L. Poláček (Hrsg.), Das wirtschaftliche Hinterland der frühmittelalterlichen Zentren
Internationale Tagungen in Mikulčice VI, Brno 2008, 313-325, Fig. XI-XX

The hinterland of an Early Mediaeval centre at Pohansko near Břeclav

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Introduction

In the 9th century Pohansko near Břeclav was undoubtedly, by the current criteria (e. g. Gringmuth-Dallmer 1999; Moździoch 1999), one of the central sites and one at the top of the hierarchy of settlements in Great Moravia. The results of systematic archaeological excavations provide evidence of all the functions attributed to settlements of this type (Dostál 1975, 1979, 1988, 1990, 1992, 1993; Macháček 2001a, 2005; Vignatiová 1992). Its administrative-political function can be linked to the so-called court of a magnate, interpreted as an emulation of the palatium, the centre of Carolingian-Ottonian pfalzes, and was very likely one of the residences of the Moravian ruler or his deputy. The military-defensive function of Pohansko is evident from massive fortification and the concentration of stand-by military troops in the outer ward. Intensive craft production left traces in the remains of workshop facilities, tools, unfinished products and production waste, concentrated in the residential/production homesteads or plots inside the fortification. Evidence of trade or exchange is seen in the obvious imports of luxurious goods and articles of everyday need. Pohansko may have been established as the centre of a cult as early as the Pre-Christian period when a pagan shrine is thought to have existed there, later replaced by a Christian church with a nartex.

It is assumed that the densely populated agglomeration at Pohansko was not autarchic and could not sustain itself without its hinterland which catered for its needs in terms of food and other important raw materials (e. g. Vignatiová 1992, 98). This assumption is also upheld by the fact that the site is situated in a flood-plain enclosed by cut-off meanders of the Dyje river (Goláň/Macháček 2004). Although the characteristics of the South Moravian flood-plain were different in the Early Middle-Ages to those of today and it even yields traces of prehistoric ploughing (Poláček 1996, 229–230), the immediate environs with the meandering river encircling Pohansko cannot be considered suitable for extensive agricultural production of mainly grain crops. Yet, it was grain that, based on the paleo-botanical finds, was the staple food in the early mediaeval Pohansko (Opravil 2000a, 168–169; Opravil 2000b, 29, 34–35). That the consumption may have been enormous goes hand in hand with the significant increase in the Pohansko population in the 9th century. According to our estimates derived from the number of uncovered graves (866 inhumation burials) and settlement features (1289 features), and/or the ratio between the excavated area (13.6 ha) and the total agglomeration area (approx. 55 ha), in the 9th century Pohansko near Břeclav had at least 700 inhabitants. We can assume a significantly greater number, probably exceeding one thousand (Macháček 2007). The people are not expected to have pursued primary agricultural activities, as the absence of grain storage or silo pits suggests (see below), which were commonly used in early mediaeval Slav settlements to keep the seed for the next year, and a relatively rare occurrence of agricultural tools (Dostál 1975, 203; Vignatiová 1992, 93), which were more often only produced at Pohansko rather than actually used there. Hence, the centre must have been provided with food and other important raw materials from its hinterland. Hypothetically, the size of the agricultural population can be taken to be at least equal to that of the people living in the centre. If this assumption is valid, the Pohansko hinterland must have been extensive enough to sustain at least 2000 people. If we accept the model created for the community from the Hallstatt period by D. Dreslerová (1995, 156), that number of people need, to sustain themselves under the conditions of prehistoric or early-mediaeval agriculture, an area of approx. 110 square km, consisting of fields, pastures and forests (according to Dreslerová, 1740 ha is sufficient for 320 people, i. e. approx. 5.44 ha per person). This is probably a realistic estimate of the area of the hinterland of Pohansko (and the nearby centres), which is also corroborated by the fact that half of the distance between Pohansko and the neighbouring

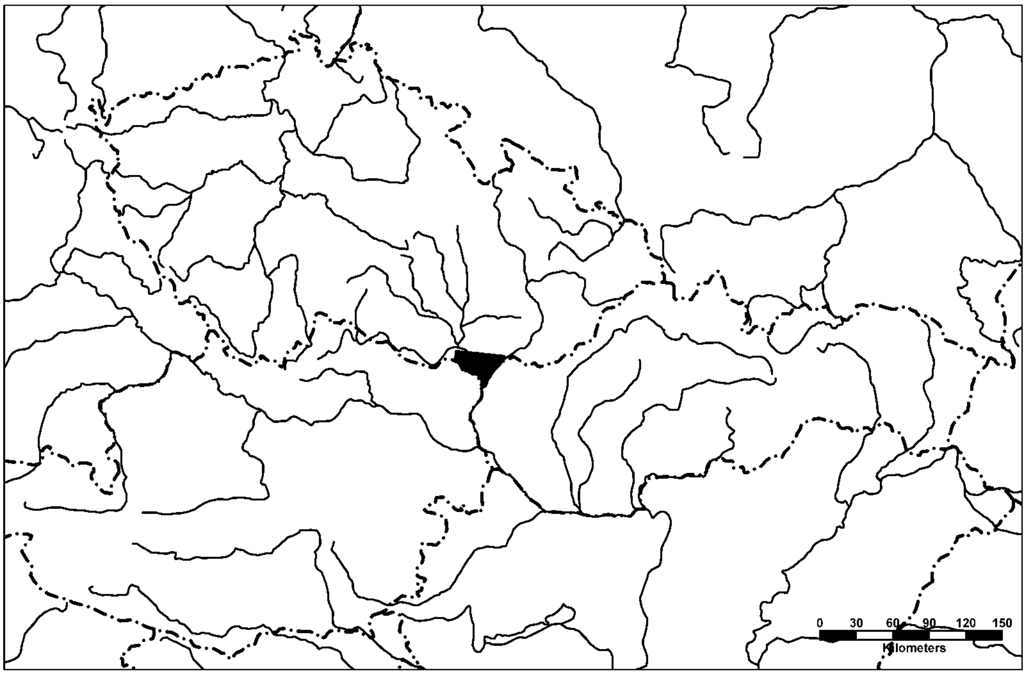


Fig. 1. Location of the area of interest (black colour) at the confluence of the Morava and the Dyje.

early mediaeval centres (half-distance between Pohansko – Nejdek: 6.9 km, Pohansko – Mikulčice: 8 km) approaches the radius of a circle with an area of 110 square km (r=5.9 km). A hinterland of 100 square km in area had also been attributed to Pohansko earlier by B. Dostál (1987, 24).

The hypothesis outlined above concerning the dependence of Pohansko on the agricultural hinterland can be verified based on an assessment of the spatial distribution of agricultural settlements in its surroundings. If, either here or in the vicinity of the neighbouring early mediaeval centres (Mikulčice, Nejdek), sites of this type are accumulated in a non-random manner, we have a reason to assume that they are related to a supporting settlement structure serving to provide for the existence of the central sites. The characteristics and function of the settlements making up this fabric need to be confirmed by their archaeological excavation. Finally, the whole system should be interpreted in the context of living culture.

Settlement structure in the Pohansko hinterland

Method

In addressing the problem described above one can use the existing spatial archaeological data, compiled in the „The official list of archaeological sites in the Czech Republic" (SAS – Státní archeologický seznam), primarily created to cater for the needs of the state heritage monument protection. The SAS databases record, and its digital maps locate, the so-called „areas with archaeological findings" (Krušinová 2004, with literature). This basic recorded unit is defined as an area with a primary occurrence of immovable archaeological finds. These are determined mainly by their location, heritage monument protection status and the dating of the identified archaeological components. They are further subdivided by confirmed activities and area types (e. g. settlement in a plain, burial-ground). The accuracy of their locating varies depending on the quality of the background data. The polygons, delimiting the areas with archaeological finds, are determined by surveyed co-ordinates (Sklenářová/Krušinová/Baštová/ Volfík 1996, 6–8, 11–17). They are of different sizes and shapes. Information pertaining to the polygons has been entered in the database by many archaeologists and is not fully comparable as a result. It differs, for example, in the accuracy of dating, or the size of the area stated as an „area with archaeological finds". The area boundaries were occasionally staked out using the edge of a water stream or limits of plots of land.

