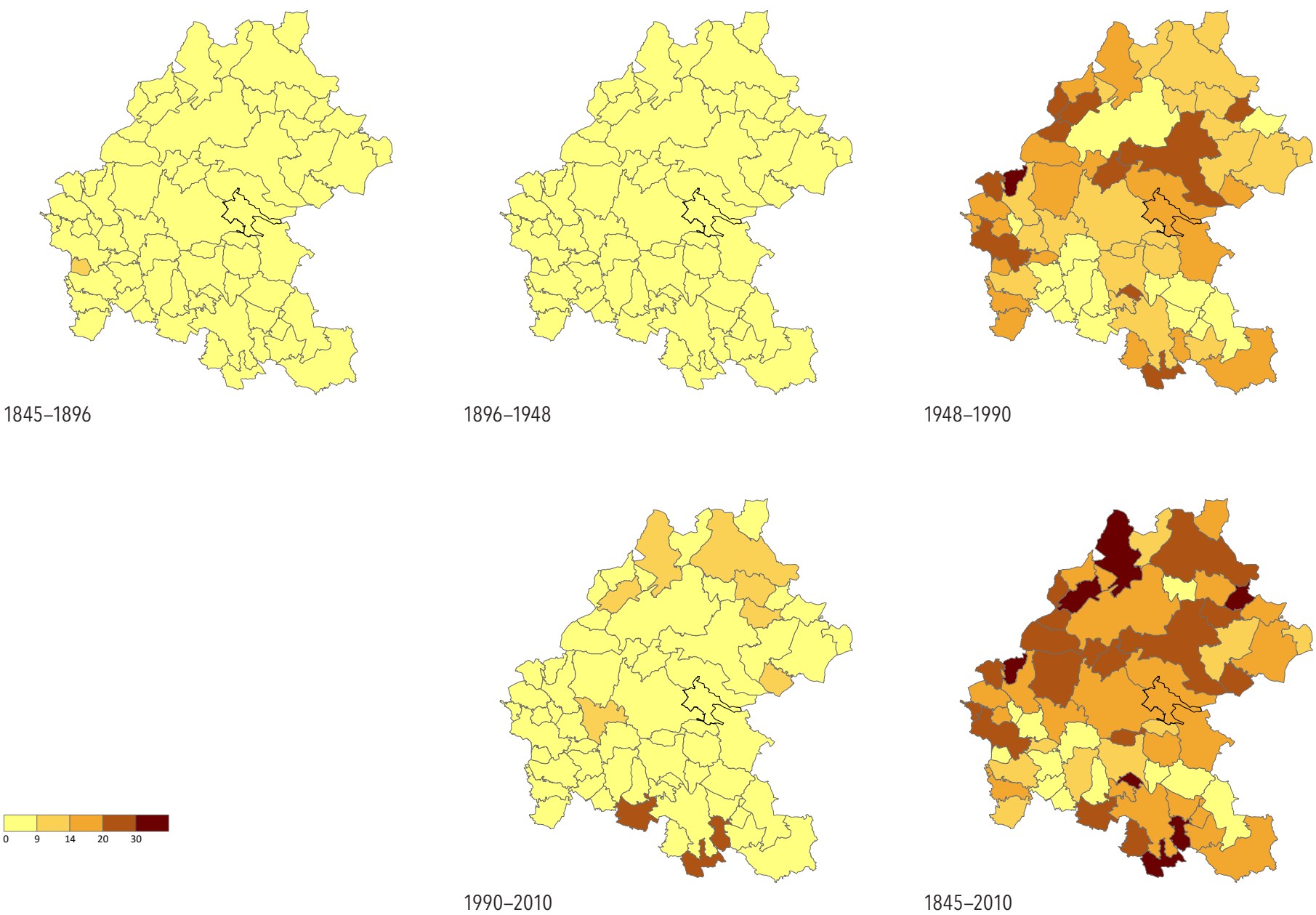

Fig. 9 – Index of change by STUs (in %). Source: LUCC Czechia Database.

Fig. 10 – Municipality emblems.
Data source: Register of municipal symbols, Chamber of Deputies of the Czech Republic, https://rekos.psp.cz (20. 8. 2020).

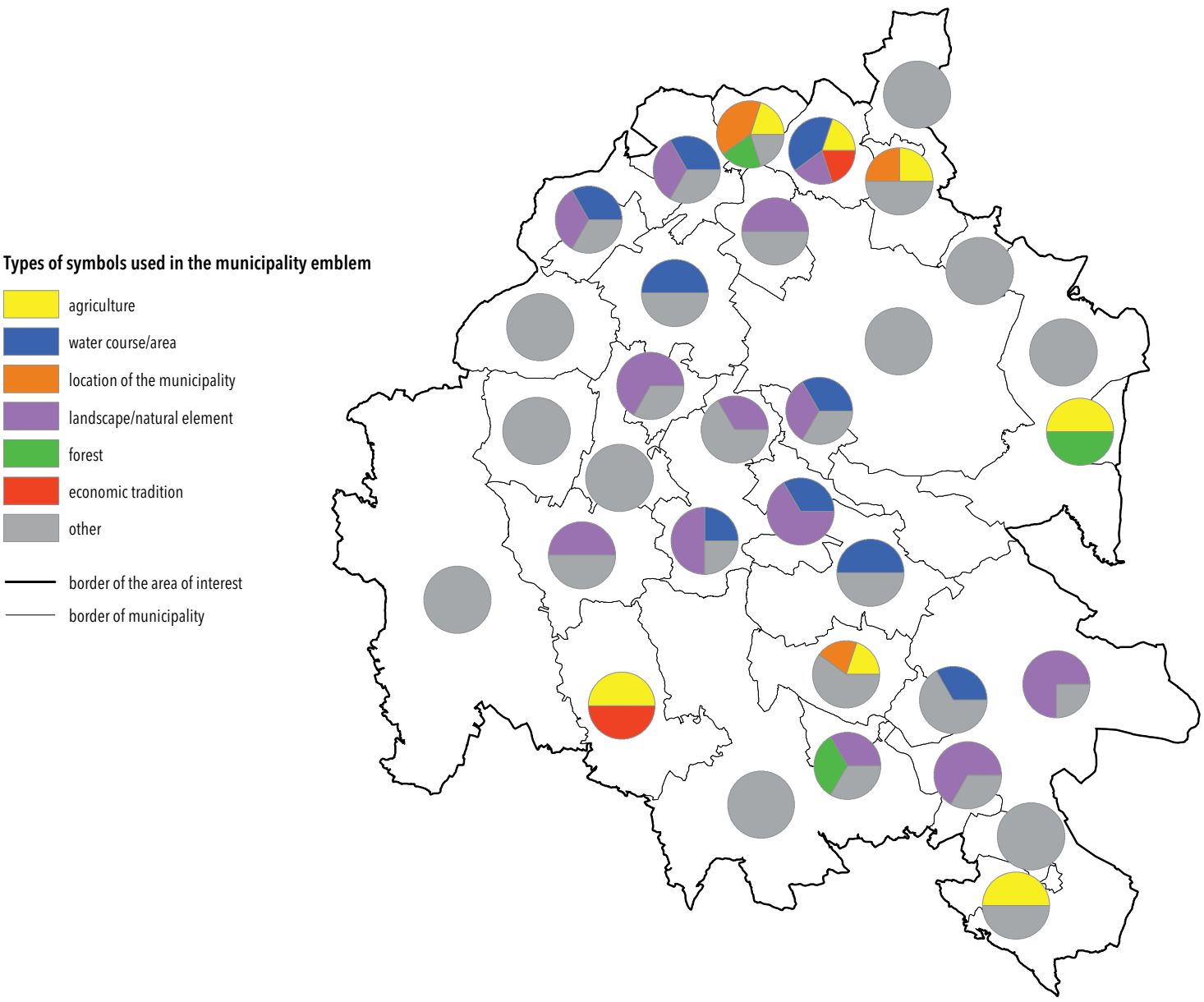

Fig. 11 – Types of symbols used in the municipality emblems.
Data source: Contant analysis of the municipality emblems (20. 8. 2020).

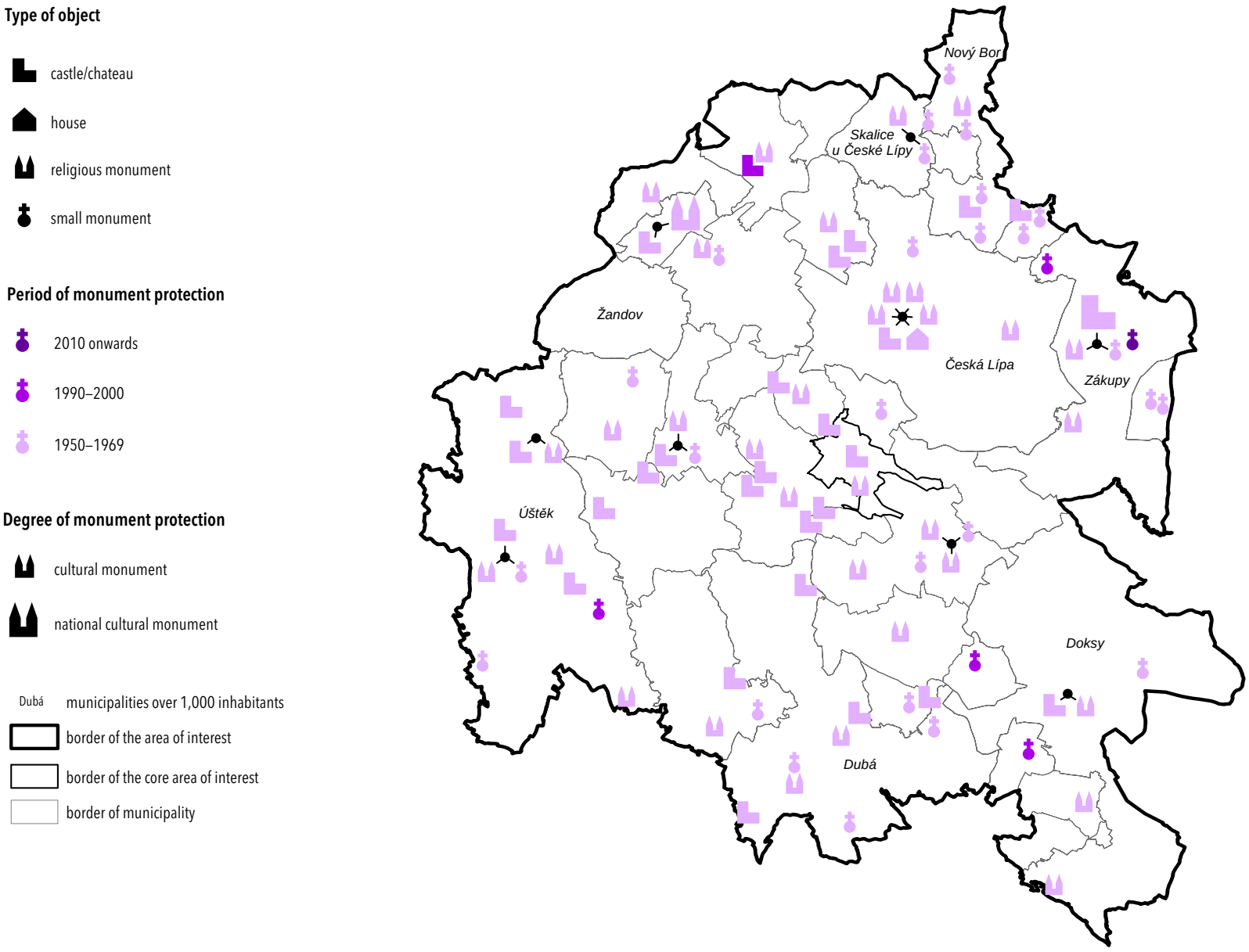

Fig. 12 – Cultural monuments and heritage areas.
Data source: National Heritage Monument Catalogue, National Heritage Institute, https://pamatkovykatalog.cz (20. 8. 2020).

