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ARCHAEOLOGY AND HISTORICAL ECOLOGY: THE ARCHAEOLOGICAL DATABASE OF THE LONGWOOD ERC PROJECT

Archaeology, as research and heritage management, often involves the creation of large datasets with different focuses and in a diverse range of forms. Information on sites with archaeological finds and contexts has been collected and organised in catalogues since the first legislative measures were passed in the 19th century (e. g. 1807 for Denmark, 1882 for England). Developments in computerization since the 1970s enabled the continuous transformation of manual card indexes into digital databases, which have flourished particularly since the 1990s. Rapid technical advancements enabled the standard use of relational databases and data analysis in geographical information systems (GIS) (Kuna et al. 2004; Hansen 1993).

The theoretical background, creation, use, sharing and other aspects of databases were discussed many times within the international archaeological community. The conference Computer Applications & Quantitative Methods in Archaeology (CAA) provided an ideal forum for such debates, resulting in reviews of European databases (Hansen 1993), the presentation of GIS-based databases of sites and finds on national levels (e. g. Berg 2001) or the introduction of web-based free database software (Bobowski 2012). Obviously, there are hundreds of databases with archaeological data around the world, and it is not our aim in this paper to provide a comprehensive review. Nevertheless, a few examples of good practice could be mentioned. The Archaeology Data Service[1] was founded at the University of York in 1996, and apart from preserving digital archaeological data produced by British archaeologists in the long term, it also serves educational and research purposes (see also Richards 1997). Research databases on regional, continental or global levels also provide opportunities to carry out quantified modelling. Archaeological examples include the ^{14}C datings database RADON[2] (Hinz et al. 2012) or the datasets of the EUROEVOL project dealing with Neolithization processes across Europe (Manning et al. 2016).

A significant event in the development of Czech archaeological databases was the establishment of the national chapter of the CAA (in Czech »Počítačová podpora v archeologii«), which laid the foundations for the modern use of databases in the Czech archaeology. The first proceedings introduced to the Czech archaeological community the basics of database systems (Smutný 1997), methodological models of working with databases (Macháček 1997b) and also some current examples (e. g. Neruda 1997; Kuna 1997; Baštová et al. 1997). Nevertheless, important works on database-like formalised descriptions and data analyses were published already in the 1970s (Podborský et al. 1977). Examples of good practice of dealing with digital data combining databases and GIS can be found at several sites, which were excavated and analysed for decades. We mention the large Neolithic settlement in Bylany (okr. Kutná Hora / CZ; Květina 2008; Květina / Pavlů 2007), the early medieval hillfort of Pohansko (okr. Břeclav / CZ), a part of which was published as a digital catalogue (Macháček 2002) while other parts are stored on a data server (Dresler et al. 2008).

The detailed history of the development of digital databases covering significant parts of the Czech Republic was recently reviewed by M. Kuna (2015). The collection, evidencing and storage of data coming from archaeological excavations have been an issue since the beginning of the institutionalisation of archaeological research and heritage management in the Czech Republic, in particular, the founding of the State Institute of Archaeology (Státní archeologický ústav) in Prague in 1919 (Kuna 2015). Information was originally stored as reports in the archive of field documentation of the Institute. Later on, a local branch was founded in Brno (1942), and reports from Moravian sites were stored there. After several organizational changes often connected with political changes in Czechoslovakia and later on in the Czech Republic (after 1948, 1989, and 1993), the two archives of the reports are currently run by the two Institutes of Archaeology of the Czech Academy of Sciences in Prague and Brno (Archeologický ústav Akademie věd České republiky, Praha, v.v.i.; Archeologický ústav Akademie věd České republiky, Brno, v.v.i.). The first attempt to create an electronic sub-national archaeological database is dated to 1990 (Archaeological Database of Bohemia; Archeologická databáze Čech). In Moravia, the digitised collection and storage of archaeological fieldwork and excavation reports started in 2007 and is still in progress. Recently, these two institutes have started to collaborate on the ambitious project of the Archaeological Map of the Czech Republic (Archeologická mapa České republiky), which should cover the whole state in the future (Kuna et al. 2015a).

In addition to the databases of the Institutes of Archaeology of the Czech Academy of Sciences, the State Archaeological List of the Czech Republic (Státní archeologický seznam České republiky) was created by the National Heritage Institute (Národní památkový ústav; Krušinová et al. 2003). This database has a wide range of collaborators providing knowledge on regional archaeology, but the quality and quantity of the data differ significantly across regions.

The Archaeological Map of the Czech Republic should solve the situation of unbalanced coverage of archaeological databases, which is caused by the different research and recordkeeping strategies of the two independent Institutes of Archaeology of the Czech Academy of Sciences. The Archaeological Map will probably integrate the State Archaeological List of the Czech Republic, too (Kuna 2015). Nevertheless, the main purpose of the above-mentioned databases is archaeological heritage management. The unique Bohemian dataset itself was only rarely used for research purposes (e.g. Demján/Dreslerová 2016; Dreslerová 2012b).

The Czech archaeology also possesses research databases focusing on the collection of very specific data. Among the best examples is the Archaeobotanical database of the Czech Republic (Archeobotanická databáze České republiky), which is used for archiving and researching data on plant macro-remains from archaeological excavations (Dreslerová/Pokorná 2015). Another example is the VITREA database, which archives and makes accessible chemical analyses of archaeological glass from the Bronze Age to the modern period (Venclová 2015).

Archaeology has often successfully contributed to interdisciplinary studies of past environments (e.g. Lechterbeck et al. 2014; Feeser/Furholt 2014). This happened in the Czech Republic as well, partly with the help of the Czech Quaternary Palynological Database (PALYCZ) (Kuneš et al. 2009; 2015). Because human societies and their environment interact, i.e. societies have an impact on the environment but they also adapt to environmental changes, it seems to be inevitable to cross disciplinary boundaries to be able to study these interactions. Archaeology combining the perspective of social science and a *longue durée* point of view is ideal for such investigations. Especially in the temperate zone of the Earth, woodlands play a significant role in human-environmental interactions. As a component of past community areas, woodland provided people with crucial resources for daily use (fuel, building, wooden tools, etc.), pyrotechnologies (pottery, metallurgy, lime production, etc.), agriculture, pasture, hunting and defence (for details see Dreslerová/Sádlo 2000; Dreslerová 2012a; Ellis 2015). The LONGWOOD project (Long-term woodland dynamics in Central Europe: from estimations to a realistic model), funded in the years 2012-2016 by the European Research Council (ERC) is an interdisciplinary venture that connects archaeological, palaeoecological, historical and vegetation ecological data and methods in a GIS environment in order to understand changes in woodland structure and species composition in Moravia and Czech Silesia in the Holocene, and the role of human societies in these changes[3]. The main aim of our project was to create a model of long-term woodland

