

Quarrying the antler adzes – a new Mesolithic site of the Boreal period at Krzyż Wielkopolski, western Poland

Geweihäxte en masse - ein neuer mesolithischer Fundplatz des Boreals bei Krzyż Wielkopolski, Westpolen

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ABSTRACT - In 2003 the chance discovery of tools made on red deer antler near Krzyż Wielkopolski (western Poland) led to the initiation of a still ongoing research project at one of the most intriguing Mesolithic sites in the European lowlands. Up to present 14 adzes and axes made on red deer antler and aurochs bone have been found, together with large amounts of antler and bone waste from tool production and a rich lithic assemblage. Some of these tools were discovered well-stratified within a beach zone of an ancient river channel. AMS-dates from a sequence of biogenic and mineral deposits indicate that the main occupation phase can be dated to the Boreal Period, though a Preboreal use of the site is also likely. Among other features the site has also yielded the oldest directly dated example of Early Mesolithic art from the Polish lowlands.

ZUSAMMENFASSUNG - Die zufällige Entdeckung einiger Geräte aus Rothirschgeweih nahe Krzyż Wielkopolski (Westpolen) im Jahre 2003 war der Ausgangspunkt für ein größer angelegtes Forschungsprojekt an einem ganz bedeutenden Fundplatz des Mesolithikums in der europäischen Tiefebene. Bislang konnten 14 Äxte und Beile aus Rothirschgeweih und Urknochen, eine größere Zahl von Produktionsabfällen dieser Geräte sowie ein reiches Steinartefaktinventar geborgen werden. Einige Geräte wurden in gut stratifizierten Sedimenten der Uferzone eines Flussaltarmes dokumentiert. AMS-Daten der Abfolge aus biogenen und minerogenen Sedimenten weisen auf eine Hauptbesiedlungsphase im Boreal hin, aber schon im Präboreal erscheint eine Nutzung des Fundplatzes gut möglich. Unter anderem hat die Station die älteste direkt datierte Kunst des Frühmesolithikums der polnischen Tiefebene geliefert.

KEYWORDS - Mesolithic, Boreal, antler tools, bone tools, art
Mesolithikum, Boreal, Geweihgeräte, Knochengeräte, Kunst

Introduction

In early summer 2003, whilst building a pond on their property situated on the bank of the Noteć River, Mr. and Mrs. Mąka happened to extract 'gyttja' sediments from an ancient river channel which yielded some 30 objects of bone and antler, including eight hammer adzes, one antler blade axe, one bone axe, and more than a dozen fragments, mainly of antler and bearing traces of processing and use wear.

This unique discovery resulted in an initial exploration of the site that commenced in 2005. In the course of the following years (2006-2008) a research team headed by the author conducted three short excavation seasons on the edge of the river terrace that aimed not only to establish the scope and chronology of the site, but also to investigate the periphery of the reservoir to gain an understanding of both its geomorphology and stratigraphy. Presently

some 57 m² have been explored on the terrace, with a further 20 m² excavated within the beach zone. This has led to the discovery of Mesolithic find horizons which are now known to extend over a considerable area of about 1 ha. Results from this work have already been published elsewhere (Kabaciński et al. 2007; Kabaciński et al. 2008); however, newly obtained data concerning site chronology, together with new finds from the 2008 season, have significantly broadened our knowledge of the site. These will be presented here.

Site location, geomorphology and stratigraphy

Site seven at Krzyż Wielkopolski is situated in western Poland, at the northern edge of a marginal stream valley of the Noteć river (part of the Toruń-Eberswald marginal valley), some 500 m east of where the Drawa flows into the Noteć (Fig. 1). Mesolithic material has been found in layers of sandy soil to have developed

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at the top of Late Glacial sands forming the flood terrace of the Noteć, and in the associated mineral and biogenic sediments of an Early Holocene oxbow lake. These sediments are best visible in trench 1/2007 where an almost four metre thick sequence of biogenic and mineral deposits has been exposed (Fig. 2). This sequence is composed of nine main beds which testify to the dynamic evolution of the local environment; significant amounts of archaeological material of Mesolithic age have been recovered from bed three to bed five (Fig. 3).