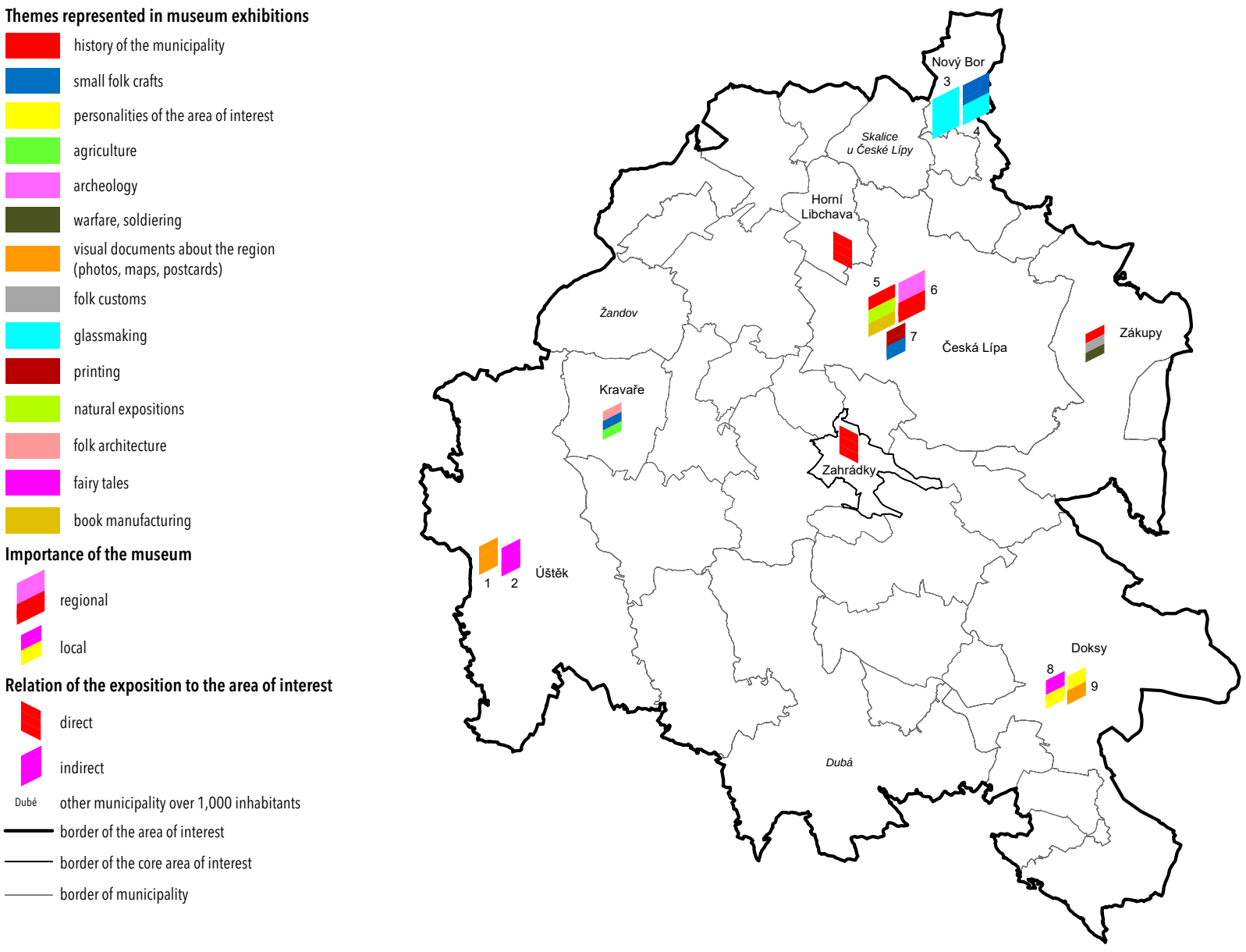

Fig. 13 – Museum exhibitions. Data source: Czech Association of Museums and Galleries, https://www.cz-museums.cz/web/amg/titulni (20. 8. 2020), Webportal Do muzea, https://www.do-muzea.cz (20. 8. 2020), Webportal Museum.cz, https://www.museum.cz (20. 8. 2020).

Valdštejnská alej avenue or the avenue leading from Zahrádky to St Barbara's Church. The construction of houses is also visible, both in Zahrádky and in the Borek area. In terms of the scale of the aerial photograph, the smallest changes have occurred in the area of the castle park and in the valley of the Robečský potok (Peklo).

Comparison photographs from Figure 5 capture the same place in the past in the archive photograph and the current state on the latest photo.

Figures 6–9 show a wider perspective of land use/cover changes in comparable territorial units and describe changes over the time by comparing the years 1845, 1896, 1948, 1990, and 2010.

The location of the area outside the main development axes of Bohemia has strongly influenced the development of land use over the last two centuries. Another factor that has had an impact here was the displacement of Czech Germans in 1945 and 1946. A third factor was the related population exchange and the conversion of a large part of the housing stock into second homes. All of these influenced the methods and intensity of farming both in Zahrádky and its wider hinterland. Overall, the development of the landscape over the last 130 years can be assessed as a steady decline in farming. This was particularly evident in the decline in the area of arable land after 1948 (by 20–30%), as well as the decline in this area after 1990 (by another 5–10% by 2010). The development of permanent grassland mirrored this trend. During the period of Communist farming, the area of permanent grassland diminished by up to one-fifth, while after 1990, due to the loss of Communist-era subsidies, it increased by 10–20% in individual territorial units. The total extent of agricultural land stock decreased by 10–15% between 1948 and 1990. In all the periods under review (except 1845–1896), the area of land registered as forestry increased by about 10–15% before World War II and by 15–30% after 1948. Changes after 1990 were very small for all these categories of areas (around 1–2%). There has been an extraordinary increase in built-up and other areas.

In the period before 1990, the increase of 250–300% compared to 1948 was similar to the national trend. While the changes in macrostructure between 1845 and 1948 varied, one could see a decline in agricultural land and an increase in woodland and other areas after 1948 to the present day. This was accompanied by the main processes that took place in the landscape of the model area. During the Communist era, strong processes of urbanisation (increase in other areas) dominated, while after 1990, the processes of moderate and strong grassing were more significant. This was undoubtedly an effect of restitution of property and privatisation, which were also linked to the loss of subsidies to support agricultural production.

The major changes in land use shown by the index of change (Bičík et al. 2010, 2015; Figure 9) were implemented between 1948 and 1990.

3.2. Landscape memory

The landscape memory of the area is shown in four maps (Figures 10–13) described in following sections 3.2.1–3.2.3 (for more details about methodology of mapping see Chapter 1 of Atlas).

3.2.1. Places and institutions of memory

The Zahrádky area of interest is one of the typical areas of converted aristocratic landscape. Already in the hands of Albrecht von Wallenstein in the 17th century, but also of the Kounic family in the 18th and 19th centuries, the area was transformed into a composed landscape with elements of castle parks and gardens. The two chateau complexes – Zahrádky (formerly Nový zámek) and Horní Libchava – are also the most representative memory institutions and cultural monuments that highlight these transformations of the whole area. They contain traditional regional exhibitions and thus present the history of the North Bohemian territory in its entirety. However, the Zahrádky castle has been undergoing numerous reconstructions since the fire in 2009 and it is currently only accessible on special occasions.

Other exhibitions that visitors may encounter at this location do not relate to the aristocratic landscape. This is exemplified by the Museum of Textile Printing, which offers an insight into the history and present of textile printing through an interactive exhibition including the chance of making one's own print. Textile production and printing has a very long tradition in the Českolipsko region.

Another is the private Postcard Museum in Úštěk, which offers a unique collection of historical postcards of the region. Interesting are also two museums designed primarily for children (the Museum of Devils and the Four-Leaf Clover Museum), who visit the area especially in the summer months during trips to the Máchovo jezero lake. The Mácha region does not forget its namesake, the poet Karel Hynek Mácha, to whom a memorial with a small exhibition is dedicated in Doksy. At the northern border of the area of interest, one can also find Nový Bor with its famous Glassmaking History Museum.

Archival materials for the Zahrádky area are available in the state district archive in Česká Lípa and also in the archive funds of the large estates or family archives of the aforementioned noble families (stored mainly in the state district archive in Litoměřice).

3.2.2. Regional and local symbols

The composite landscape of the area of interest is also reflected in the symbols of the municipalities. The very emblem of the village of Zahrádky, which is the centre of the area of interest, is very rich in the elements reflecting the landscape features (in purple in the cartogram in Figure 11). The white (in heraldry, silver) cross in the Zahrádky coat of arms emphasises the architectural uniqueness of the local chateau park, the snowflake in it refers to the Peklo nature reserve and the presence of these rare plants, and the blue tincture (colour) which is the background of the coat of arms represents the Holany pond system (it is therefore a symbol from the category of watercourses and areas; in blue in Figure 11).

The Holany ponds are also symbolised by the blue tincture in the coat of arms of the municipality of Holany. The water lily leaf in the emblem of Jestřebí is a historical coat of arms element, but according to its today's interpretation it also represents the Holany pond system. The water lily is also a symbol for the ponds in the coat of arms of Sosnová. In that of Chotovice, the water area is symbolised by an unusually red tincture – it is a reference to the Červený rybník (Red Pond). In addition, the coat of arms of Chotovice depicts a spring as a symbol of the local healing iron water spring. The blue tincture in the emblem of Skalka u Doks represents the Máchovo jezero lake. In the emblems of Horní Police and Stružnice, blue is the symbol for the Ploučnice River. In the coat of arms of Volfartice, the blue tincture refers to the Libchava River.

As mentioned above, the coat of arms of the municipalities in the Zahrádky area of interest contain a number of elements referring to landscape features, both architectural and natural. The coat of arms of Holany depicts the local castle (the birch tree also symbolises a typical tree of the surrounding landscape).

Two hills with towers on their tops in the coat of arms of the town of Doksy symbolise the important royal castle Bezděz (the brown mud at the foot of both hills is also a reference to the local marshy landscape). The central figure of the coat of arms of Horní Police is a block bridge over the Ploučnice River with a cross standing on it. The ruins of the Hřídelník and Ronov castles are referred to by the castle figure and two stars in the coat of arms of Blíževedly. The tower figure in the Vrchovany emblem symbolises the castle of Starý Berštejn. The battlements in the coat of arms of Volfartice represent two fortresses, which are the dominant features of the village (the wolf here is a speaking sign as it is a reference to the original German name of the village – Wolfersdorf).

The battlements together with the figure of a bloom represent the Kvítkov castle in the coat of arms of the village of the same name. Furthermore, in the coat of arms of Horní Libchava, the figure of a scallop shell and a pilgrim's staff symbolise the local church of St. James the Greater (the scallop shell is an attribute of the saint and the pilgrim's staff refers to the St. James pilgrimage). Other landscape elements that are depicted in the symbolism of the municipalities in the Zahrádky area of interest are local hills (the symbol of the spike in the coat of arms of Chotovice represents the Chotovický vrch hill; the green hill in the coat of arms of Kozly refers to the Kozel hill, at the foot of which the municipality lies, and it is therefore also a speaking sign; the hill in the coat of arms of Tachov represents the Tachovský vrch hill). The emblem of Tachov also contains linden leaves as a reference to the memorial linden tree in the village. A branch of the pine tree in the emblem of Sosnová serves as a speaking sign and as a symbol of a typical tree in the surrounding forests. The general location of the village (orange in the chart) is shown in the emblems of the villages of Chlum and Skalice u České Lípy.

In both cases, it is a symbol of the location of the village at higher altitudes (the hill depicted in the emblem of Chlum and the spike in the emblem of Skalice u České Lípy, which symbolises that the village is located in the Lužické hory mountains). The Lužické hory (Lusatian Mountains) and the pleasant climate are represented by a figure of the sun and the green triple-peak in the emblem of Slunečná. The sun is also, of course, a speaking sign in this emblem, and the green trefoil also serves here as a reference to meadows and forests.

Forests (in green in Figure 11) are also symbolised by the green tincture in the Vrchovany coat of arms. In the emblem of Bohatice, the forested nature of the surrounding landscape is represented by the figure of a spruce tree; the green tincture in this coat of arms is a symbol of meadows. Meadows and the agricultural tradition are also represented by a green tincture in the coat of arms of Luka (it is therefore also a speaking sign and the figure of a lily is a symbol for meadows). The green spike in the coat of arms of Skalice u České Lípy, in addition to its location in the Lužické hory mountains, as mentioned above, also refers to the local meadows and floodplains. The green tincture in the coat of arms of Chlum also recalls the agricultural tradition (yellow in the chart). In the coat of arms of Chotovice, the agricultural character of the village is symbolised by scythes, in the coat of arms of Tuhaň by the sickle. The coat of arms of Tuhaň also depicts two axes as a symbol of traditional wood-cutting. In the coat of arms of Chotovice, glass tongs are a reference to traditional glassmaking. There are no more symbols depicting traditional farming in the flags of the municipalities in the Zahrádky area of interest.

As of 1 October 2020, 97% of the municipalities in the Zahrádky area of interest (32 out of 33 municipalities) have a municipal emblem.

3.2.3. Heritage sites

In the area of interest, extinct aristocratic landscapes are monitored, specifically the composed landscape of Zahrádky. There are nearly one hundred properties in the area that have been designated as monuments and also associated with this type of landscape. Almost all of them have the status of a cultural monument, which they obtained between 1950 and 1969. National cultural monuments in the area are represented by the pilgrimage site with the Church of the Visitation of the Virgin Mary with a rectory and bell tower in Horní Police and the castle in Zákupy. Most of the elements in the area are small or religious monuments, supplemented by several castles or chateaux. In addition, there are several summer houses, monasteries, statues and calvaries, which complete the complex of the Zahrádky landscape.

4. Summary

Zahrádky near Česká Lípa is a village with a strong recreational potential, which is determined by its specific natural values and a centuries-old cultural landscape with specific values (ponds, waterworks, castle, landscaping, etc.). In view of the increase in leisure time and the overall development of the population's standard of living, it can be concluded that the model area has already benefited from part of its recreational potential in the past. It can be assumed that in the future tourism of specific forms (hiking, cycling, car tourism, swimming and climbing) will continue to develop in the wider area of interest. It will be necessary to analyse this process and not to allow the most attractive sites to lose their values due to too many visitors. The proximity of a town of almost 40,000 inhabitants (Česká Lípa) and others in the vicinity, not only local and micro-regional sources of such tourism can be expected, but also sources from more distant areas of Czechia and Central Europe. Due to the unclear development of housing prices and quality housing, interest in the purchase of houses for recreation by wealthy buyers able to influence the quality of natural conservation and protected sites with money and contacts is likely to increase. In addition, there are a number of other attractions in the vicinity of Zahrádky, which together with Česká Lípa and Mimoň should provide an interconnected system of offers for the whole area ready for more distant travellers (both in Czechia and abroad).

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II

External contributions

Legacy of Iron Curtain in border landscape development

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1. Introduction

Landscape alternations and changes in land use and land cover are crucial processes implying the undesirable environmental changes (Rockström et al. 2009), leading, among others, to the loss of biodiversity (Newbold et al. 2015), unsustainability in food production or loss of freshwater and forest resources (Foley et al. 2005). These changes are driven by various (driving) forces (socio-economic, technological, cultural, natural or political) materialized in a particular landscape by different agents (Plieninger et al. 2015).

