Identification of workshop activities by use-wear analysis: Antler processing at Zlechov-Padělky (South Moravia) in the Late Roman period

Traseologická identifikace dílenských aktivit Zpracování parohoviny na sídlišti Zlechov-Padělky (okr. Uherské Hradiště) v pozdní době římské

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Settlement features containing raw antler material at various stages of manufacturing are not uncommon in Germanic settlements. However, their connection with craft production and subsequent interpretation as workshops producing antler objects are often inferred a priori, without being based on a deeper analysis. Many years of research into a Germanic settlement from the late Roman period and the beginning of the Migration period at the Zlechov-Padělky site (Uherské Hradiště district), carried out in the second half of the 20th century, revealed several possible workshop features for the processing of antler material. The antler processing could be mainly related to the production of compound antler combs, which were typical during this period. Use-wear analyses supported by the results of a manufacturing experiment allowed us to base such interpretations on objective data. After evaluating aspects of the production process, it is possible to compare the Zlechov features with similar finding situations from other settlements of the studied period. This helps to clarify the degree of the organisation of production and distribution of compound antler combs in the 4th and 5th centuries in the barbarian territory.

use-wear analysis – antler technology – Roman period – craftsman workshops – combs

Sídlištní objekty obsahující parohovou surovinu v různých fázích zpracování nejsou zcela neobvyklým jevem na germánských sídlištích. Jejich spojení s řemeslnou výrobou a následné interpretace jako dílny produkující parohové předměty jsou však často apriorní, aniž by byly podloženy hlubší analýzou. Dlouholetý výzkum germánského sídliště z pozdní doby římské a počátku stěhování národů v poloze Zlechov-Padělky na jižní Moravě, realizovaný v 2. polovině 20. století, odkryl hned několik možných dílenských objektů na zpracování parohového materiálu. Výroba mohla souviset zejména s produkcí složených parohových hřebenů, které jsou pro daná období typické. Využití traseologické analýzy podpořené výsledky výrobního experimentu nám umožnilo opřít podobné interpretace o objektivní data. Po zhodnocení aspektů výrobního procesu je možné zlechovské objekty porovnat s podobnými objekty z jiných sídlišť sledovaného období. To přispívá k objasnění míry organizace výroby a distribuce složených hřebenů v horizontu 4. a 5. století na území barbarika.

traseologie – zpracování parohoviny – doba římská – dílenské areály – hřebeny

Introduction

The identification of workshop premises, not only those of antler processing, is limited in terms of the informative value of the context in which they are found. Production tools did not always have to be specialised or functionally and morphologically distinct from tools of unspecialised daily use. Production did not necessarily require specifically adapted premises. Different phases of the production could have taken place gradually at several locations, and their identification in settlement deposition could be uncertain. Production

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zones could have been subjected to more or less regular and careful waste removal. Among the few clues are findings of raw materials, product preforms (semi-finished products), and production waste, which can help identify possible specialised production (*Hrnčiarik 2017*, 24). If the semi-finished products and production waste are materially homogeneous, it is possible to assume that specialised production took place in the zone or settlement feature. However, such an indication can only be confirmed by use-wear analysis combined with experimental verification of the origin of specific traces (*Costin 1991*, 20). This methodological approach demonstrably identifies and visually documents whether manufacturing traces are present, what tools caused these traces, whether manufacturing was steady in terms of techniques, the range of tools used, and manifestations of the manufacturers' routine experience. As such, this approach provides objective, validated data on which it is then possible to reliably base the interpretation of the collection or even the site.

In terms of the complexity of production organisation, various theoretical models are available (*Leeuw 1977*; *Peacock 1982*), but they are usually valid for societies with more pronounced economic stratification, in which there were complex control mechanisms of production, transport, and distribution asserted by the so-called elite (*Costin 1991*; *Rice 1981*). We cannot prove such a degree of social organisation and control at most known sites in case of the Germanic societies of Central Europe (*Szpondowski 2017*, 44–64; *Szabová 2019*, 78–79, 99–102; *Březinová – Hrnčiarik 2021*, 128–129). It would be speculative to transfer theoretical models based on the complexity of La Tène (*Thér – Mangel 2014*, 15–16) or (early) medieval societies (*Hodges 1982*, 13–20; *Hodges 2000*, 76–88; *Macháček 2005*, 451–455) to Germanic society. Even in above mentioned more complex societies, the models were built for the processing of another raw-materials. Antler working were not analysed in sufficient degree to require data for such model. Moreover, available excavation documentation of the Zlechov site is lacking in sufficient details in many cases. A more detailed distinction of the production organisation than the division into home and craft production is not objectively possible on the basis of available data in the context of the studied site.

We consider a proper craftsman workshop to be a space-limited unit in which some systematic specialised production activity took place. Here, "specialised" is used in a technical sense; i.e., the routine use of specific manufacturing techniques with specific tools, regardless of the variability of products, which may or may not be of the same type, purpose, and form. The "workshop" is considered as archaeologically detectable manifestation of the realisation of craft (or workshop) production. A necessary precondition for factual craft production is considerable standardisation, the use of a steady set of specialised tools, and proven subsequent distribution. The standardisation of production is reflected in the use of steady technical solutions and technological procedures (*Thér – Mangel 2014*, 13), steady visual forms or patterns for individual types of products, and routine patterns of the solution of the situations, when defects or limits of raw material are encountered. Without a clear distribution of products outside the household or community – i.e., the sale of products, where the producer uses the exchange as at least a partial source of livelihood (*Costin 1991*, 4) – no craft production is justified and so inevitably disappears from an economic point of view. There could be symbolic reasons for specialised craft production, the products of which are not distributed but are handled in a different way (for example, by deposition or destruction), but even these require a certain motivation or social order.

Home production may show some but not all of the above parameters. Home production does not have a distribution network, and usually involves commonly available non-specialised tools that have universal use (e.g., a knife). Such products may show certain features of routine mastery of material processing techniques, but not features of routine solution of specific tasks. Moreover, home production is small in scale. That is, it is characterised by low waste generation and minimal occurrence of unused semi-finished products. There may be worn products of this production; i.e., products that have been put into use after their production at that place, in the collection of artefacts from the site.

It is always necessary to identify (by use-wear analysis) the traces of production and a steady production chain, including the use of the routine procedures, the same type of tools, etc. Craft or workshop production should be distinguished from occasional home production, which usually lacks these parameters. Insufficient evidence of this can lead to over-interpretation, when the mere accumulation of artefacts is interpreted to be a workshop, although it does not have workshop or craft characteristics. A specific problem with workshop identification is the situation when production waste from the manufacturing activity zone was regularly removed and entered into the accumulations of common settlement waste, which included butchering or kitchen bone waste. In this case, the identification of a workshop may be limited on the other side; even real workshops are not identified as workshops because the use-wear analysis is not systematically applied to settlement waste (*Choyke 2012*, 337). Moreover, settlement features interpreted as workshops are usually published only in the form of preliminary reports, brief general mentions in the text, or a selection table with drawings or photos of the most important artefacts found, without presenting the complete findings. Current knowledge of comb-making workshops or zones in Germanic settlements in Central Europe is thus disturbed by the amount of data with uncertain validity. It is thus possible to present only a brief overview of the findings published so far on this production activity, without the possibility of a review of their justification and presented conclusions. So far, no detailed or partial microscopic (high-power) use-wear analysis of the following workshop areas or their relics has been published.

Besides the Zlechov site, more intensive activities aimed at the comb-production were documented in the settlement at Držovice, near Prostějov, from the late Roman period (*Konečný 2019*). Both untreated and partially processed raw materials, as well as cut and smoothed comb plates, were found in six sunken houses. Some of the findings were overburnt, which may indicate waste accumulation, rather than a workshop. Only individual finds of semi-finished products of arched comb handles came from the cultural layer of the settlement in Vlčnov-Dolní Němčí (*Droberjar 1988*, 62, tab. 40: 1–2), Moravské Knínice (Accession Book of the Institute of Archeology, Moravian Museum Brno, Pa 37/34), and Mořice (*Peškař 1971*, 20, tab. 22: 2). The accumulation of antler comb plates together with a finished comb from the settlement in Most (*Kučera 1934–1935*) and individual plates from the settlements in Šlotava and Sány (*Motyková-Šneidrová 1964*, 202) are known in the Bohemia. In southwestern Slovakia, raw antler material and semi-finished products of three-part combs with an arc handle were found in a settlement from the Late Roman period at Pobedim (*Kolník 1964*, 264–265, tab. 74). The Nitra-Chrenová settlement site is somewhat better documented (*Březinová – Hrnčiarik 2021*, 122–129, fig. 3–9). Loam-pit feature no. 52/96 was secondarily filled with common settlement waste, which contained a larger amount of antler plates, cuttings, and pieces of raw material with production traces (*Březinová et al. 2003*, 34, tab. 29–30). A similar spectrum of finds came from base groove no. 5/99