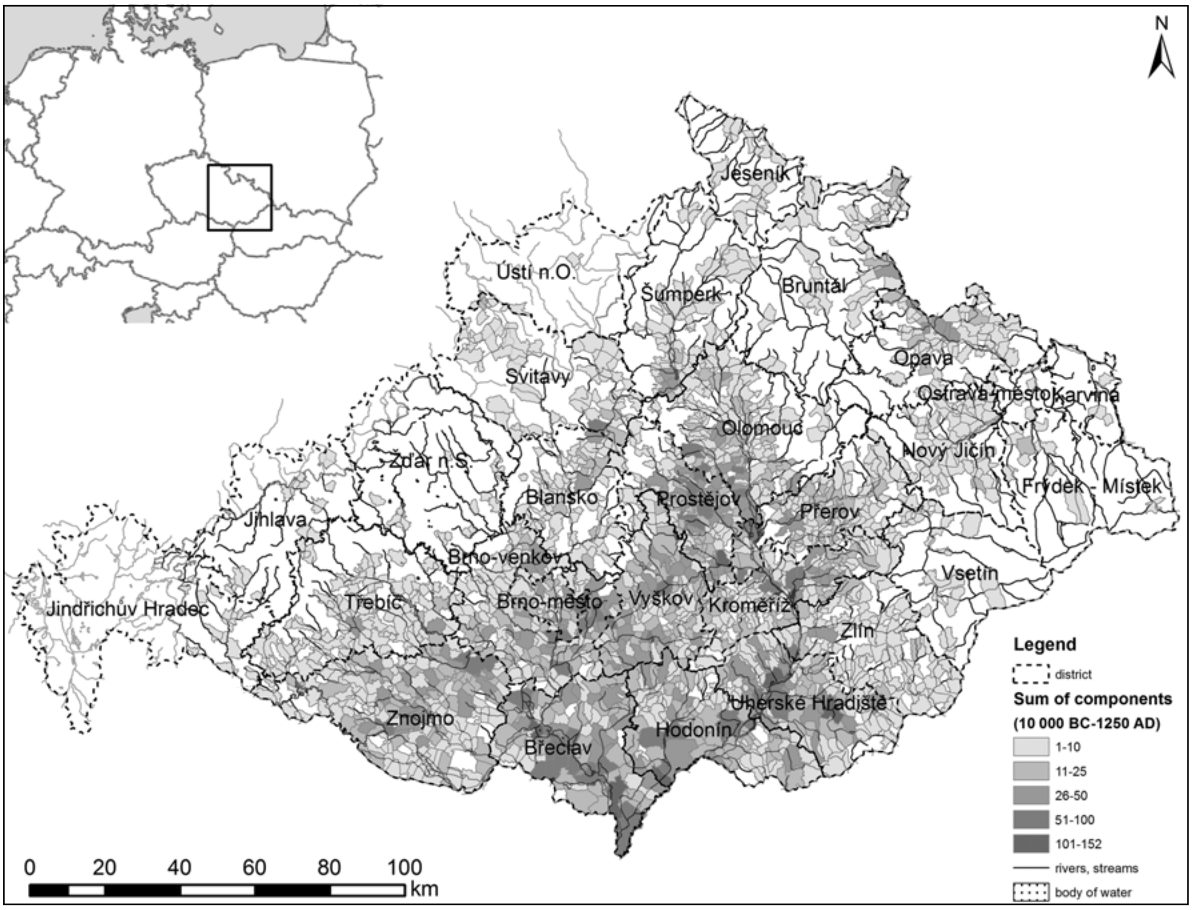

Fig. 1 Quantification of archaeological components in the LONGWOOD archaeological database per parish in Moravia (31 August 2016). – (Illustration J. Kolář).

dynamics with the highest possible spatiotemporal resolution. This could be achieved only through quantified modelling based on digital databases created for research purposes. Because of the absence of an archaeological database with reliable coverage of the whole area of interest, we decided to create our own database. The LONGWOOD archaeological database

1. covers the whole of Moravia and Czech Silesia,
2. includes nearly all available data on archaeologically detected human activities from the Mesolithic to the early medieval period (10,000 BC-1250 AD),
3. incorporates metadata,
4. enables the creation of quantified models of human activity.

The main aim of this paper is to present the dataset that was created in the past five years, to explain the data structure and to present a basic statistical evaluation. We will also discuss further perspectives of data collection and the significance of the dataset for future research.

MATERIALS AND METHODS OF DATA COLLECTION

The study area was delimitated partly by the historical borders of Moravia (in the west) and partly by the current borders of the Czech Republic (in the north, east and south). It includes not only Moravia but also the Czech parts of historical Silesia (**fig. 1**). The whole area covers 26,804 km^2. The primary source of data

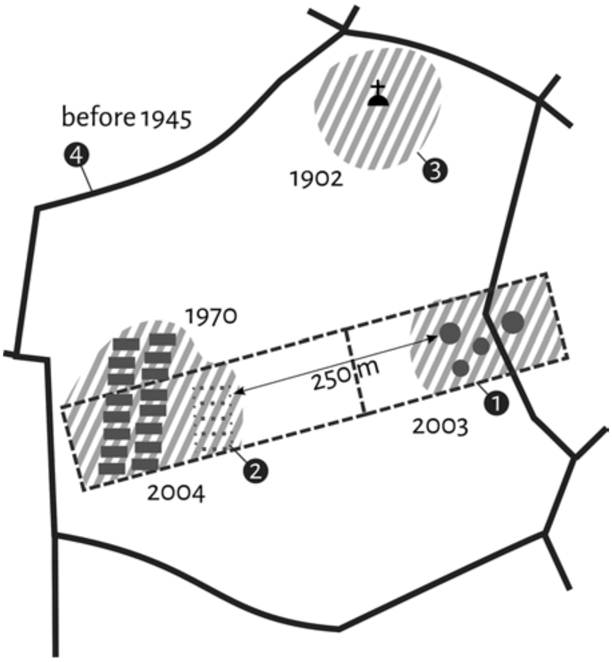

Fig. 2 Relationship between parish, site and archaeological component used in the database. Spatial relationships within a hypothetical parish: **1** area excavated in 2003 and 2004, two sites were examined. The first stretches to a neighbouring parish (but appears in only one parish in the database). The second consists of two components. One of them was already discovered in 1970 (one component in our database), the other is new. – **2** newly discovered component at already known site, which is 250 m away from components of same dating. – **3** hoard found in the vicinity of a chapel in 1902 – it is registered in the database as one component at a site with a spatial precision of 250 m. – **4** area of parish, to which all pre-WWII finds with unspecified site were assigned. – (Illustration P. Tkáč).

was the Archive of the Institute of Archaeology of the Czech Academy of Sciences in Brno, which stores reports of single finds and excavations from the whole area. This archive is organised according to existing parishes, which also determine the lowest common level of geographic accuracy. Secondary sources consisted of already published papers and books. We used books or papers summarising archaeological evidence on different spatial scales and topics. Our database includes data on hillforts in Moravia (Čižmář 2004), data from papers summarising archaeological evidence for specific parishes (e. g. Klanicová 2009; Matějíčková 2011; Poláček 1997), and periodic summaries of archaeological excavations led by the Institute of Archaeological Heritage Management Brno (Ústav archeologické památkové péče Brno, v. v. i.; e. g. Čižmář / Geislerová 2006). On a limited scale, we also used data from major Czech archaeological journals, such as Archeologické rozhledy or Přehled výzkumů.

The data on archaeological evidence were structured into components, sites and parishes (fig. 2). An archaeological component is defined as a spatially continuous set of finds delineated by their function (e. g. residential, burial) and chronological position (e. g. Neolithic, Early Bronze Age). Chronologically and spatially corresponding finds were considered as one component. The number of finds in one component played no role – a spatially isolated single grave was considered as one component in the same manner as an entire graveyard consisting of hundreds of chronologically contemporary graves. To spatially distinguish between individual sites, an arbitrary distance of 250 m was set.

Archaeological components were excavated or surveyed on sites. Despite ambiguity concerning the meaning of the term, the concept of the site is widely used in archaeology. In our project, we defined the site as spatially continuous set of archaeological finds. These finds (in the form of artefacts or underground or aboveground features) could originate from one or more periods, and could be functionally different. This means that a site can consist of several archaeological components. The same archaeological site could be scientifically examined several times (»fieldwork events« in the language of the project of the Archaeological Map of the Czech Republic, see Kuna et al. 2015a). Similarly to M. Kuna and his colleagues, we understand that archaeological sites are not only results of past human activities but also of formation processes and fieldwork methods. Sites were also used as spatial identifiers for the components. Especially from the research period before World War II, the number of fieldwork events would be nearly impossible to determine, thus the category of the site was necessary for the database.

The next level of data recording was the (civil) parish (katastrální území in Czech). The Archive of the Institute of Archaeology of the Czech Academy of Sciences in Brno is organised according to parishes, thus this was a logical decision. Civil parishes also serve as the basic (i. e. lowest precision) spatial unit. Although

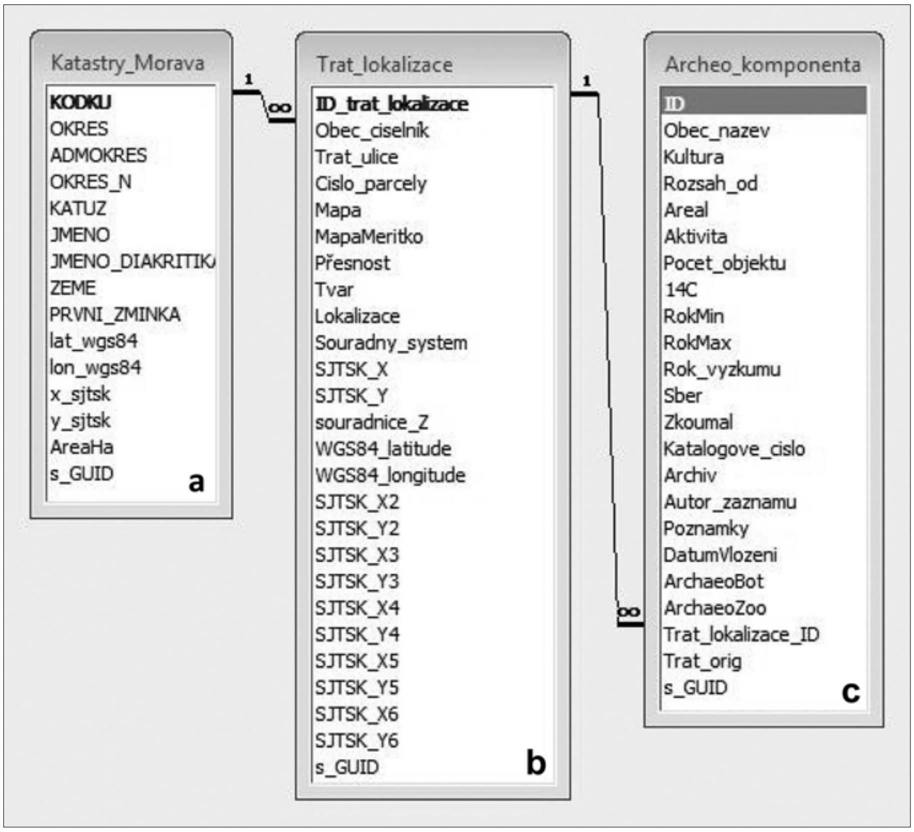

Fig. 3 Data model of the relational database: **a** table for parishes. – **b** table for sites mainly dealing with localisation. – **c** table for archaeological components. – (Illustration J. Kolář).

modern excavations and recent single finds are usually spatially very well-defined, pre-WWII components were sometimes spatially defined only to the level of parishes. They might indicate already vanished archaeological components, thus this information cannot be simply disregarded as unimportant due to low spatial precision. In reality, a civil parish is then a set of archaeological sites made up of components and several spatially imprecise components (usually stray finds or traces) localised only to the level of the parish.