With the above in mind, for the purposes of our assessment, the spatial data from the SAS were unified into the form of a centroid – a point situated in the centre of each of the variably defined polygons. The information loss was balanced out by the unification of the spatial data. A certain level of generalization was also induced by the selection database records, based on chronological data or area types. We included precisely dated and functionally classified sites as well as those dated, based on the finds, to a broader period (e. g. Early Middle Ages) or those where their original function was not exactly identified. Without the latter sites the source base in the area of interest would have been too narrow.

To resolve the problem of the settlement structure in the hinterland of Pohansko and the neighbouring early mediaeval centres (Mikulčice, Nejdek) we chose an area of 532.5 square km, delimited in the south by the confluence of the Morava and the Dyje, and in the north by the Hodonín – Dolní Dunajovice line (Fig. 1). The area of interest is further delineated by the Czech-Austrian and the Czech-Slovak borders partly running alongside the Morava and the Dyje rivers. It is an artificially demarcated section of the landscape, selected mainly for practical reasons (e. g. restricted access to digital mapping data from the neighbouring countries). The chosen outlines enclose 158 areas with archaeological finds from the Early Middle Ages, registered in the SAS database (Fig. XI). For the purposes of further spatial analyses we made a narrower selection from the complete set.

The archaeological data was assessed by means of GIS software (GeoMedia Professional, Intergraph) in combination with environmental data.

An emphasis was put on the geological substrate and the georelief used to calculate the so-called cost distance model. The calculation basis was the DEM (Digital elevation model), based on the digital elevated maps of the examined area at a scale of 1:10 000 (ZABAGED), purchased from the Czech Office for Surveying, Mapping and Cadastre, made complete and modified using older analogue maps of the same scale, capturing the situation before recent changes to the relief. The geological substrate data (e. g. flood-plain sediment boundaries) were derived from digital vector geological maps (Czech Geological Survey) at a scale of 1:50 000. To establish the size of the area of interest the vector layers (elevation, flood-plain sediments, archaeological sites) were transferred into raster (bit map) format with a pixel size equivalent to 20 m per pixel (Fig. XI).

The DEM calculation was made in the Grid application (an add-in to the GeoMedia Professional software for working with raster layers) employing the Spline function. The basic DEM was smoothed out using a mean filter. The final DEM, as well as the raster layers of flood-plain sediments and archaeological sites, was imported into the raster analytical IDRISI GIS software which is better suited for processing raster layers and offers a wider range of analytical functions.

The cost surface calculation was made using the VARCOST algorithm. It had to be preceded by creating the so-called friction surface, the basis of which is the relief slope in %, direction of the resistive force (direction surface) and resistive force function. The friction surface calculation and the resistive force direction were calculated using the procedure described in the publication by J. Golán (Goláň 2003, 76–77) based on the works by M. Van Leusen (1999, 217) and M. De Silva and G. Pizziolo (2001, 281). The resistive force function is incorporated in the VARCOST algorithm. The result was the cost surface, where each pixel gives the value of the distance of selected landscape features in relative units of „cost". By multiplying the relative units by a value of 0.02 (the dimension of 1 pixel – 20 m) and dividing by a value of 5 (assumed speed of walk 5 km * h-1) we obtained the values of the approximate time cost distance of the individual pixels from the initial landscape features (Goláň 2003, 77). In this example they were the centroids of the early mediaeval centres and the boundaries of flood-plain sediments. The data then made it possible to establish the actual distances of peasant settlements to the nearest centre.

The calculated cost time surfaces were re-imported to the GeoMedia Professional Grid environment. The time distance values of the archaeological sites were arrived at by a simple addition of the time surfaces and the raster layer of the archaeological sites by means of the so-called Grid calculator.

Finally, the obtained results were compared with the predictive archaeological model created for a smaller area at the confluence of the Morava and the Dyje by J. Goláň (Goláň 2003; Goláň/Kučera/Macháček 2003, 254–261) based on a combination of several geographic variables.

Results

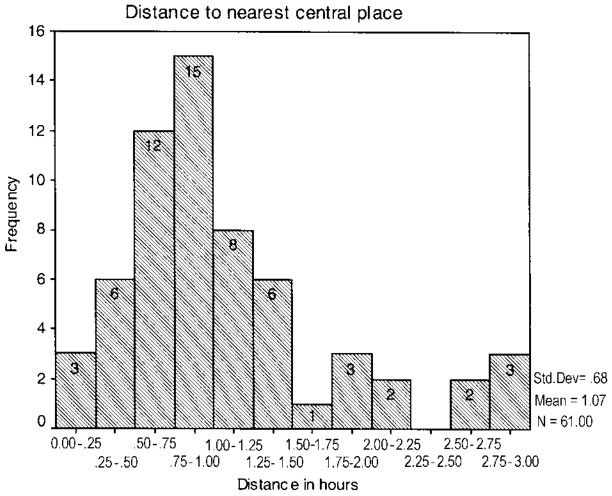
For the purposes of investigating the early mediaeval settlement structure within the chosen territory, we filtered out „areas with archaeological sites" referred to in the SAS database (see above) as settlement areas or areas with an unidentified role (although their being settlements cannot be ruled out). There are 61 sites which are more or less contemporary with the early mediaeval centres of the 9^{th} century (Fig. XII). They yield finds dating from the Middle „Burgwallzeit" (Hillfort) period (RS.3: 9^{th}-10^{th} AD), „Burgwallzeit" (Hillfort) period (RS.HRA: 7^{th}-12^{th} century AD) or generally the Early Middle Ages ('RSTRED').

The selected sites tend to cluster into conspicuous concentrations in the surroundings of the centres under investigation. This was clearly demonstrated on the map of site density created by means of raster GIS software tools (Fig. XII). The calculation ran in the GeoMedia Professional Grid program, where the whole investigated area was transformed into a raster made up of cells whose side represented 100 m. As the next step, the centroids of the selected areas with archaeological finds were transferred into the raster model. The Local Scan (Density, Total) statistics function was then applied to calculate their density in a scan window representing 4 km in diameter. The result was visualized using a range of colours from dark brown (highest concentration of sites) to green. Areas with a minimum occurrence of settlements from the period under investigation remained transparent. It was found that the highest concentration of known sites of the settlement type was situated around Mikulčice, followed by Nejdek and Pohansko near Břeclav.

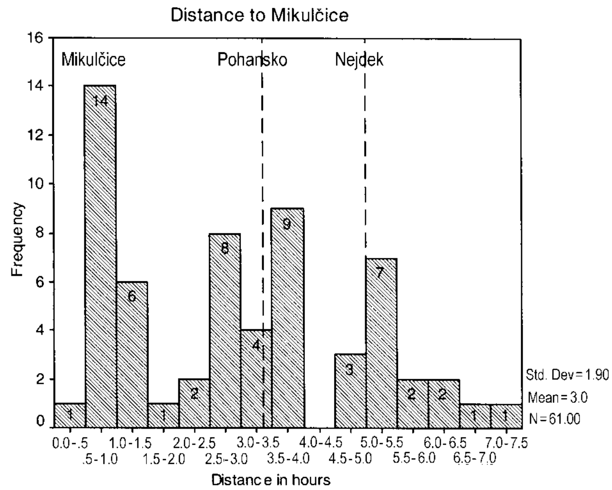
This conclusion can also be verified using quantitative data, based on the evaluation of the distance between the centres (Pohansko, Nejdek, Mikulčice) and sites of the settlement type in their surroundings (Graph 1). The cost distance model, derived from the digital elevation model (DEM), was used to assign each site a value indicating the time needed to negotiate the distance from the site to the centre (cost time distance). The method revealed that as much as 59 % of all sites are found within an hour's walk from the nearest centre. The histogram (Graph 1) further shows that most of the early mediaeval sites of the settlement type (15 sites, i. e. 25 %) are situated inside a zone from which one can walk to the nearest centre within 45 to 60 minutes.

