

Early Medieval castle of Libice nad Cidlinou, large or small hinterland?

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1. Introduction

Early medieval strongholds were dominating elements in early medieval society. They usually served as multi-functional centres of political power, administration, trade, religion, military organization, etc. These centres are assumed to have been a major consumers of food (non-productive elite), human labour (construction of fortification) and raw materials. The needs of early medieval strongholds are usually characterised as “*very large*”, but always without any proper context of comparison. The main aim of this paper is an attempt to quantify the needs of the stronghold from the point of view of the natural environment, population size and accessible raw materials.

2. The Agglomeration of Libice

The early medieval stronghold in Libice nad Cidlinou is situated on the confluence of the rivers Labe and Cidlina in the Eastern part of Central Bohemia, 60 km east of Prague. We define the **agglomeration** of Libice as a stronghold and its immediate vicinity. The border of the agglomeration is determinable thanks to the high density of archaeological trenches especially in the cadastre of the modern villages of Libice and Kanin, south and north of the fortified enclosure (Fig. 1). The furthest point on the east is marked out by graves belonging to burial place of Kanin III, and they were situated 1200 m from the fortified area. The most attractive places for settlement were as close as possible to the edges of river terraces. The southern and western surroundings of the enclosure are situated on the river floodplain.

Two settlements have been identified to the south and west (Fig. 2.E, F). Both are situated on small remnants of river terraces that seem to be part of the agglomeration as well (see chapter 7).

The agglomeration, which includes both the enclosure and the non-fortified area with all traces of human activity, especially with settlement and burial grounds,

is considered to have been one complex from the point of view of its needs and production capabilities.

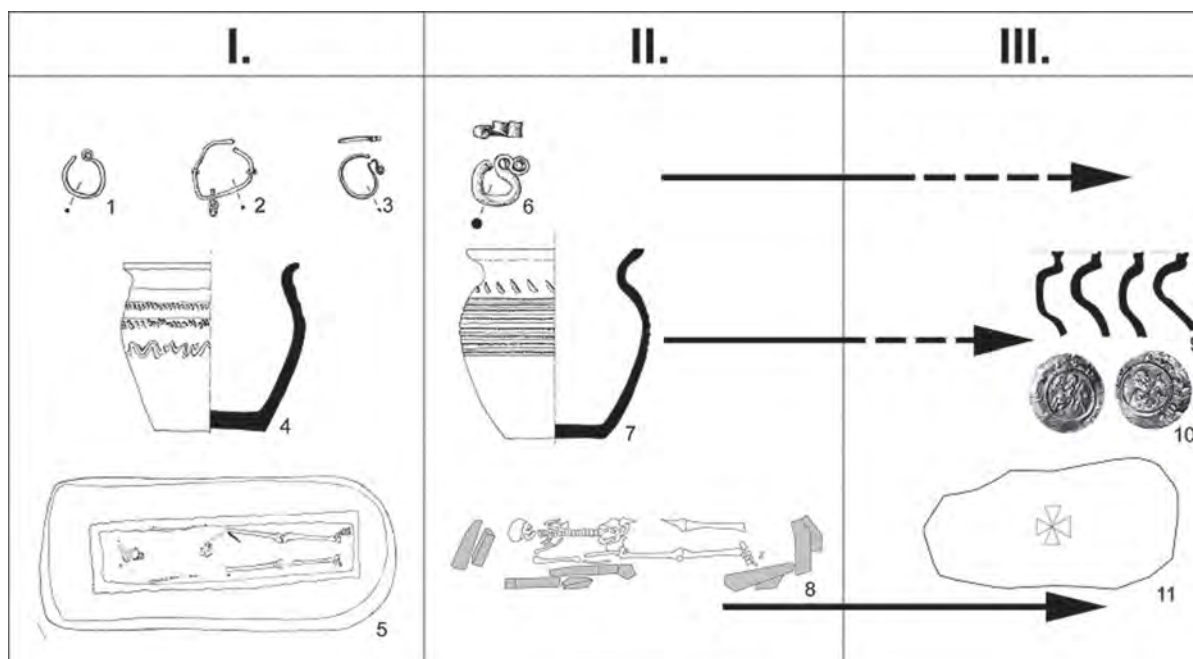
The agglomeration:

1. Inner bailey (fortified), ducal palace, church, burial place, intensively settled area (Fig. 2.A).
2. Outer bailey (fortified), the best explored part of the agglomeration, intensively settled area (Fig. 2.B).
3. Right bank of the Cidlina, prevailing traces of settlement (Fig. 2.C, D) and smaller burial places (Fig. 1.4-7).
4. Left bank of the Cidlina; the largest burial place of the agglomeration (Kanín I-III; Fig. 1.2-3).
5. Two settlements south and west of the enclosure on the river floodplain (Fig. 2.E-F).

3. Natural environment

The fortified area of the enclosure of Libice was situated on two remnants of sand and gravel terraces above the rivers of Cidlina and Elbe. The smaller part of the stronghold, designated only the inner bailey, is completely surrounded by river floodplain, while the larger, outer bailey, is protected by the river floodplain only on the southern side. The modern level of the floodplain is about 4-6 m lower than the ground level of the inner and outer bailey. A detailed geological survey has shown that about 2 m of sediments have accumulated on the alluvial plain since Early Medieval times (HAVRDA 2006).