For storing the data, a relational database in Microsoft Access was created. The three main tables (for parish, site and component) were connected through unique identifiers (**fig. 3**). Geographic coordinates were included on the level of parish and site. For parishes, the centroids of their area were considered. The geographic coordinates for sites were acquired from maps included in the reports and publications or from the State Archaeological List, which launched a public geographical information system[4]. The table for archaeological components was inspired by the Archaeological Database of Bohemia, as it includes information on archaeological cultures[5], activity areas and registered activity. Special terms and definitions were adopted from the Archaeological Database of Bohemia. The same table includes also data on the date and leader of the excavation, and two fields referring to the metadata. References to short reports, excavation reports and literature are stored in these fields. This table also contains data on whether or not environmental archaeological investigations were conducted and to which components they are related. Nevertheless, we did not include the actual environmental data into the database.

RESULTS AND DISCUSSION

Archaeological evidence on past human activities was found in 1685 parishes within the area of interest; additionally, we analysed also 18 parishes from Slovakia. Altogether 19,021 archaeological components

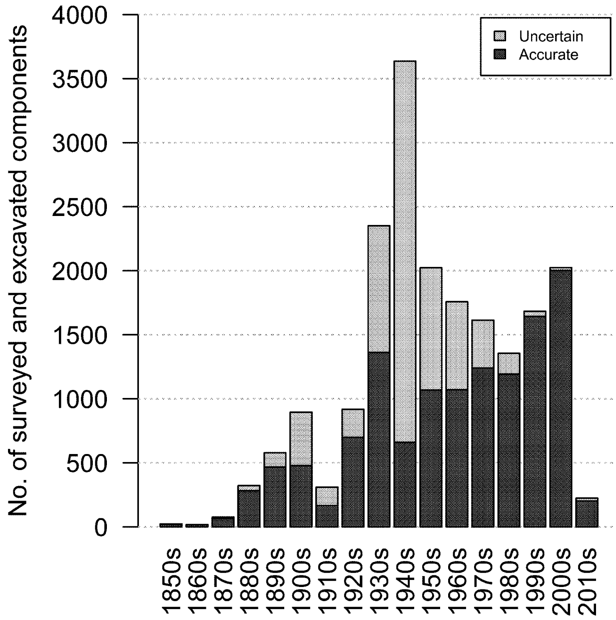

Fig. 4 History of archaeological finds, surveys and excavations in Moravia. – (Illustration M. Macek).

were collected. For the present paper, the dataset was reduced to 18,736 components, excluding data from Slovakia and those from periods after 1250 AD.

Research history

Because the database also includes the year (period) of excavation or the occasion of the find, we were able to summarise the history of archaeological excavations and survey campaigns (**fig. 4**). Components which were examined only once (e.g. in 1956), are included in only one decade. Those which were excavated several times (e.g. 1956 and 1987) or for which the excavation period stretches over more decades (e.g. 1967-1975) are included in each decade. However, the archives include also many short reports with no indication of the investigation period, and the only time indicator is the dating of the report itself. When the short report was added to the archive in 1946, we dated the archaeological components to before that year. Therefore, the histogram shows a very high number of undated components in the 1940s when the Archive of the Archaeological Institute of the Czechoslovakian Academy of Sciences in Brno became independent and started to build its own paper-based catalogue of sites and finds. Most probably this high value does not reflect the actual intensity of archaeological fieldwork, but rather the attempts to summarise in a systematic way the archaeological knowledge produced during the previous century. Taking into account only those components with reliable dates of the investigation, we observe an increasing trend in the number of components from a few dozen in the 1850s up to more than 2000 in the 2000s. World War I and the political change in 1918 probably caused the significant decrease in archaeological activities in the 1910s. The 1920s show a rising trend. It seems that in the 1930s the archaeological activities were so intense that such a value was not reached again for the next five decades. The most likely reasons behind lower archaeological fieldwork activities in the 1940s were WWII and the subsequent expulsion of the German-speaking population (including archaeologists), followed by further political changes (communist takeover) in Czechoslovakia. The intensity of archaeological fieldwork increased for the next four decades, and finally in the 1990s it reached the pre-WWII values. This could also be connected to the decentralisation of archaeological investigations, namely the foundation of the Institute of Archaeological Heritage Management Brno and the non-governmental research organisation Archaia. Another probable reason is the adoption of formalised data collection, which had been practised for years in Prague. From the 1940s onwards we can also observe a decreasing tendency in the number of components with an uncertain year of investigation, which probably means that the production of excavation reports and their submission to the archive became a routine. The excavation reports themselves became formalised documents with a basic set of necessary information (including the period of investigation).

The results of the quantification of research history indicate the main periods of the creation of our current archaeological knowledge about Moravia. These data highlight the relationship between archaeological research and past socio-political situations in Czechoslovakia and the Czech Republic. Based on this knowledge, better decisions can be made as to which data to include in modelling procedures. **Figure 4** shows that good quality data are available from approximately the last 40 years.

Functional, chronological and spatial quantification

To characterise the dataset, we used the division of Moravia into districts. Obviously, this division does not reflect past realities but rather the acquisition of archaeological data and the organisation of archaeological fieldwork (excavation licences are usually available for specific districts or regions). Districts with little archaeological evidence (fewer than 50 components) were excluded from further analyses, leaving 18,550 components (**tab. 1**). Firstly, we categorised components according to the activity area. In the resulting diagram (**fig. 5**) we can observe the relationship between the total number of components and their character. On the left side of the diagram, where districts with more components are situated, a higher proportion of stratified components (especially burial sites and settlements) can be seen. By contrast, on the right side, where districts with fewer components can be found, higher proportions of unstratified archaeological components (traces) are evident. Whether this phenomenon is caused by the distance to central archaeological institutions or is a reflection of reality has to be decided by future research. We can also observe differences caused by the natural conditions of the districts. The mountain district (Czech: okres) of Vsetín has a higher proportion of fortified hillforts and elevated settlements in the archaeological evidence. Interestingly, the district of Bruntál in the Jeseníky Mountains has the highest proportion of traces coming from elevated sites, and the proportion of fortified hillforts is comparable with the other regions. Naturally occurring caves and abris in the Moravian Karst offered to past human communities specific activity areas, and this is evident also in the archaeological record of the Blansko district.

district	sum of sites	sum of undeterminable sites	sum of components
Blansko	172	33	402
Brno-město	378	27	744
Brno-venkov	631	89	1598
Bruntál	28	20	130
Břeclav	973	61	1971
Frýdek-Místek	23	5	33
Hodonín	589	71	1412
Jeseník	12	8	30
Jihlava	8	8	18
Jindřichův Hradec	14	9	28
Karviná	7	0	13
Kroměříž	456	102	1218
Nový Jičín	80	26	138
Olomouc	565	101	1449
Opava	146	28	416
Ostrava-město	5	2	10
Prostějov	667	81	1747
Přerov	320	86	797
Svitavy	116	25	208
Šumperk	117	36	261
Třebíč	147	66	379
Uherské Hradiště	625	71	1458
Ústí n. O.	20	0	34
Vsetín	24	14	52
Vyškov	709	88	1692
Zlín	225	54	521
Znojmo	794	167	1960
Žďár nad Sázavou	10	5	17
sum	7861	1283	18736

Tab. 1 Number of sites and components registered in districts.