Valuable information is also disclosed by the histogram quantifying the distribution of sites in relation to the early mediaeval centre in Mikulčice (Graph 2). The graph, in which each bar indicates the number of sites belonging to the individual zones at various distances from Mikulčice, exhibits three prominent peaks, identifiable with the sites around Mikulčice, Pohansko and Nejdek. It is worth noticing that, according to the created model, it is possible to walk from Mikulčice to Pohansko within about three hours and twenty minutes and to Nejdek in five hours. The zone at the interface of the hinterlands of the centres contains only a minimum of contemporary sites of the settlement type (Fig. XIII).

Research into the relationship between the settlement structure and the flood plain is of no less worth (for more details see e. g. POLÁČEK 1999), as it was of profound significance for early mediaeval settlement in the area under investigation. This is borne out by the fact that the most important centres in Great Moravia are found within this very flood-plain – Pohansko and Mikulčice roughly in its centre, Nejdek on the edge. The other known sites of the settlement type from their hinterland tend to be concentrated outside the flood plain rather than inside, nevertheless they are in the close vicinity of the fluvial sediments which define the flood-plain in terms of its geology (for more see also GOLÁŇ/MACHÁČEK 2004, 523). The map (Fig. XIV) clearly shows that most sites of this type are situated



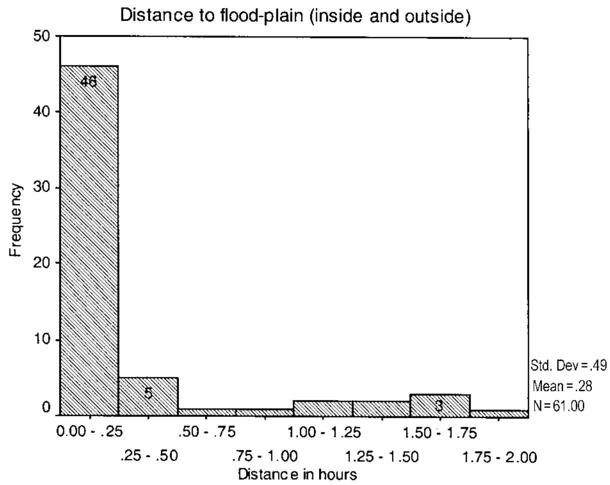
Graph 1. Histogram. Cost/time distance of early mediaeval sites (9^{th} - 10^{th} century and others) of settlement type (according to SAS) to nearest centre.



Graph 2. Histogram. Cost/time distance of early mediaeval sites (9^{th} - 10^{th} century and others) of settlement type (according to SAS) to Mikulčice.

at a distance of 500 m from the flood-plain boundary, inside the so-called buffer zone. The relationship between the flood-plain edge and the early mediaeval sites of the settlement type can also be quantified by applying the cost distance model. A total of 46 sites (i. e. 75 %) are found either within the flood-plain or fifteen minutes away from its boundary (Graph 3). If we regard only sites located outside the actual flood-plain (44 sites, i. e. 67 %), as many as 66 % are in the immediate vicinity of the flood-plain (Graph 4).

The above described variables (distance from the centre, distance from the flood-plain fluvial sediments) also served as important criteria in creating an archaeological predictive model developed for the confluence area of the Morava and the Dyje by J. Goláň



Graph 3. Histogram. Cost/time distance of early mediaeval sites (9^{th} - 10^{th} century and others) of settlement type (according to SAS) to flood-plain boundary (settlement inside and outside flood-plain).

Graph 4. Histogram. Cost/time distance of early mediaeval sites (9^{th} - 10^{th} century and others) of settlement type (according to SAS) to flood-plain boundary (settlements outside flood-plain).

(Goláň 2003; Goláň/Kučera/Macháček 2003, 254–261). The studied area is demarcated by the two river channels and takes up approx. 207 square km. In addition to Pohansko near Břeclav it also comprises Mikulčice and its environs (Fig. XV).

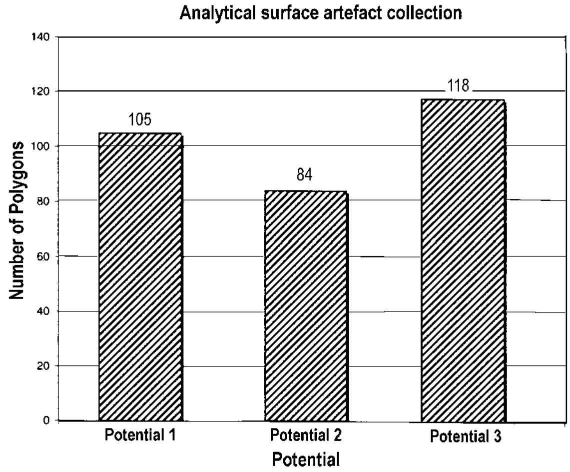
In his work, J. Goláň examined the geographic and social variables which influenced most the settlement structure in the area in different prehistoric and early mediaeval periods. He found that, apart from the distance to the centres (Mikulčice, Pohansko) and to the fluvial sediment boundary, the location of the early mediaeval settlements was most importantly influenced by the angle distance of hillsides from the north direction, local relief within a distance of 100 and 200 metres, the so-called RIM index (or shelter quality – specifying the convex or concave properties of the relief), cost distance to the potential or ideal river network (different from present day streams, it establishes where water streams may have run in the past) and the distance to the fluvial sediments of small streams outside the flood-plain. The variables were complemented by information about elevation above-sea-level and, using a combination of the above data, the predictive model, which had been based on the distribution of known archaeological sites within the area, was calculated. The model defines three zones of probability of archaeological finds from various periods in the modern landscape (Fig. XV). A highly-reliable model was developed by Goláň for settlements from the Middle „Burgwallzeit"(Hillfort) period (9^{th} – 10^{th} century AD), according to which 67 % of known sites (15 sites in total) can be pinpointed to a narrow zone with the highest potential representing only 6.4 % of the overall area. In contrast, the largest area (71.2 %) was assigned the lowest potential where only 13.3 % of the Middle „Burgwallzeit" (Hillfort) period settlements were identified. Although slightly less reliable, the predictive model where the sites from the Middle „Burgwallzeit" (Hillfort) period were combined with settlements only generally attributed to Early Middle Ages (together 30 sites) still produced quite satisfactory results. The lowest potential there takes up 60.1 % of the area and contains only 16.7 % of known sites while an area comprising 11.1 %, assigned to the highest potential zone, encompasses 36.7 % of known sites.

As the results arrived by the authors of this contribution and by Goláň suggest the settlement structure in the area under investigation was, in addition to standard environmental variables, significantly influenced by the existence of sites exhibiting the characteristics of a centre which to a great extent determined the location of the other settlements. Their distribution in the landscape was also profoundly affected by the edge of the flood-plain which simultaneously made up an important boundary between two ecosystems.