There have been three archeobotanical analyses aimed at reconstructing the natural environment in the vicinity of stronghold. The description of the early medieval natural conditions on the outer bailey is based on an analysis of the filling of the feature 126 on the outer bailey (ČULÍKOVÁ 1999). Several samples were obtained from sediment in the outer fortification moat (ČULÍKOVÁ 2006, KOZÁKOVÁ/KAPLAN 2006). Pollen analysis of the organic contents of a ceramic vessel from the burial site of Kanín has enlarged our view of natural conditions within the river flood plain



Tab. 1. Distinction of the chronological horizons of the Libice agglomeration.

(POKORNÝ/MAŘÍK 2006). The results of paleoecological analysis allow reconstruction of the landscape around Libice, especially the river-flood plain. The prevailing vegetation was dry to mesic meadows and pastures. The forest was mainly cleared in the surroundings of the stronghold, but not completely. Growing on the banks of rivers and oxbows, near water and on often flooded places, there were willows (*Salix*) and poplars (*Populus*). The forest on higher and dryer levels consisted mainly of oak (*Quercus robur*) and elm (*Ulmus*) with an admixture of hornbeam (*Carpinus betulus*), common maple (*Acer campestre*) and linden (*Tilia cordata* and *T. platyphyllos*). The pollen analysis shows that the AP/NAP ratio was balanced. Pastures and meadows were situated very close to the castle and were continuously changing into forest. The area of the flood plain south of stronghold was probably used for either grazing or hay-making while according to pollen analysis arable land seems to have been situated elsewhere.

4. Historical Background

The first recorded date in the history of Libice is 981: the chronicler Cosmas (d. 1125), wrote that on that date: “*Obiit Zlaunic, pater sancti Adalberti ... ducis metropolis fuit Lubic sita loco, ubi amnis Cidlina nomen perdit suum intrans liberioris aque in fluvium Labe*” (Kosmas, 49). Libice is assumed to have been a centre of the huge domains of the Slavnik family. The extent of the domains, the position of the Slavnik family in early medieval Bohemia and their relation to Přemyslid dukes, especially the degree of their subjugation has

been the subject of a great deal of debate (see SLÁMA 1995; LUTOVSKÝ/PETRÁŇ 2004). The Slavniks' exceptional position in Early Medieval Bohemia is documented by two mints situated in Libice and in Malín (20 km south of Libice), that they ran in the 80s and 90s of the 10th century (LUTOVSKÝ/PETRÁŇ 2004). The rule of the Slavniks family ended on the 28th September 995 when Libice was attacked by the troops of Boleslav II and the members of the family were killed.

During the 11th century Libice became a Přemyslid warden castle, one link in the Přemyslid castle system. Nothing is known of the ducal wardens in Libice during the 11th century. At the beginning of the 12th century Božej of the Vršovci dynasty is mentioned as the warden; together with his son Bořut fell victim to the wrath of Prince Svatopluk in 1108. The last mention of the fortified settlement comes from 1130 and in 1228 Libice reappears in written sources as a village in the ownership of the Benedictine nuns of the Convent of St. George in Prague Castle.

5. History of the archaeological research

The first archaeological excavations were carried out by the amateur archaeologist Jan Hellich, who explored most of the Early Medieval cemeteries and some parts of the settlement in the agglomeration of Libice at the end of the 19th century. Research at the inner bailey started under the direction of Rudolf Turek after WW II. Excavations here uncovered the remains of a church, cemetery and ducal palace in the inner bailey. This research was finished in 1973 and its