Categorising the same dataset by the dating of the components (**fig. 6**), we got a slightly different result. With the decrease of the total number of components, an increase in Neolithic/Aeneolithic dating is observed. This is related to the increase of traces, as stated above, because most of the components with such dating are single finds of stone axes and hammer-axes. The four districts with the lowest total number of components (Svitavy, Nový Jičín, Bruntál, Vsetín) have the highest numbers of these temporally imprecise components, and they have also very low numbers of Neolithic components. By contrast, the highest proportion of the Neolithic components is registered from the Třebíč district at the foothills of the Bohemi-

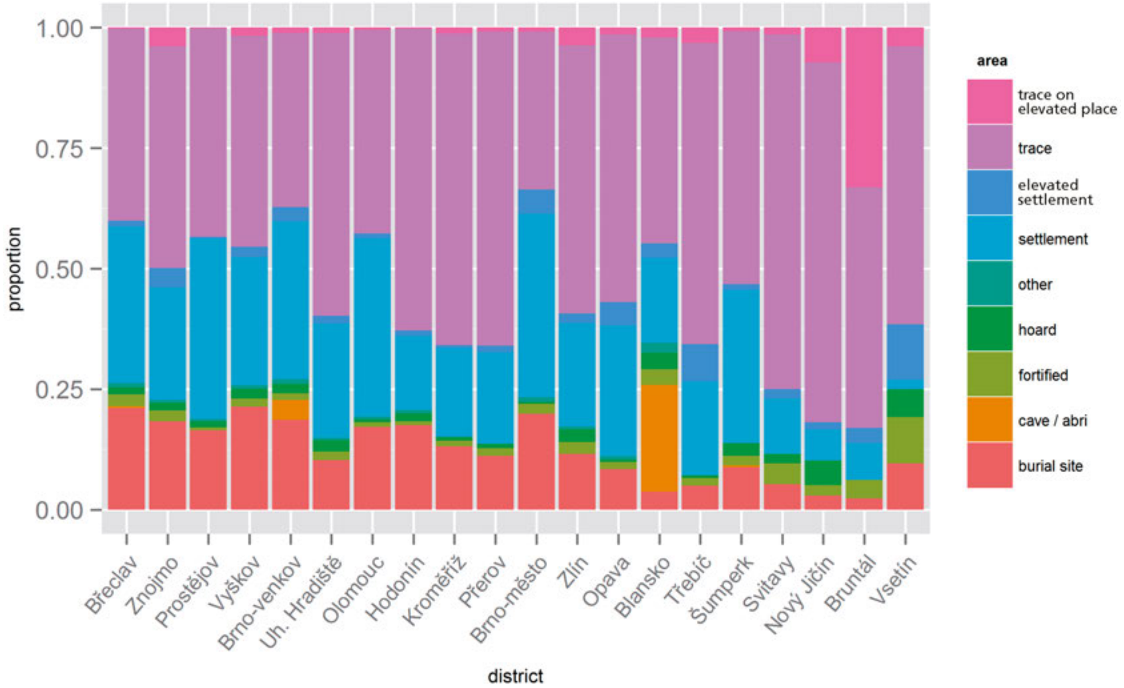

Fig. 5 Stacked barplot visualising the proportion of activity areas split into districts. The number of components in districts descends from left to right on the x-axis. Only districts with more than 50 components are included. – (Illustration P. Tkáč).

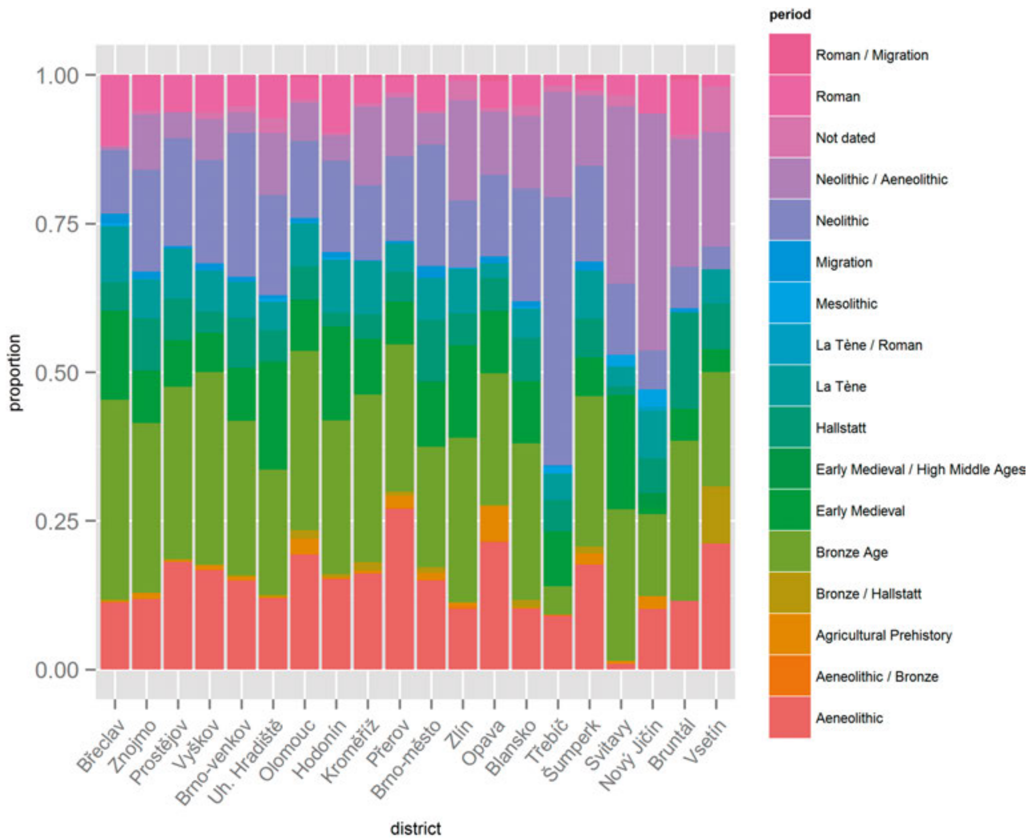

Fig. 6 Stacked barplot visualising the proportion of chronological periods split into districts. The number of components in districts descends from left to right on the x-axis. Only districts with more than 50 components are included. – (Illustration P. Tkáč).

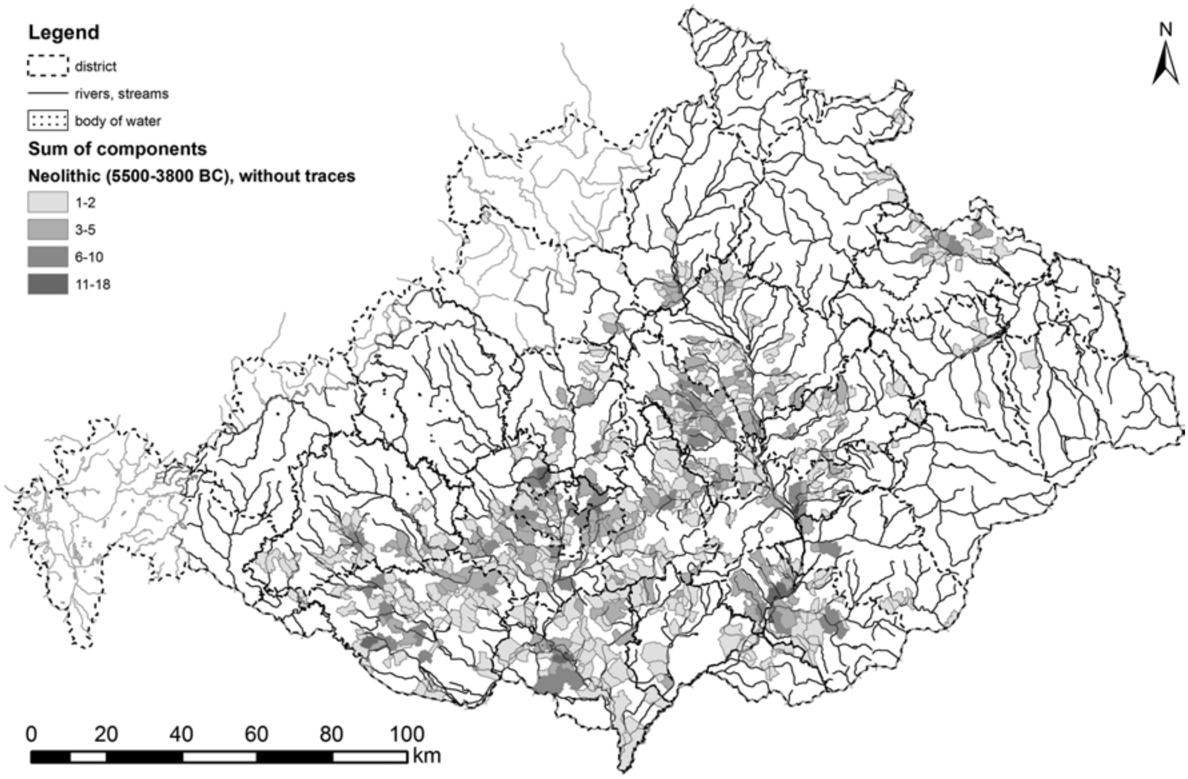

Fig. 7 Quantification of archaeological components dated to the Neolithic (*Linearbandkeramik* culture, *Strichbandkeramik* culture, Lengyel culture) in the database per parish in Moravia (31 August 2016). – (Illustration J. Kolář).

an-Moravian Highlands. The same region shows the lowest proportion of the Bronze Age components. This again raises the question whether such a phenomenon is related to natural conditions (more to the north, hilly and mountain regions) or to the state of research.