and dwelling feature no. 6/99. The findings of a rough preform product of a comb handle and saw (pit no. 36) and a whole comb (dwelling feature no. 38) came from the Ózd settlement site in the Quadian territory of northern Hungary (*Párducz – Korek 1959*, 162, 190, Taf. II: 1, III: 6–7). If we focus on more distant areas, a group of three settlement sites in the Saale region is considered to be a concentration of comb workshops. The supposed workshop from Quenstedt contained over 50 pieces of cut antlers, preforms of arched handles, and a finished comb (*Grimm 1930*, 169, Taf. 18). A complete antler assortment was stored in a semi-sunken house in the Großjen settlement. The assortment included raw material, cut blocks, half-blocks, plates, semi-finished handles, and one finished decorated comb, probably originally in an organic package (*Bicker 1936*, 295, Taf. 64: 2). Only local concentrations of cut deer antlers and semi-finished plates, without any indication of sunken feature ground-plane, were found in Gröbitz (*Schmidt 1967*, 44–45, Abb. 1–2). The cluster of settlements around the central site of Krusza Zamkowa (Inowrocław, Łojewo, Jacewo, Konary, Dobieszewice) in Kujawy is considered to be a workshop agglomeration in the territory of the Przeworsk culture from the Early Roman period. All production phases, from the raw material to the final products, were documented in the production of single-layer combs, needles, game stones, and sticks (*Cofta-Broniewska 1979*, 112, ryc. 6). Settlement feature no. 13 from Przemyśl is considered to be a workshop, based on the fact that all stages of production were documented there to–from raw material and variously cut wedges and semi-finished products to fragments of finished combs, including iron tools for their production (*Koperski 1986*, 105–106, tabl. 1: 4–5, 2–6). A specific finding is known from the Regów (Przeworsk culture settlement), where 551 antlers at various processing stages were laid out in two lines forming area of 25–30 m^2 along the dwelling features (*Brzeziński 1980*, 28–33, 36, ryc. 2–6). Based on a macroscopic comparison of working traces on antler waste from Regów with traces created during the experimental production of antler comb components, such working traces were interpreted as traces from an axe, knife, file, and drill. Similar mass production is evidenced by over 10,000 artefacts from all stages of the production process found in a dwelling feature destroyed by fire at the Slawsko Wielkie site from the 3rd and 4th century (*Bednarczyk 1998*, 74, 77, figs. 89–97). Farther from our studied area, comb workshops were located in the Geto-Dacian territory of the Chernjachov culture. The largest was the Bîrlad-Valea Seacă site in Moldova, where 32 workshops in sunken houses and above-ground structures were identified that had operated throughout the 4th century (*Palade 1966*, 265–275, fig. 5–15; *2004*; *Harhoiu 2005*, 162, Abb. 9A–B). Comb manufactories operated at the Ukrainian site of Velika Snitinka since the end of the 3rd century. A total of 16,500 antler fragments were obtained from five sunken dwellings. Besides several finished combs, they were represented mainly by raw cut material, waste, and 550 semi-finished products at various stages of the production process. The accumulations were accompanied by iron tools, whetstones, and rivet preforms. Along with the combs, antler pyramid pendants were also produced there (*Magomedov 2001*, 101).

When craft production from hard animal materials is assumed, the production of composite combs is most often considered to be a craft, with regard to their visual attractiveness. Although the settlement infrastructure usually offers a wide range of fauna skeletal material that could further be used for the production of bone objects, comb production was based on the processing of the European deer antler (*Cervus elaphus*) in and outside Central Europe (*MacGregor 1985*, 74, *Ashby 2013*, 20; *Cnotliwy 2013*, 165). Apart from

the antlers of European deer, the antlers of roe deer (*Capreolus capreolus*) and the horns of the domestic cattle (*Bos taurus*) are rarely found in the dwellings of Germanic settlements. The production of combs from roe deer antlers is unlikely, due to the structure and dimensions of the antlers, and has not yet been proven. In contrast, the production of combs from cattle horns has been recorded, but only after the protohistoric period (*Carlsson 2004*, 2). In a few cases, more exotic materials have been documented, such as tortoiseshell (Thomas A type comb from grave no. 124 at the Przeworsk culture burial ground in Oblin: *Czarnecka 2001*, 65–66, ryc. 1) and ivory (Roman provincial comb from Lauriaca: *Deringer 1967*, 55–56, fig. 13). At the opposite pole of accessibility are presumed but non-evidenced wooden combs. Antler is more suitable than bone for the production of combs, thanks to a combination of compact and spongious tissue. The components for making composite combs are cut along their long axis across the fibre, where the antler is the most coherent, whereas bone is more brittle and fragile at any point of handling (*MacGregor 1985*, 28). Thus, antlers are generally considered more resistant and harder, yet more flexible than bone (*Petković 1995*, 14). Antlers could be obtained in two ways: by hunting or by collecting those that were shed. The occurrence of deer bones and antler bases was documented at the Zlechov site (*Sůvová et al. 2008*, 170), indicating that the raw material could been obtained in both ways. The antlers could have been collected by the craftsman himself, or they could have been a commodity of exchange or trade (*MacGregor 1985*, 35–36). Antlers that had been shed were previously considered to be of better quality than antlers from hunted game (*Teichert 1983*, 117, 120), but this has not been confirmed in the experiments performed so far (*Nováčková 2021*). Stored whole deer (Zlechov pit no. 15/67) and a roe-deer skeleton (Lipová-Ondrochov – pit no. 86) found in a storage pit were interpreted as possible deposits of meat and antler (*Zeman 2008*, 63, 193, Abb. 28: 3; *Kolník 1962*, 391, fig. 124). Similar depositions could have symbolic connotations, however, as is often assumed in the case of storing whole animals in settlement pits. The current use-wear analysis of 16 composite combs from the studied period, and nine other samples from other phases of the protohistoric and early historical period (*Nováčková 2021*) shows that the antler processing procedures were considerably steady in individual phases of the operating chain. Even the choice of specific working tools, which leave well-distinguishable traces, was steady. The nature of the raw antler material in itself significantly limits the variability of processing approaches. Thus, it is clear that manufacturers adhered to established production processes and visual concepts of the final form during production (*Biró et al. 2012*, 18).

Analysed collection

The Zlechov "Padělky/Močidla" settlement site (Uherské Hradiště district), located northeast of the village of Zlechov (*fig. 1*) in South Moravia, was systematically excavated by Vilém Hrubý between 1964 and 1969. Almost the entire settlement was excavated, consisting of at least two time phases: Germanic and early Slavic. The research identified a total of 432 features, of which the presence of antler at various stages of processing was registered in 43 features, forming a collection of a total of 391 pieces (*Zeman 2008*, 30–41). The findings of raw antler material, preforms, or already finished artefacts were individual in some features, and they can therefore be considered places of use or places of small personal production. Features in which the number of antler artefacts exceeded five pieces

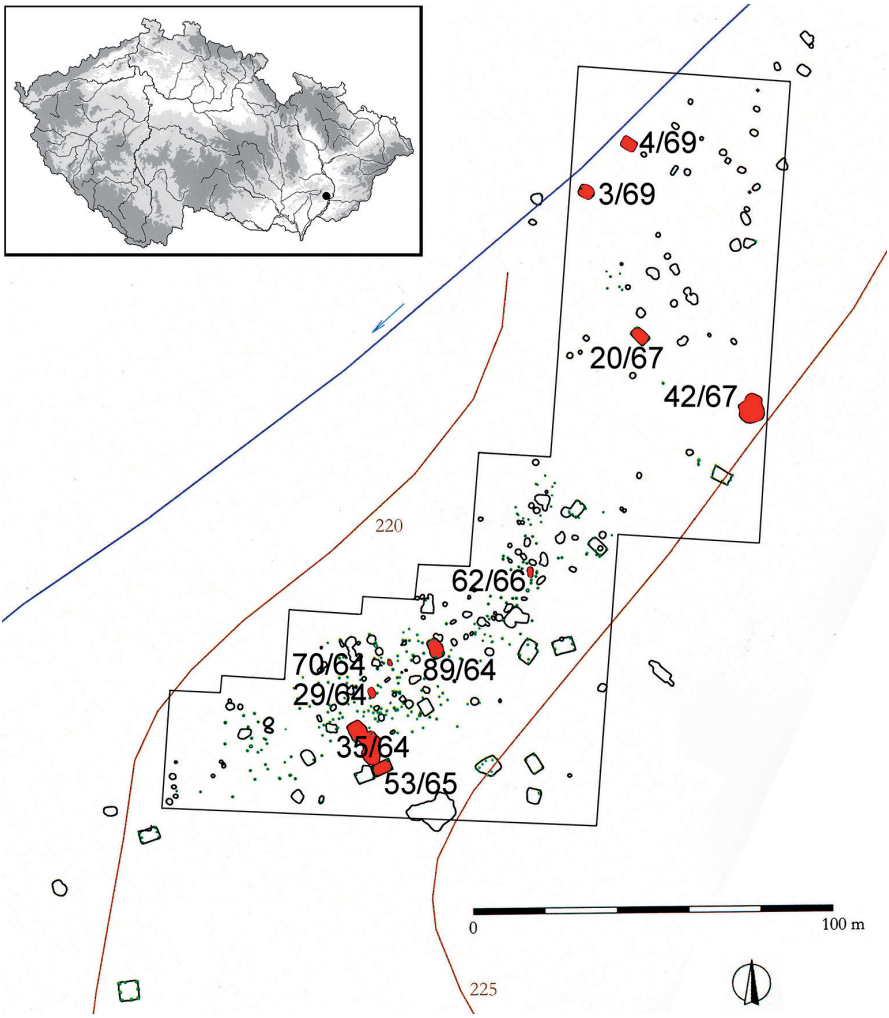

Fig. 1. Plan of the excavated area on site Zlechov-Padělky. Settlement features containing antler artefacts in at least 5 pcs are emphasised.
Obr. 1. Plán exkavované plochy lokality Zlechov-Padělky s vyznačením objektů s výskytem parohových produktů v množství min. 5 ks.

were selected for analysis to locate possible workshops, as they can be considered places of possible targeted production at a larger scale. There were ten such features (nos. 29/64, 35/64, 70/64, 89/64, 53/65, 62/66, 20/67, 42/67, 3/69, and 4/69; artefacts from feature nos. 62/66 and 42/67 were not available for analysis). These are from settlement pits and dwellings with a floor sunken into the ground. For the purposes of the analysis, 228 pieces of antler material were selected (from the originally registered 391 pieces), all of which were subject to use-wear analysis. The results include only the analytical data obtained; data mediated, for example, by a written description or drawing, were not used. Unfortunately, it is not possible to reconstruct the exact location or possible concentrations of antler

relics in individual features based on find diaries with verbal descriptions of the ground plan and the fillings of the features or photographic documentation by the author of the field research, V. Hrubý. Antler findings are listed together with archaeological findings from the feature filling, without distinguishing the contexts of backfill material (upper or lower part of the filling, bottom, etc.). Thus, it is not possible to relate the occurrence of antlers in individual features to the phase of active existence of that feature. It is possible; they got into the archaeological filling of the sunken feature after the extinction of that feature, together with other waste from activities taking place in the feature vicinity. Only in the most prominent feature, no. 3/69, is the occurrence of scattered antler chips noted on the bottom in its northern part. The following short description of selected features includes only information potentially relevant to the monitored issue. Therefore, only artefacts that may have been related to the production or processing of the antler are listed here. A complete and more detailed description is published elsewhere (*Zeman 2008*).