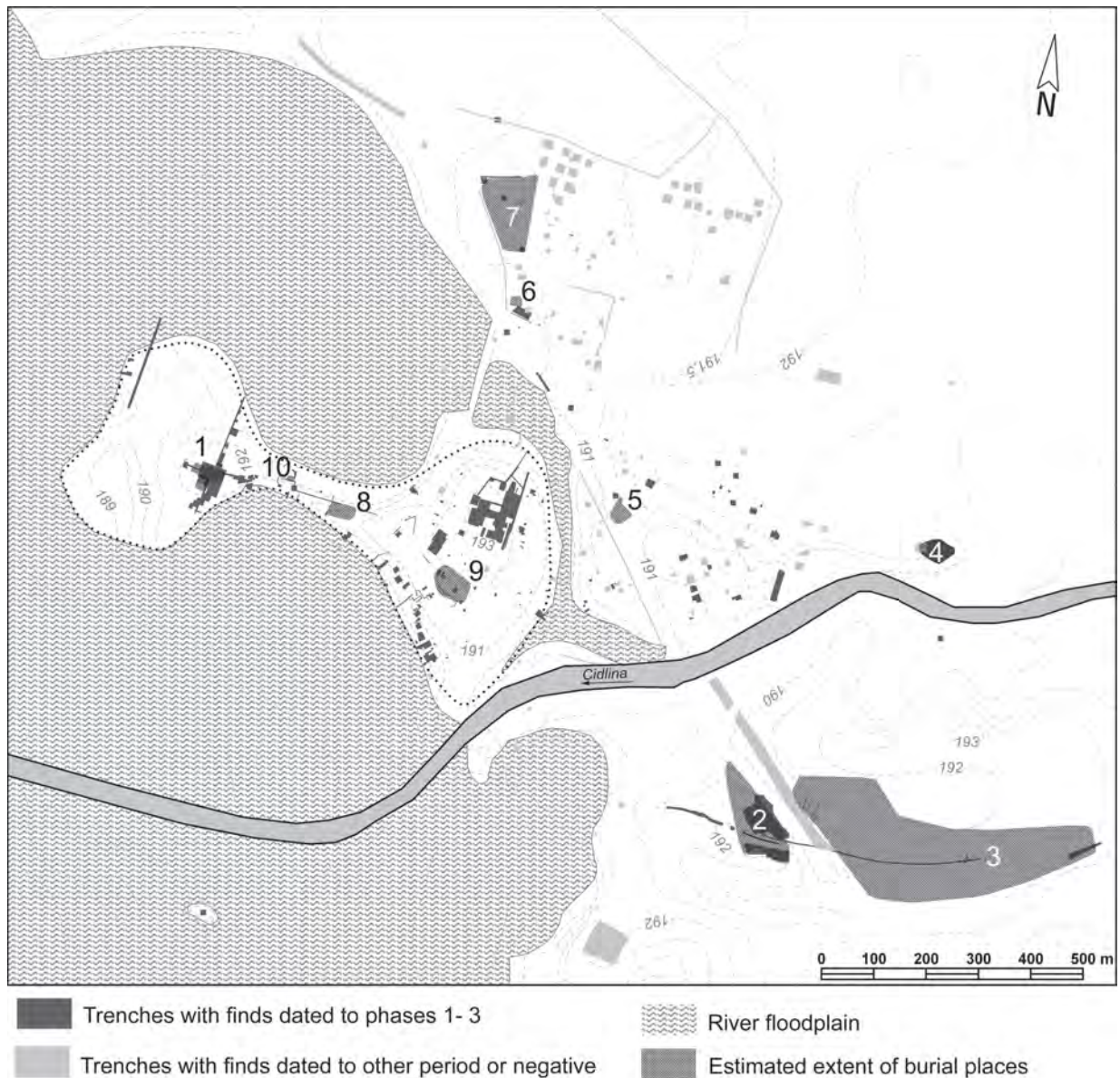


Fig. 1. The agglomeration of Libice.

results were published in part (TUREK 1966-68, 1976, 1978, 1981). Archaeological excavations inside the area of the outer bailey and the rest of modern village of Libice have been underway since 1974. Most of them have been rescue excavations preceding construction of new buildings (PRINCOVÁ 1980, 1985, 1990). The network of these excavations is dense enough to allow us to identify settled and unsettled areas and the extent of burial grounds in the vicinity of the agglomeration.

6. Chronology

The relative dating of archaeological finds from Libice is based on very well stratified finds of pottery (PRINCOVÁ/MAŘÍK 2006) and on collections of the

grave equipments. The development of Libice is divided into 3 chronological phases (Tab. 1).

Phase I (Middle 'hillfort' period)

The beginnings of the early medieval centre at the Libice agglomeration reach back to as far as the turn of the 10th century. This dating is based mainly on richly equipped graves with jewellery influenced by late Greater Moravian production (Tab. 1.2). The typical pottery of this period is decorated by diagonal combed stitches and combed wavy lines (Tab. 1.4). Traces of settlement have been recorded on the right bank of Cidlina, at the inner and outer bailey. However the existence of fortifications is unclear (MAŘÍK 2006). Layers dated to the Phase I of the period were found in most of the trenches on the

Tab. 2. Libice – agglomeration, burial places. Review of excavated graves and estimation of the real size of burial places.

Site Nb.	Site	Phase	Excavated graves - number of individuals	Estimated area of a burial place (m ²)	Estimated total number of individuals
1	Akropole	I	500 (phase I - III)	355	175
1	Akropole	I - II	500 (phase I - III)	443	552
2 - 3	Kanín	I - II	230	51898	2706
4	U cukrovaru	I - II	82	2200	82
5	U nádraží	II	53	1819	62
6	Na růžku	I	12	611	12
7	Katolický a ev. hřbitov	I - II	3	9100	352
8	Ke hradišti	III	22	1778	426
9	Katolická fara	III	5	2183	1024
10	Evangelická fara	III	2	288	44

Tab. 3. Libice – agglomeration. Estimation of the population size of the agglomeration.