The archaeological evidence is not distributed homogeneously within the area of interest. Taking a closer look at the data in space (**fig. 1**), we observe that parishes with the strongest record are located in the southern and central parts of Moravia. The western parts of Moravia, where the foothills of the Bohemian-Moravian Highlands are located, provide significantly less evidence of prehistoric and early historic evidence of human activities. The Třebíč district has an exceptional position, caused by the strong archaeological evidence dated to the Neolithic.

The northeast part of the study area comprises not only Moravia but also the Czech parts of historical Silesia. At first sight, the archaeological evidence is much weaker here, which is most likely caused by natural conditions. The Jeseníky Mountains and the western parts of the Carpathians (Moravskoslezské Beskydy) were probably a limiting factor for human settlement here. Nonetheless, human communities were present here as well, but their land use probably differed from that in other regions and is less visible archaeologically. The lowland parts of the northern region show more archaeological evidence, which is related to favourable natural conditions. However, the role of the oldest public museum (Silesian Museum; Slezské zemské muzeum) in the Czech Republic in Opava cannot be underestimated. The significance of the Moravian Gate as a communication route is reflected also in the archaeological record of the parishes surrounding the rivers Odra and Bečva in Přerov and Nový Jičín districts.

The database also enables us to examine the coverage of archaeological evidence categorised by period. The Neolithic and La Tène periods were chosen as illustrations (**figs 7-8**). The first is an example of a long period, which accumulated many archaeological components during more than 1000 years. It is also a

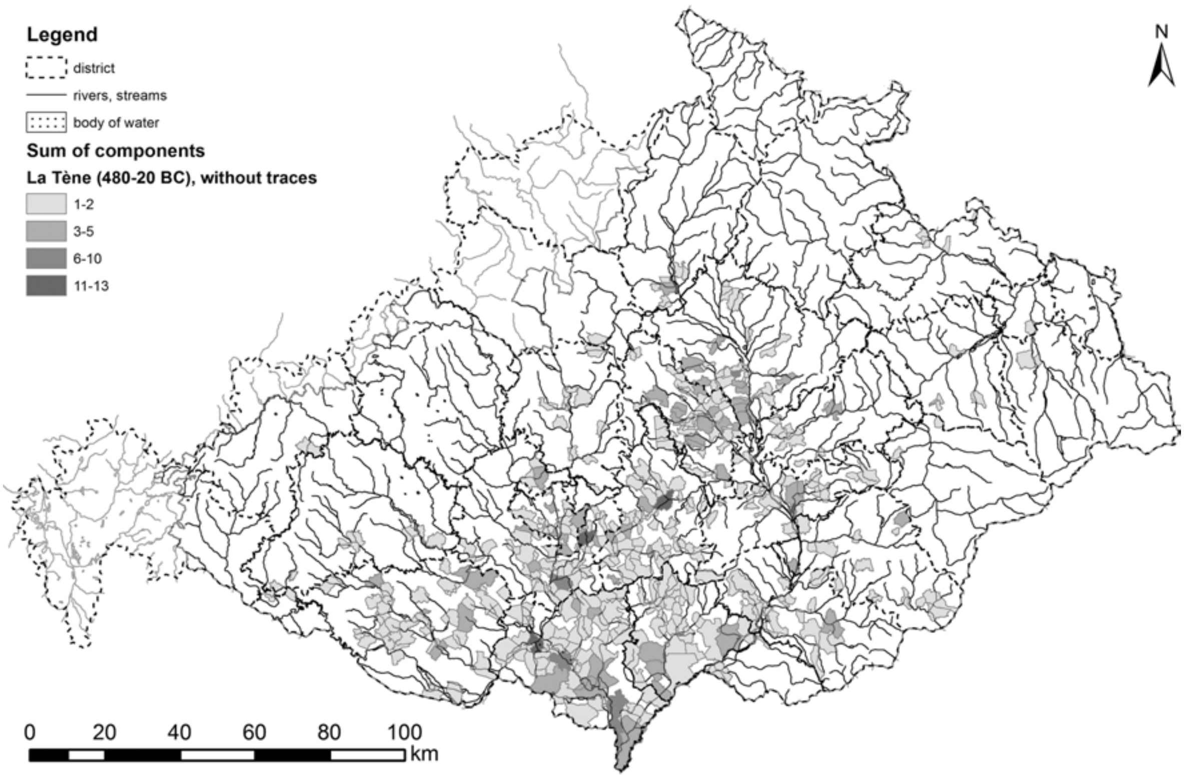

Fig. 8 Quantification of archaeological components dated to the La Tène period in the database per parish in Moravia (31 August 2016). – (Illustration J. Kolář).

period with several archaeological cultures which slightly differ in their archaeological record. The La Tène period in our region was shorter than 500 years. Even during this relatively short time span, we register cultural and social changes influencing the nature of the archaeological record (e.g. the disappearance of burial sites, the emergence of *oppida*). Our intention is not to discuss the causes and effects of these changes, but to show that the archaeological evidence is not spatially homogeneous across Moravia, as is sometimes suggested by archaeological maps (cf. Podborský et al. 1993). Whereas evidence of the La Tène period seems to be concentrated especially in the lowlands of southern Moravia (valleys of the rivers Dyje, Svratka and Morava), the Neolithic archaeological record appears to have originated more frequently from slightly higher altitudes. Thus we see parishes with higher numbers of stratified components between today's Znojmo (okr. Znojmo), Moravský Krumlov (okr. Znojmo) and Brno (okr. Brno-město). To answer questions regarding the possible social and environmental causes of such phenomena in the archaeological evidence, further research is obviously needed. The spatial analysis of our database can provide a solid foundation for such research.

Current and future use of the database

The primary reason for the development of this database was to significantly contribute to the reconstruction of the long-term patterns of woodland cover, structure and management with the highest spatiotemporal resolution possible. To overcome problems connected to the different spatiotemporal resolutions of the disciplines involved, we employed a spatiotemporal modelling approach (Kolář et al. 2016). Large databases are ideal for such modelling, and similar approaches were applied to the Archaeological Map of