Feature No. 29/64, an irregularly shaped pit (285 × 185 cm) that contained 25 pieces of antler. All were available for analysis. There were also sandstone whetstones and animal bones in the pit (*Zeman 2008*, tab. 22: 2, 38–39).

Feature No. 35/64, a loam pit with an adjoining ironworks workshop in the N part, which is evidenced, among other things, by the finding of a hearth (furnace) in the SE part and iron slag. The largest concentration of antler raw material and bones (900 pcs) was found in the filling of the probable ironworks workshop. A total of 32 pieces of identifiable antler material were analysed. A fragment of a comb was also found in the feature, but it was not obtained for analysis. Bronze objects (spatulas, tape, and sheet metal), an iron knife, fragments of an iron object, slags, whetstones, a Neolithic intrusion (drill), and a horn were also found (*Zeman 2008*, tab. 15: 3, 40–43).

Feature No. 70/64, an irregular oval pit (150 × 95 cm). Forty-three pieces of processed antlers were originally registered, and 63 pieces of antler material were found in the analysis. This number is not final, as a large part was so fragmented and mixed with other osteological material that it could not be further classified. It was probably recent fragmentation that increased the number of objects (*Zeman 2008*, tab. 45).

Feature No. 89/64, a sunken, irregularly trapezoidal dwelling (560 × 400 cm) with five pole holes and a kitchen oven adjacent to the building (registered separately as feature no. 92/64). There were 39 antler artefacts, and 22 pieces of antler material were analysed. The feature also contained iron tools (a knife, needle, nail, wedge, and slag), bone tools (a needle of a brooch/pin and needle casen), whetstones, stones, and a horn (*Zeman 2008*, tab. 8: 3, 49–52).

Feature No. 53/65, a rectangular dwelling (528 × 320 cm) with four pole holes in the corners (connected with no. 35/64, described above). It contained 13 pieces of antler at various stages of processing, including four pieces from two or three distinct combs. There were also iron tools (brooches, wedges, a rod, an artefact with eyelets, and slag), astragal, whetstones, animal horns, and bones (*Zeman 2008*, tab. 9: 2, 56–58).

Feature No. 20/67, a rectangular sunken dwelling (304 × 460 cm) with four pole holes in the corners, containing nine semi-finished antler products (including a preform of an arc-shaped comb handle) suitable for further use; i.e., non-waste material. Other findings included a piece of an iron knife, whetstone, slag (dross?), and animal bones (*Zeman 2008*, tab. 10: 2, 88–91).

Feature No. 3/69, an oval-shaped sunken dwelling (447 × 372 cm) with two stake holes in the middle of the shorter sides, and a fireplace located in the N part, containing the highest number of raw antler materials, semi-finished products, and artefacts of all analysed objects. A total of 52 processed antlers were found, all of which were available for analysis. Most of the material was concentrated in the middle of the N part. In addition to the high concentration of antler, the feature also contained bronze objects, a bear tooth pendant, a bone needle, whetstones, stones, a silicite blade, and animal bones (*Zeman 2008*, tab. 11: 1, 122–124).

Feature No. 4/69, a rectangular sunken dwelling (435 × 312 cm) with a fireplace in the immediate vicinity of feature no. 3/69, containing 19 pieces of processed antlers and semi-finished products. During the revision, the number rose to 22, which were analysed. Among other things, there were bronze and iron tools, whetstones, pebbles, and animal bones (*Zeman 2008*, tab. 13: 4, 125–126).

Methods

The antler objects were classified according to the four (respectively five, if we reflect artefacts in the phase of the use) stages of the production process. This classification was based on the operational-chain methodology for antlers designed by Niall Sharples (*Ashby 2005*; *Marković – Stamenković 2016*, 221). Phase 1 represents a pre-treated raw antler; i.e., roughly transversely divided parts of antler intended for further manufacturing. At this stage, the original morphology of the antler is more or less preserved, and traces of chopping and cutting are typical on both bases. Phase 2 is represented by blocks obtained by longitudinal division of antler parts. These products are then divided into four or more parts (sectors), which serve as the rough shapes of future comb plates. Phase 3 is already represented by semi-finished cover plates and tooth plates at various stages of manufacturing. Phase 4 includes all further unusable waste generated during the three other phases described. It includes not only fragments caused during production and processing (e.g. shavings), but also rejected or defective scraps, which are unusable even for other production uses. Phase 5 is represented by complete combs in the use phase, with documented functional wear by use-wear analysis, that also occurred at the sites. Despite established practice, they cannot be a priori associated with local comb production. Fragments of worn combs belong to phase 5 too. The assignment of individual findings to the defined phases of the operational chain was based on a combination of technological analysis, use-wear analysis, and a comparison of the identified traces with those achieved experimentally by tested individual production steps. Olympus BX51M and BXFM reflected light optical microscopes were used for the use-wear analysis and comparison, using bright field mode without polarisation and magnifications of 50×, 100×, and 200×. The samples were cleaned of surface impurities with 96% ethanol just before the observation. The artefacts were not treated with a conservation coat, and as such they could be analysed in all cases. The comparative production experiment was carried out in 2020 (*Nováčková 2021*, 165–182) as a part of a broader study of antler combs, according to the usual rules of authenticity and objectivity of scientific experimentation in archaeology (*Coles 1973*; *Picod et al. 2016*). The experiment used several antlers of European deer, of various origins and ages, on which three methods of softening were practised (in oxalic acid, in water, and in boiling water). Iron tools (axes, saws, knives, wedges, and files) and stone tools (sandstone and whetstone) were used for the material division and later modification. The traces of individual production steps were documented and compared with the wear record of preserved combs from archaeological sites. The occurrence of individual phases of antler processing was evaluated in individual settlement features, with regard to the frequency, continuity of phases, and occurrence of possible processing tools or technological equipment.

Results

Processed deer antlers and comb preforms from the Zlechov site show the usual production methods observed on semi-finished products found in sites in Moravia and elsewhere in Europe with demonstrable production of antler combs. The first phase of the production sequence is evidenced by raw antlers as a whole and its burrs or tines, with or without traces of division (*fig. 2*). The primary transverse division into coarse preforms, the creation

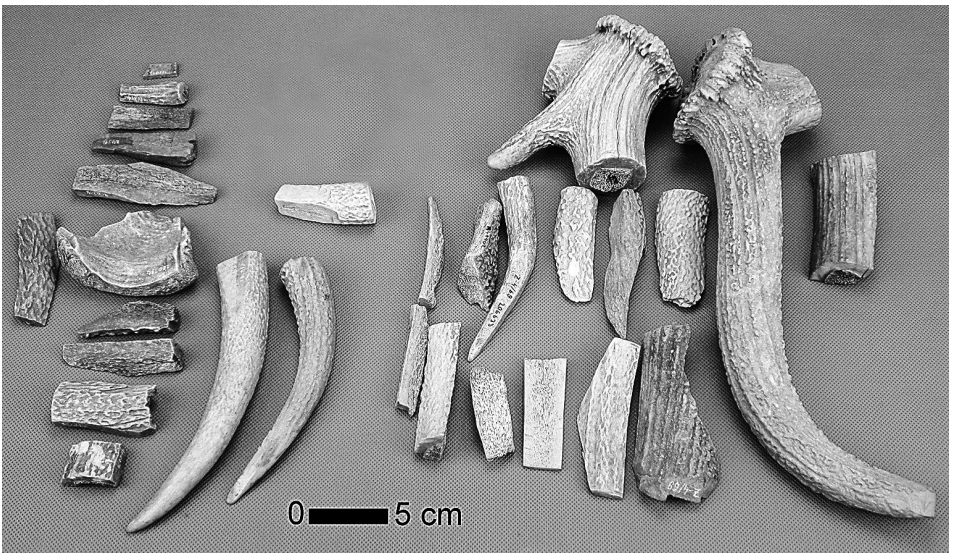

Fig. 2. First phase of manufacturing sequence of antler combs – pieces of antler with traces of coarse dividing.
Obr. 2. První fáze výrobní sekvence parohových hřebenů – části parohu se stopami hrubého dělení.

of antler blocks, and the separation of burrs and tines was carried out using a knife or saw. The antler was cut to a depth of a few millimetres in several places or around the entire perimeter, and then broken off with a sharp blow. A characteristic feature of this method is the uneven cut surface with longitudinal facets on the perimeter and an uneven fracture of the central (spongy) part (*fig. 3*). This simple, yet effective method of division was documented in almost all observed features (except for the dwelling feature no. 53/65, where phase 1 was not recorded at all). The only exception in antler division technology is the preform from feature no. 35/64; a clean and smooth cut, typical of saw use, was identified on one of the tines (*fig. 4*). Knives were found at the site in several features together with semi-finished antler products (object nos. 35/64, 89/64, and 20/67) Saws were not discovered, although this does not exclude the possibility of their use at the site. Due to the thin construction, a saw is more easily subject to corrosion, which limits its identification in the finding context. Nevertheless, there are records of iron saws from the Roman period and Migration period at the Ózd settlement in Hungary (*Párducz – Korek 1959*, taf II–III) and at Ceričin Grad in Serbia (*Marković – Stamenković 2016*, fig. 6). A bronze saw is known from the territory of the Czech Republic (*Šumberová 2012*, 41). Primary semi-finished products of the first phase occurred only in small quantities in most of the monitored settlement features. The highest number was recorded in the sunken dwelling no. 3/69, or still in the dwelling feature no. 4/69.