I. phase (875/900 - 930/950)	II. phase (930/950 - 1000)	III. phase (1000 - 1130)
Akropole (site 1) 49 - 123	58 - 64	
Kanín (site 2-3) 454 - 730		
U cukrovaru (site 4) 14 - 22		
	U nádraží (site 5) 16 - 33	
Na růžku (site 6) 3 - 11		
Katolický a ev. hřbitov (site 7) 59 - 95		
		Ke hradišti (site 8) 69 - 88
		Katolická fara (site 9) 165 - 213
		Evangelická fara (site 10) 7 - 9
579 - 981	601 - 944	299 - 374

Tab. 4. Libice – agglomeration. Estimation of an area of arable land.

	minimal	middle	maximal
	0,2 ha/ person (Gunilla/Olsson 1991)	0,825 ha/ person (Kudrnáč 1962)	3 ha/ person (Dzieduszycka 1985)
I - II Phase	120 ha	639 ha	2850 ha
III Phase	60 ha	276 ha	1110 ha

Tab. 5. Libice – agglomeration. Estimation of an area of the clear cut forest needed for construction of rampart and houses in the first and the second phase.

	I - II Phase	
Number of households	66	158
187 m ³ /ha (Lapes/Sommer 1996)	39 ha	48 ha
300 m ³ /ha (Dzieduszycki 1977)	24 ha	30 ha
700 m ³ /ha (Schwappach 1943)	10 ha	11 ha

Tab. 6. Libice – agglomeration. Estimation of homesteads during the first and the second phase.

I - II Phase						
	Minimalist model 66 households		Middle model - 112 households		Maximalist model – 158 households	
Firewood	6 m ³ / household (Labes/ Sommer 1996)	79 ha	10 m ³ / household (Labes/ Sommer 1996)	224 ha	20 m ³ / household (Pleinerová 1986)	632 ha
Construction	8 m ³ / household (Dzieduszycki 1977)	5 ha	9 m ³ / household (Labes/ Sommer 1996)	10 ha	15 m ³ / household (Dreslerová 1996)	24 ha
Total		84 ha		234 ha		656 ha

Tab. 7. Libice – agglomeration. Estimation of homesteads during the third phase.

III Phase						
	minimal - 50 households		middle - 71 households		maximum model – 92 households	
Firewood	6 m ³ / household Labes/Sommer 1996)	60 ha	10 m ³ / household (Labes/ Sommer 1996)	142 ha	20 m ³ / household (Pleinerová 1986)	276 ha
Construction	8 m ³ / household (Dzieduszycki 1977)	4 ha	9 m ³ / household (Labes/ Sommer 1996)	6 ha	15 m ³ / household (Dreslerová 1996)	2 ha
Total		64 ha		148 ha		278 ha

southern edge of the outer bailey, but only in trench 2 they could be identified as remains of fortification (PRINCOVÁ/MAŘÍK 2006).

Phase II (Later 'hillfort' period)

Significant for the late 'hillfort' period is the occurrence of so-called '*pottery of the Slavnik phase*' (PRINCOVÁ 1994). The typical decoration of this pottery consisted of horizontal lines on the two upper thirds of the pots and a simple or combed wavy line as well as one row of diagonal combed stitches lines under the rim (Tab. 1.7). It is made of very sandy material with a high admixture of mica. The typical colour is dark red to red-brown. In terms of dating this pottery is not absolutely restricted to the period of Slavniks rule. The beginning can be synchronized with chalice-shape rim pottery from the Central Bohemia, dated *post quem* in the first third to half of the 10th century, and it holds the line until the turn of the 11th century. A conspicuous change has been recorded at the inner bailey, where the burial place of a previous period was covered by a levelling layer, into which a church, ducal palace and several other buildings were set. The fortification of the baileys shows two phases of destruction dated to this period (MAŘÍK 2006).

Phase III (Later – Terminal 'hillfort' period)

The identification of the Phase III is based more on grave inventories than on settlement finds. The burial grounds outside the fortified area ceased to be used and a new one appeared within the enclosure. This change indicates a fundamental change in burial rite. On the other hand the absolute dating of the settlement finds is more complicated. The so-called '*pottery of the Slavnik phase*' was replaced by pottery

with a rim pulled upwards (Tab. 1.9), typical of the Terminal 'hillfort' period, as early as in the first half of the 12th century (PRINCOVÁ/MAŘÍK 2006).

7. Settlement

The traces of early medieval settlement have been recorded within the enclosure (inner and outer bailey) and on the right bank of Cidlina. Libice is one of the best archaeologically explored Early Medieval centres in the Czech Republic. An area of 11 000 m² has been excavated in the outer bailey and about 5 000 m² in the inner bailey (KOŠTA 2006). The relatively even network of 93 trenches in the outer bailey as well as aerial photographs of the inner bailey show that the whole fortified area was settled very intensively (Fig. 1). It is still impossible, however, to say anything about the spatial organization of this area. The prevailing finds are sunken features of oval or irregular shape, the function of which are in most cases obscure.

About 20 000 m² have also been monitored on the right bank of Cidlina and only one third of trenches have brought a positive record of early medieval settlement. The difference between the enclosure and the right bank of Cidlina is also clear from the density of sunken features. While about 1800 sunken features have been found on the 11 000 m² of excavated area of the enclosure, there are only 55 sunken features in trenches with a positive record (2700 m²) on the right bank of the Cidlina. Trenches with negative evidence are very important for defining the size of the settlement. There are two concentrations of settlement traces north-east and north of the outer bailey (Fig. 2.C, D). Both were situated as close as possible to the edge of the river terrace.