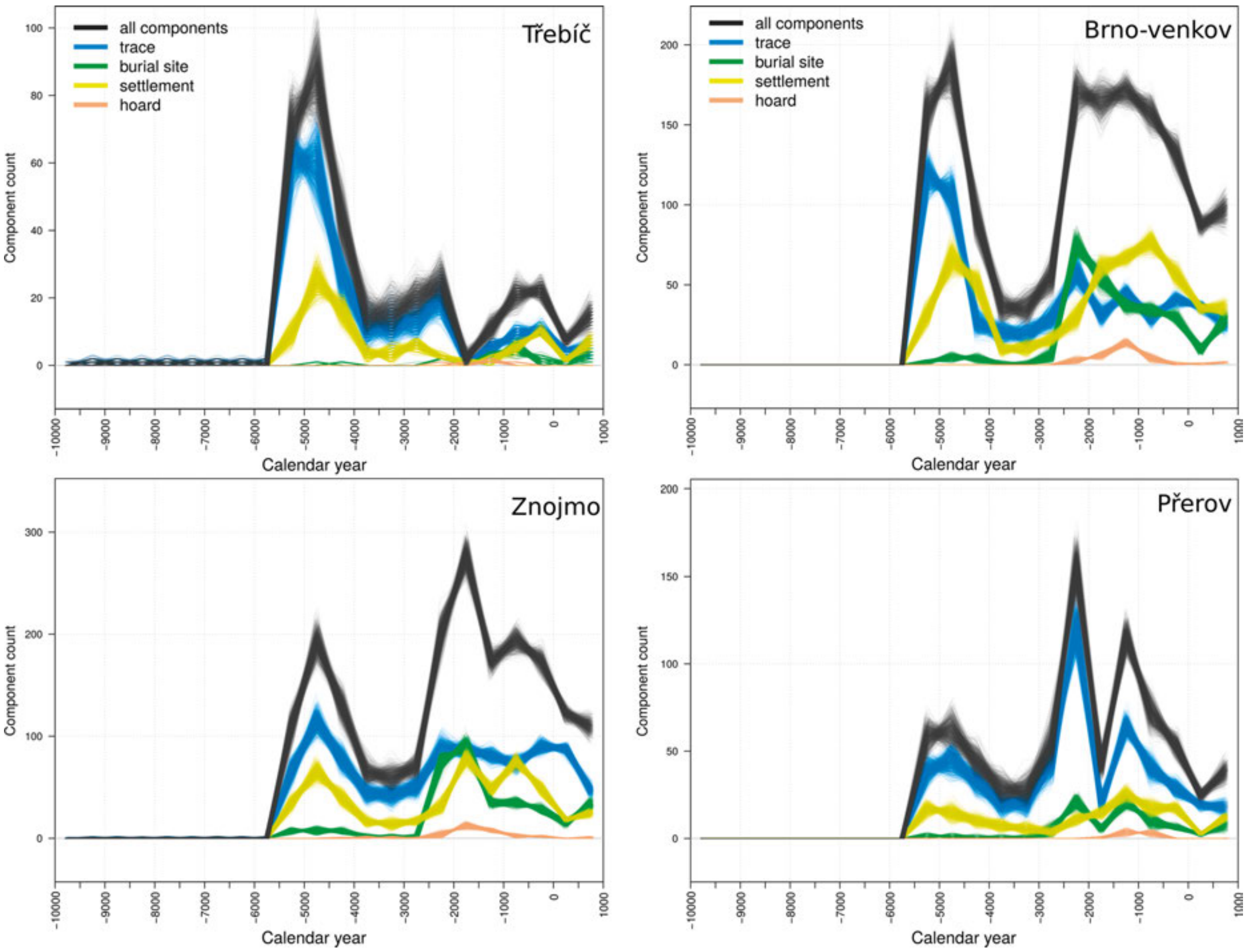

Fig. 9 Human activity models based on Monte Carlo simulations (details of calculations in Kolář et al. 2016). – (Illustration M. Macek/ P. Tkáč).

the Czech Republic (Demján/Dreslerová 2016). The modelling approach based on our data was successfully used in interdisciplinary studies of grasslands and secondary forests (Kuneš et al. 2015; Kolář et al. in press), and we can envisage further studies revealing regionally specific developments of human settlement processes (**fig. 9**). Here, four human activity models based on data from four districts are compared. In all of them we see an increase of archaeologically detectable human activities at the beginning of the Neolithic, and a few hundred years later a decrease during the Aeneolithic, in three cases followed by an increase at the beginning of the Bronze Age. The Třebíč district is again exceptional regarding the archaeological record, which raises several questions about possible depopulation or changes in subsistence strategies.

The database can be used in a more traditional way as well. In case we want to know, for example, what the character of the archaeological evidence of the first farmers of the *Linearbandkeramik* culture (LBK) is in the whole area, we can easily produce maps of categorised components (**fig. 10**). In this map, we observe that the archaeological evidence is again not homogeneous across Moravia. Past behavioural practices, post-depositional processes, research history or preferences, and natural conditions are behind the concentration of burial sites in the south-west, the use of caves and abris in the Moravian Karst or the low number of activity areas in the lowlands of southern Moravia (except the Pálava Hills). The aim of this paper is not to discuss issues such as the role of the Pálava Hills in a region with otherwise low density of human activity

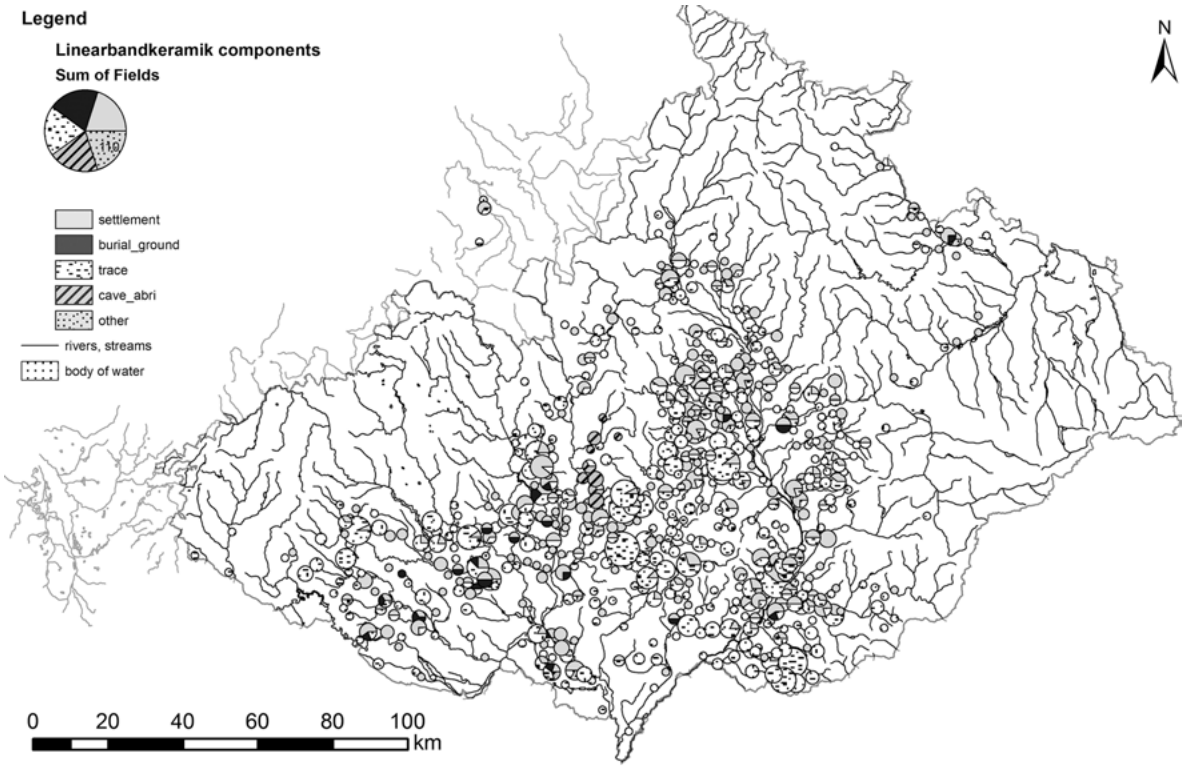

Fig. 10 Map of archaeological components dated to the *Linearbandkeramik* culture, categorised according to the activity area type. – (Illustration J. Kolář).

in the Neolithic or the preferences of LBK farmers for some regions for their settlement areas, but to show that with such tools as our database, it will be possible to get closer to answers in the future.

One of the disadvantages of our database is its incompleteness. Until now we processed the reports stored in the Archive of the Institute of Archaeology of the Czech Academy of Sciences in Brno. Although all institutions carrying out excavations in Moravia are obliged to submit their reports to this archive, some ignore it. Thus the archaeological evidence of some regions dominated by excavations of such institutions could be underestimated. In addition, due to time and personal limits we were not able to systematically collect all data from publications. However, this would be easily possible for future projects.

The second problematic issue could be research history and preferences. The archaeological evidence in some regions could be artificially strong due to the proximity of a city with several archaeological institutes employing dozens of professional archaeologists and high numbers of development-led excavations (e. g. Brno). The preferences of individual archaeologists focusing on specific periods (typically the early medieval period) could also deform the archaeological evidence.

As all archaeologists, we face the problem of the concept of site (e. g. Gaffney/Tingle 1984). The criterion of distinguishing sites by a distance of 250 m is artificial and slightly contradicts the community area theory based on activity areas spread (continuously) in the landscape (Neustupný 1991; Kuna 2001). Nevertheless, the archive and topographical summaries are organised by sites, therefore we cannot simply avoid them. A further disadvantage is the format of the database. We used a Microsoft Access database, enabling the creation of replicated databases. We are aware of the restricted readability and use of such a database for users without this software and we plan to transform our database into a web-based SQL database in the near future.

The large-scale acquisition and analysis of the archaeological evidence seem to be the most significant advantage. However, the temporal perspective also needs to be stressed. Although the discipline of archaeology has a unique *longue durée* perspective on human societies, traditionally archaeologists in the Czech Republic (and not only there) are trained to understand only one period (e. g. the Neolithic). This is one of the most important obstacles for collaboration with disciplines with a broad temporal spectrum such as palaeoecology. Creating datasets, covering large areas with long-term temporal perspective is an effective tool not only in our case, and similar examples exist across Europe (e. g. Feeser / Furholt 2014; Whitehouse et al. 2014; McLaughlin 2016). We also believe that this is not the final state of our research. There is much more data to be collected or connected with our dataset, which would help us to reveal the spatiotemporal dynamics of the human-environmental relationships in an interdisciplinary way. Through understanding this, archaeology can provide current society and policy makers with knowledge on past land use and its relevance for the future.