The second phase is evidenced by coarse preforms, which already foreshadow the shape of future products or their components. Typically, these are prepared antler blocks and segments manufactured by longitudinal splitting – quarter sections, and less often half sections. They serve as the initial preform of comb plates. The production experiment and subsequent comparison with the original artefacts (*fig. 5*) showed that in most cases the segmentation into such sections was performed using wedges or chisels. The wedge or

Fig. 3. First phase of manufacturing sequence of antler combs – facets formed by circumferential cutting by knife and consequent breaking off the spongiose. A – artefact from feature no. 3/69, B – traces of experimental cutting by iron knife.
Obr. 3. První fáze výrobní sekvence parohových hřebenů – fasety vzniklé obvodovým nařezáním a stopy následného vylomení spongiózy. A – artefakt z objektu č. 3/69, B – experimentální dělení s použitím železného nože.

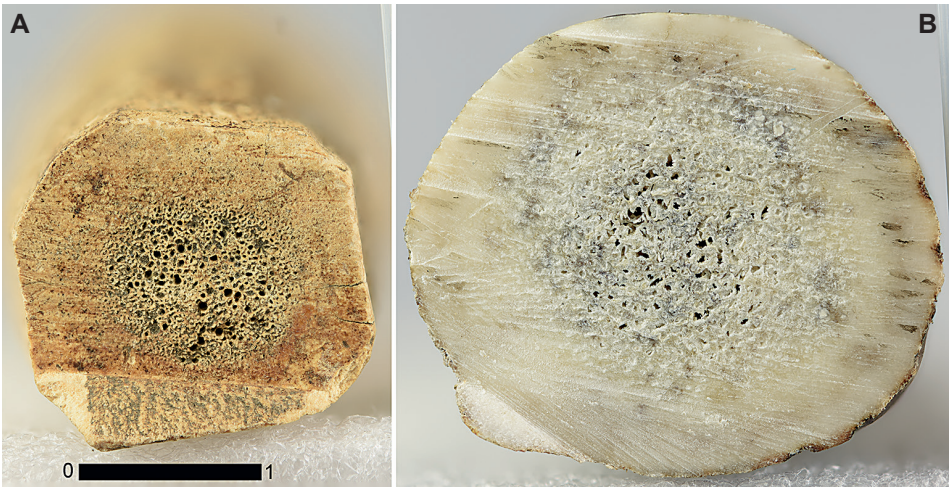

Fig. 4. First phase of manufacturing sequence of antler combs – plain surface of sawing. A – artefact from feature no. 35/64, B – traces of experimental sawing.
Obr. 4. První fáze výrobní sekvence parohových hřebenů – hladký řez způsobený pilou. A – artefakt z objektu č. 35/64, B – experimentální dělení s použitím pily.

chisel was placed on a longitudinal cut or shallow groove and knocked with a hammer or stone to split the block into two halves (or subsequently into quarters) by gradually moving the tool. This method of division leaves an uneven surface on the chipped object, both in part of compacta and spongiose (*fig. 6*). On the contrary, if a saw were used for segmen-

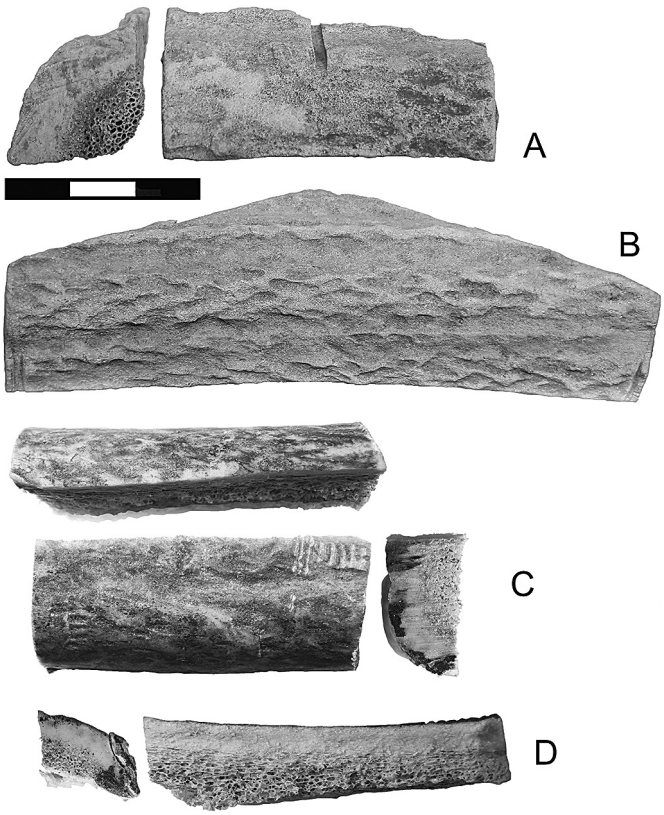

Fig. 5. The second phase of manufacturing sequence of antler combs – products of longitudinal dividing of antler blocks using wedges or chisels. A – antler segment from feature no. 3/69, B – plate preform from feature no. 4/69, C–D – products of experimental segmentation by wedges.
Obr. 5. Druhá fáze výrobní sekvence – produkty podélného dělení špalíků parohoviny s pomocí klínů nebo dlátka. A – parohová výseč z objektu č. 3/69, B – polotovar destičky z objektu č. 4/69, C–D – produkty experimentálního podélného dělení na výseče.

tation, the edges would be smooth (see *fig. 4*). The difficulty of the described method lies in the higher risk of unsuccessful chipping and the formation of unsatisfactory (uneven) segments, which can no longer be further modified to comb plates. Nevertheless, it is one of the most efficient and time-saving methods of antler division without the use of a saw. In principle, any chisel-shaped edge can be used, a single wedge, as well as their set in various sizes. Iron wedges were probably the most common. The use of wooden wedges can also be expected (*MacGregor 1985*, 57). Wedges from antler tines with traces of hammer hits from Gdańsk and Wolin are documented (*Cnotliwy 1973*, 36, 164). Iron wedges were found at the site of feature nos. 89/64 and 53/65, which also contained antler artefacts. Two antler tines were also found (feature nos. 29/64 and 70/64), which would meet the ergonomic parameters of this type of tool (*fig. 7*). Wedge splitting was probably also used in the production of omega-shaped cover plates. The preform of the omega-shaped plate from feature no. 70/64 bears traces of chipping and subsequent treatment of unevenness with a knife. Unsuccessful chipping explains their resignation to the next stages of manufacturing. Artefacts of the second phase were also identified in all observed settlement features, with the exception of the sunken dwelling no. 53/65. As found during the experiment, using a saw to cut a straight plate directly from the side of the antler block is inefficient, because the uneven and curved shape of the antler makes it impossible to obtain an evenly thick plate. Even thickness along the plate length and width is necessary

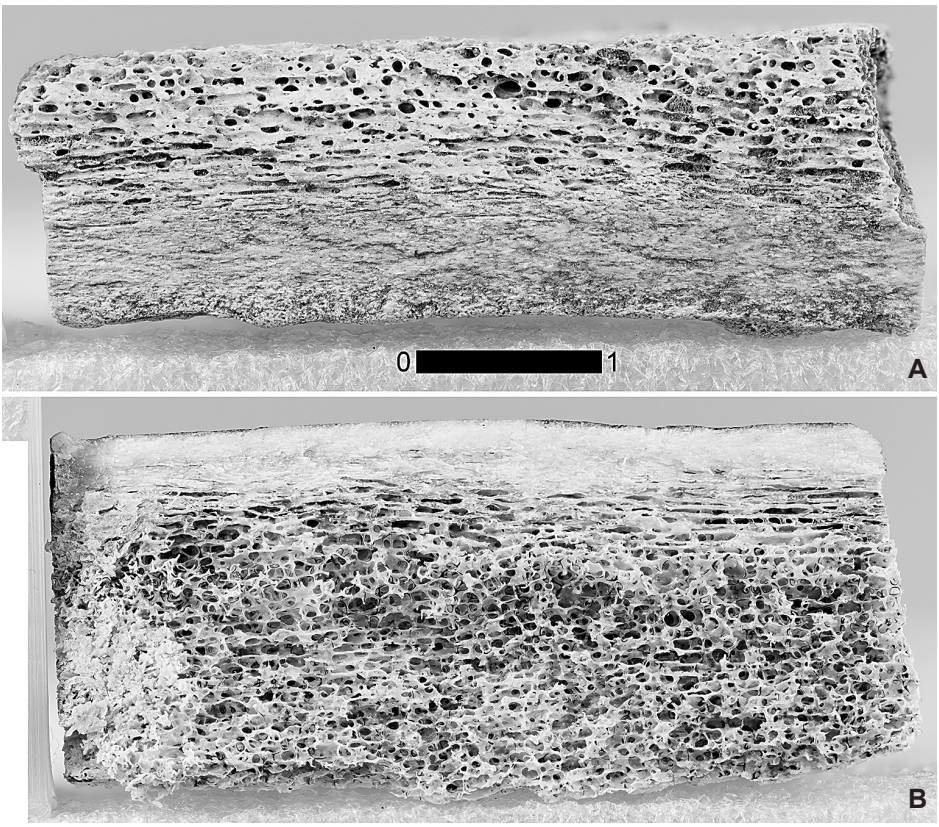

Fig. 6. Detail of typically uneven surface caused by wedge or chisel splitting. A – artefact from feature no. 3/69, B – product of experimental longitudinal splitting.
Obr. 6. Detail charakteristicky nerovného povrchu způsobeného dělením klíny či dlátem. A – artefakt z objektu č. 3/69, B – produkt experimentálního podélného dělení.

for successfully completing the compound comb. When sawing a long object, the cut part often suffers a fracture, which degrades a large piece of raw material. The procedure of longitudinal splitting into quarters is the most economical and simplest in terms of performance. This procedure does not require a saw. On the contrary, handling the saw in antler division is more complicated than cutting with a knife.