Although there has not yet been any archaeological excavation on the flood plain and there are fewer grounds for predicating the existence of a settlement, identification of any human activity in this area is hampered by a 2 m thick layer of recent sediments. There are two sites situated on small remains of the river terrace south and north of the enclosure.

They both probably had functions different from the settlement on the right bank of Cidlina. These may have been connected with activities in the flood plain (hay making, pasture), though some military function cannot be excluded.

8. Population

8.1 Burial places

There are ten locations with evidence of early medieval burial activity within the fortified enclosure and in its close environs (Fig. 1.1-10). Burial places in the vicinity of the fortified area of Libice castle and the results of their excavation to date them offer quite a complete picture. Thanks to the very high density of archaeological trenches in the agglomeration it has been possible to define the position and size of nearly all of the cemeteries and to try to estimate the population of early medieval Libice (MAŘÍK 2005).

8.2 Population of Libice

The population size is calculated using formula introduced by ACSÁDI/NEMESKERY (1970)

$$\text{Population size} = \frac{\text{(Life expectancy at birth)} \times \text{number of buried individuals}}{\text{time}}$$

The number of individuals buried is calculated from the hypothetical original size of the burial places and the density of graves per m². There is the only one completely excavated cemetery inside the agglomeration of Libice, the site “*U cukrovaru*” (Fig. 1.4). In the case of partly excavated burial places, their original size has been reconstructed on the basis of nearby trenches with negative evidence. Non-destructive methods were also used, such as geophysical survey and aerial photographs of the Kanín burial ground (Fig. 1.2-3).

It is assumed that the spatial organization of a burial ground is regular throughout the whole area. This assumption was tested on all excavated burial grounds in the agglomeration. A distinct difference emerged between the burial grounds inside the enclosure and in the rest of the agglomeration (Tab. 1). The median of the density of all excavated parts in the vicinity of the enclosure is 0.035 individuals per m², while the average density of buried individuals is nearly

ten times higher in the cemetery in inner bailey (0.35 individuals per m²).

8.3 The life expectancy at birth

The population life expectancy at birth could be ascertained by anthropological analysis of skeletons from modern excavations. Two analyses have been carried out in Kanín (27 years) (BLAJEROVÁ 1985) and at the inner bailey (21 years) (HANÁKOVÁ 1969). The two figures do not differ strikingly from the average for prehistoric and early medieval communities (NEUSTUPNÝ 1983).

8.4 Time

Although the burial places are very convenient for the Libices chronology, their absolute dating is still problematic. For each phase an earlier and later limit was established; nearly every burial place was also used for more than one phase and there were many graves without any dating material on the burial places (Tab. 3). The population of those burial places had to be calculated as average for both phases without any chance of detecting the dynamics of their development.

8.5 Population size

The method used to estimate the population gives only approximate values, because chronology is not precise and the latest burial grounds in particular (the third phase are in a poor state of preservation as well as hard to map in terms of boundaries. We therefore did not attempt a detailed calculation of „missing” children (NEUSTUPNÝ 1983) or precise estimates of adults and juveniles in the community. The estimated extent of the unexcavated or destroyed parts of burial places is based on assumption of regular spatial organization of graves within the whole area. It sets a maximum of buried individuals and upper limit of calculated population size must be regarded as an absolute maximum too. In my own view the lower limits of the calculations are closer to reality. The number of inhabitants of the whole agglomeration during the first and the second phase was 600-950, while the population in the third phase rapidly decreased (300-370 of inhabitants). It is a change reflected in the abandonment of burial grounds outside the fortified area, but our knowledge about the burials in the third phase is very poor and the degree of change requires further research.

The population size was calculated for each burial ground separately, to give a view on the communities that used the burial ground. The largest were the burial grounds near Kanín (454-730 inhabitants in phases I and II), for a settlement that could have been situated only within the fortified area. The cemetery at the inner