Possible directions for the research of driving forces have been proposed by Bürgi et al. (2004). There, the authors suggest that regions separated by administrative borders might represent an area for investigation of the driving forces as they allow a comparison of two areas with expected differences in political and socio-economic driving forces. Such an approach addresses the issue of impossibility to manipulate factors (e.g., legislation, demography) in wide regions in order to examine their effect on landscape change (Kuemmerle et al. 2006). The approach could be divided into a) a temporal design (examining a region in different periods, see Palang, 2010) and b) a spatial design (cross-site or cross-border examination, see Senetra et al. 2013; Sklenička et al. 2014). The cross-site and cross-border (spatial) research design is used for comparative purposes in many places worldwide, often testing the impact of legislative interventions or sectoral policies on a landscape. Such approach was used for border-landscape research in Vietnam-Cambodia (Grogan et al. 2015), China-Hong Kong (Xie, Ng 2013), Angola-Namibia (Röder et al. 2015), Mexico-USA (Zhao et al. 2017) Austria-Czechia (Rašín, Chromý 2010) or along the former firm borderlines such as the "Iron Curtain" (hereinafter IRC) line (Kupková et al. 2013), separating various political blocs of states. However, the final condition of the landscape under study has resulted from many complex forces (Plieninger et al. 2016), influenced by historical circumstances (Ernoult et al. 2006) and recorded in the site/region specific memory of a landscape (Balej et al. 2010).

2. Specific features of landscape development in Central Europe

It was especially in northern, western and eastern Europe that underlying political and socio-economic driving forces have had a significant influence on the development of land use and land cover (Plieninger et al. 2016). In central and eastern Europe in particular, the driving forces related to the transition from the Communist to post-communist regimes were frequently mentioned as having major importance for land use and land cover changes (Skokanová et al. 2016). Based on differences in historical political settings of the Eastern and Western blocs in Europe (following the division by an official IRC boundary), significant differences in the land use and land cover change and trajectories were observed and described. Since the early 1950s, major differences stemmed from the productivist (Western) market and Communist (Eastern) centrally planned agricultural management (Skokanová et al. 2016). In the West, the period lasting from 1950s till the 1990s followed a productivist agricultural scheme with intensification of the agricultural output, which was further accelerated by the Common Agricultural Policy (CAP, 1960s; see Strijker 2005). A similar process was described in the East as well. It was fuelled there by the idea of self-sufficiency (Prokopová et al. 2018). Contrary to general intensification of the land use, extensification (mainly afforestation of farmland or land abandonment) took place in remote areas and in the areas with unfavourable conditions for agriculture both in the Eastern (e.g., border areas of Czechia; see Bičík et al. 2001) and Western blocs (Strijker 2005).

The transition towards market economies in the Eastern Bloc in the 1990s had a major impact on general extensification of land use (i.e. land abandonment). The extensification trend was observed across the entire European continent as a predominant proximate driver (Plieninger et al. 2016) with a higher accentuation in Eastern Europe (van Vliet et al. 2015). This was due to such factors as technological lags, price liberalization, competition, abolition of subsidies or return of state-owned property (Levers et al. 2018). Contrary to quite stable and intensive land use in the West, the period before accession to the EU (all countries except East Germany by 2004) led in the Eastern Bloc to a significant shift towards de-intensification and afforestation (Feranec et al. 2017, Levers et al. 2018, Prokopová et al. 2018). The trend of land abandonment later diminished due to the CAP implemented in the Eastern Bloc after accession to the EU. The implementation of the CAP brough about improved sustainability of agriculture and application of agri-environmental schemes, resulting in an increase in grassland areas (Prokopová et al. 2018). A similar trend, i.e., stabilisation of the land use intensity by the CAP, was observed in the Western bloc in the decade between 2001 and 2011 (van der Sluis et al. 2016).

The research into landscape changes of the IRC border zone has been rather scarce. Based on an evaluation of the land change in a 15-km strip along the border, Bičík et al. (2010) and Kupková et al. (2013) concluded that the land use in 1990, i.e., at the beginning of the studied period, differed between the situation on either side of the border. In that year, the proportion of arable land was higher in the eastern part of the borders, while heterogeneous agriculture (a combination of small patches of pastures, arable land or permanent crops on the same tract, etc.) was more frequent on the western side. The higher volume of arable land in the East results from a historical emphasis on

bigger plots and areas of arable land facilitating a higher financial profit and easier land management in the centrally planned agriculture (e.g., Batáry et al. 2017 for Germany, Sklenička et al. 2014 for Czechia).

From the perspective of trends over the entire period of 1990-2006 (Bičík et al. 2010, Kupková et al. 2013), the most significant difference was in the pace of afforestation that was much higher in the East than in the West, where a slight tendency towards deforestation was observed. When it comes to the dynamics of changes, a significantly higher volume was observed in the Czech parts of the eastern side of the border than in the remaining parts. On the other hand, since the Austrian (western) part of the area under study was stable, it only had a low volume of land use and land cover changes. In general, major land use and land cover changes on the western side of the borders were only detected in parts of the former West Germany, which the authors explained by inferior natural conditions for agriculture. A dominant type of the land use and land cover transition on the Eastern side between 1990 and 2006 is the transition to extensive forms of land management (arable land to pastures, afforestation) with the exception of south Moravia. On the Western side, the transition from the forest stands to shrubs was the most common land use change, though highly variable among the individual sections of the border. The authors also predicted a further decrease in the area of arable land, accompanied with the formation of new forest stands and pastures on the Eastern side of the border.

Our aim is to examine landscape change on the former border between specific regions under different management/policy in the past. For such a comparison, the bordering landscape between former eastern and western blocs, separated by the IRC in Europe, was chosen. There are the assumptions that different political conditions (drivers) and transformation dynamics must be necessarily reflected in the different structure of land use and land cover changes between the states of the former Eastern and Western blocs in the period after the fall of the Communist regime as well as the individual sections of the borders, defined by individual national border areas. In addition, there is the expectation of convergence of the volume and structure of individual processes (e.g., afforestation, urbanisation) between the former Eastern and Western countries over time from 1989 onwards due to harmonization via supranational policies.

3. Study site and sampling design

The former line of the IRC, that persisted until the late 1980s, serves as a good example of an area suitable for performing research in a spatial setting/design. A border of more than 2,700 kilometres spanned from the Baltic to the Adriatic Sea (Fig. 1a), separating the Eastern countries (the former East Germany, Czechia, Slovakia, Hungary and Slovenia) with central planning from the Western countries with market economies. As regards biophysical characteristics, the landscape settings of the IRC borderline are highly variable. Based on the LANMAP (landscape) typology (Mücher et al. 2010; Table 1), the altitude varies from 50 to 1,500 metres above sea level. The majority of the sampling sites are located in the continental climate (54%), followed by the Pannonian (23%) climate, with the rest belonging to the south alpine, North Atlantic and Mediterranean mountains climate. Correspondingly to the variation in climate and altitude, the majority of the parent material forms are crystalline rocks as well as migmatites (35%) and soft loam (31%), while the rest includes calcareous rocks, sandstones and soft and hard clayey materials.

The higher variability of environmental settings in the study area was a reason to choose the sampling site design instead of evaluation of the entire border landscape. In order to verify the extent of the differences between LANMAP landscape types on both sides of the border (Table 1, Fig. 1b; cf, c, d) a statistical comparison was made. The proportion testing was done by the pairwise proportion test with the Bonferroni correction. Such a rather simplistic comparison of the area (disregarding spatial distribution) led to unequal proportion in 10 landscape types ($p < 0.001$) out of 20. Despite the fact that incongruent landscape types covered only 12% (east) and 16% (west) of the area under investigation, a more conservative approach based on sampling plots was used. The localization of the 10×10 km square plots respects the rule of placement equally on either part of the border and in identical landscape types (LANMAP Level 3, Fig. 1b). The technique generated 25 sampling plots, unevenly placed along the entire border. The border section of Italy-Slovenia was excluded from the analysis due to the fact that only a single plot met the above-mentioned criteria or sampling plot delimitation.

4. Methods and data

In order to gather information about the land use and land cover change, CORINE Land Cover (CLC) data sets for three particular years (Table 1) were employed on the level 2 of the CLC classification (for details, see EEA 2021). For the sake of homogeneity of the landscape under study, there was incorporation of the pan-European landscape typology of the LANMAP project (Mücher et al. 2010). This data set divides the European landscape according to the climate, altitude and geological composition into 76 classes (Fig. 1b) on the third level of classification. The information on the delimitation of former Eastern Bloc boundaries was obtained from the Mosaic project as a spatial data set (Table 1).

After defining the sampling plots along the IRC border, it was necessary to acquire data on the degree of transition of individual land use and land cover types on the CLC 2 level. In other words, it was necessary to detect the trajectory of land change on the level of individual patches. The data from individual examined years (1990, 2000, 2012) were mutually compared in the ArcGIS environment (ESRI 2019) by intersecting the individual layers in the chronological order. The change (or a lack of it) of the intersections of the individual areas (Fig. 1c) between the years 1990–2000 and 2000–2012 was therefore observed.

In order to further analyse the transition of land use classes between individual years (periods), the transition scheme was created. The transition scheme (or matrix, Figure 2) was used to generalise the processes of transition of land cover classes into nine groups. In this way, the whole area of multiple land use and land cover classes that belongs to the single process was summed up. Thus, three internal conversion groups of anthropogenic classes, agriculture and natural classes (Fig. 2G, H, I) were distinguished. The antagonistic processes of urbanisation and deurbanisation follow the transition to urban or urban-like forms (Industrial, Mining, Dump and transport areas, Artificial vegetated areas) from the rest of the categories and vice versa. The naturalisation and denaturalisation processes express a conversion from potentially valued natural classes (Open space, Shrubs, Wetlands and Waters) to agricultural use or vice versa. Finally, afforestation and deforestation processes are distinguished (Fig. 2C, D).

For the purpose of a comparison between the individual processes on both sides of the former IRC line and time, the

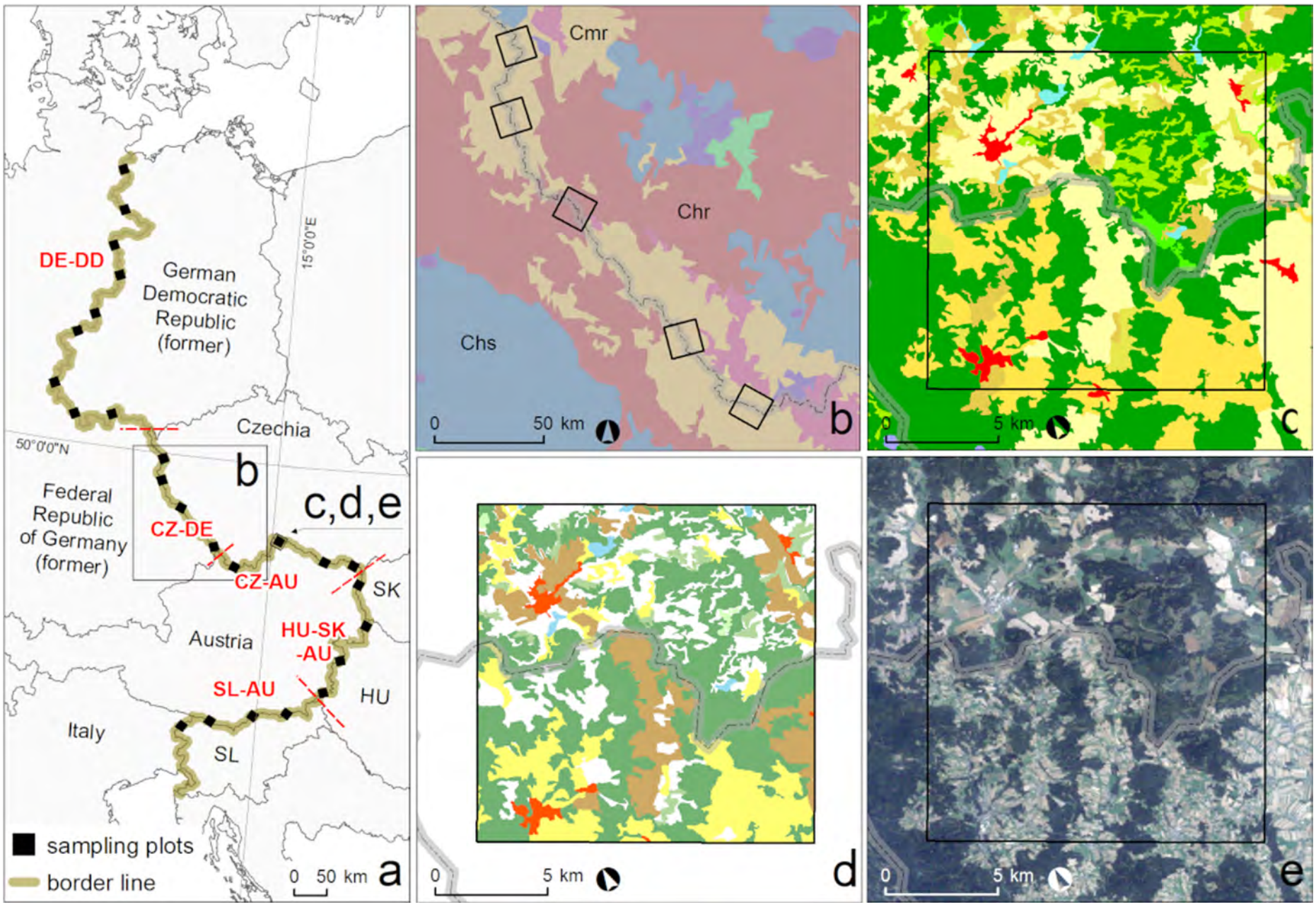

Fig. 1 – (a) Localisation of the sampling plots on the Iron Curtain border (the borderline divided Germany into Western and Eastern parts; at the time of the Iron Curtain Czechia and Slovakia (SK) create one state – Czechoslovakia, HU – Hungary; SL – Slovenia, at the time of Iron Curtain part of Yugoslavia); (b) position of the sampling plots within landscape types, Chs = continental (climate) – hilly (relief) – sediments (parent material); Chr = continental – hilly – rocky; Cmr = continental – mountains – rocky; (c) 2010 state of the land cover; (d) persistent features based on the intersection of the 1990 and 2010 (white patches indicate land use change between the time points) and (e) Landsat-5-TM image, 1991 (U.S. Geological Survey).