Verification of the proposed model

The result of the special analyses described above need to be further verified. Problems may stem from the two following facts. First, the relatively small number of archaeological sites used as the foundation for the construction of Goláň's predictive model (Goláň/Kučera/Macháček 2003, 261): the evaluation and improvement of its stability necessitates obtaining new archaeological data from the region, which, after all, J. Goláň himself proposed in the conclusion of his work (2003, 116). Second, the nature of the archaeological data which provided the foundation for both models: the SAS database is primarily intended to serve the purposes of the state heritage monument protection, it does not record individual archaeological excavations or surveys (Sklenářová/Krušinová/Baštová/Volfík 1996, 9). The results of the work appear in the SAS only provided a positive finding was made and the uncovered site falls under heritage monument protection. In the case of a negative finding, which indicates a certain level of probability that no archaeological finds occur at that location (although they cannot be ruled out), the information will not figure in the SAS database (not being relevant for heritage monument protection). Hence, the SAS data cannot be employed to objectively verify whether the early mediaeval settlements in the region under investigation really were unevenly distributed. In theory, the accumulation of settlements around the early mediaeval centres might be merely the result of an intensive effort on the part of the archaeologist who fostered a specific apriori idea about the area and need not reflect the actual settlement structure in Early Middle Ages.

The solution to the problems as well as the verification of the previous results can be seen in the application of the so-called analytical surface artefact collection as described below.



Graph 5. Analytical surface artefact collection. Numbers of investigated polygons by potential.

Method

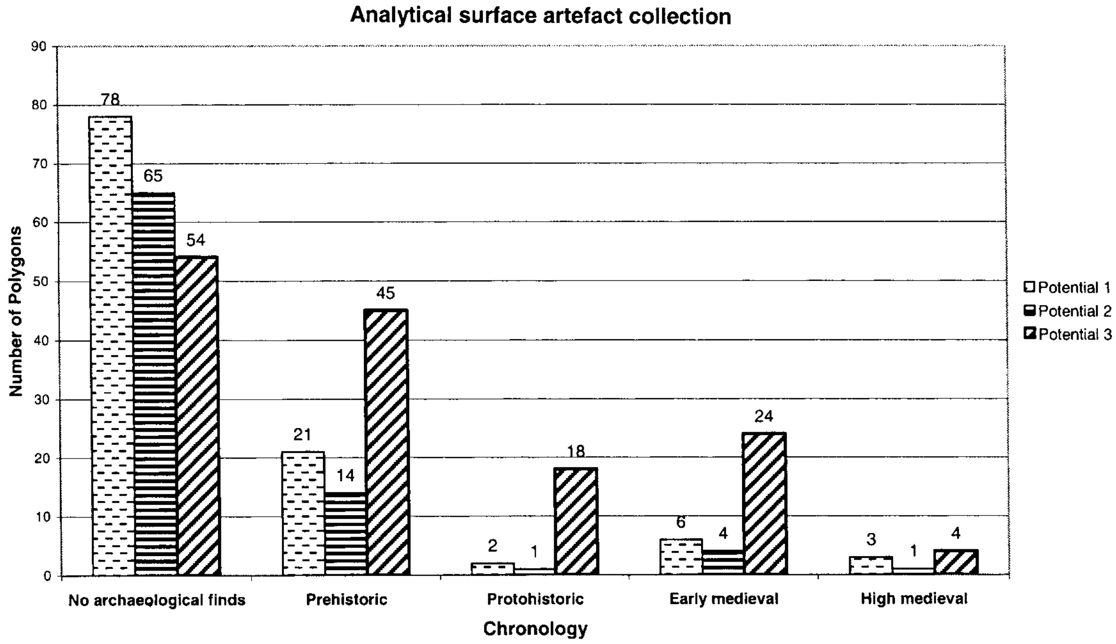
The analytical surface artefact collection method was theoretically justified in Bohemia by E. Neustupný (e. g. 1986a, 1998) and implemented in archaeological practice by M. Kuna (e. g. Kuna et al. 2004, 305–352 with literature; Kuna 2000b). In this analytical approach the investigated space is divided up into small partitions, within which the data collection takes place, independent of the original idea of the spatial structure. Rather than a mere detection of „sites" as locations with a high concentration of archaeological sites, it is a method that enables the archaeologist to capture the quantitative aspects of surface collections of archaeological finds and identify the presence of less conspicuous components as well. As a result the results of the investigation can be analyzed without prejudice (Kuna et al. 2000a, 25, 326).

As a method the analytical surface artefact collection is highly suitable for the verification of our previous findings arrived at based on the SAS data, which had been created as a result of a purposeful search for sites in the field (the so-called synthetic approach, see Kuna et al. 2004, 24) for heritage monument protection.

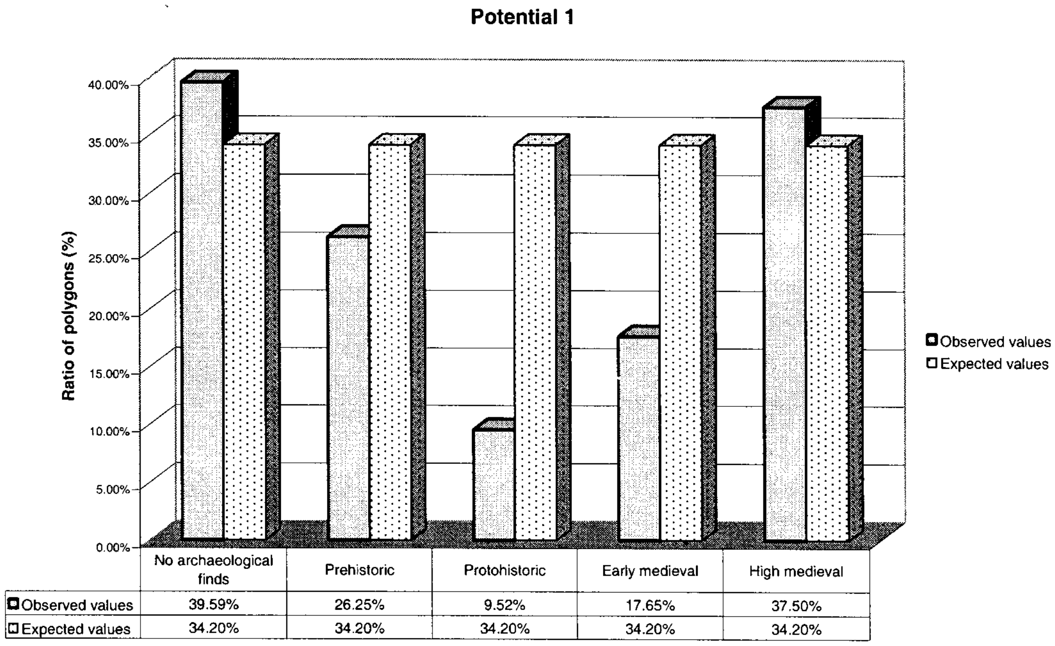
The work on the verification of our model can be subdivided into two stages. In the first stage the predictive model of Goláň was tested against the independent results of analytical surface artefact collections. These were performed over the same area for which the model had been created. In the next stage, which remains to be realized, the analytical collections need to be applied to a much wider region. The focus will be on areas where, based on the previous findings, the occurrence of early mediaeval settlements is only sporadic in spite of the fact that the natural conditions are optimal. The areas in question are mostly interfaces between the hinterlands of neighbouring centres.

For the purposes of analytical surface artefact collections the whole area under investigation was divided into 50 x 50m square-shaped polygons (the so-called enclosing polygons conceived by E. Neustupný 1986b, 114), marked by a unique identifier. GIS tools were applied to determine those which were suitable for archaeological field-walking, i. e. preferably arable land. The area covered by Goláň's predictive model comprised 24 026 polygons. After calculating the centroid of each polygon it was assigned a potential for the occurrence of early mediaeval settlements (low/1 – medium/2 – high/3). A generator of random numbers was used to make a selection so that the area of all settlement potentials would be evenly covered.