The third phase consists of various stages of manufacturing the quarters into plates and finished components: modified cover plates, tooth plates, and plates with holes. The most convenient tool for thinning the quarters is a knife at the stage of rougher adjustment. Stone whetstones or files were used for finishing work (*fig. 8*). Traces on the surface of the plates from feature nos. 3/69 and 4/69 can be mentioned as a probable proof of the use of an iron file combined with a knife (*fig. 9*). Individual direct proof of antler processing tools was confirmed at the site. The iron tool from feature no. 6/68 (*Zeman 2008*, 114, tab. 82: 8) was interpreted as a drawknife, and the tool from feature no. 7/69 was interpreted as a file (*Zeman 2008*, 113, fig. 24: 21). Due to the higher occurrence of stone whetstones, even in cases of more pieces per object (object nos. 29/64, 35/64, 89/64, 53/65, 20/67, 42/67, 3/69,

Fig. 7. Two antler tines from settlement site Zlechov-Padělky (features no. 29/64, 70/64) with wedge-shaped adjusted working edge.
Obr. 7. Dvě parohové výsady ze sídliště Zlechov-Padělky (objekty č. 29/64, 70/64) s klínovitě upravenou pracovní hranou.

Fig. 8. Facets of manufacturing antler segments to plates by a knife. A – Artefact from feature no. 3/69, B – Product of experimental manufacturing of antler plate.
Obr. 8. Fasety způsobené opracováním výsečí nožem do podoby destičky. A – artefakt z objektu č. 3/69, B – produkt experimentální výroby destičky.

and 4/69) their possible use for final adjustments can be considered. The use of sandstone whetstone can be clearly demonstrated by the presence of the buried grains of the whetstone raw material buried in the mass of the smoothed plate, as demonstrated by the experiment. The most striking are the mica grains (*fig. 10A*). However, this phenomenon was not identified on the artefacts from Zlechov (*fig. 10B*), whose surface is completely grain-free. An important finding documenting the third phase is antler shavings (slightly curved flakes),

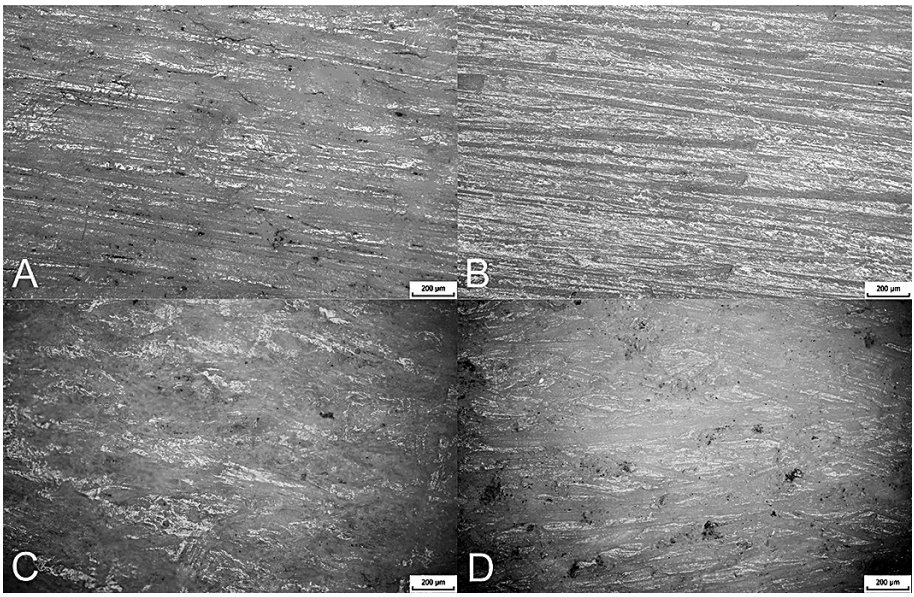

Fig. 9. Wear traces on the surface of plates from features on Zlechov site, comparison of file traces and traces of probable combination of the knife and saw use. A – Artefact from feature no. 70/64, B – product of experimental surface treatment by file, C – Artefact from feature no. 3/69, D – product of experimental treatment by knife and file. Magnification 50×.
Obr. 9. Traseologické stopy na povrchu destiček z objektů v lokalitě Zlechov, porovnání stop pilníku a pravděpodobné kombinace užití nože a pilníku. A – artefakt z objektu č. 70/64, B – produkt experimentu, úprava pilníkem, C – artefakt z objektu č. 3/69, D – produkt experimentu, úprava nožem a pilníkem. Zvětšení 50×.

which probably arose during the formation of plates (*Ashby 2005*). Such shavings were found in feature nos. 70/64, 89/64, and 3/69 (*fig. 11*). These shavings were created using a knife. Hypothetically, a similar formation could be caused by a planer or the above-mentioned drawknife.

The drilling of holes for rivets, riveting, and decoration forms other steps of the third phase. Drills themselves are not documented from Germanic settlements. It is possible that iron drills were damaged by corrosion (*Cnotliwy 2013*, 164) to such an extent that they lost the morphological details needed to identify their function. Iron rod artefacts of various thicknesses and lengths are common in the collections of Germanic settlements (*Droberjar 1997*, 180, Taf. 14: 2; *Zeman 2008*, 101, 113, fig. 24: 22–24, tab. 40: 9, 46: 1, 73: 1, 97: 14–15, 99: 4, 113: 3, 127: 1, 133: 9; *Hrnčiarik 2011*, 155, Abb. 1: 5–8; *Konečný 2019*, 80, tab. 51: 2, 54: 1). Some drills might be among them. Unfortunately, X-ray analyses of these artefacts, which could contribute to identification, are still lacking. The use of silicite drills obtained by re-collecting the older chipped tools may be considered. A Neolithic drill morphologically suitable for the given activity was found in feature no. 35/64. Older, Epi-Palaeolithic, Mesolithic, or Neolithic lithics are well documented in Germanic settlements, and their remodification for new purposes is known (*Kaňáková 2013*, 170). Although it is usually assumed that drilling took place after the final modifications of the components, four pieces of unsuccessful, broken plates with an unfinished surface were