Tab. 1 – Data sets used in the study

Name / Type	Year	Min. mapping unit	Original repository	Source of digitized version	Extent
CORINE Land Cover (CLC)	1990, 2000, 2012	25 ha / 100 m	Copernicus System, ESA	EEA, 2021	European (Central European Contries involved)
LANMAP database (ver. 3)	–	11 km²	Wageningen University	Obtained via personal communication	European (Continent – wide)
Former boundaries	1989	line data	Max Planck Institute for Demographic Research	MPDIR, 2021	Germany

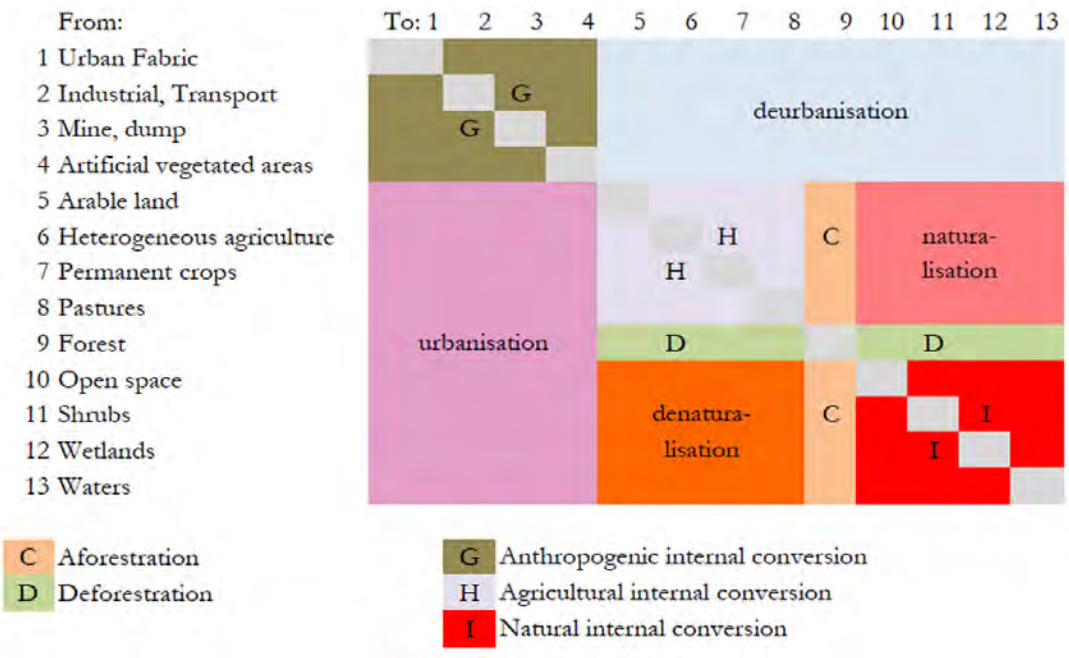

Fig. 2 – Generalisation scheme – clustering transition of individual LULC classes into specific processes.

Tab. 2 – Response variables and predictors used in the study (* response variables included, ** repeated measure)

Response variables		Values min–max; mean±StD (ha per year)
Afforestation*	The dynamics of afforestation, i.e. conversion of other than urbanized patches to forest (ha/year).	0–101.18; 17.01±24.02
Agricultural internal conversion*	The dynamics of conversion among Arable land, Heterogeneous agriculture, Permanent crops and Pastures (ha/year).	0–287.28; 60.33±71.98
Anthropogenic internal conversion	The dynamics of conversion among Urban Fabric, Industrial & Transport, Mine & dump and Artificial vegetated areas (ha/year).	0–7.73; 0.59±1.65
Deforestation*	The dynamics of forest loss, i.e. conversion of other than urbanized patches to other than forest (ha/year).	0–94.62; 10.18±15.66
Denaturalization	The dynamics of water, wetland, open space and scrubs loss, i.e. conversion of natural patches to agricultural use (ha/year).	0–13.08; 0.7±2.24
Deurbanization*	The dynamics of conversion from Urban Fabric, Industrial & Transport, Mine & dump and Artificial vegetated areas to other types (ha/year).	0–14.77; 2.02±3.45
Natural internal conversion	The dynamics of conversion among water, wetland, open space and scrubs (ha/year).	0–18.13; 0.41±2.13
Naturalization	The dynamics of conversion in favour of water, wetland, open space and scrubs (ha/year).	0–13.48; 1.12±2.35
Urbanization*	The dynamics of conversion in favour of Urban Fabric, Industrial & Transport, Mine & dump and Artificial vegetated areas to other types (ha/year).	0–39.79; 6.15±7.79
Predictors		
TIME **	Time period divided to span of (1) 10 and (2) 12 years; two levels	(1) 1990–2000; (2) 2000–2012
BORDER **	Division to old democratic and post socialistic regime; two levels	(1) East; (2) West
REGION	Part of the frontier divided according to specifics of bordering countries; five levels (see Fig. 7)	(1) DE–DD: West and East Germany; (2) CZ–DE: Czechia and Germany; (3) CZ–AU: Czechia–Austria; (4) HU–SK–AU: Hungary and Slovakia–Austria; (5) SL–AU: Slovenia–Austria

rates of change between processes were calculated as a sum of the particular land cover classes in transition between 1990 and 2000 and between 2000 and 2012. Such rates were divided by the factor of 10 (years) for the first and 12 (years) for the second period in order to normalise the results (dynamics in hectares per year). As a result, this yielded relatively low values for particular processes, where the mean values plus standard deviation did not exceed five ha per year and the group was omitted from the later analysis (see Table 2). The data on the rates for both the 1990–2000 and 2000–2012 periods and for all five remaining processes (Fig. 2) were later employed for statistical modelling as a response variable together with predictors of time (two levels reflecting the periods) and side of the border (two levels – East and West). The dynamics calculation was followed by a check of comparability of the land use and land cover classes proportion in the initial 1990-time segment by the pairwise proportion test (R Core Team 2020) in order to find possible discrepancy in the share of land use and land cover classes proportion.

In order to find out the influence of the border and of the time period on the individual processes (Table 2), a statistical model with the repeated measures (spatial BORDER and temporal TIME dependency) was created. The violation of assumptions for parametric testing made it necessary to use a nonparametric test, namely the nonparametric analysis of longitudinal data in factorial experiments (nparLD R package, Noguchi et al. 2012). As predictors of TIME and BORDER acted in the model as repeated measures predictors, the twofold temporal (TIME) and spatial (BORDER) dependency was articulated. Testing via nparLD generated two types of results – the Wald statistics and ANOVA type statistics. For the sake of reliability, a conservative approach was adopted. The results were considered significant only where both analyses (both the ANOVA type and Wald type) yielded a significant result.

5. Results

5.1. Evaluation of the entire study area

If a look is taken at the entire study area, differences between the individual examined periods were detected in almost all processes (Table 3). The individual processes characterise the grouped land use and land cover classes (see Fig. 2) that underwent changes or remained unchanged over the individual periods. In order to clarify the situation before the analysis of the dynamics (i.e., of increase/decline in the areas of individual classes), the comparability of the initial situation in 1990 was assessed (to allow a subsequent evaluation of the trajectory of the processes). From the perspective of sampling areas along the entire border, the proportions of land use and land cover classes did not differ significantly between the two sides of the border; the only exception was the category of shrubs (which includes transitional forest development stages and shrubby formations with sparse trees), the representation of which was bigger in the East (W – 1.51%; E – 3.9% of the total area on the Eastern or Western sides of the border, respectively).

The afforestation dynamics, i.e., an increase in the areas of the land use and land cover class identified as forest, was significantly different (Tab. 3, column BORDER) if the East and the West are compared. Here, the dynamics was much more apparent on the Eastern part of the border and in the second studied period (Fig. 3a, b). The higher afforestation rate in the East is due especially to a conversion from shrubs (Fig. 4) and to a smaller degree to heterogeneous agriculture and arable land. A similar transition was not apparent in the West in the first period when the forest areas were solely increasing at the expense of shrubs. In the second period, the afforestation dynamics had similar patterns as in the East.

As far as the total converted area is concerned, agricultural internal conversion was the dominant transition process. Figure 3c showed that the dynamics of the Eastern part of the borders was relatively stable in both periods while in the West, a significant increase in the dynamics can be observed in the second period. In a more detailed assessment, the process of internal agricultural conversion was consistent on the Eastern side of the border throughout the periods, namely due to a conversion of arable land into pastures. In the West, the situation was more diverse. In both periods, the pattern was similar – conversion from heterogeneous agriculture into pastures and arable land; in the second period, a transfer of arable land into pastures was an additional trend. The total values for the process of agricultural internal conversion were caused by a higher rate of change (15%) in the West (see Fig. 4).

As far as deforestation is concerned (Fig. 3d), a significant change was only found between periods – a higher rate of deforestation was seen in the second. This process was largely

caused by the losses in favour of shrubs (Fig. 4), which is not surprising from the viewpoint of the forest life cycle in forestry management. In the second period, however, one can observe conversion of forests into arable land and pastures on both sides of the border.

Deurbanisation and urbanisation processes, i.e., the conversion to/from urban areas (including industrial use, etc.), were marginal in the area of interest. A gradual increase in the dynamics of both losses and rise in the urban areas can be, however, observed in the second period (Fig. 3e, Fig. 3f) and a significantly higher urbanisation rate was detected in the West (Fig. 3g). An increase in deurbanisation processes in the second period can be attributed to the transition to arable land and pastures on both sides of the border. The opposite process, urbanisation, was more pronounced in the West and it primarily occurred at the expense of arable land.

5.2. A comparison of results for individual border segments

The Iron Curtain still passed through several countries with various environmental conditions and different development after 1989. For this reason, it is necessary to analyse the results separately for individual regions (segments of the Iron Curtain). Figure 5 and Table 4 present results of the dynamics of individual processes for the first period. There was the detection of significant differences in the individual border segments when comparing their Eastern and Western parts for all processes apart from deurbanisation. The most significant differences were recorded in the afforestation dynamics, which was, compared to the Western part, higher in three out of the five segments in the Eastern parts of the border (all but the West German-East German and Slovenian-Austrian sections). The volume of dynamics of agricultural internal conversion significantly differed between the sides of the border only for the Czech-German and West-East German sections of the border. The deforestation dynamics was also higher on the Eastern side of the Czech-German border when compared to the Western side. The opposite trend, i.e., the higher dynamics in the West, was observed on the Slovenian border. The last process was urbanisation, whose dynamics was generally higher in the Czech-Austrian segment of the borders than in the others, with a higher rate of changes observed in the West.

No significant interaction (the segment of the Iron Curtain vs. East/West) was detected in the afforestation dynamics in the second period (Fig. 6). The only difference was in the Slovakian/Hungarian-Austrian part where higher afforestation dynamics could be observed in the East. The opposite trend, deforestation, differed significantly between Eastern and Western sides of the border in both regions of the Czech border. In both, one can see a lower deforestation rate in the East than in the West. Surprising results were yielded by an analysis of agricultural internal conversion. In the second period, the East-West sides of the Czech-Austrian and Czech-German borders differed in this respect. In both regions, the decrease in the dynamics in the East and its increase in the West were apparent (Fig. 6b). In the second period, differences were also detected in the border segments as far as the deurbanisation processes were concerned. Higher dynamics can be observed in the Western part at the Czech borders (both "Czech" segments) than in the East. On the other hand, this process was somewhat more intensive on the Eastern side of the border (albeit to a minor extent) in the Hungarian-Slovakian segment of the border. The opposite – an increase in urban and urban-like areas – was recorded on the Western side of the border in both "Czech" segments of the Iron Curtain (Table 5).

Tab. 3 – Principal differences between the investigated periods and the Western and Eastern parts of the border

		Time (1990–2000 and 2000–2012)	Border (East and West)	Time*border (interaction)
Afforestation	Statistic	7.93823	16.05745	2.99354
	p-value	**	****	0.0836
Agricultural internal conversion	Statistic	2.34147	0.08762	5.71783
	p-value	0.12597	0.76722	*
Deforestation	Statistic	14.47481	0.02413	1.2362
	p-value	***	0.87655	0.26621
Deurbanisation	Statistic	22.38388	0.09316	3.14791
	p-value	*****	0.7602	0.07602
Urbanisation	Statistic	5.58815	6.77351	1.59114
	p-value	*	**	0.20716

Note: Asterisks express the significance levels as follows: *p < 0.05; **p < 0.01; ***p < 0.001; ****p < 0.0001; *****p < 0.00001; note: all results have to be significant in both Wald test and ANOVA-type statistics (ats) to be considered significantly different.

Tab. 4 – Differences in the dynamics of processes in the individual regions (segments of the Iron Curtain, e.g., Czechia–Austria) and the East–West classification in the first period (1990–2000)

1990–2000		Region (e.g. Czechia, Germany)	Border (East and West)	Region*border (interaction)
Afforestation	Statistics	7.93823	16.05745	2.99354
	p-value	0.04492; ats n.s.	*****	*****
Agricultural internal conversion	Statistics	2.34147	0.08762	5.71783
	p-value	****	0.08997	****
Deforestation	Statistics	14.47481	0.02413	1.2362
	p-value	****	0.14535	*****
Deurbanisation	Statistics	22.38388	0.09316	3.14791
	p-value	*****	0.10648	0.34667
Urbanization	Statistics	5.58815	6.77351	1.59114
	p-value	***	0.45118	0.20935

Note: Asterisks express the significance levels as follows: *p < 0.05; **p < 0.01; ***p < 0.001; ****p < 0.0001; *****p < 0.00001; note: all results have to be significant in both Wald test and ANOVA-type statistics (ats) to be considered significantly different.