The actual fieldwalking was approached employing the survey around selected points or dog-lead method (Kuna et al. 2004a, 329–330). The centroids of randomly selected polygons were loaded into the memory of a GPS device (Timble GeoExplorer CE GeoXT) so they could be located in the field. If the local conditions proved suitable for fieldwalking (good surface visibility; see Kuna et al. 2004, 334–336), the polygon centroid was temporarily staked out and, using a 25m long line, sampled. The fieldwalking was performed by four persons searching for surface finds alongside their line in four directions at a right angle. After walking down the length of the line, it was turned by 45° and the process was repeated.



Graph 6. Analytical surface artefact collection. Investigated polygons by dating of finds.



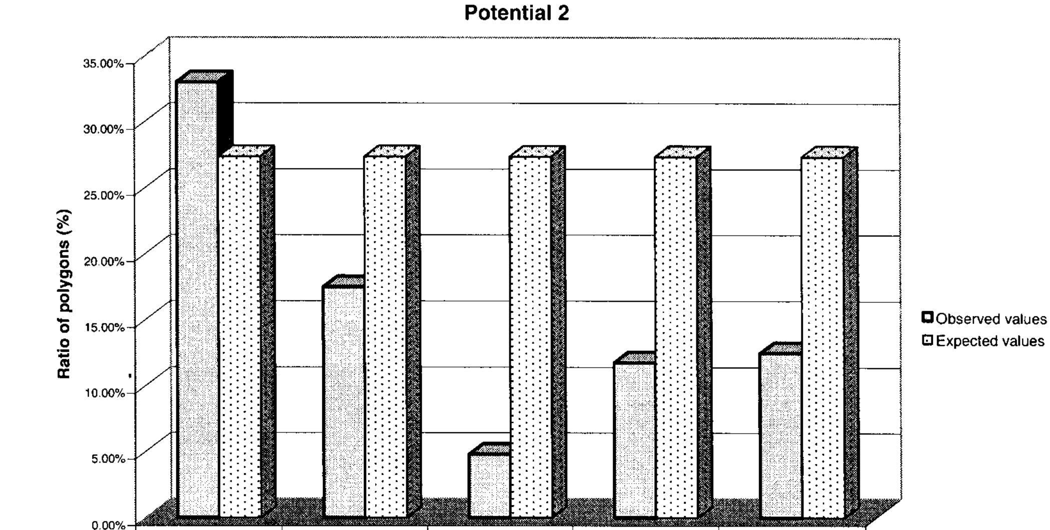
Graph 7. Analytical surface artefact collection. Prediction model verification. Potential 1.

The acquired finds were stored and marked by the unique polygon identifier, assigned in the preparatory phase to each polygon within the area under investigation.

Results

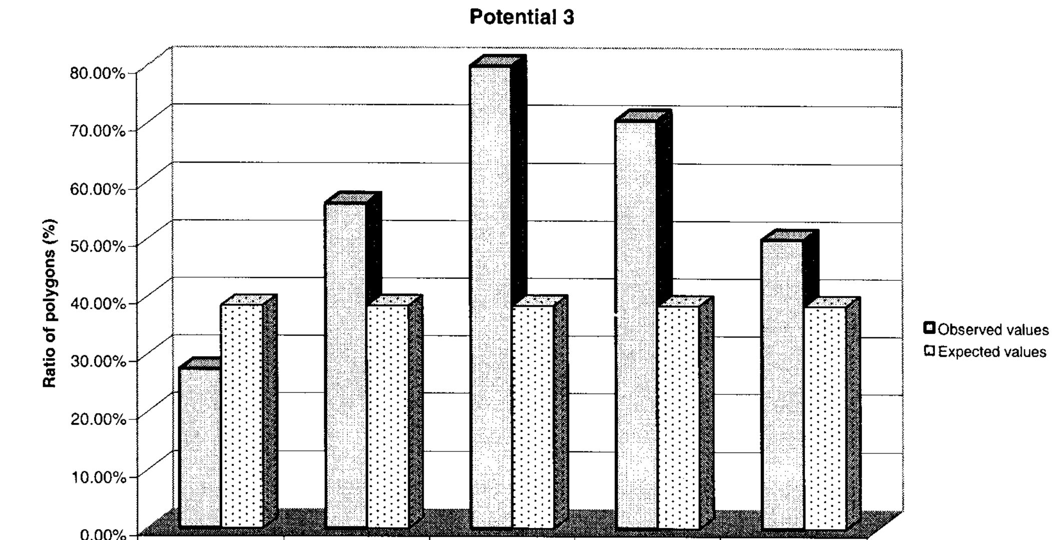
By 2005 analytical surface artefact collections had been made in 307 polygons (Fig. XVI, Graph 5). Of those, 105 polygons (34.2 %) were in the low potential area (1), where the predictive model did not assume an occurrence of early mediaeval settlements. On the contrary, the highest probability of an early mediaeval settlement was expected in 118 polygons (38.44 %), situated in the highest potential area (3). The medium potential (2) comprised 84 polygons (27.36 %).

The collection evaluation showed that 197 polygons did not contain any finds at all or they were from modern times only. The remaining polygons yielded archaeologically relevant artefacts of various dating (some polygons contained finds from different periods). A total of 80 polygons comprised finds of preliminary general dating to the prehistoric period (the Neolithic to Hallstatt period) and 21 polygons



	No archaeological finds	Prehistoric	Protohistoric	Early medieval	High medieval
Observed values	32.99%	17.50%	4.76%	11.76%	12.50%
Expected values	27.36%	27.36%	27.36%	27.36%	27.36%

Graph 8. Analytical surface artefact collection. Prediction model verification. Potential 2.



	No archaeological finds	Prehistoric	Protohistoric	Early medieval	High medieval
Observed values	27.41%	56.25%	85.71%	70.59%	50.00%
Expected values	38.44%	38.44%	38.44%	38.44%	38.44%

Graph 9. Analytical surface artefact collection. Prediction model verification. Potential 3.

to protohistory (the La Tène to Roman period). In 34 polygons artefacts dated back to the Early Middle Ages. Only 8 polygons were identified as having finds from the High Middle Ages (Fig. XVII, Graph 6).

During the verification we examine the distribution of polygons with archaeologically relevant finds from various periods in areas with a different settlement potential. We try to establish whether they are evenly and randomly distributed among the different settlement potentials just as the polygons selected by the generator of random numbers for the purposes of analytical surface artefact collections (see above, Graph 5). If it is so, then roughly 34.2 % of the polygons should always be situated within potential 1, 27.36 % in potential 2 and 38.44 % in potential 3. It was shown, however, that the data acquired through surface collections did not support the assumption.

If, for example, we focus our attention on polygons with early mediaeval finds (Fig. XVIII, Graph 9), we find that, they differ quite substantially from the random distribution as 24 (i. e. 70.59 %) of them lie within the area with the highest settlement potential (3). It is

Tab. 1. Analytical surface artefact collection. Chi-square test.

OBSERVED VALUES				
Chronology	**All polygons**	**Potential 1**	**Potential 2**	**Potential 3**
No archaeological finds	197	78	65	54
Prehistoric	80	21	14	45
Protohistoric	21	2	1	18
Early medieval	34	6	4	24
High medieval	8	3	1	4

EXPECTED VALUES				
Chronology	**All polygons**	**Potential 1 (34.20%)**	**Potential 2 (27.36%)**	**Potential 3 (38.44%)**
No archaeological finds	197	67.37785016	53.90228013	75.71986971
Prehistoric	80	27.36156352	21.88925081	30.74918567
Protohistoric	21	7.182410423	5.745928339	8.071661238
Early medieval	34	11.6286645	9.302931596	13.06840391
High medieval	8	2.736156352	2.188925081	3.074918567

almost double the number expected in the case of the random distribution of finds in the landscape. On the contrary, the area with the lowest settlement potential (1) has a mere 17.65 % of polygons compared to the expected 34.2 % (Graph 7). The area assigned to the medium settlement potential (2) is insignificant for the early mediaeval settlement (only 11.76 % of polygons with finds, Graph 8). Similar results can be observed in finds from the protohistoric period (the La Tène to Roman period), of which a striking 85.71 % (Graph 9) are found within the area with the settlement potential 3. Less affinity with this area (early mediaeval settlement potential 3) is noted in finds dated to the prehistoric period, representing only 56.25 %. Against theoretical expectations, polygons without archaeological finds occur significantly less frequently (27.41 %) within the area of highest early mediaeval settlement potential (3).