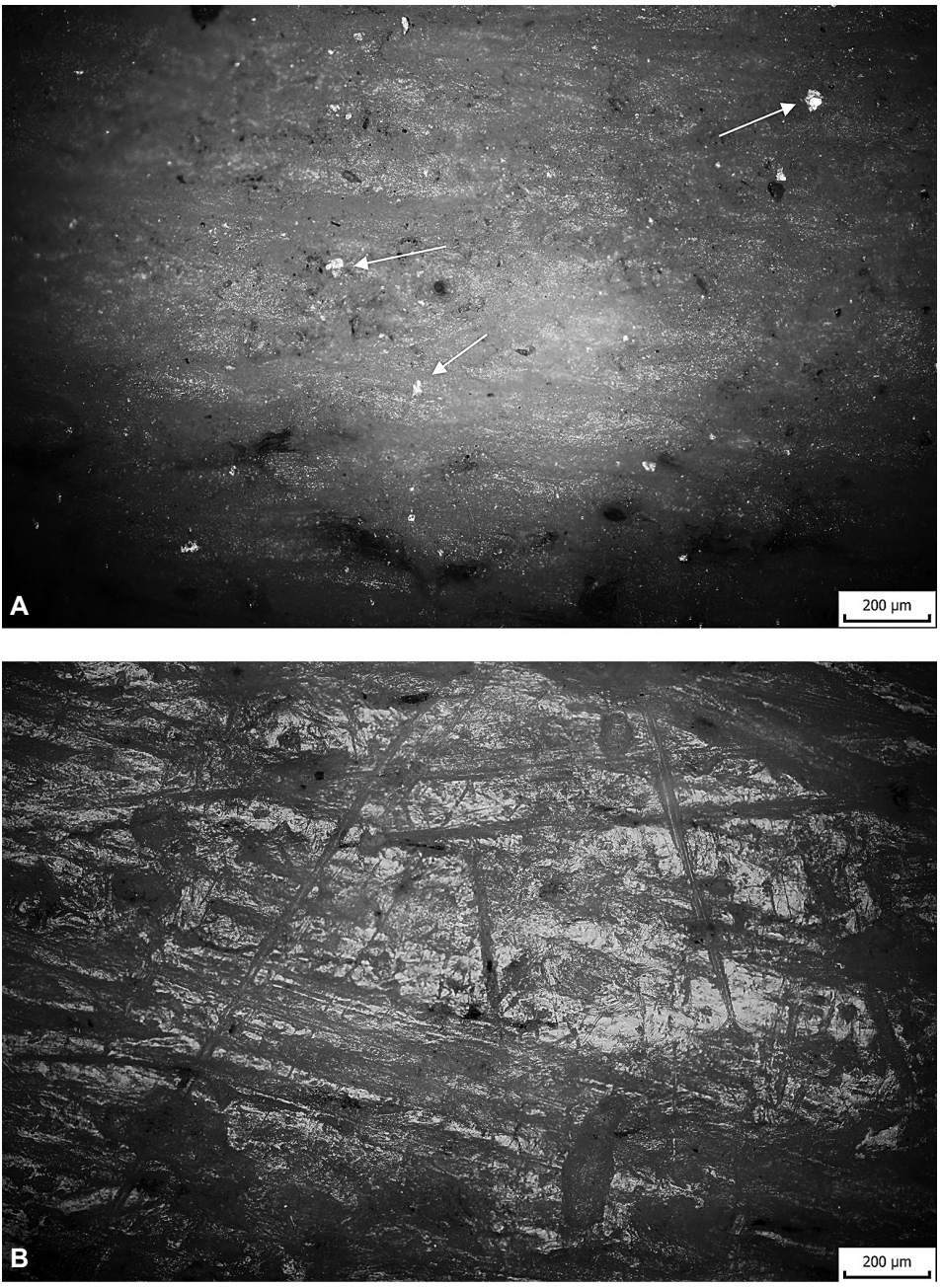

Fig. 10. Engraved grains of stone raw-material as evidence of the polishing/smoothing by stone whetstone. A – product of experimental polishing by sandstone whetstone, B – plate from feature no. 4/69 with a clean surface without engraved grains. Magnification 50×.
Obr. 10. Pohřbená zrna kamenné suroviny jako doklad broušení/hlazení kamenným brouskem. A – produkt experimentu, B – destička z objektu č. 4/69 s povrchem bez pohřbených zrn. Zvětšení 50×.

Fig. 11. Identified antler shavings from features no. 70/64, 89/64, and 3/69.
Obr. 11. Identifikované hoblinky parohoviny z objektů č. 70/64, 89/64 a 3/69.

Fig. 12. Four plates broken before final treatment of the surface, with prepared holes for rivets (feature no. 70/64).
Obr. 12. Čtyři destičky rozlomené před finální úpravou povrchu, s připravenými otvory pro nýty (objekt č. 70/64).

found in feature no. 70/64, which already had holes prepared for rivets. Their surfaces were not completely finished; they were uneven with remains of antler bark (*fig. 12*). No other plates with holes were found at the site. Iron, bronze, and copper, but also silver or bone and antler rivets, were used to compound the combs (*MacGregor 1985*, 62). The issue of the production of necessary rivets has not yet been solved. Iron slag is often found in features with antler artefacts in Zlechov, not only in settlement pits (35/64 and 42/67), but also in dwellings (89/64, 53/65, and 3/69). Nevertheless, the slag is evidence of ore smelting, not blacksmithing. Any sufficiently thin iron or bronze rod could be used for riveting, of which a larger number are documented at Zlechov (*Zeman 2008*, 113), including the features involved in our analyses (89/64, 53/65). Only one riveted comb fragment was found on the site (feature no. 11/69); unfortunately, this artefact was not analysed (lost), and a more detailed description of the rivets is not known. The most frequent decoration motive–an engraved ring with a hole in the middle–was formed by a compass (*Hrnčiarik 2011*, 155, Abb. 1: 9; *Biró et al 2012*, 55–58). Two decorated fragments of omega-shaped comb cover plates proceeded from feature no. 53/65 (*fig. 13*). Two different compasses were used to decorate the comb, although the tools were not documented directly at the site. The products of the third phase were identified only in feature nos. 35/64, 20/67, 3/69, and 4/69. Except in the case of no. 35/64, these were sunken dwellings.

The fourth phase of the production sequence forms the category of further unusable production waste that was generated during the entire production process. An artefact is defined as further unusable waste on the basis of zero perspective of shape and dimensions for the production tasks of comb components, by the detection of an irreparable defect of raw-material homogeneity, or by an irreparable defect caused by previous processing. In

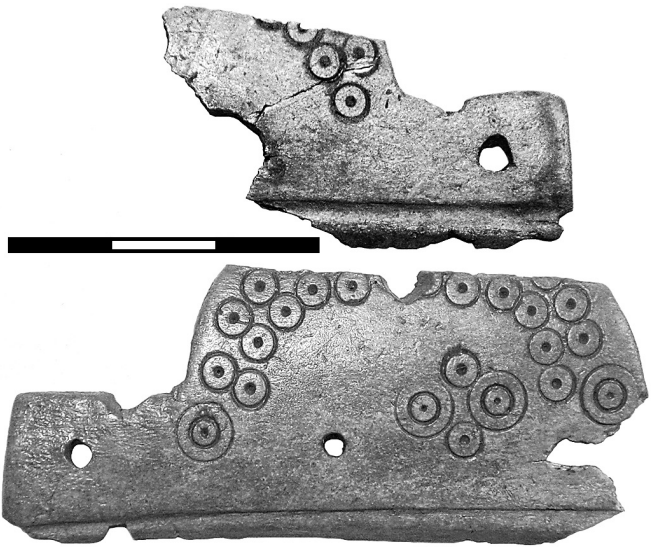

Fig. 13. Two fragments of cover plates of omega-shaped comb with compasses decoration from feature no. 53/65.
Obr. 13. Dva fragmenty krycích destiček omegovitého hřebene s výzdobou kružidlem z objektu č. 53/65.

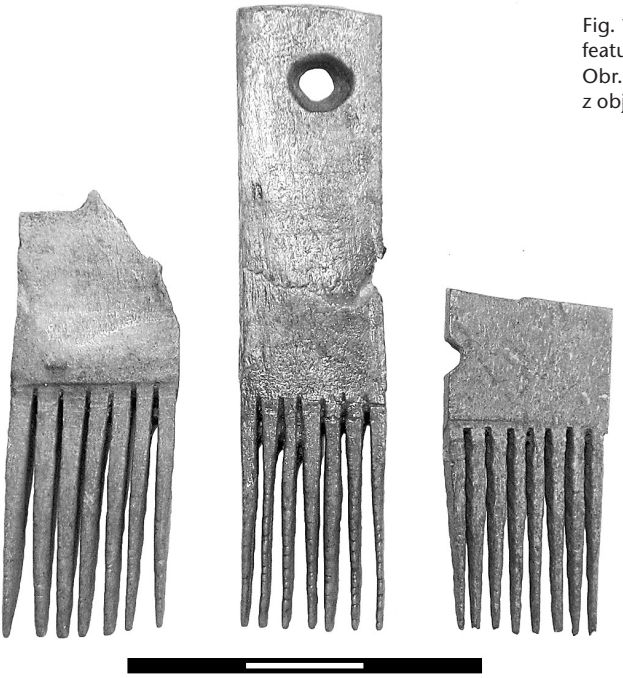

Fig. 14. Fragments of antler combs from features no. 89/64 and 53/65.
Obr. 14. Zlomky parohových hřebenů z objektů č. 89/64 a 53/65.

contrast to the occurrence of phase 3, unusable waste is dominantly found in settlement pits, while in dwellings it is exceptional.

Within the completeness of the description of the collection of antler artefacts, the fifth phase can be noted, which includes already completely finished combs, namely those that have already passed from the production phase to the following phases of the operational

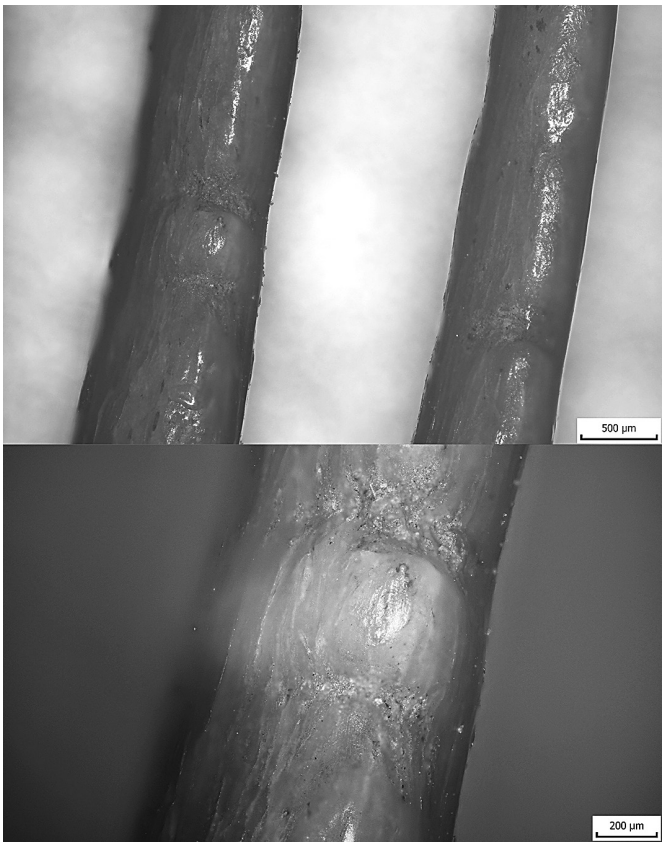

Fig. 15. Use-wear traces of intensive use of the comb from feature no. 53/65. Magnification 50× and 200×.
Obr. 15. Traseologické stopy intenzivního užívání hřebenu z objektu 53/65. Zvětšení 50× a 200×.

chain; i.e., functional use. The category involves damaged, repaired, intentionally deposited, or discarded combs. This phase includes five fragments of antler combs (*fig. 14*) with striking features of functional use (*fig. 15*). Four of them come from the same context. Two fragments of the cover plate match each other, whereas the affiliation of two tooth plates to them is not clear, because it is evident that they proceed from two different combs (feature no. 53/65). Due to this ambiguity in the number of original combs in context, we leave the data for four pieces. It is possible that the antler combs were kept even in a fragmented form, and that they were not always discarded to waste pits. The storage of fragments could reflect the secondary functions of the comb on a symbolic or prestigious level, or storing individual components could be motivated by possible repair of other combs when damaged.