Tab. 5 – Differences in the dynamics of processes in the individual regions (segments of the Iron Curtain, e.g., Czechia–Austria) and the East–West classification in the first period (2000–2012)

2010–2012		Region (e.g. Czechia, Germany)	Border (East and West)	Region*border (interaction)
Afforestation	Statistics	7.93823	16.05745	2.99354
	p-value	*****	0.11925	0.00159 (ats n.s.)
Agricultural internal conversion	Statistics	2.34147	0.08762	5.71783
	p-value	*****	***	*****
Deforestation	Statistics	14.47481	0.02413	1.2362
	p-value	*****	0.20058	**
Deurbanisation	Statistics	22.38388	0.09316	3.14791
	p-value	*****	*****	*****
Urbanisation	Statistic	5.58815	6.77351	1.59114
	p-value	*****	*****	*****

Note: Asterisks express the significance levels as follows: *p < 0.05; **p < 0.01; ***p < 0.001; ****p < 0.0001; *****p < 0.00001; note: all results have to be significant in both Wald test and ANOVA-type statistics (ats) to be considered significantly different.

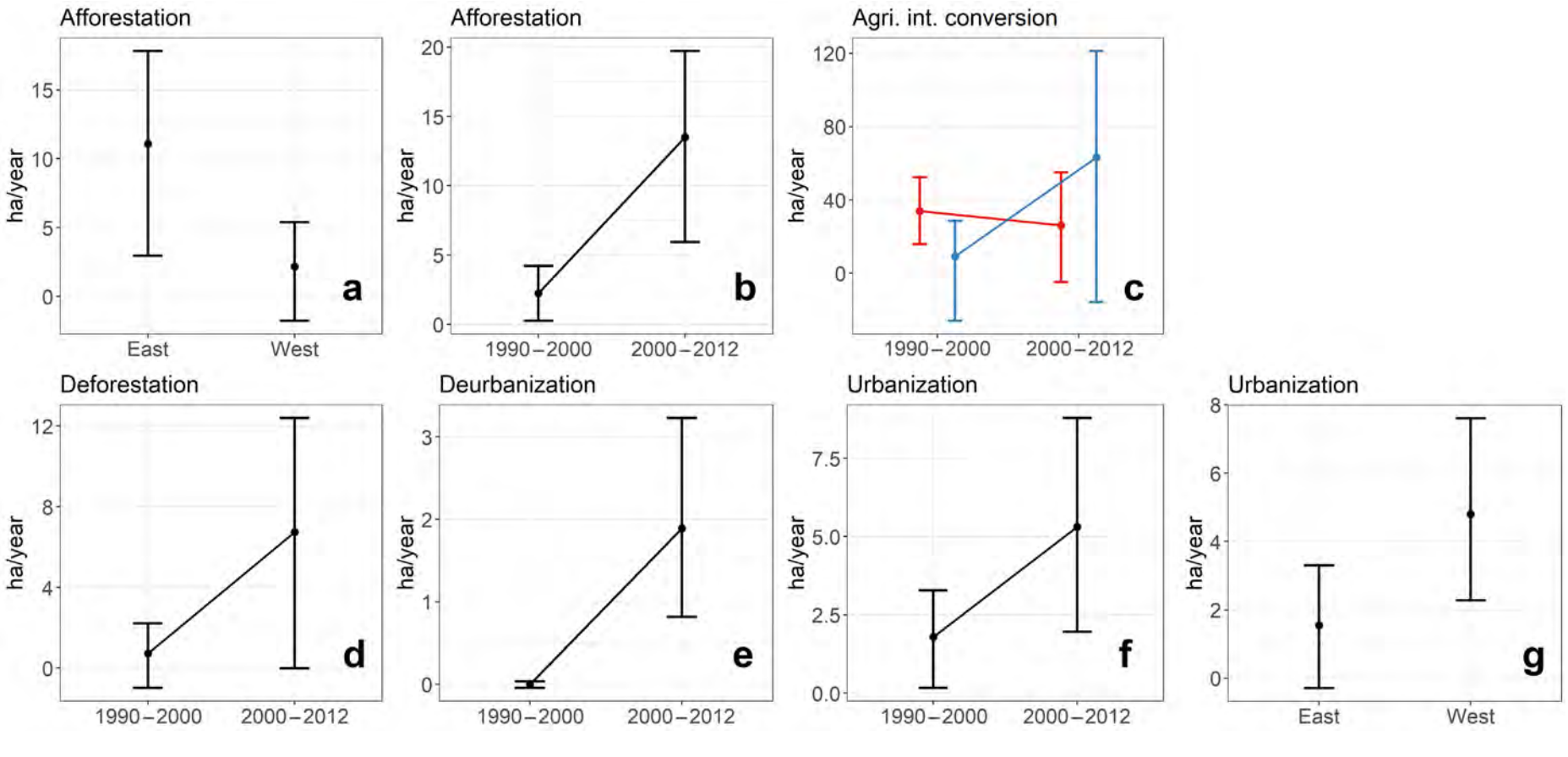

Fig. 3 – Differences in the process dynamics for the entire Iron Curtain border. (c) red – EAST, blue – WEST. Note: Median values with 95% confidence interval for median based on bootstrapping (normal method, R = 10,000).

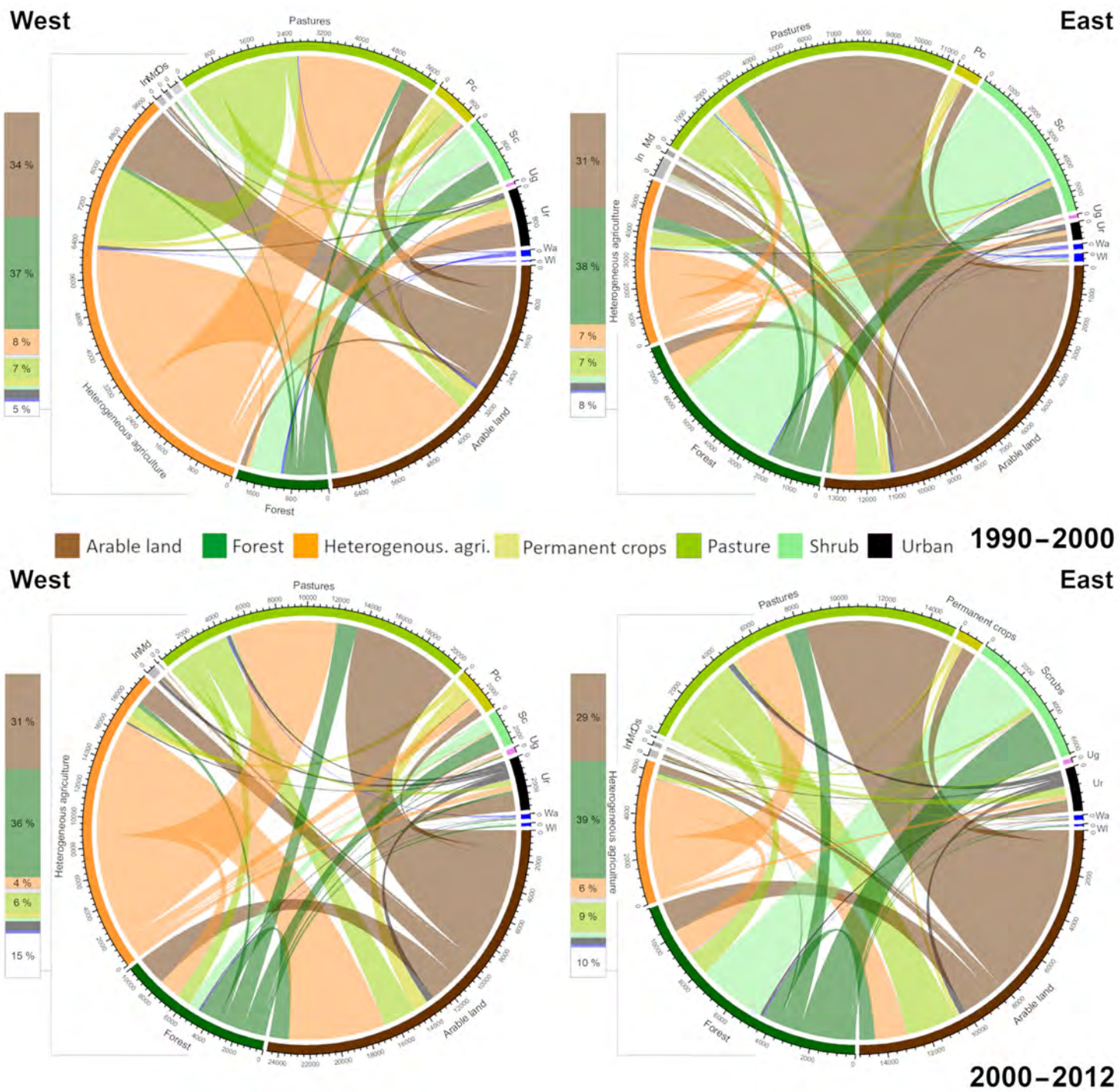

Fig. 4 – Transition scheme for LULC classes at the general level for both sides of the border (East, West) and both time periods (1990–2000, 2000–2012). Circles represent the area under transition (indicated in the bar to the left of the circular graph; for example, the circular graph for the West 1990–2000 presents only 5% of the entire area as only 5% underwent transition). Each colour of the perimeter stands for a particular LULC class. Inner bands depict the part of the LULC class transitioning to another LULC class (to a different colour of the perimeter).

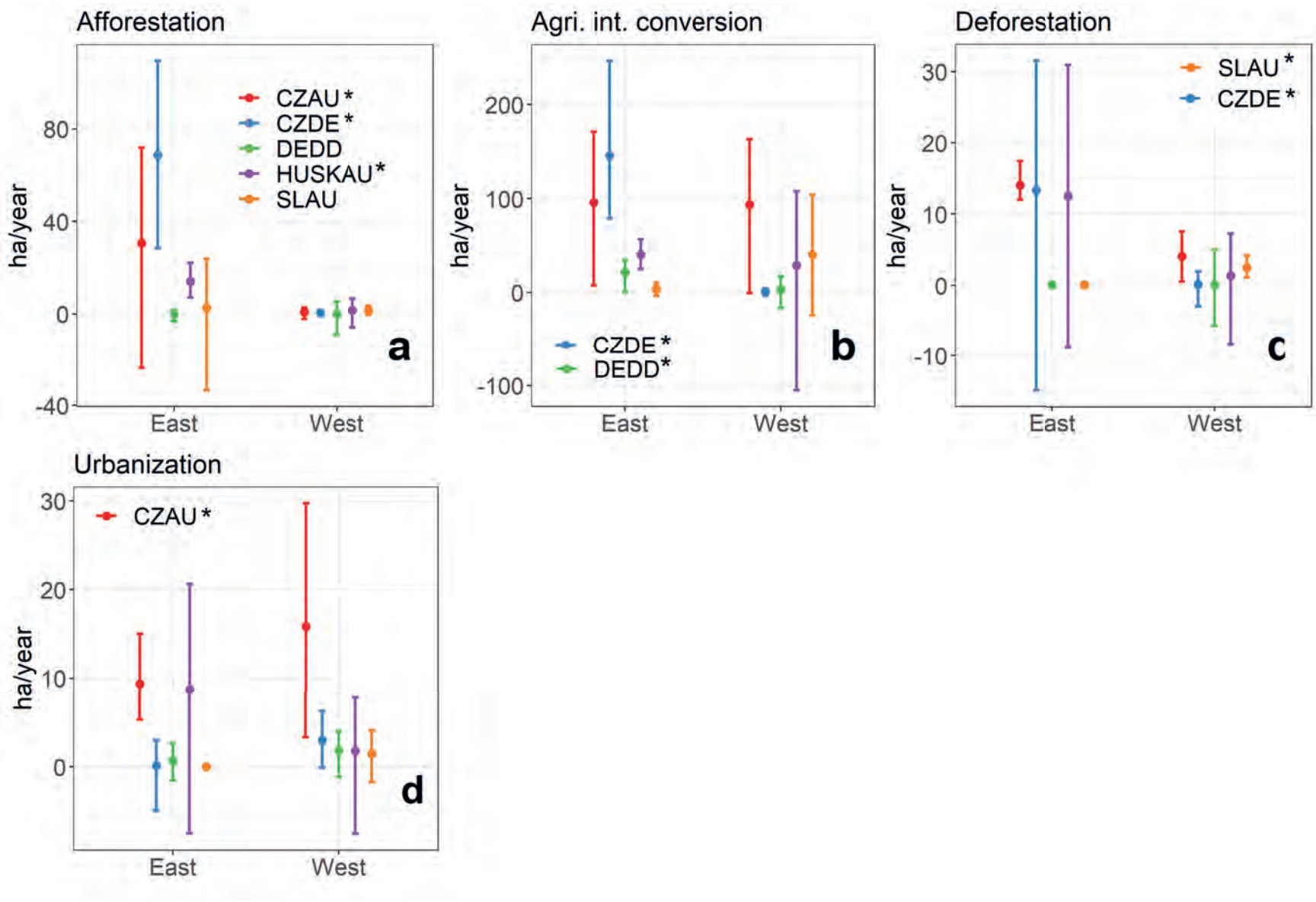

Fig. 5 – Comparison of the rate of changes between individual segments of the Iron Curtain – the segments in the first period (1990–2000); Note: Median values with 95% confidence interval are based on the bootstrap method (normal method, R = 10,000); asterisks indicate significant differences between the East and the West.