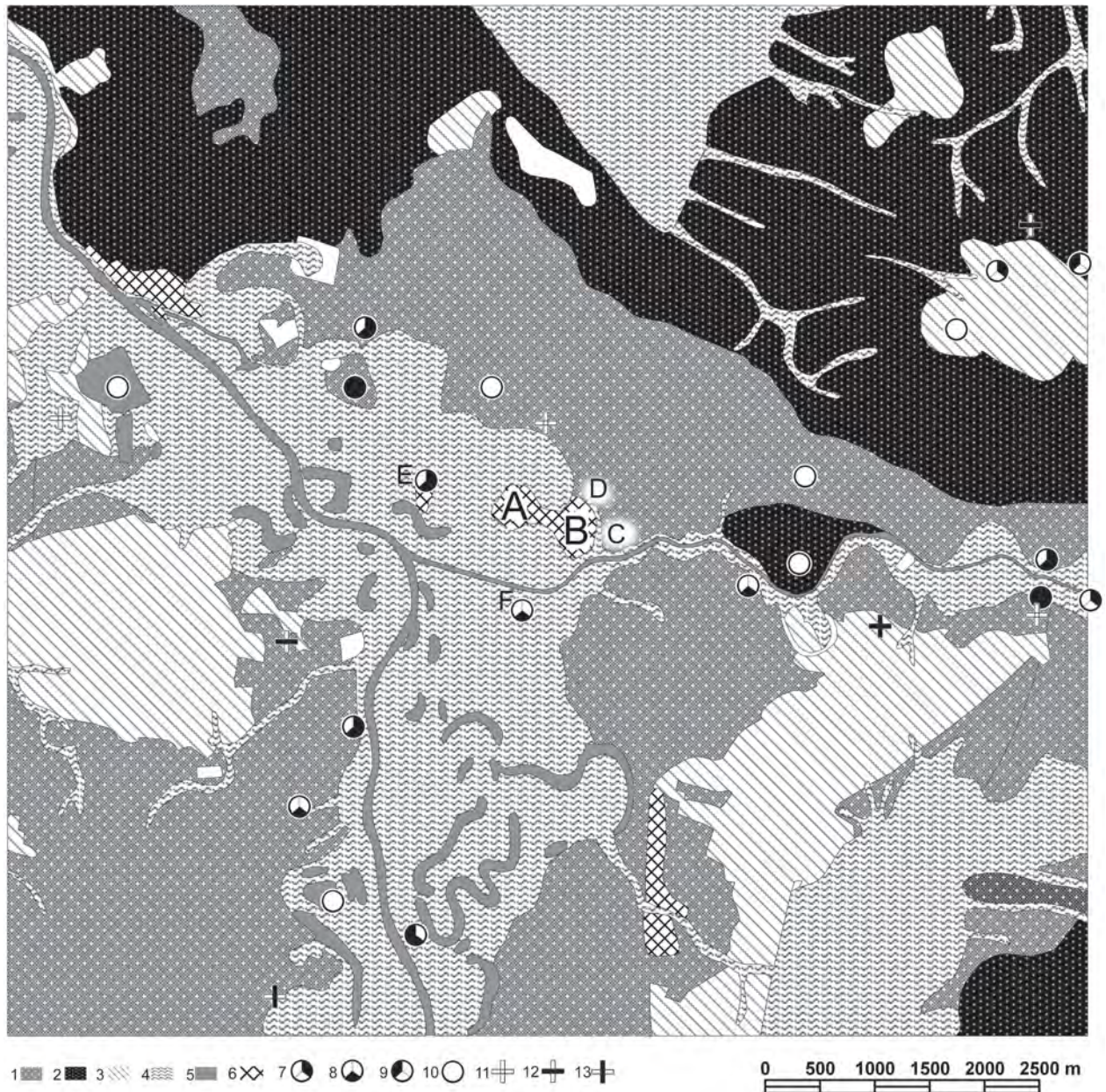


Fig 2. Libice and its surrounding on the background of pedological map. 1 – brown sandy soil; 2 – black soil; 3 – gley soils, podzolic soils; 4 – floodplain deposits; 5 – water and oxbows; 6 – recently damaged; 7 – Middle ‘hillfort’ period settlement; 8 – Later ‘hillfort’ period settlement; 9 – Later - Terminal ‘hillfort’ period settlement, 10 – ‘hillfort’ period settlement; 11 – hillfort period burial place; 12 – Middle ‘hillfort’ period burial place; 13 – Later ‘hillfort’ period burial place.

bailey was probably destined for a particular group in this society, since status is indicated not only by the rich equipment of the graves, but also by the position of the cemetery itself. As regards the rest of the society living in the agglomeration, the people who used to bury their relatives in the immediate vicinity of their dwellings had completely different perception of the world of the dead. Smaller burial places on the right bank of Cidlina (Fig. 1.4-6) were used by communities they did not exceed a population of 30 inhabitants. Only Site 7 (Fig. 1) may have been larger, but the quality of archaeological sources is very low in

this case and most of the burials were found in the 19th century. This means that the estimated size of the burial ground is only an upper limit and the real number of graves probably lower.

9. Landscape and its economic potential

9.1 The agrarian landscape

The reconstruction of agrarian landscape is based on paleobotanical and geological studies (see chapter 3).

The natural environment of the agglomeration was divided in three parts:

1. Within the enclosure with its intensive traces of settlement we can assume the strong impact of human activity; this can be regarded as a place of consumption. The paleobotanical analyses from the outer bailey (ČULÍKOVÁ 1999) suggest the existence of gardens, where some vegetable and fruit may have been grown.
2. Pollen analyses show that the river floodplain was covered by dry to mesic meadows and pastures. The forest was not completely chopped down and the pasture took place on meadows as well as in the forest. Unfortunately our knowledge on livestock breeding is not sufficient to allow us to estimate the proportion of food production that it represented.
3. The dryer and higher situated places on the river terraces north of the agglomeration and southeast on the left bank of Cidlina in the neighbourhood of burial places of Kanín. This area covered by sandy light brown soil and black soil was probably arable land.

9.2 Arable land and production

The capacity of fields to satisfy the need for cereals is influenced by several factors: seed return, yield per hectare, average consumption per head. These three factors are used as a basis for the calculation of the amount of permanently arable land necessary for subsistence of the community. The estimate of the amount needed to support one person range between 0.2-3 ha (Tab. 4). The divergence is caused by each author taking different views of the factors mentioned above.