During the analysis, emphasis was placed on the detection of used manufacturing processes and tools used in individual phases of comb production. As the experiment itself showed, no specialised tools typologically distinguished from the current household inventory (knives) or woodworking tools (wedges or saws) were used in the first and second stages of comb production.

Drilling is also not a specialised activity, and drills were certainly commonly used in other work procedures. A bronze or iron rod is needed for riveting, which involves the use

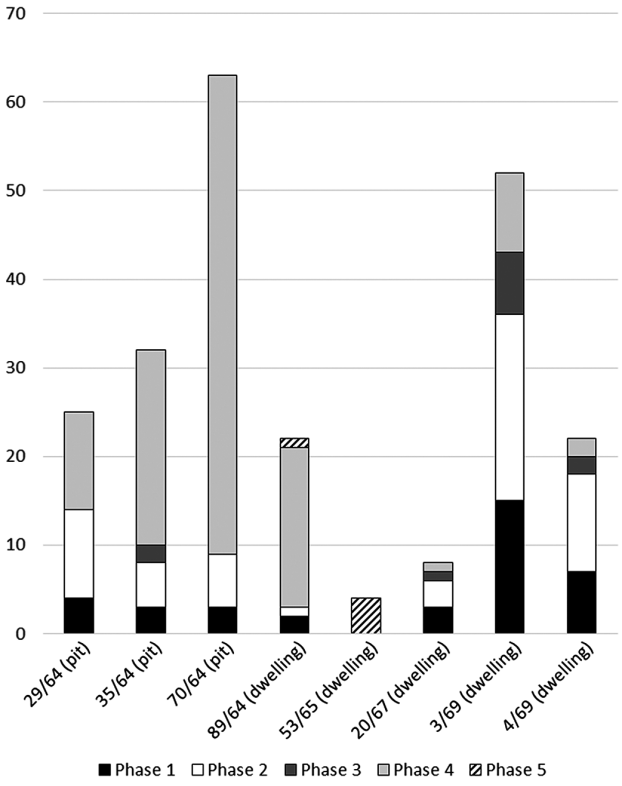

Fig. 16. Presence of production phases in individual analysed features on the Zlechov-Padělky settlement.
Obr. 16. Zastoupení výrobních fází v jednotlivých sledovaných objektech sídliště Zlechov-Padělky.

of an anvil and a hammer, and possibly some improvised clamping device. Only the compasses used to decorate cover plates can be considered specialised tools.

If the collection is sorted into individual production phases (*fig. 16*), specific zones of the production of antler combs can be located. Typically, the production place is characterised by the presence of all four phases, although phase 4 (small production waste) may be less represented, due to its possible clearing or incineration. If, on the other hand, phase 4 is dominant in the feature, whereas promising preforms are few, we can interpret such a feature as a waste accumulation. We can interpret feature nos. 29/64 and 70/64 as such waste pits. In contrast to other features, any iron tools in these features were involved. The spectre of phases of antler artefacts in feature no. 89/64 can also be considered waste, although it was a sunken feature with a furnace. The other inventory also testifies to the original dwelling function. Phase 1 is represented by two pieces, phase 2 by one, and phase 3 is not represented at all, whereas waste comprised 18 pieces; in addition, it was mostly burned. If we consider the strong smell of burnt antler, its burning probably cannot be assumed in currently used living spaces. Although the tools found (an iron knife and a wedge) could be used for processing the antler, their storage in the feature might be related to the previous dwelling function, as well as a fragment of the intensively used comb. It is possible that there were multiple phases of the formation process. Another possibility is that in this sunken dwelling the antler was only roughly divided, and these products were taken away by the producers. Feature no. 3/69 can be identified as the place of production

(eventual workshop), where all four stages of production were identified, with a high proportion of raw material and semi-finished products for comb production, including semi-finished omega-shaped plates and a minimum amount of waste that was probably cleared. Likewise, manufacturing probably took place in feature no. 4/69, which has the highest number of artefacts from phases 1, 2, and 3 after feature no. 3/69. All stages of production are also represented in feature no. 20/67, where a tool (iron knife) was also found, but all phases are represented only in small quantities. Feature no. 53/65 itself cannot be linked to any production activity, as no production phase was recorded here. Only worn final product (phase 5) was found. Iron tools that could be used for production (iron wedges and rods) were found in the feature, which is connected to feature no. 35/64, where all stages of production were documented. It is possible that these features were functionally linked: in dwelling no. 53/65 the comb manufacturer lived and stored his tools, and in feature no. 35/64, most of the production activities took place.

Discussion

Based on the results of the analysis of the antler artefacts from Zlechov and the results of the experiment, it is clear that it was not necessary to own a set of specialised tools for the production of antler combs. Common tools of general daily use were preferred, and they were sufficient for all manufacturing tasks. Clamping devices and compasses can be considered the only specialised tools, and these were easy to obtain or make. The production of antler combs at the settlement could have been carried out by anyone who owned a basic set of tools (a knife, wedge, hammer, saw, and drill) and had a template or appropriate knowledge. Manufacturers could procure the raw material for the production of combs themselves or obtain it through exchange. Antler burrs identified at the site prove that shed antlers were collected. This must have taken place in the spring, shortly after the shedding (due to risk of damage caused by animals eating antlers for their high mineral content). However, processing could have taken place throughout the year, as the workability of the material does not deteriorate significantly. Both seven-month-old antlers (collected the previous fall) and antlers collected several years prior were used in our experiment, and the results of workability were comparable. However, 431 deer bones from at least 15 individuals are documented at the site (*Sůvová et al. 2008*, 170). Therefore, at least part of the processed antler could have come from hunted animals.

The analysis of the presence of the production phases shows that the entire production chain actually took place at the settlement. It was performed in several settlement features, and sunken dwelling features were preferred. It is therefore likely that the total amount of processed antler corresponds to the work of several producers (*fig. 17*). We deliberately use the term "manufacturer", because the term "craftsman" has the connotation of significant specialization and production, not only for personal or community needs.

If we try to quantify the volume of production based on the preserved collection, we can use metric data. If the total length of a deer antler is about 100 cm, after separating the burr, tines, and parts with a high proportion of spongiose, the resulting amount of the raw material is about 80 cm for further processing. The average length of an antler tooth plate is between 4 and 5 cm, and the length of omega-shaped handles is between 7 and 8 cm, based on the detected length of the semi-finished plates, sections, and already finished comb tooth