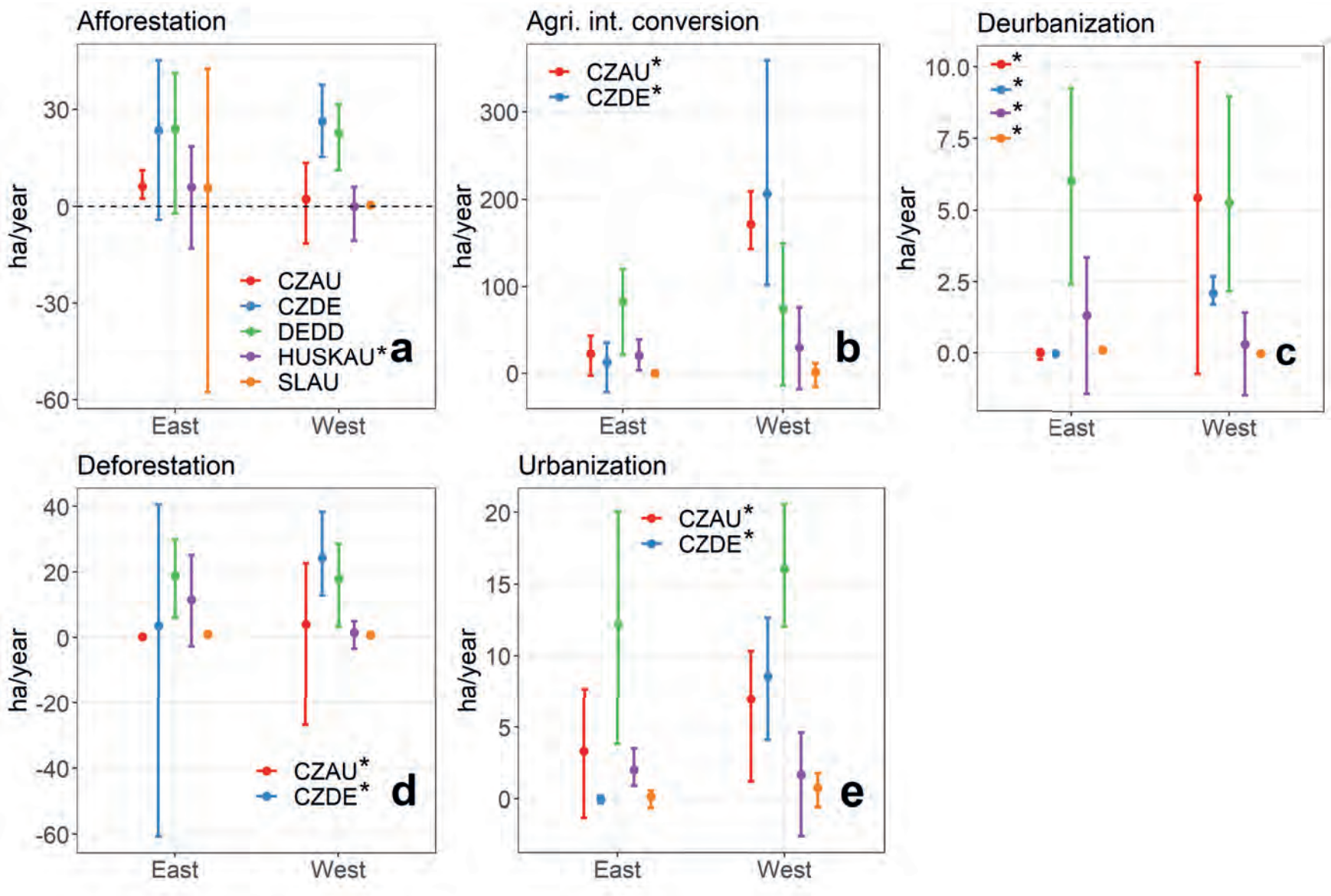

Fig. 6 – Comparison of the rate of changes between individual segments of the Iron Curtain in the second period (2000–2012); Note: Median values with 95% confidence interval are based on the bootstrap method (normal method, R = 10,000); asterisks indicate significant differences between the East and West.

6. Discussion and conclusion

Based on an evaluation of landscape structure in 1990 (the first year of the study period) and using the sampling plots on the same land use and land cover type, a similar composition of land use and land cover categories in the West and in the East was revealed. Bičík et al. (2010) and Kupková et al. (2013) reported a higher representation of arable land in the East and of heterogeneous agriculture in the West. The results differ due to the different approaches to the extent of the processed data adopted in the studies. Smaller samples on the same landscape type are likelier to show similar proportions of individual land use and land cover classes than when comparing entire landscapes differing in environmental settings. On the other hand, the aforementioned disproportion between the higher area of heterogeneous agriculture in the West and arable land in the East in 1990, cited in the works by Bičík et al. (2010) and Kupková et al. (2013), is, however, indirectly observable in this study as well. The evaluation of development trajectories of all sampling plots revealed a dominance of different land change processes in the East and in the West. In the West, transition from heterogeneous agriculture is the main process while in the East, it is transition from arable land. The differences in the character of these trajectories can be interpreted as a tendency to utilise the dominant agricultural land use and land cover class (reserve) for conversion into other land use and land cover classes.

As regards convergence of individual processes, i.e., a question whether or not some processes tend to be harmonised as an effect of, e.g., similar incentives, a detailed assessment has revealed that if the border is analysed as a whole, the volume of agricultural internal conversion differs significantly on both sides of the border and in both periods. The volume of such changes is significantly higher in the second period in the West compared to the East. This can be explained by a higher economical readiness of farmers in the West to respond to subsidy policies and agri-environmental schemes such as the Common Agricultural Policy (CAP). In the initial year of this study (1990), the CAP underwent a transformation: a significant shift from supporting the volume of production to supporting the farmer's income. This change in the CAP policy was intended as support for increasing the effectiveness (intensification) of production and in principle resulted in two major impacts on the landscape. One of the described paths (van Zanten et al. 2014) made the farmers adopt the long-awaited and long-expected intensification of production (increase in competitiveness on the world market). The other brought about a gradual abandonment of less profitable farmland. Such areas were then converted into forests or pastures. The pastures are also subject to subsidies and despite criticism and a change in definition (the CAP reform in 2013) towards the support of wood pasture, there is still a major support for their preservation on the supranational EU level (Plieninger et al. 2015).

In accordance with Bičík et al. (2010) and Kupková et al. (2013), there was the finding of a higher degree of afforestation in the Eastern part of the border and in this study, it even increased in the second period. The character of this land use and land cover change is similar on both sides of the border – namely a transition from shrubs. According to the CORINE data definition, shrubs are a transitional forest stage or a more open type of forest on former pastures. This type of conversion continues at a higher pace in the East. As a result, it can be probably explained by the gradual succession by forests on abandoned plots, a deliberate increase of forests or a cultivation cycle in forestry. Another interesting result at the level of the entire border is the similarity of land use and land cover classes transitioning into forest in the second period, clearly indicating abandonment of certain land-use types (arable land, heterogeneous agriculture, pastures) to the benefit of forest stands. In agreement with Plieninger et al. (2016) and van Vliet et al. (2015), this is typical of the phenomenon of agricultural land abandonment. The transition between arable land and forest stands can be explained by another tendency towards agriculture intensification, which leads to preferring agricultural plots with a higher yield. If a smaller number of agricultural plots can result in similar yields due to the intensive agriculture, the less fertile plots can be utilised for extensive land management such as forestry. This phenomenon was found on both sides of the border, but it was more pronounced in the East.

The greatest volume of changes can be seen in the internal agricultural conversion category. A relatively stable (higher) volume of changes in the East is a result of an obvious extensification when arable land is transformed into pastures. The same process can be observed in the West (here, heterogeneous agriculture is the source). A strong focus on the transfer to pastures can be attributed to the land extensification here as well (in accordance with the conclusions by Bičík et al. 2010; Kupková et al. 2013). The transition of land use and land cover into pastures is also apparent in the deforestation volume as a part of the forests is also converted into pastures. Another difference between the East and West is a higher degree of urbanisation in the West. This trend is most likely explained by the limitations to the urban area development before 1989, when most border segments in the East were subject to building limitations, preventing new construction activities in the Iron Curtain border zone. Despite a higher pace of urbanisation (although marginal as far as the total area is concerned), the second period was also associated with a higher deurbanisation pace. This can be caused by land reclamation and transformation of brownfields/abandoned plots.

If one disregards the possibility of an uneven impact of environmental conditions, i.e., if it is accepted that the sides of the border are comparable, differences in land use and land cover trajectories exist. It is therefore necessary to look for driving forces of the land use and land cover change. Wilson and Klages (2001) studied the changes in agriculture in the former communist states in Central Europe (CECs) and found similarities in the transition pattern from centrally planned to market economies. An exception can be observed only in the transition of Poland and Slovenia (the latter can be also observed from our results for the Slovenian part). In all countries, this transition brought about a period of "transition recession" (see Kornai 2008 for details), coupled with an increase in the income imbalance and unemployment, but later resulting in a relatively rapid adaptation to the market economy and a rise in productivity compared to the period prior to 1989 (usually since approximately 1995). As a result, the transition recession could be part of the driving forces mosaic reflected by land abandonment tendencies in the East during the first period.

Based on the data discussed above, it is obvious that the transformation process triggered spatially different changes in the case of the cross-border comparison (East-West). The resulting trajectories may be divided into three groups:

1. The first category: East-West German border regions – the transition was faster, under one leadership and therefore a stable, single political course. These are most likely the principal factors resulting in the similarity of the trends (towards the second period) on both sides of the border in the case of the West-East German part of the Iron Curtain.

2. The second category: the Slovenian-Austrian segment of the border, which is, due to a historical context and specific environmental conditions, relatively stable as far as land use and land cover changes are concerned.
3. The third category includes such regions as Czechia, Slovakia and Hungary. On their borders with traditional democratic countries, the differences in land-use changes between the sides of the border were the highest. This was probably predominantly caused by the significantly worse position of agriculture (especially) in the first period compared to the "Western" countries, which only stabilised following the accession to the EU and associated agri-environmental subsidy schemes.

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Dynamics of wood-pastures in Czechia in the context of its historic changes in the last two centuries

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Introduction

According to the European Landscape Convention (Council of Europe 2000), landscape is an important contributor to quality of life and society well-being. Wood-pastures, which are the subject of this article, represent traditional European landscapes, that combine livestock grazing with scattered trees and shrubs (Plieninger et al. 2015). They were widespread from the Middle Ages (Forestry Commission Scotland 2009; Jørgensen, Quelch 2014) until the 19th century before being dominated by other land use/land cover categories due to the increasing demand for timber and agricultural products (Hartel et al. 2013, 2016). The trees are spatially arranged as points (e.g., isolated trees), lines (hedgerows, alleys, riparian buffers) or clustered (e.g., woodlots, tree groups; Plieninger 2012; Figure 1). They can be a product of spontaneous regrowth or planted, domesticated and cultivated, and they are usually seminatural habitats within the farmland mosaic, which is grazed by deer or domestic stock, and form part of a high-quality agricultural matrix. Older or younger trees may be present, distributed irregularly and forming mosaics with open habitats such as grazed grassland. The ground vegetation is very rich in species but is not generally managed in an intensive way (Scotland's natural heritage 2015). Among natural preconditions for these habitats, solid and drift geology with nutrient poor, free-draining soils have been mentioned as favourable (Thames Valley Environmental Records Centre 2015). Older (and veteran) trees with widely spreading branches, often with signs of traditional silvicultural management such as pollarding, are typical of open parcels, while denser patches of younger trees may exhibit more upright growth forms.

Wood-pastures are common throughout the world in traditional cultural landscapes and in recently modified landscapes (Manning et al. 2006), and even "farm trees" (single trees) are often considered as belonging to this group (Arnold, Deewes 1997). Historically, these habitats were valued for their socioeconomic and cultural importance (Roellig et al. 2015, Surová et al. 2014, Plieninger et al. 2015). From the early stages of agricultural evolution, they have been playing an essential role for local communities, being a source of a variety of products of major local importance, such as firewood, brushwood, timber and wood for tools and furniture, bark, bast fibre for textiles and rope, cork, litter, fruits, mushrooms and honey. Various tree species serve various purposes and can fulfil local demands of sustenance, craft, trade and industry in various regions of Europe (Hartel, Plieninger 2014). People also generally have positive feelings towards large trees for their impressive size, shape, and age. Specific terms (e.g., "veterans" or "working trees" in the UK) and names or stories associated with them are sometimes used (Moga et al. 2016).

Nowadays more attention is paid to their ecological values (Hartel, Plieninger 2014). Wood-pastures increase biodiversity and create unique vegetation structures with light/shadow gradients (Read 2000; Gibbons, Lindenmayer 2003; Garbarino, Bergmeier 2014). Scattered woody vegetation, defined as "keystone structures", is a key factor for the ecological role of wood-pastures. The effect of trees on ecosystem functioning is disproportionately high in relation to the small area occupied by any individual tree (Gibbons et al. 2008), by buffering against wind and dryness, control of nutrient cycling and soil erosion (Manning et al. 2009, Hartel et al. 2016), carbon sequestration and air quality (Burgess et al. 2017), regulation of surface water (Nisbet et al. 2011), and adaptation to anthropogenic climate change (Manning et al. 2009). Trees create structural diversity in agricultural landscapes, also permitting animal movement (Manning et al. 2009). Moreover, some species are sometimes regionally

Fig. 1 – Example of traditional wood-pasture from Southern Transylvania, vicinity of Romanian Sighișoara, and vicinity of Czech Koněprusy (right)

restricted only to wood-pastures (e.g., shade-tolerant unpalatable geophytes, including peonies and hellebores in southern Europe; Chaideftou et al. 2009). Traditional low-intensity management supports rich flora and fauna (Rosenthal et al. 2012) and a larger cover of native vegetation than in other managed landscapes and specific structure and succession stages (Hartel et al. 2013). High genetic diversity results from human maintenance of certain tree species (Bergmeier et al. 2010) selected over centuries. A study in Czechia (Vojta, Drhovská 2012) has demonstrated a higher species diversity of wood-pastures as compared to e.g., ancient ungrazed forests. Old, scattered trees in particular provide a broad range of habitat features, such as dead branches or hollows (Gibbons, Lindenmayer 2003), representing local biodiversity hotspots in the ecosystems they are located in. Recent studies (Stephenson et al. 2014) mentioned that old trees are better at absorbing carbon from the atmosphere than commonly assumed. Finally, they store precious information about the past climatic and environmental conditions in their annual rings (Moga et al. 2016).