The above results clearly show that there is a strong link between early mediaeval (and protohistoric) finds from analytical surface artefact collections and the area which had been assigned the highest settlement potential for the Early Middle-Ages based on archaeological prediction (Fig. XVIII). The conclusion can be confirmed by the chi-square test from the statistics employed to verify whether the observed values (results of new analytical surface artefact collections) at a given level of significance differ from the expected values (random distribution between settlement potentials). Under the test we compared the numbers of polygons with finds from prehistory, protohistory, the Early Middle Ages, High Middle Ages and polygons with no finds with expected random distribution between three settlement potentials (Tab. 1). The obtained result (0.00000000194) proves that both distributions on the given statistical significance level (0.01) are significantly different and, consequently, the relationship between the spatial distribution of archaeological finds of various ages and the early mediaeval settlement potential calculated for the given area cannot be accidental. From this point of view the created predictive model can be considered verified, although its stability needs to be further tested. In addition, the model validity must also be verified on a more extensive area.

Archeological excavations of agricultural settlements in the Pohansko hinterland

The current state of research shows that conspicuous accumulations of contemporary settlements formed in the environs of the early mediaeval centres. Their function within the settlement hierarchy can be estimated from archaeological excavations mainly of a rescue nature undertaken on some of them. Two of those – Břeclav-Poštorná and Břeclav-Líbivá, which belong to the hinterland of the early mediaeval centre at Pohansko, deserve special attention.

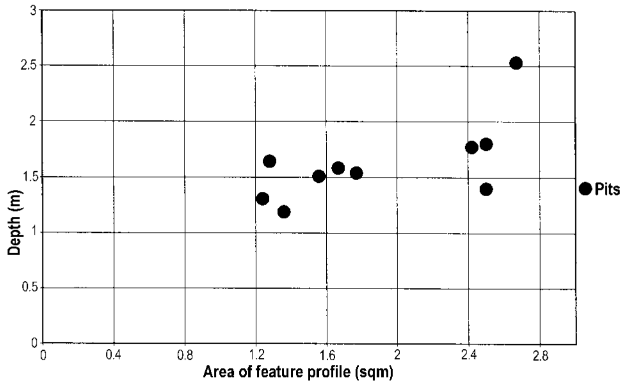
In Poštorná, lying in the immediate vicinity of Pohansko (2.2 km as the crow flies), a small archaeological rescue excavation was carried out in 1988 on the premises of the Fosfa company. The finds included three sunken huts, two settlement pits and six graves. One grave yielded weapons (sword, battle-axe) and riding tackle (spurs). Judging from the ceramics the settlement features date back to the 9th century. This dating is supported by the grave goods. One of the settlement pits can be described as a storage or silo pit as is suggested by its considerable depth (245 cm) and typical pear shape. Its usable volume is estimated at 36 hl (Kavánová/Vitula 1990, 327–352).

Excavations on the second site situated at Břeclav-Líbivá took place between 1995-1998 and were slightly more extensive (Macháček 2001b). The exposed area of 1285 square metres provided evidence of traces of intensive settlement from prehistory to modern times. The finds from Líbivá comprised in total 92 settlement features, 15 human graves, 5 dog burials, and 37 post-holes. The most numerous archaeological finds uncovered in Líbivá belong to an early mediaeval settlement which existed there continuously from the Early Slav period (6th century) to the High Great Moravian phase (9th/10th century).

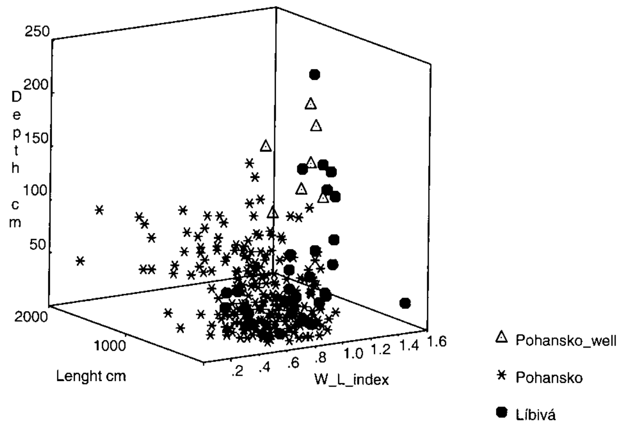
The most intensive settlement activity at Líbivá is confirmed in the Great Moravian period (Fig. XIX-XX). The features occurring with notable frequency were storage or silo pits totalling ten pits. They are predominantly concentrated at the edge of a sand dune in a special precinct at a distance of about 10 m from two inhabited sunken huts. The Great Moravian features yielded mainly ceramics – including, alongside standard Great Moravian production, specimen of distinctive types indentified at Pohansko near Břeclav and other Great Moravian centres. The burials of five dogs situated either in the Great Moravian deep storage pits or in special shallow pits just underneath the surface was an unusual find.

It was rather remarkable to find that the Great Moravian storage pits can be classified into two groups by their dimensions among which especially the deep and voluminous storage pits (of more than 2.4 square m in cross-section) are significant (Graph 10). In contrast to the smaller pits they do not appear near the half-sunk huts but only in a special separate precinct. This might be related to the fact that the settlement at Líbivá was one of the settlements in the agricultural hinterland of Pohansko in the Great Moravian period, being only 5.5 km away. The existence of two categories of storage pits may reflect the fact that production in a settlement of this type must have met two types of demand – one to fill its own needs and one to sustain the populous centre which Pohansko undoubtedly was. It should be noted here that similar storage or silo pits are virtually missing at Pohansko in the Great Moravian period as is confirmed by the 3-D Scatterplot (Graph 11) depicting settlement features from Líbivá and Pohansko, represented by a set of 245 features from an excavation in the so-called Lesní školka. The graph is defined by three axes used to plot the depth, lenght and width-length index (calculated as the ratio of the max. top view width and length) of the features. The graph clearly shows that at Pohansko, with the exception of wells, there are no settlement features of similar parameters to the storage pits from Líbivá or Poštorná (the features from Pohansko are generally more elongated and shallower, possibly even longer).

The absence of this type of feature at Pohansko might be explained by the groundwater level which rises much higher in the flood-plain and prevents the digging of deep holes. On the other hand, their absence testifies to the functional difference between the centre and the sites in its hinterland. The pits played a crucial role and were irreplaceable in (not only) early mediaeval



Graph 10. Břeclav-Líbivá. Storage pits. 2-D Scatterplot.