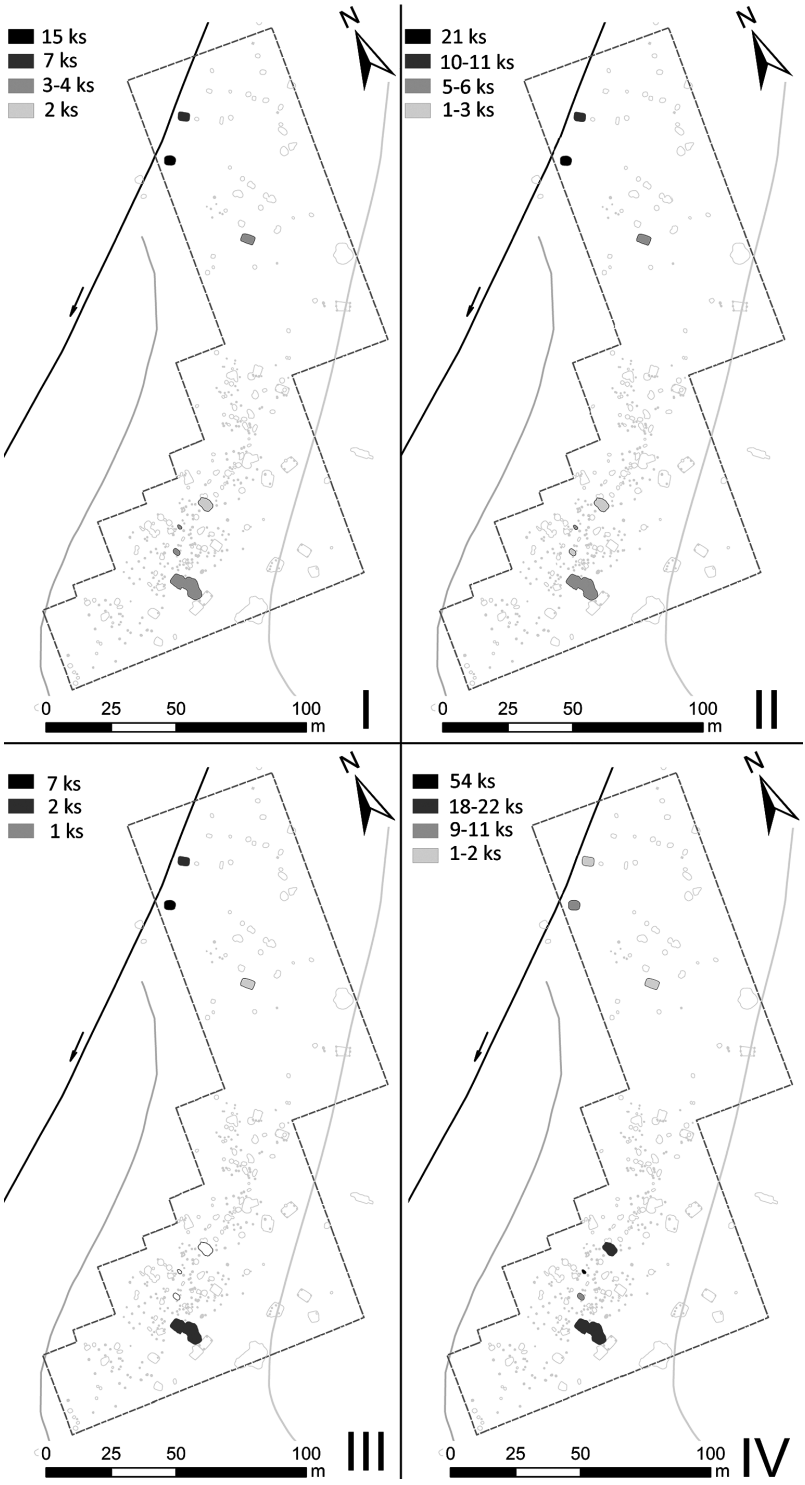

Fig. 17. Visualisation of the presence of phases 1st to 4th of comb manufacturing in space context of the settlement site Zlechov–Padělky.
Obr. 17. Vynesení zastoupení 1. až 4. výrobní fáze hřebenů do prostorových souvislostí sídliště Zlechov–Padělky.

plates found at the site. Due to the specific shape of the omega-shaped plate, it is possible to form it only from the part of the antler at the tine base. Therefore, under ideal conditions, it is possible to produce three omega-shaped combs with a length of 8 cm from one antler (if we count six tines per antler). Fourteen blocks can be made from the remaining material, from which it is possible to create 56 tooth inserts with a length of 4 cm, if we choose the usual method of segmentation into quarters. It is necessary to have two cover plates and about five tooth plates to complete an omega-shaped compound comb. As a result, a maximum of three omega-shaped combs and a few extra plates can be made from a complete shed; i.e., a pair of antlers. However, it is necessary to take into account the relatively high percentage of failures when the plate breaks during manufacturing or turns out to be too unevenly thick or curved to match each other during riveting into cover plates.

Even this simple consideration makes it clear that the actual craftsman production for the purpose of distribution had to produce an order of magnitude more waste and secondary products than were found on settlement features. The low presence of waste cannot be attributed a priori to the practice of burning antler waste. Burnt antler fragments are documented in only a small volume and area. There is no evidence of such intensive burning, which would have left an archaeological indication. The documented finding context does not justify any other reason for such disappearing of the waste. For example, some hygienically motivated burning of all; i.e., mixed, waste would have affected the condition of other (non-antler) findings from waste accumulations. The extent of comb production at Zlechov was therefore rather communal and corresponded to a supplementary production activity, such as a work activity in the winter or the activity of older members of the community who were no longer able to work all day in agriculture or other full-time production. The more intensively the manufacturer deals with a specific production process, the more significantly his individual routine and hand-signature stabilises. A craftsman producing combs as his main means of subsistence would have not only a steady type of products (with the same dimensions, component metrics, riveting, and decoration patterns), but also a steady manufacturing technique, and a standard approach to the antler (i.e., to dividing initiation or surface treating). Such finalised products could then be identified in the vicinity of the production site. A wider distribution of the same type of comb was not found in the near or distant surroundings of Zlechov (distribution radius up to 150 km). So far, no combs similar to the comb from feature no. 53/65 have been found. The combs that were found had differently shaped handles (triangular, arcuate: *Vlach 2007*), the production of which was not found at Zlechov, or they were omega-shaped but with a different design (decoration, shape, location of rivets), such as the omega-shaped combs at Drslavice (*Tejral 1975*, 42; *Tejral 1985*, 330–331, fig. 7), Havřice (*Tejral 1985*, 330–331, fig. 7), Kozojídky (*Zeman 2017*, 144, tab. 41: 2), Rymice (*Tejral 1985*, 330–331, fig. 7), and Znojmo-Hradiště (*Tejral 1982*, fig. 6; *1985*, 324, fig. 4). Despite the lack of similar combs, which may be caused by a state of research, the hypothesis of craftsman production of combs at Zlechov is not supported by our results. Previous conclusions about the existence of a specialised workshop for the Thomas III combs at Zlechov (*Zeman 2001*, 101; *2009*, 285; *Szabová 2019*, 93) will therefore need to be reconsidered. Even previous hypotheses of wandering craftsmen (*Musteaţâ 2017*, 202–206) cannot be applied to the situation at Zlechov, because all phases of production were found at the settlement, and because their distribution was concentrated in several dwelling features, with waste cleared to several settlement pits.

Conclusions

Forty-three settlement features were excavated at the Zlechov site, which contained 391 pieces of antler at various stages of processing. The findings from eight features (found in five or more antler artefacts) were selected for use-wear analysis. Collections from feature nos. 29/64, 35/64, 70/64, 89/64, 53/65, 20/67, 3/69, and 4/69, in a total 228 artefacts, were analysed. Four production phases were defined, based on the identified manufacturing traces and comparisons with the results of a production experiment. Based on the presence and amount of artefacts of individual phases, feature nos. 29/64, 70/64, and 89/64 were determined as waste objects, nos. 35/64, 3/69, and 4/69 as places of production, and no. 20/67 as a possible production place. Feature no. 53/65, where a fragment of a worn comb and iron tools were found, could be related to production only in terms of the dwelling of the comb manufacturer, assuming the functional connection of feature nos. 53/65 and 35/64. However, feature no. 35/64 could be an independent production place or zone. On the contrary, in feature no. 53/65, the production itself probably did not take place. Thus, in all four identified cases, the production place was located in features whose floor plan is generally associated with the function of a primary dwelling. This finding is in accordance with the supplementary nature of production activities. Considering the total amount of antler material found, local production of antler combs cannot be interpreted as a primary subsistence activity, but rather as a supplementary activity undertaken during rest periods of the agricultural year or life cycle. The findings of antler combs in the near and far vicinity do not correspond to a more massive production and wider distribution.

Our analysis showed that the interpretation of settlement features with the presence of antlers at different stages of processing needs to be approached more carefully than previous interpretations suggest. The waste and production accumulations were clearly distinguished, using the use-wear analysis and production experiment. As a result, the number of production places at Zlechov was reduced to three or four, all located in dwellings. There was no workshop in the sense of a space reserved for full systematic production. The experience from the experiment allowed us to quantify the yield of antlers, and it showed that the amount of raw material and waste at Zlechov does not correspond to systematic specialised production. The experiment and use-wear analysis also showed that common daily tools, which were available to most members of the community, were predominantly used for antler processing, including comb production.

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Traseologická identifikace dílenských aktivit
Zpracování parohoviny na sídlišti Zlechov-Padělky (okr. Uherské Hradiště) v pozdní době římské

Z germánského sídliště ve Zlechově bylo v rámci exkavace získáno 391 ks parohoviny v různých fázích opracování, což vedlo k domněnce o účelovém výrobním areálu na výrobu parohových artefaktů, se zaměřením na parohové složené hřebeny. K potvrzení či vyvrácení této hypotézy jsme využili traseologickou analýzu spojenou s experimentálním ověřením výrobního procesu. Z původního počtu nálezového fondu parohových produktů bylo vybráno 228 ks artefaktů z osmi objektů, u kterých se předpokládala možná cílená výroba. Soubor byl roztříděn na základě experimentálně ověřených fází výroby složeného hřebene (surovina, hrubý polotovar, polotovar, odpad, finální výrobek či jeho komponenty) a traseologicky analyzován. Při komparačním experimentu byly využity různé výrobní postupy a testovány různé typy nástrojů k obsažení co nejvyšší variability výrobních traseologických stop pro srovnávací účely.

Výsledky prokázaly, že opracované jelení parohy a polotovary hřebenů na sídlišti Zlechov vykazují obvyklé výrobní postupy pozorované na polotovarech nalezených i v jiných lokalitách, kde byla doložena výroba parohových hřebenů. Paroh byl pomocí několika zářezů po obvodu a následným odlomením rozčleněn na hrubé špalíky, které byly dále s využitím klínku a tupého nástroje upraveny do podoby výsečí. Tyto výseče byly poté ořezány a případně obroušeny do tvaru hřebenových destiček. Poté následovalo vytvoření otvorů pro nýty, kompletace/nýtování, a na závěr vyřezání zubů hřebene a případná výzdoba.

Na sídlišti byly zachyceny všechny čtyři fáze výroby (5. fázi tvoří artefakty ve fázi používání a vyřazení), byly identifikovány možné objekty, v nichž výrobní fáze probíhaly, i objekty, které sloužily k depozici vzniklého odpadu. Vzhledem k celkovému množství nalezeného parohového materiálu a experimentálně zjištěné výtěžnosti parohu nelze interpretovat místní výrobu parohových hřebenů jako doklad systematické řemeslné/specializované produkce. Této hypotéze neodpovídají ani nálezy parohových hřebenů v blízkém i vzdálenějším okolí. Nelze doložit žádnou distribuci, která je předpokladem řemeslné specializované výroby. Zjištěné hodnoty odpovídají spíše podomácké aktivitě, doplňkové k jinému způsobu obživy. Mohla být provozována v klidových obdobích zemědělského roku nebo životního cyklu.

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