The lower estimates reflect an optimistic figure on seed return 4-8 (GUNILLA/OLSSON 1991), while usual assumption is that only 3 corns returned from one (GOETZ 2005, 230-231; KUDRNÁČ 1962, 1958). The upper limit 3 ha proposed by B. DZIEDUSZYCKA (1985) estimates 2 ha for cereals production and 1 ha for legume. She also assumes very high annual requirements for cereals (278.9 kg) per person. While for example E. NEUSTUPNÝ and Z. DVOŘÁK (1983) specified the maximum consumption of 240 kg only where cereals were the sole source of food. The lowest estimate of consumption per head – E. GUNILA and A. OLSSON (1991) – is only 65.4 kg.

9.3 The wood and forest

Wood played a very important role in the early medieval economy as an essential raw material. The range of applications of timber was very wide: as building material for fortifications and houses, fuel in households, pottery firing and metallurgy. Our estimates are focused on the construction of houses and fortification and on the firewood in households. Although archaeological research has shown that there was iron-smelting and refining of silver and gold within

the agglomeration and probably the firing of pottery as well, it is impossible to determinate the volume of these activities.

Reconstruction of early medieval forest in the Libice vicinity on the basis of the paleobotanical analyses mentioned above, offers only a quite general characterization of hornbeam-oak wood on dryer places and marsh alder carr in the inundated areas. The mosaic of meadows and pastures merged in the immediate vicinity of the enclosure into pasture forest and natural forest.

9.4 Fortification

The fortification of the enclosure has been the subject of archaeological research on several occasions, but precise reconstruction is still impossible, because of insufficient publication as well as the poor state of preservation (MAŘÍK 2006). The rampart was built of loam with wooden reinforcement, the front and probably also the inner side were covered by stone packing. The rampart was approximately 10 m wide (TUREK 1966-68) and 2 846 m long. The height of this type of construction was according to structural calculations around 4-5 m (PROCHÁZKA 1986; PAVLIS 1978) and the total volume 93 918 m³. The proportion of wood used in this type of fortification did not exceed 7 % of the total volume – 6 574 m³ (PROCHÁZKA 1986), which required 9-15 hectares of forest – an area that had to be cut down in a very short time (Tab. 5). There have been recorded maximally two phases of fortification in Libice enclosure that could not be dated earlier than in the phase I or II (Tab. 1) and that is why the calculation of requirement on construction wood are made only for those two periods.

9.5 Houses and firewood

Despite very intense archaeological research, we know very little about the appearance of the early medieval houses in Libice. Only 8-10 sunken dwellings have been recorded (PRINCOVÁ/MAŘÍK 2006). The absence of more evidence suggests that houses were timbered and built on the surface, thus leaving no traces. For timbered houses in Gross Raden S. LABES und U. SOMMER (1996) estimate that construction 9 m³. W. DZIEDUSZYCKI (1977) estimates 8 m³ for houses in Kruzswica. Taking into consideration the fact that the wood was used not only for the house but also for outbuildings, we accept the higher level of the further calculations the 15 m³ calculated by D. DRESLEROVÁ (1996), which also includes construction of fences and other farm buildings. If we suppose that there was one family (4-6 members) in one homestead, it is possible to reach an estimate of 66-158 homesteads (Tab. 5, 6) in the agglomeration during the first and the second phase and 50-92 in the third phase (Tab. 7).

In addition to timber for building, every household needed a large amount of firewood. Some experiments have shown that 6-10 m³ (LABES/SOMMER 1996) up to 20 m³ (PLEINEROVÁ 1986) of wood were burnt in a single household yearly.

9. 6 Timber resources and wood management

Wood requirement can be divided into two groups. Major constructions like fortification or the building of several houses in the same time had more impact on the forest and could be close to clear cutting. However archaeological excavations have shown that timber harvesting was selective, orientated to tree trunks with a diameter of 17-28 cm (PROCHÁZKA 1986), and in the specific case of Libice it was about 17 cm (TUREK 1966-68). The most convenient and the most frequently employed building material was oak (PROCHÁZKA 1986, see BEHRE 1983). The timber reserve of an oak forest is conditioned by the age of the forest, height of the trees and crop density. Modern data shows that it can be harvested up to 700 m³ per ha (SCHWAPPACH 1943). S. LABES und U. SOMMER (1996) estimate the timber production at 187 m³ per hectare and W. DZIEDUSZICKI (1977) at 300 m³ per ha. Although the sources for the two estimates are not explained in detail, considering the modern data and selective timber harvesting they can be accepted as realistic. The forest and its timber resources were probably intact in the time of foundation of the stronghold. A distinct growth of the settlement in the agglomeration is associated with the beginnings of the castle in the middle hillfort period and traces of the previous settlement were sporadic in the Early „Hillfort Period” (mid- 7th to 8th centuries).