Graph 11. Břeclav-Líbivá and Břeclav-Pohansko/Lesní školka. Settlement features. 3-D Scatterplot.

agriculture, as confirmed by archaeological experiments, ethnographic parallels and historical reports. They served as the storage of seed for the next season (KUDRNÁČ 1958a, 1958b; MEURERS-BALKE/LÜNING 1990, 91; PLEINEROVÁ 2000, 211–221). In early mediaeval Slav settlements they were one of the dominant features (e. g. Březno u Loun – PLEINEROVÁ 2000, 218; Mužla-Čenkov – HANULIAK/KUZMA/ŠALKOVSKÝ 1993, 55–59; Bajč – RUTTKAY 2003, 265–266; Břeclav-Líbivá – see above). At Pohansko they appeared only in the pre-Great Moravian (Early Slav and Early „Burgwallzeit" (Hillfort) phase (6th-8th century), when the agricultural settlement on the site was probably fully autarchic in terms of food sources. A total of eight pits for storing grains were investigated on the site. They are mostly features of smaller dimensions (depth 70-95 cm), which are typical for the beginning of the Early Middle Ages (PLEINEROVÁ 2000, 215, 221; RUTTKAY 2003, 265). Silo pits with seed were identified together at two locations – in the middle and on the edge of two settlement clusters made up of several lived-in sunken huts. Their inhabitants provided for their sustenance by working together, growing mainly wheat, rye, and millet (Dostál 1982, 47–56). A change at Pohansko occurred during the Great Moravian period. Silo pits started to disappear and were not detected at all in most of the investigated areas (Dostál 1975, 87–92; Dostál 1993, 44; Vignatiová 1992, 30). Nothing indicates that the local inhabitants were engaged in intensive wheat-growing, as opposed to the farmers from the neighbouring settlements. Supplying the centre with grain, which was the staple food at Pohansko (Opravil 2000a, 168–169; Opravil 2000b, 29, 34–35), must have been provided from the settlements in its hinterland. However, even this conclusion will have to be verified in the future, for example by means of modern paleobotanical analyses which are capable, under ideal conditions, of identifying the locations of production and consumption.

Discussion

If we accept the conclusions so far, of which some still need to be verified, it is possible to state that a settlement structure fully subordinated to the needs of the centre was established in the 9th century in the immediate surroundings of Pohansko. Judging from the model created by Z. Kurnatowska for the early mediaeval Great Poland the settlement did not arise through natural local development in the region but artificially, by enforced centralization. According to Z. Kurnatowska (1999, 55) the hinterland of the Piast centres were colonized following a plan. In the case of Pohansko near Břeclav it is obvious that the contemporary agricultural settlements were not randomly located in its environs. The peripheral areas on the interface between the hinterlands of two neighbouring centres remained only sporadically settled (Fig. XIII). They were probably de-populated due to the dislocation of the population which provided for the needs of the centre (in addition to producing the fundamental foodstuffs probably the construction and maintenance of the road and fortification systems as well; for more on the subject see Kurnatowska 1999, 55). In Poland a similar development of the settlement structure is observed a little later, after the establishing of the Piast castles in the 10th century (Moździoch 1999, 41–43). It is quite an archaic model of territorial organization typical for early mediaeval societies standing on the threshold of statehood. Its characteristics are the concentrating of large fortified agglomerations with a densely populated hinterland into an area which may be considered the core of the early „states". However, this form of territorial organization did not prove to be viable and disappeared during the next phase of development (Kurnatowská 1984, 169–170). Later, the whole settlement structure was redesigned and stabilized, including purpose-built subcentres (e. g. fora, villae forenses), fulfilling the function of, for example, weekly markets or inns (tabernae), whereby the peripheral areas were populated as well (Moździoch 1999, 41–43; Žemlička 1996, 18–21).

The above outlined model is only valid for East Central and Eastern Europe. It differs quite substantially from the situation in the West (Henning 2004, 396–435; Henning 2005, 41–59) where the structure of village settlements became stabilized as early as the beginning of the 6th century. It was so solid that it could not be affected by political nor economic changes. The location of the villages, consisting of independent and co-operating farmsteads, which were missing in Eastern Europe in the Early Middle Ages, was determined predominantly by the infrastructure (in particular the system of roads) and natural conditions. The economic system that, in the West, gradually developed into the form of the manorial system had to adapt to the settlement structure. Within the system, the individual farmsteads were taxed depending on their performance. Over the years the manorial system showed itself to be more effective than the forced manipulation of an undifferentiated and uniform mass of village inhabitants, as confirmed by our findings in the Pohansko hinterland. It is therefore hardly surprising that from the 10th century (or 12th century) onwards the new system started to spread in the eastern part of Central Europe as well (Henning 2005, 41–59). This, however, happened at a time when Pohansko and the other Great Moravian centres no longer existed. The system they were part of failed to resist the fatal upheavals set in motion by various external and internal influences (e. g. Hungarian military attacks, climate change). The question with regards to what extent its instability might have been caused by forceful interventions into its settlement structure potentially leading to social and political unrests (e. g. Moździoch 1999, 41) will undoubtedly become the topic of further discussions.

Literature

Dostál 1975 – B. Dostál, Břeclav-Pohansko IV. Velkomoravský velmožský dvorec (Brno 1975).

Dostál 1979 – B. Dostál, K opevnění hradiska Břeclavi-Pohanska, Sborník Prací Fik. Fak. Brno E 24, 1979, 73–93.

Dostál 1982 – B. Dostál, K časně slovanskému osídlení Břeclavi-Pohanska (Praha 1982).

Dostál 1987 – B. Dostál, Vývoj obydlí, sídlišť a sídlištní struktury na jižní Moravě v době slovanské (6.-10. století). In: XVI. Mikulovské sympozium 1986, Vývoj obydlí, sídlišť a sídlištní struktury na jižní Moravě (Praha 1987) 13–32.

Dostál 1988 – B. Dostál, Raně městské prvky hradiště Břeclavi-Pohanska. In: Rodná země – Sborník k 100. výročí Musejní a vlastivědné společnosti v Brně a k 60. narozeninám PhDr. Vladimíra Nekudy, CSc. (Brno 1988) 146–155.

Dostál 1990 – B. Dostál, Raně feudální společnost Velké Moravy na základě objevů v Břeclavi – Pohansku. In: Pravěké a slovanské osídlení Moravy. Sborník k 80. narozeninám Josefa Poulíka (Brno 1990) 282–287.

Dostál 1992 – B. Dostál, K rekonstrukci velkomoravského kostela na Pohansku. Sborník Prací Fil. Fak. Brno E 37, 1992, 73–88.

Dostál 1993 – B. Dostál, Ein Handwerkliches Areal des 9. Jh. in Břeclav-Pohansko (Mähren). Actes du XIIe Congrés ISPP 4 (Bratislava 1993) 220–225.

Dreslerová 1995 – D. Dreslerová, A settlement-economic model for a prehistoric microregion: settlement activities in the Vinoř-stream basin during the hallstatt period. In: Kuna, M./Venclová, N. (eds.): Whither archaeology? Papers in honour of Evžen Neustupný (Praha 1995) 145–160.

Goláň/Kučera/Macháček 2003 – J. Goláň/M. Kučera/J. Macháček, The Application of GIS in the Archaeology – intra and inter site analysis in Břeclav - Pohansko, Czech Republic. In: Digital Earth - Information Resources for Global Sustainability, Proceedings (Brno 2003) 246–262.

Goláň/Macháček 2004 – J. Goláň/J. Macháček, Velkomoravské hradisko Pohansko a jeho zázemí. In: H. Hrib/E. Kordiovský (eds.), Lužní les v Dyjsko-moravské nivě (Břeclav 2004) 513–526.

Goláň 2003 – J. Goláň, Archeologické prediktivní modelování pomocí geografických informačních systémů na příkladu území jihovýchodní Moravy. Geografický ústav PřF, Masarykova univerzita, manuscript – PhD thesis (Brno 2003).

Gringmuth-Dallmer 1999 – E. Gringmuth-Dallmer, Methodische Überlegungen zur Erforschung zentraler Orte in ur- und frühgeschichtlicher Zeit. In: S. Moździoch (ed.), Centrum i zaplecze we wczesnośredniowiecznej Europie środkowej. Spotkania Bytomskie III (Wrocław 1999) 9–20.