Yet, throughout the past 200 years European wood-pastures experienced a major decline (Bergmeier et al. 2010), often explained by abandonment of traditional management and discontinuation of livestock husbandry, transformation into commercial forests or built-up areas (Rackham 1998, Forestry Commission Scotland 2009), increased uncontrolled burning, leading to fires (Hartel et al. 2013), intensive tree cutting or other changes in land use and lack of regeneration. Historic socioeconomic changes also significantly affected management regimes, such as in the Age of Enlightenment, when peasant forestry and agricultural practices were often transformed into lands with a strict separation of forestry and agriculture. This brought about a decline in less intensive use of traditional wood-pastures in economically advanced countries (Hartel, Plieninger 2014). Over the last two centuries European landscapes were affected by the "Complex Revolution of the Modern Age", which took place in Czechia in the 19th century (defined as the Industrial and Scientific Revolution, starting in 1848–1849), marked by technological innovations towards intensification of agriculture. Here, major changes in land use were triggered by the Agricultural Revolution, with its peak in the 1860–70s, when socioeconomic and political forces were gaining more importance. Studies for Central and Eastern European countries show a decline in non-forest woody vegetation during the Communist period and of grasslands between 1845 and 1948, followed by a renewed increase. Today, "functioning" wood-pastures can still be found, especially in Southern and South-Eastern Europe, in parts of boreal and subarctic Europe and in the central European mountains (Bergmeier, Roellig 2014), occupying about 203,000 km² in the EU27 (4.7%; Plieninger et al. 2015).

Though some authors (e.g., Vojta 2012) have argued that Czech ancient wood-pastures have mostly disappeared, similar habitats of diverse origin and management in Central, Western and Northern Bohemia and Southern Moravia can still be found.

Among the factors that have been shaping European landscapes in recent centuries, esp. in relation to agricultural lands such as wood-pastures, a growing need for products, population changes and thus, geographical location have traditionally been seen as the ruling factors. Von Thünen (1990) in his manuscript "The Isolated State" (1826) explained it by the (physical) distance to the market (Bičík et al. 2015). Later, Marx (1967) reflected the role of this factor via the concept of "differential rent", also with fertility of land being a factor.

Landscape combines all natural elements, together with their functions as well as socioeconomic elements, in one complex organism, whose health is critically dependent on the balance between all these elements. Their relative importance depends heavily on the level of development of the local society. Since landscape changes result from a complex interaction of such location-specific factors, this article will review the dynamics of Czech wood-pastures by answering the following questions:

1. What are the change trajectories of wood-pastures in different types of the Czech landscape over the last two centuries?
2. How can continuity of Czech wood-pastures be characterized?
3. What was the relative importance of the human-driven/natural factors for dynamics of Czech wood-pastures?

Study area

For this work, locations across the whole area of Czechia were selected for analysis. Czechia demonstrates significant climatic and species variation across its landscapes. The diversity of climatic conditions, geological composition and geomorphology creates a high biological and landscape diversity (Plesník,Roudná 2000). Up to 80% of the land had been covered by forest until the 13th century (Lipský 1994). Later on, political circumstances across the regions of the country were also playing a significant role. During only the last hundred years, the history of the country included the foundation of Czechoslovakia, German occupation during World War II and forty years under the Communist regime. Only in November 1989, remembered as the Velvet Revolution, the country became known as Czechia. All this affected the diversity of Czech culture and landscape. After the 'Iron Curtain' was torn down, it became known as a country of two faces, showing the signs of both the period of industrialization and ecological awareness, with heavily damaged environments (Northern Bohemia and Northern Moravia-Black Triangle) and remarkably well-preserved ecosystems, habitats, species, and biodiversity in general in other areas of the country.

According to Bičík et al. (2015), the last two centuries were particularly dynamic in agricultural development. In the first half of the 19th century, a striking contrast existed between the northern (relatively densely populated) and southern (sparsely populated) halves of Bohemia. Czech landscape was comprised of a mixture of fields, meadows, pastures, and forests, demonstrating rather heterogeneous patterns on the local level, but quite homogeneous on the national level. Production was limited to local markets and each region had enough arable land, grassland and forest to cover its essential needs (Krausmann et al. 2003), supporting environmental balance. Agricultural land covered two-thirds of the country in 1845, with arable land occupying almost one half. In the latter half of the 19th century a decline in agricultural population and growth in urban population took place, in parallel with changes in the land ownership system: if long-term lease was applied before (all land was divided by the cultures raised at each parcel, and farmers could rent a "share" of them, which also helped support crop rotation), after 1848–1849 the fragments of land were divided between small farmers, and the proportion of land in ownership of big landlords declined from 42% to 38%. Animal husbandry experienced radical modernization, with a sharp increase in the amount of farm animals and use of sheds and stalls, while arable lands reached 52% of the country area by 1896. Pasture land declined by over 30% between 1845 and 1896 and major changes happened close to cities and roads, but also in border highlands. During the market-oriented era between 1870 and 1914 animal husbandry almost doubled and it became necessary to secure enough fodder. This, however, slowed down during World War I and led to significant

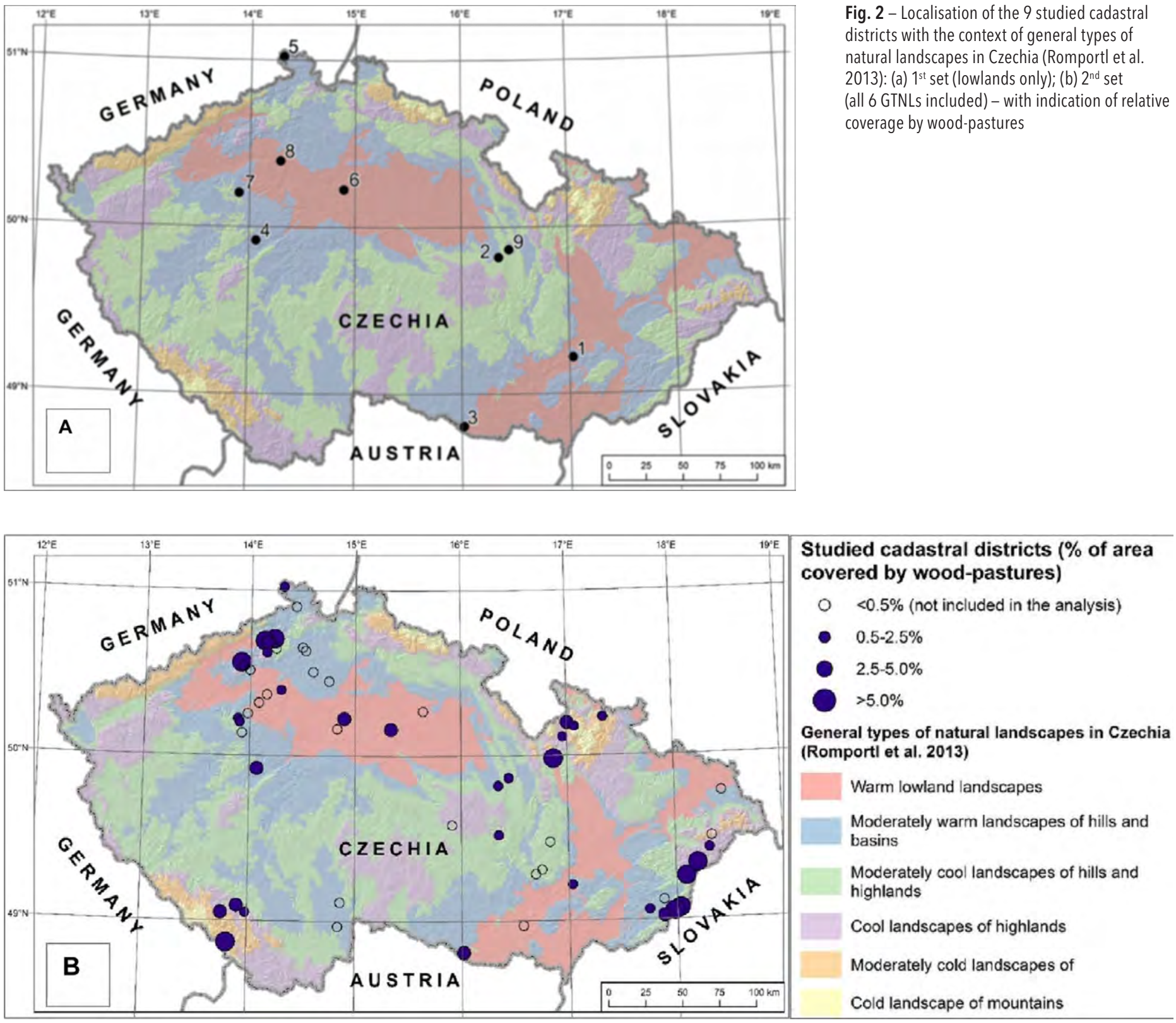

Fig. 2 – Localisation of the 9 studied cadastral districts with the context of general types of natural landscapes in Czechia (Romportl et al. 2013): (a) 1st set (lowlands only); (b) 2nd set (all 6 GTNLs included) – with indication of relative coverage by wood-pastures

changes in the structure of Czech agriculture towards a more cost-effective system. The Land Reform Act (1919) introduced limitation of the land to be owned per one landowner, and it was now distributed by fragments, with the excess land paid for by the state, while forests were given to big farmlands or military. Small farms started being abandoned or merged.

Agricultural intensity decreased again during World War II and animal husbandry only reached its previous level by 1960. The Communist era (after 1948) caused the most considerable land use changes due to changes in geopolitical orientation, economic system, large-scale industrialization, collective farming, emergence of military training areas and depopulation of rural areas and transfer of Czechoslovak Germans. The Iron Curtain soon hampered access to some big land plots, which brought about even more abandonment of countryside and traditional agriculture. Farming, now under cooperatives, became more intensive and mechanized and animal husbandry shifted to large cowsheds. Since the 1970s, less fertile areas were supported by subsidies to maximize their productive use. Industrial plants, residential projects, roads, dams, mines and quarries were replacing traditional rural landscape.

The selection of sites and analysis of change trajectories in wood-pastures from the early 19th century for this work was done with consideration of the socio-political changes and natural variability of the country and former findings of their presence in Czechia in historical/modern landscapes.

The study sites were selected by two criteria in order to analyse the changes. First, the locations represent different administrative (cadastral) districts and their historical borders were selected for consistency. Second, various climatic and geomorphologic characteristics are represented, following "general types of natural landscapes" (GTNL) by Romportl et al (2013) and based mainly on the criteria of average annual temperature, slope and elevation. Two sets (Figure 2) of study sites were analyzed consequently: (1) lowland areas only ("warm lowland landscapes" and "moderately warm landscapes of hills and basins" in this classification), (2) all 6 GTNLs included. Only districts with at least 0.5% of their area covered by wood-pastures were selected.

The first set was comprised of 9 districts, between 3.8 to 28.6 km², and the total area of districts equaling 98.6 km² or 0.3% of the total area of the selected GTNLs. The second set included sites from all 6 GTNLs, but moderately cold and cold mountain landscapes were merged into one category, creating 30 districts with the areas from 1.94 to 80.58 km² and the total area of the districts equaling 450.75 km².

Methodology

Among authors there is some inconsistency regarding the definition of wood-pastures, which may be related to the location in general, type of woody vegetation, amount and density of trees and canopy cover, intensity of using these lands as pasture, age or continuity, etc. For this work they were defined as a subtype of semi-open habitats where grazing is the dominant management of semi-open grassland (with at least 7 trees/ha and maximally 80% tree canopy cover). For lowlands only (the 1st set), the change trajectories between wood-pastures and other land use/land cover (open/semi-open non-cultivated landscapes, closed landscapes, open/semi-open cultivated landscapes, other) during the temporal horizons of the early 19th century, mid-20th century and the current time were estimated based on "Imperial Imprints of the Stable Cadastre" (ČÚZK 2015) for the 1st temporal horizon, historic black-and-white orthophotos from 1953/1954 (CENIA 2012) for the 2nd temporal horizon (which only shows land-cover and thus presence of woody vegetation accurately), while for the current horizon modern orthophotos (ČÚZK 2016) were used in combination with the Land Parcel Identification System (LPIS; eAGRI 2016), the Regional Forest Development Plan (in Czech: "Oblastní plán rozvoje lesů"; ÚHUL 2000), the base map of the Czech Republic (scale 1:10,000; ČÚZK 2016) and repeated field trips (current time, Figure 3). For the 2nd set the middle horizon was excluded due to the above-mentioned limitation. However, additional factors as drivers of change were analyzed (additional sources included the Digital Relief Model (ArcČR 500 by Arcdata Praha 2016) for topographical data and the European Soil Database v2 Raster Library (1×1 km; European Soil Data Centre 2018) for soil types data). Analytical procedures are described in Pereponova and Skaloš (2018).