CONCLUSION

From 2012 to 2016 a new archaeological database of sites and finds covering Moravia and the Czech parts of Silesia was created for the purposes of the interdisciplinary ERC funded project LONGWOOD, which is based at the Institute of Botany of the Czech Academy of Sciences. Most of the data come from the excavation and survey reports stored in the Archive of the Institute of Archaeology of the Czech Academy of Sciences in Brno. Basic localisation information, lists of components, details about the year and leader of the examination were stored in a relational database. The dataset includes data on 1685 parishes and represents at least 7861 sites with 18,736 components. The highest numbers of components were discovered during the 1930s and after 1990. The functional, chronological and spatial differences between districts are caused by environmental conditions, research history and preferences, and past cultural practices. The database is currently used for dealing with specific questions about past human-environmental relationships, but because it is currently the only relatively up-to-date database covering the whole of Moravia and Czech Silesia, it can be effectively used also for other purposes. The simple quantifiable form enables researchers to deploy statistical and GIS analyses and modelling approaches, which proved to be efficient within our interdisciplinary project.

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Notes

1) http://archaeologydataservice.ac.uk/
2) http://radon.ufg.uni-kiel.de/
3) www.longwood.cz
4) http://isad.npu.cz/ost/archeologie/ISAD/free/
5) The term »archaeological culture« is problematic itself and it was discussed by many papers (e. g. Shennan 1994; Květina 2010; Furholt 2014). However, in our database and following analytical work we used the archaeological cultures only for the dating purposes.

References

Baštová et al. 1997: D. Baštová / L. Krušinová / Z. Sklenářová / P. Volfík, Státní archeologický seznam ČR – informační systém archeologických nalezišť. In: Macháček 1997a, 115-126.

Berg 2001: E. Berg, National Registries of Sites and Monuments in Norway – Developing GIS-based Databases. In: Z. Stančič / T. Veljanovski (eds), Computing Archaeology for Understanding the Past. CAA 2000. Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 28th Conference, Ljubljana, April 2000. BAR International Series 931 (Oxford 2001) 133-138.

Bobowski 2012: B. Bobowski, Easy Recording System: Solution Based on Web Free Apps Databases. In: M. Zhou / I. Romanowska / Z. Wu / P. Xu / P. Verhagen (eds), Revive the Past. Proceeding of the 39th Conference on Computer Applications and Quantitative Methods in Archaeology, Beijing, 12-16 April 2011 (Amsterdam 2012) 170-176.

Čižmář 2004: M. Čižmář, Encyklopedie hradišť na Moravě a ve Slezsku (Praha 2004).

Čižmář / Geislerová 2006: M. Čižmář / K. Geislerová (eds), Výzkumy – Ausgrabungen 1999-2004 (Brno 2006).

Demján / Dreslerová 2016: P. Demján / D. Dreslerová, Modelling distribution of archaeological settlement evidence based on heterogeneous spatial and temporal data. Journal of Archaeological Science 69, 2016, 100-109.

Dresler et al. 2008: P. Dresler / M. Kučera / J. Macháček / R. Petrželka / M. Vlach / O. Žídek, POHAN DATA SERVER – digitální datový sklad archeologické organizace. In: J. Macháček (ed.), Počítačová podpora v archeologii II (Brno, Praha, Plzeň 2008) 30-46.

Dreslerová 2012a: D. Dreslerová, Les v pravěké krajině II. Archeologické Rozhledy 64, 2012, 199-236.

2012b: D. Dreslerová, Human response to potential robust climate change around 5500 cal BP in the territory of Bohemia (the Czech Republic). Interdisciplinaria Archaeologica. Natural Sciences in Archaeology 3, 2012, 43-55.

Dreslerová / Pokorná 2015: D. Dreslerová / A. Pokorná, Archaeobotanical database of the Czech Republic. In: Kuna et al. 2015b, 129-133.

Dreslerová / Sádlo 2000: D. Dreslerová / J. Sádlo, Les jako součást pravěké kulturní krajiny. Archeologické Rozhledy 52, 2000, 330-346.

Ellis 2015: E. Ellis, Ecology in an anthropogenic biosphere. Ecological Monographs 85, 2015, 287-331.

Feeser / Furholt 2014: I. Feeser / M. Furholt, Ritual and economic activity during the Neolithic in Schleswig-Holstein, northern Germany: an approach to combine archaeological and palynological evidence. Journal of Archaeological Science 51, 2014, 126-134.

Furholt 2014: M. Furholt, Upending a »Totality«: Re-evaluating Corded Ware Variability in Late Neolithic Europe. Proceedings of the Prehistoric Society 80, 2014, 67-86.

Gaffney / Tingle 1984: V. Gaffney / M. Tingle, The tyranny of the site: method and theory in field survey. Scottish Archaeological Review 3, 1984, 134-140.

Hansen 1993: H. J. Hansen, European archaeological databases: problems and prospects. In: J. Andresen / T. Madsen / I. Scollar (eds), Computing the Past. Computer Applications and Quantitative Methods in Archaeology. CAA92 (Aarhus 1993) 229-238.

Hinz et al. 2012: M. Hinz / M. Furholt / J. Müller / D. Raetzel-Fabian / C. Rinne / K.-G. Sjögren / H.-P. Wotzka, RADON – Radiocarbon dates online 2012. Central European database of ^{14}C dates for the Neolithic and Early Bronze Age. http://radon.ufg.uni-kiel.de/ (18.11.2016).

Klanicová 2009: E. Klanicová, Archeologické lokality na katastru Břeclavi. 1. část (stav k 31.12.2006). Jižní Morava 45, 2009, 119-130.

Kolář et al. 2016: J. Kolář / M. Macek / P. Tkáč / P. Szabó, Spatio-Temporal Modelling As A Way to Reconstruct Patterns of Past Human Activities. Archaeometry 58, 2016, 513-528.

Kolář et al. in press: J. Kolář / P. Kuneš / P. Szabó / M. Hajnalová / H. Svitavská Svobodová / M. Macek / P. Tkáč, Population and forest dynamics during the Central European Eneolithic (4500-2000 BC). Archaeological and Anthropological Sciences (in press, online first).

Krušinová et al. 2003: L. Krušinová / P. Volfík / L. Bečváč / P. Vachůt / M. Ernée / A. Knechtová / M. Cejpová / Z. Sklenářová, Státní archeologický seznam ČR, verze 2.0 – uživatelská příručka (Praha 2003).

Kuna 1997: M. Kuna, Archeologická databáze Čech. In: Macháček 1997a, 105-114.

2001: M. Kuna, Povrchový sběr a intenzita využití krajiny v pravěku. In: J. Kozłowski / E. Neustupný (eds), Archeologia Przestrzeni. Metody I Wyniki Badań Struktur Osadniczych W Dorzeczach Górnej Łaby I Wisły (Kraków 2001) 27-54.

2015: M. Kuna, Archaeological heritage recordkeeping in the Czech Republic. In: Kuna et al. 2015b, 11-24.

Kuna et al. 2004: M. Kuna / J. Beneš / D. Dreslerová / M. Gojda / P. Hrubý / R. Křivánek / A. Majer / K. Prach / M. Tomášek / M. Dobeš / D. Kolbinger / P. Květina / J. Laušman / J. Matoušek, Nedestruktivní archeologie: teorie, metody a cíle (Praha 2004).

Kuna et al. 2015a: M. Kuna / J. Hasil / D. Křivánková / D. Novák / O. Lečbychová, Archaeological Map of the Czech Republic. In: Kuna et al. 2015b, 25-67.

Kuna et al. 2015b: M. Kuna / J. Hasil / D. Novák / I. Boháčová / L. Čulíková / P. Demján / D. Dreslerová / M. Gojda / I. Herichová / D. Křivánková / O. Lečbychová / J. Mařík / J. Maříková-Kubková / M. Panáček / J. Podliska / A. Pokorná / J. Řihošek / E. Stuchlíkova / M. Suchý / J. Válek / N. Venclová / L. Haišmanová, Structuring Archaeological Evidence. The Archaeological Map of the Czech Republic and Related Information Systems (Prague 2015).

Kuneš et al. 2009: P. Kuneš / V. Abraham / O. Kovářík / M. Kopecký / PALYCZ contributors, Czech Quaternary Palynological Database – PALYCZ: review and basic statistics of the data. Preslia 81, 2009, 209-238.

Kuneš et al. 2015: P. Kuneš / H. Svobodová-Svitavská / J. Kolář / M. Hajnalová / V. Abraham / M. Macek / P. Tkáč / P. Szabó, The origin of grasslands in the temperate forest zone of east-central Europe: long-term legacy of climate and human impact. Quaternary Science Reviews 116, 2015, 15-27.

Květina 2008: P. Květina, Revitalizace dat z naleziště Bylany. In: J. Macháček (ed.), Počítačová podpora v archeologii II (Brno, Praha, Plzeň 2008) 9-16.