The second category of necessary timber for the agglomeration is firewood and probably construction wood for repairs. These demands did not require extensive timber harvesting. Forest management based on coppicing and pollarding has been documented since the Neolithic period (RÖSCH 1990; see DRESLEROVÁ/SÁDLO 2000) and there is no reason to believe it was not practised in the early medieval agglomeration of Libice. The annual yield of coppiced wood is higher than the high forest (MÍCHAL/PETŘÍČEK 1999). Depending in an interval of clearance this kind of woodland management is able to produce different types of timber, 5-6 year-wood for firewood, 20 year-wood for charcoal and straight trunks for building work (LABES/SOMMER 1996). The annual yield from the recent coppiced oak forest is 5 m³ per ha (VYSKOT 1958, 200). If we assume that this woodland management covered demands for firewood and part of the construction wood necessary for renovations (every 20 years), the coppiced forest had to cover 84-656 ha in the phases I, II and 64-278 ha in the phase III (Tab. 6, 7).

10. Three models

The data estimated and calculated for the Libice agglomeration specify the hypothetical demands of the population and the capacity of the natural resources to satisfy them. The required areas were measured within the buffer zones created around the fortified area on the digital map of the Libice agglomeration with help of GIS software Geomedia Professional 6.0. Three buffers were made for each model. Arable land was measured on brown sandy soils and black soils (gley soils, podzolic soils and floodplain deposits were excluded), clear-cut forest within the whole buffer and renewable coppiced forest on the river floodplain. The buffer zone is an artificial geometric figure bounding an area in a given distance around the fortification of the enclosure, which makes it easy to measure irregular areas.

The differences between the upper limits of the estimates (in some cases as much as ten times) have led us to construct three spatial models. The maximalist model shows the highest possible requirements of maximum population (950 persons I-II phase, Fig. VIII.A; 370 persons III phase, Fig. VIII.D) with the worst variant of agricultural production and timber resources. On the other hand, the minimalist model assumes the best harvest for the lowest limit of population (600 persons I-II phase, Fig. VIII.C; 300 persons III phase, Fig. VIII.F). These two models represent the boundaries of possible speculations about size of economic hinterland, but they are not close to reality. For this reason a third „middle model” was created. The middle variable value for estimate of arable land has been used the J. KUDRNÁČ (1962), the calculation and the average population size for each phase (Tab. 4). The medium extent of the coppiced forest has been calculated using the arithmetic mean between maximum and minimum households within the agglomeration. Two sets of each model were created. The first set is applicable for the first and second phase together, because the population size in the two periods differed only minimally (Fig. VIII.A-C). The second set is valid for the third phase (Fig. VIII.D-F).

There are also some settlements in the vicinity of the enclosure with arable land inside the created buffers. This area has to be excluded from the calculations and measurements. The detailed research on micro-regions of early medieval sites has proved that the arable land was situated up to 300-500 m from the sites (GUNILLA/OLSSON 1991) and the complete site catchment does not exceed 2000 m (GUNILLA/OLSSON 1991; DULINICZ 1991; BEHRE/KUČAN 1994).

The estimate of timber resources shows in each model that the requirements of the agglomeration could be satisfied in its vicinity and transport of timber

from further distances was not necessary. This finding seems also to be in line with the results of paleobotanical analysis. The fact that the most distant fields are situated 4.2 km suggests that the most cereal production could take place in the vicinity of the agglomeration and some smaller part was dependent on settlements forming the economical hinterland of the agglomeration.

Not a single one of these three models is a reconstruction of the past reality, because many factors that could influence the results have not been taken into consideration. Higher-ranking members of society as well as some groups of specialised craftsmen did not take the same part on agricultural production as the rest of the community. Furthermore trade, which indubitably strongly influenced the life of Libice, is not part of the calculations. All the three models simply try to define the boundaries of further thinking about the economy of centres like Libice.

11. Conclusions

This paper makes an attempt to quantify the demands of the agglomeration of early medieval castle in Libice on agricultural production and timber resources. The basis of the estimates is population size calculated according to the results of archaeological excavations of burial grounds. The population size of the agglomeration of Libice has been estimated for three phases (Middle, Later and Later - Terminal 'hillfort' period). It ranged between 600-900 inhabitants during the first and second phase while a distinct

change has been recorded in the third phase when the population decreased to 300-370 inhabitants.

The further calculations of requirements focused on estimate of the amount of arable land needed to ensure the subsistence of the agglomeration. The estimate of the timber requirement assumes that the construction wood for fortification and houses were obtained by clear-cut, while the firewood and construction wood for repairs came from coppiced forest. Absence of sufficient data means that the estimate does not include a figure for pastures or the volume of wood needed for pottery, firing and metallurgy.

Spatial models have been produced showing the maximum, middle and minimum territory needed to supply the agglomeration requirements. None of these models is meant as a reconstruction of a past reality, but as an attempt to define the limits of further thinking about the economy of Early Medieval centres.

The maximalist model for the first and for the second period could go as far as 4.2 km behind the fortification. The models have shown that requirements on arable land and cereal production were not exaggerated and the most of them could be satisfied in the vicinity of the agglomeration. The calculations of timber resources and the timber consumption (in every model less than the calculations for arable land) show these to be relatively balanced with no need for transport of timber from further away.

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