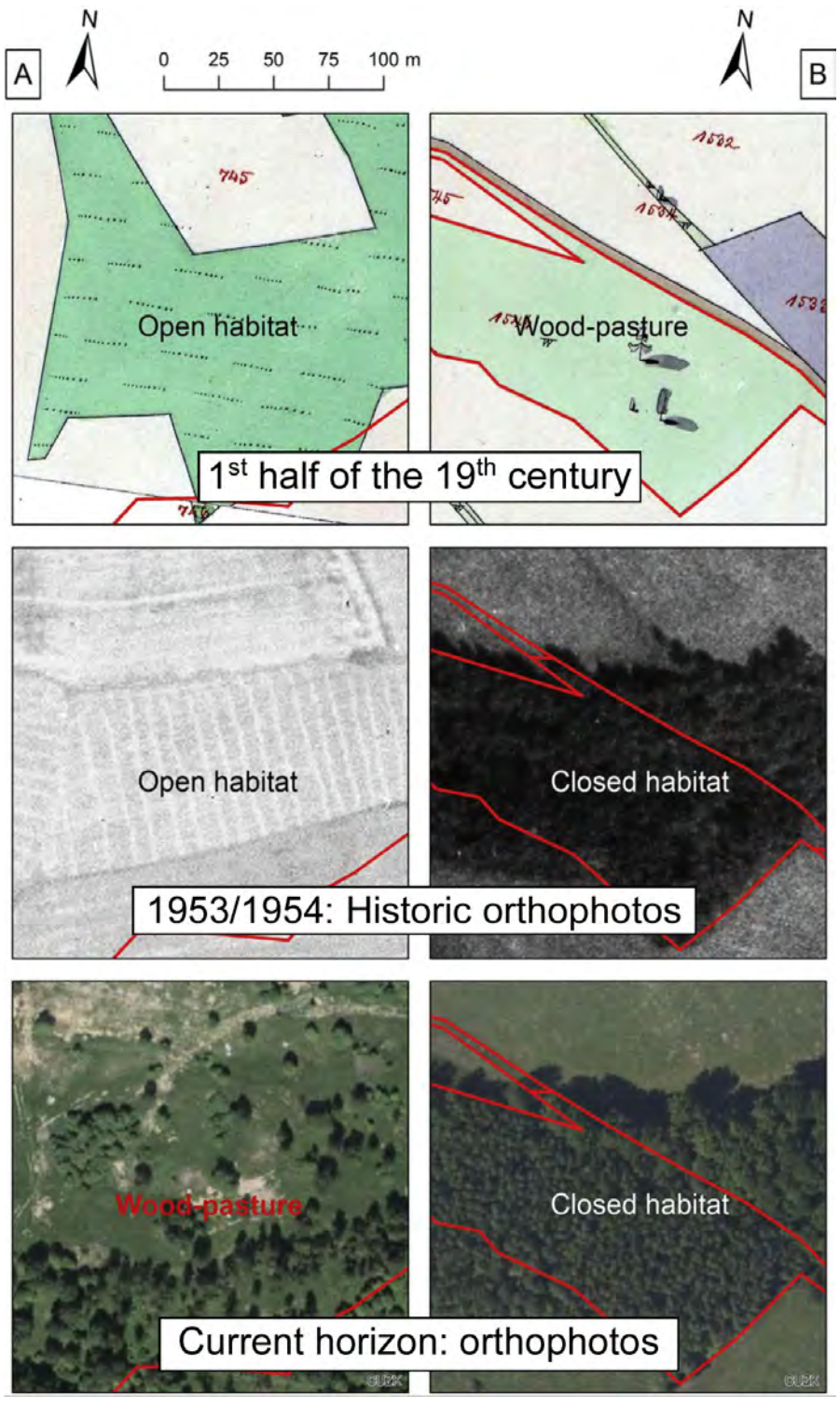

Fig. 3 – Examples of typical change trajectories of wood-pastures in current (A) and historical temporal horizon (B)

Results

After applying the minimal mapping unit (0.3 ha) to the parcels, a total of 163.7 hectares of wood-pastures were identified for the current horizon (1.7% of the total area of the corresponding cadastral districts) for the 1st set (lowlands only). This is almost double of their area in early 19th century (78.1 hectares, or 0.8% of the studied area of the same cadastral districts), though this trend differs between the different districts. Looking into continuity, over a half of the original wood-pastures were lost at the beginning of the Communist era (between the early 19th century and 1950s), and another 44.1% were lost later (between 1950s and 2015/2016), with only 1.9% existing continuously ("ancient" wood-pastures; Figure 4). They were converted predominantly to open lands (arable land or grassland) by the 1950s, and later to semi-open/closed lands. Over 80% of currently present wood-pastures appeared after the 1950s and the majority emerged from more open land use/land cover categories (for details, see Forejt et al 2017).

The 30 cadastral districts of the 2nd set contained 4.7% of wood-pastures (2,128.12 ha) in the current temporal horizon, as compared to 10.89% in the beginning of the 19th century, which differed between various GTNLs (Figure 5); only 263.08 ha of wood-pastures (5.36% of all old) could be categorized as persistent. From the different GTNLs, relative areas of persistent wood-pastures were the highest in (1) warm lowland landscapes (0.997%) and (3) moderately cold landscapes of hills and highlands (0.801%) and the smallest in (2) moderately warm landscapes of hills and basins (0.20%; for more details, see Pereponová, Skaloš 2018). The most significant decline (69% of old wood-pastures) occurred towards closed areas (mainly forests), while open land use/land cover was the major source of current wood-pastures (50.96%) in all GTNLs (reaching 91.75% in (1) warm lowland landscapes), though the former (woody) grasslands and pastures also were relatively important.

Altogether, the majority of wood-pastures appeared due to overgrowing of open areas rather than opening of closed areas.

Two main types of wood-pastures were noticed in the current temporal horizon, explained by their location within different GTNLs and local management traditions:

1. large areas with either oak, pine or birch, with dry grasslands on slopes, or with maples, spruce or rowan in highlands, often in former military areas
2. small patches with fruit trees with sheep, goats and horses.

Veteran trees are disappearing, while old oaks and silver spruce are scarce and require protection, as do the surrounding ecosystems. In some cases, restoring old wood-pastures from the currently overgrown closed areas is possible (Roellig et al. 2015). In general, Czech wood-pastures, compared to other European ones, are lacking traditional land use (Krčmářová, Jeleček 2017).

Discussion

Climatic conditions determine the presence and type of human activities and related land-use patterns to a significant degree. This partly explains the elsewhere uncommon increase in wood-pastures in the course of time in the case of moderately cold and cold mountain landscapes, since they are less affected by socio-political factors. However, the absolute value of wood-pasture area and its increase was small and may also have resulted from other local factors, e.g., seasonal rotation of land use. The observed increase in wood-pastures in lowlands was partly related to the particular selection of the study sites, which was relatively small and only covered the districts with currently significant cover of wood-pastures. From the combination of the results, it can be assumed that many changes took place in the last 60 years, due to the rapidly changing political situation, leading to collectivization, large open fields and heavy mechanization. On the other hand, as early as late 19th century husbandry was aimed at higher production levels, thanks to which more animals were kept in stables and the area of pastures, including wood-pastures decreased (Bičík et al. 2015). The recent appearance of most current wood-pastures, mainly from cultivated open landscapes such as arable lands, reflects again the processes of abandonment of less accessible lands during communism and extensification of agriculture in the 1990s (Bičík et al. 2001, Feranec et al. 2010). This was followed by a continuous decline in arable land after 1994 (Vachuda 2017). A comparable area of wood-pastures came from semi-open (woody grasslands) or open non-cultivated landscapes (pastures, grasslands), which is partly due to periodical rotation of land use and less intensive grazing and slow successional overgrowth (in the case of open non-cultivated landscapes) of grazed areas. It could be observed in most GTNLs.

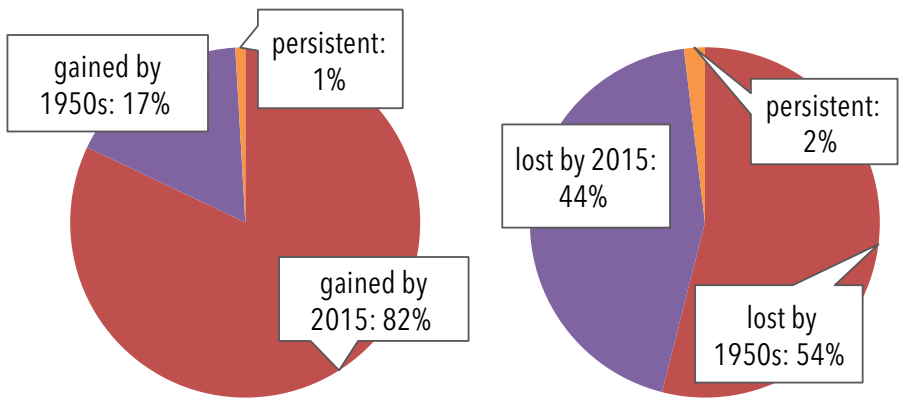

Fig. 4 – Continuity of wood-pastures in lowlands present between the periods of 1824–1843 and of 2015/2016 (Forejt et al. 2017)

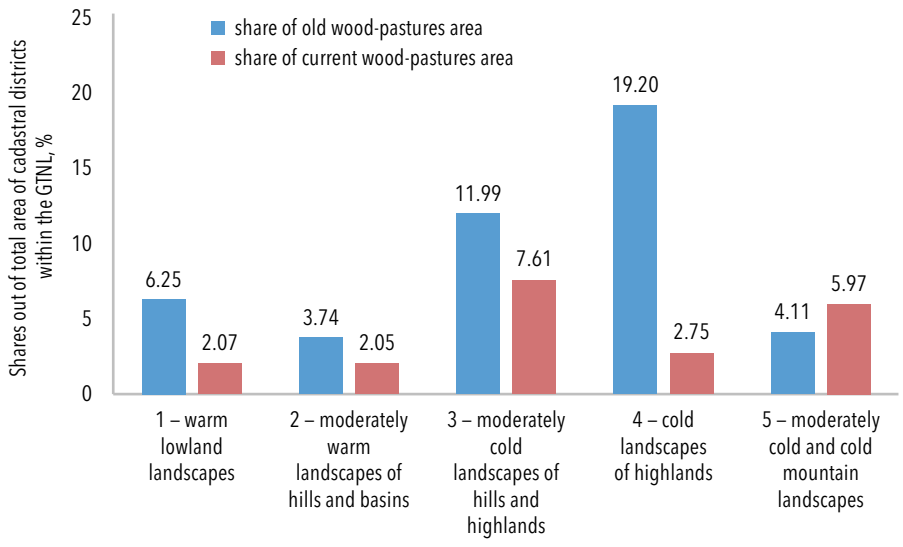

Fig. 5 – Presence of wood-pastures in historical and current temporal horizons in each GTNL

Intensification of land use and grazing prompted a rapid loss of wood-pastures (Plieninger 2006; Schaich et al. 2015; Varga et al. 2015) in favour of more open land use/land cover, while extensification of agriculture and abandonment of farming and corresponding areas and traditional management (due to migration to urban areas from the 19th century, as a result of Industrial Revolution and abolition of serfdom of 1848–1849 (Fialová et al. 1996)) led to an invasion of woody vegetation in corresponding areas (Plieninger 2006).

The introduction of differential rents I and II supported the shift to more fertile areas for farming from 1880 (Bičík et al. 2015), causing an abandonment of less fertile lands together with traditional wood-pasture management. Another wave of rural depopulation was due to the transfer of Czechoslovak Germans to Germany and Austria after World War II. During the Communist era private farming was suppressed in favour of cooperative or state ownership, and after its collapse rural areas were influenced by privatization, denationalization, and restitution of property.

The role of forests as sinks of wood-pastures reflects the processes of natural afforestation after abandonment of former semi-open areas (or "forest transition", as the process of reversal of the forest decline in the previous period due to the agricultural expansion) and commercial planting in the last decades (Postulka 2008). In moderately cold and cold landscapes forests share the leading position as sinks with semi-open non-cultivated landscapes, which can be partly attributed to the development of tourism and climatic conditions.

A higher proportion of persistent wood-pastures in moderately cold landscapes of hills and highlands and cold landscapes of highlands highlights the importance of socio-political changes for landscape stability: these remote lands are less reactive due to a "slow diffusion" of central decisions and have a stronger connection to tradition and pastoralism (which was also confirmed in informal interviews with local people). Wood-pastures in these areas are also more "integrated" into the territory of the villages, forming a part of the local lifestyle.

Several potential drivers of change were statistically estimated, suggesting the conclusion that the dynamics of wood-pastures within the considered time-frame was explained primarily by economic and political changes, manifested especially in the form of losses of wood-pastures, before 1950s, while their reappearance (after the 1950s) was more related to natural factors (following the GTNLs analysis).

The role of relief factors (elevation, steepness) in the trajectories of change and particularly persistence of wood-pastures during the period under study appeared to be determined by the possibility to use corresponding land for cultivation, also taking into consideration technological (heavy mechanisation) and methodological developments (Bičík et al. 2015), as well as such factors as traditional management. It is less responsive to central political decisions and is better conserved in remote highland regions. The above-mentioned influence of abandonment of these remote areas can be revealed by means of an analysis of these factors. Financial support (e.g., subsidies) has also proved to be successful enough to support motivation for traditional management among farmers, though technical improvements are required for the corresponding systems.

Designation of the protection status to help preserve traditional land use/land cover areas was also analysed and it proved to be successful for conserving Czech wood-pastures. This also explains some sink/source change trajectories in lowlands,

where abandonment of former military areas in recent decades and their conversion into protected wood-pasture-like areas (e.g., the Milovice reserve) was taking place.

Structural changes related to extensification and new methods (irrigation systems) are also illustrated by the distribution of the land use/land cover changes on account of the vicinity of water bodies. Meanwhile, the development of transportation infrastructure showed that it is positively related to emergence of new wood-pastures, potentially due to the development of the market and of all (semi)agricultural activities closer to connection points. At the same time, no strong direct relation between the presence of wood-pastures and natural factors (also soil and geology) could be confirmed regardless of the natural preferences of these land use/land cover.

Conclusion

In summary, the results demonstrate the major role of socio-political and technological drivers in recent change trajectories of wood-pastures in Czechia, especially in the case of their losses, whilst natural factors were more important for the appearance of new wood-pastures. The idea that "environmental factors are usually believed to play a more important role in less fertile areas" could also be demonstrated by the fact that arable activities shaped the landscape where the use of modern techniques is suitable. Most ecosystem changes stem from the growing demand for the provision of ecosystem services (food, water, timber, fibre, fuel). This substantially improves human well-being and economic development, but goes along with ecosystem degradation, expressed in losses of natural capital. This often happens at a scale that is larger than could be justified by producing greater gains in other services. Meanwhile, though some authors state that major decisions regarding land use are often made by urban people with limited knowledge of agriculture, administrative or legislative measures on the national level (subsidies, protection status) possess tools to effectively support traditional land management. However, some improvement needs to be made to current mechanisms of implementation of such policies to support quality of data (e.g., LPIS datasets).

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