2010: P. Květina, Archeologie smyšlené identity. Archeologické Rozhledy 52, 2010, 629-660.

Květina / Pavlů 2007: P. Květina / I. Pavlů, Neolitické sídliště v Bylanech – základní databáze (Praha 2007).

Lechterbeck et al. 2014: J. Lechterbeck / T. Kerig / A. Kleinmann / M. Sillmann / L. Wick / M. Rösch, How was Bell Beaker economy related to Corded Ware and Early Bronze Age lifestyles? Archaeological, botanical and palynological evidence from the Hegau, Western Lake Constance region. Environmental Archaeology 19, 2014, 95-113.

Macháček 1997a: J. Macháček (ed.), Počítačová podpora v archeologii (Brno 1997).

1997b: J. Macháček, Metoda základního zpracování archeologických vědeckých dat s pomocí počítačové podpory. In: Macháček 1997a, 33-45.

2002: J. Macháček, Břeclav-Pohansko. 5: Sídlištní aglomerace v Lesní školce. Digitální katalog archeologických pramenů. Opera Universitatis Masarykianae, Facultas Philosophica 340 = Paginae Historiae Mediaevalis Series V – Archaeologica 1 (Brno 2002).

Manning et al. 2016: K. Manning / S. Colledge / E. Crema / S. Shennan / A. Timpson, The Cultural Evolution of Neolithic Europe. EUROEVOL Dataset 1: Sites, Phases and Radiocarbon Data. Journal of Open Archaeology Data 5, 2016, e2.

Matějíčková 2011: A. Matějíčková, Archeologické lokality na katastru obce Borkovany, okr. Břeclav. Jižní Morava 47, 2011, 269-282.

McLaughlin et al. 2016: T. R. McLaughlin / N. J. Whitehouse / R. J. Schulting / M. McClatchie / P. Barratt / A. Bogaard, The Changing Face of Neolithic and Bronze Age Ireland: A Big Data Approach to the Settlement and Burial Records. Journal of World Prehistory 29, 2016, 117-153.

Neruda 1997: P. Neruda, Výpočetní technika a zpracování kamenné štípané industrie. In: Macháček 1997a, 93-104.

Neustupný 1991: E. Neustupný, Community areas of prehistoric farmers in Bohemia. Antiquity 65, 1991, 326-331.

Podborský et al. 1977: V. Podborský / E. Kazdová / P. Koštuřík / Z. Weber, Numerický kód moravské malované keramiky. Problémy deskripce v archeologii. Opera Universitatis Purkynianae Brunensis, Facultas Philosophica 207 (Brno 1977).

Podborský et al. 1993: V. Podborský / M. Čižmář / P. Dvořák / A. Erhart / V. Janák / A. Medunová-Benešová / J. Nekvasil / J. Ondráček / J. Pavelčík / M. Salaš / S. Stuchlík / J. Stuchlíková / L. Šebela / M. Šmíd / A. Štrof / J. Tejral / K. Valoch, Pravěké dějiny Moravy. Vlastivěda Moravská N. R. 3 (Brno 1993).

Poláček 1997: L. Poláček (ed.), Studien zum Burgwall von Mikulčice 2. Spisy Archeologického Ústavu AV ČR Brno 7 (Brno 1997).

Richards 1997: J. D. Richards, Preservation and re-use of digital data: the role of the Archaeology Data Service. Antiquity 71, 1997, 1057-1059.

Shennan 1994: S. Shennan, Introduction: Archaeological Approaches to Cultural Identity. In: S. Shennan (ed.), Archaeological Approaches to Cultural Identity. One World Archaeology 10 (London 1994) 1-32.

Smutný 1997: J. Smutný, Databázové systémy. In: Macháček 1997a, 15-32.

Venclová 2015: N. Venclová, VITREA – database of chemical analyses of archaeological glass. In: Kuna et al. 2015b, 135-139.

Whitehouse et al. 2014: N. J. Whitehouse / R. J. Schulting / M. McClatchie / P. Barratt / T. R. McLaughlin / A. Bogaard / S. Colledge / R. Marchant / J. Gaffrey / M. J. Bunting, Neolithic agriculture on the European western frontier: the boom and bust of early farming in Ireland. Journal of Archaeological Science 51, 2014, 181-205.

Zusammenfassung / Summary / Résumé

Archäologie und historische Ökologie: die archäologische Datenbank des Projektes LONGWOOD ERC

Seit den 1990er Jahren wurden mehrere archäologische Datenbanken mit Informationen zu Fundstellen und Funden auf dem Gebiet der Tschechischen Republik geschaffen. Aufgrund der teilweisen Dezentralisierung war das prominenteste Beispiel, die Archäologische Datenbank von Böhmen, nur auf den westlichen Teil der Tschechischen Republik beschränkt. Für Mähren und den tschechischen Teil Schlesiens fehlte eine vergleichbare archäologische Fundstellendatenbank mit einer zuverlässigen Flächendeckung. Das Hauptziel des Projektes LONGWOOD ERC (2012-2016) war die Schaffung eines dynamischen Modells zur Waldbedeckung in Mähren und Tschechisch-Schlesien, das den menschlichen Einfluss mit einschließt. Dies konnte nur durch das quantifizierte Modellieren der Mensch-Umwelt-Beziehungen auf der Grundlage digitaler Forschungsdatenbanken erzielt werden. Wir schufen unsere eigene archäologische Datenbank, die das gesamte Forschungsgebiet (26 804 km²) mit einschloss. Ausgrabungs- und Prospektionsberichte, die im Archiv des Archäologischen Instituts der Tschechischen Akademie der Wissenschaften in Brno aufbewahrt waren, bildeten die Hauptinformationsquelle. Mit dem Stand vom 31. August 2016 beinhaltete die Datenbank mehr als 19 000 archäologische Einträge von mehr als 7000 Fundstellen aus 1685 Gemeinden. Grundlegende Quantifizierungen zur Forschungsgeschichte und zu funktionalen, zeitlichen und räumlichen Unterschieden werden in diesem Aufsatz vorgestellt und diskutiert.

Archaeology and Historical Ecology: the Archaeological Database of the LONGWOOD ERC Project
Several archaeological databases containing information on sites and finds in geographical space have been created in the Czech Republic since the 1990s. Due to partial decentralisation, the most prominent example – the Archaeological Database of Bohemia – was spatially restricted to the western part of the Czech Republic. Moravia and the Czech parts of Silesia lacked a comparable database of archaeological sites with reliable coverage. The main aim of the LONGWOOD ERC project (2012-2016) was to create a model of long-term woodland dynamics including the influence of human society for Moravia and Czech Silesia. This could only be achieved through the quantified modelling of human-environmental relationships based on digital databases created for research purposes. We created our own archaeological database covering the whole area of interest (26,804 km^2). Excavation and survey reports stored in the Archive of the Institute of Archaeology of the Czech Academy of Sciences in Brno were the main source of information. As of 31 August 2016, the database consists of more than 19,000 archaeological components from more than 7000 sites located in 1685 parishes. Basic quantifications regarding research history, functional, chronological and spatial differences are presented and discussed in this paper.

Archéologie et histoire de l'écologie: la base de données archéologique du projet LONGWOOD ERC
De nombreuses bases de données centralisant des informations sur les sites et les objets archéologiques ont été mises en place en la République tchèque depuis les années 1990. Suite à des décentralisations partielles, la plus importante d'entre elles – la base de données archéologique de Bohème – a été restreinte spatialement à l'Ouest de la République tchèque. La Moravie et la Silésie tchèque ne disposaient dont pas d'un outil comparable et de confiance. Le but principal du LONGWOOD ERC (2012-2016) était de créer un modèle des dynamiques forestières sur la longue durée incluant les impacts anthropiques pour la Moravie et la Silésie tchèque. Ceci ne put être réalisé que grâce à une modélisation quantifiée des relations homme/environnement reposant sur des bases de données de chercheurs. Une base de données propre a été créée, couvrant l'intégralité de la zone d'études (26 804 km^2). Les rapports de fouille et de prospections archivés par l'Institut d'archéologie de l'Académie tchèque des sciences de Brno étaient la source principale. Au 31 août 2016, la base de données comporte plus de 19 000 éléments archéologiques en provenance de plus de 7000 sites localisés dans 1685 paroisses. Les quantifications basiques concernant l'histoire de la recherche, leur fonctionnement chronologique et spatiale différenciés sont présentés et discutés dans cet article. Traduction: L. Bernard

Schlüsselwörter / Keywords / Mots clés

Tschechische Republik / Mähren / Datenbank / Quantifizierung / Modellierung / Historische Ökologie
Czech Republic / Moravia / database / quantification / modelling / historical ecology
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