Hanuliak/Kuzma/Šalkovský 1993 – M. Hanuliak/I. Kuzma/P. Šalkovský, Mužla-Čenkov I. Osídlenie 9.-12. storočia (Nitra 1993).

Henning 2004 – J. Henning, Germanisch-romanische Agrarkontinuität und -diskontinuität im nordalpinen Kontinentaleuropa – Teile eines Systemwandels? Beobachtungen aus archäologischer Sicht. In: D. Hägermann/W. Haubrichs/J. Jarnut (Eds), Akkulturation. Probleme einer germanisch-romanischen Kultursynthese in Spätantike und frühem Mittelalter (Berlin–New York 2004) 396–435.

Henning 2005 – J. Henning, European Ways of Life in East and West during the Early Middle Ages: Which Way was the 'normal' one? In: F. Curta (ed.), East Central and Eastern Europe in the Early Middle Ages. Series: Studies on the history and archaeology of Eastern Europe during the early Middle Ages (University of Michigan Press 2005) 41–59.

Kavánová/Vitula 1990 – B. Kavánová/P. Vitula, Břeclav - Poštorná, pohřebiště a sídliště střední doby hradištní. In: Pravěké a slovanské osídlení Moravy. Sborník k 80. narozeninám Josefa Poulíka (Brno 1990) 327–352.

Krušinová 2004 – L. Krušinová, The official list of archaeological sites in the Czech republic - an information system of archaeological sites in the CR. In: Enter the Past. The E-way into the Four Dimensions of Cultural Heritage. BAR International Series 1227 (Oxford 2004) 170–174.

Kudrnáč 1958a – J. Kudrnáč, Skladování obilí v jamách – obilnicích. Vznik a počátky Slovanů II, 1958, 233–252.

Kudrnáč 1958b – J. Kudrnáč, Staroslovanské obilnářství v českých zemích, Pam. Arch. 49/2, 1958, 478–498.

Kuna 2004 – M. Kuna, Beyond identification: dating sites by surface artefact survey and the information from test excavations. In: M. Gojda (ed.), Ancient Landscape, Settlement Dynamics and Non-Destructive Archaeology. Czech Research Project 1997-2002 (Praha 2004) 72–90.

Kuna et all 2004 – M. Kuna et all, Nedestruktivní archeologie (Praha 2004).

Kurnatowska 1984 – Z. Kurnatowska, Bildungsprozeß des polnischen Staates und siene Spiegelung in der Besiedlungsstruktur. In: Interaktionen der mitteleuropäischen Slawen und anderen Ethnika im 6.-10. Jahrhundert (Nitra 1984) 165–172.

Kurnatowska 1999 – Z. Kurnatowska, Centrum a zaplecze. Model wielkopolski. In: S. Moździoch (ed.), Centrum i zaplecze we wczesnośredniowiecznej Europie środkowej. Spotkania Bytomskie III (Wrocław 1999) 53–59.

Macháček 2001a – J. Macháček, Pohansko bei Břeclav – ein bedeutendes Zentrum Großmährens. In: L. Galuška/P. Kouřil/Z. Měřínský (eds.), Velká Morava mezi Východem a Západem. Großmähren zwischen West und Ost (Brno 2001) 275–290.

Macháček 2001b – J. Macháček, Zpráva o archeologickém výzkumu Břeclav - Líbivá 1995-1998. In: Z. Měřínský (ed.), Konference Pohansko 1999. Archaeologia mediaevalis Moravica et Silesiana I (Brno 2001) 39–62.

Macháček 2005 – J. Macháček, Raně středověké Pohansko u Břeclavi: munitio, palatium, nebo emporium moravských panovníků? Arch. Rozhledy 57, 2005, 100–138.

Macháček 2007 – J. Macháček, Pohansko bei Břeclav. Ein frühmittelalterliches Zentrum als sozialwirtschaftliches System. Studien zur Archäologie Europas 5 (Bonn 2007).

Meurers-Balke/Lüning 1990 – J. Meurers-Balke/J. Lüning, Experimente zur frühen Landwirtschaft. Ein Überblick über die Kölner Versuche in den Jahren 1978-1986. In: M. Fansa (ed.), Experimentelle Archäologie in Deutschland. Archäologische Mitteilungen aus Nordwestdeutschland, Beiheft 4 (Oldenburg 1990) 82–92.

Moździoch 1999 – S. Moździoch, Miejsca centralne Polski wczesnopiastowskiej. Organizacja przestrzeni we wczesnym średniowieczu jak źródło pozania systemu społeczno-gospodarczego. In: S. Moździoch (ed.), Centrum i zaplecze we wczesnośredniowiecznej Europie środkowej. Spotkania Bytomskie III (Wrocław1999) 9–20.

Neustupný 1998 – E. Neustupný (ed.), Space in prehistoric Bohemia (Praha 1998).

Neustupný 1986a – E. Neustupný, Sídelní areály pravěkých zemědělců. Pam. Arch. 77, 1986, 226–234.

Neustupný 1986b – E. Neustupný, Polygons in Archaeology. Pam. Arch. 87, 1986, 112–136.

Opravil 2000a – E. Opravil, Archäobotanische Funde aus dem Burgwall Pohansko bei Břeclav. In: L. Poláček (ed.), Studien zum Burgwall von Mikulčice IV (Brno 2000) 165–169.

Opravil 2000b – E. Opravil, Zur Umwelt des Burgwalls von Mikulčice und zur pflanzlichen Ernährung seiner Bewohner. In: L. Poláček (ed.), Studien zum Burgwall von Mikulčice IV (Brno 2000) 9–164.

Pleinerová 2000 – I. Pleinerová, Die altslawischen Dörfer von Březno bei Louny (Praha–Louny 2000).

Poláček 1996 – L. Poláček, Zum Stand der siedlungsarchäologischen Forschung in Mikulčice. In: Č. Staňa/ L. Poláček (eds.), Frühmittelaterliche Machtzentren in Mitteleuropa. Mehrjährige Grabungen und ihre Auswertung. Internationale Tagungen in Mikulčice III (Brno 1996) 213–260.

Poláček 1999 – L. Poláček, Talaue der March und die Erforschung der großmährischen Machtzentren. In: L. Poláček/J. Dvorská (eds.), Probleme der mitteleuropäischen Dendrochronologie und naturwissenschaftliche Beiträge zur Talaue der March. Internationale Tagungen in Mikulčice V (Brno 1999) 227–232.

Ruttkay 2003 – M. Ruttkay, Mittelalterliche Siedlung und Gräberfeld in Bajč - Medzi kanálmi (Vorbericht). Slovenská arch. 50-2, 2003, 245–322.

Silva De/Pizziolo 2001 – M. Silva De /G. Pizziolo, Setting up a „Human Calibrated“ Anisotropic Cost Surface for Archaeological Landscape Investigation. 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, Archaeopress BAR Oxford (Ljubljana 2001) 279–286.

Sklenářová/Krušinová/Baštová/Volfík 1996 – Z. Sklenářová/L. Krušinová/D. Baštová/P. Volfík, Státní archeologický seznam verze 1.1. Uživatelská příručka (Praha 1996).

Van Leusen 1999 – M. Van Leusen, Viewshed and Cost Surface Analysis Using GIS (Cartographic Modelling in a Cell-Based GIS II). In: J. A. Barceló/I. Briz/A. Vila (eds.), New Techniques for Old Times CAA 98 (BAR International Series 757, 1999) 215–223.

Vignatiová 1992 – J. Vignatiová, Břeclav-Pohansko II. Slovanské osídlení jižního předhradí (Brno 1992).

Žemlička 1996 – J. Žemlička, Entstehung und Entfaltung der Marktorganisation in Böhmen und Mähren, In: Hausbau und Raumstruktur früher Städte in Ostmitteleuropa, Pam. Arch. – Supplementum 6 (Praha 1996) 17–27.

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