An initial interpretation of the stratigraphic sequence suggests that Mesolithic settlement on the sandy terrace adjacent to the ancient channel could have begun as early as the end of the active meander (bed two), and was certainly present when the channel became cut off from the mainstream (bed three). From its earliest stage the lake of the dead channel was relatively deep, as is attested by the presence of black gyttja (bed three), at which time the beach zone was located at its most westerly point. From then on the basin became shallower as indicated by layers four and five. Both of these layers have yielded numerous artefacts and charcoal, and are contemporaneous with

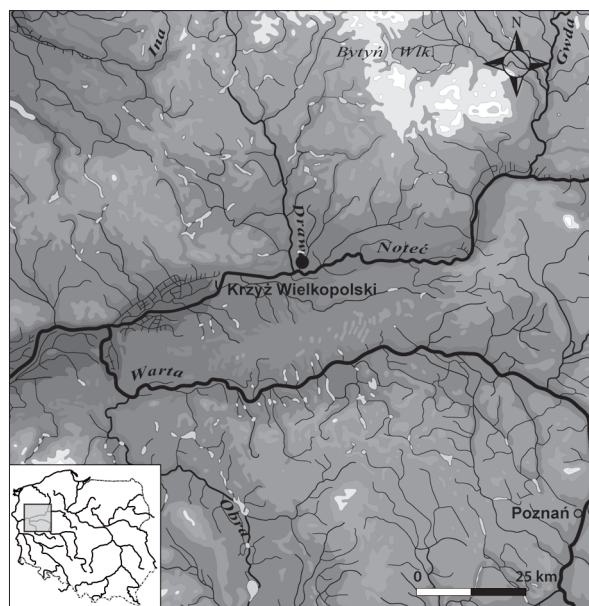


Fig. 1. Krzyż Wielkopolski, site seven. Location of site on the Polish Plain (prepared by P. Szejnoga & J. Kabaciński).

Abb. 1. Krzyż Wielkopolski, Fundplatz sieben. Lage des Fundplatzes in der polnischen Tiefebene (Grafik: P. Szejnoga & J. Kabaciński).

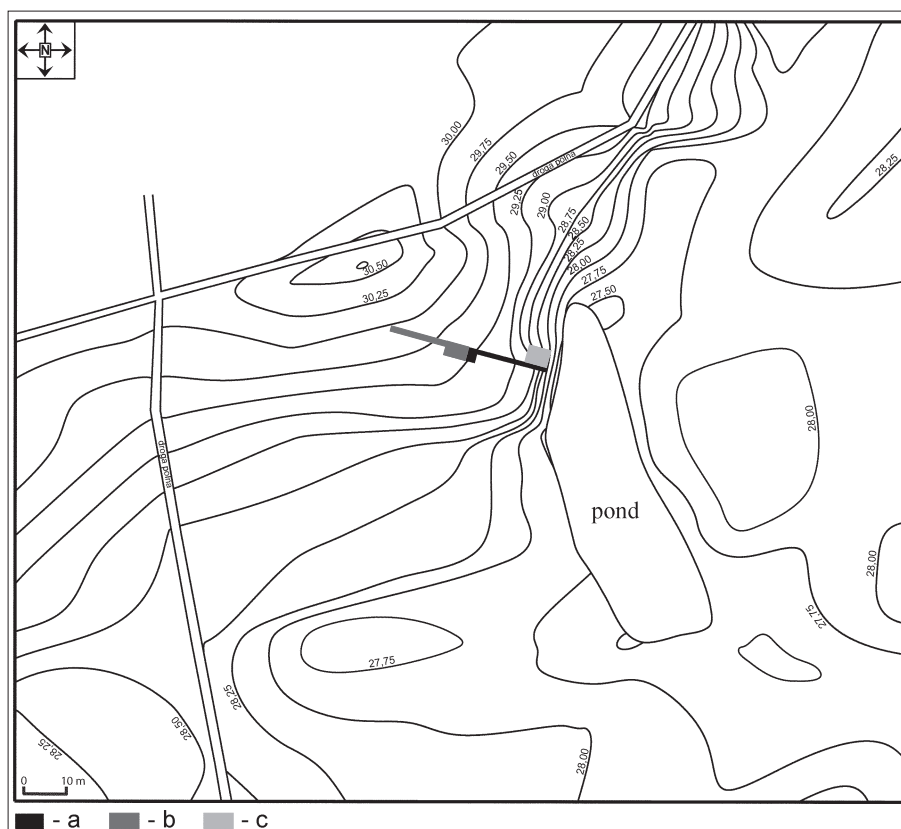


Fig. 2. Krzyż Wielkopolski, site seven. Hypsometric map of the site with the position of trenches and the pond (a – area investigated in 2005; b – area investigated in 2006; c – area investigated in 2007-2008) (prepared by M. Sip and P. Szejnoga).

Abb. 2. Krzyż Wielkopolski, Fundplatz sieben. Isometrische Karte des Fundplatzes mit Lage der Grabungsschnitte und dem Teich (a – in 2005 untersuchter Bereich; b – in 2006 untersuchter Bereich; c – in 2007-2008 untersuchter Bereich) (Grafik: M. Sip und P. Szejnoga).

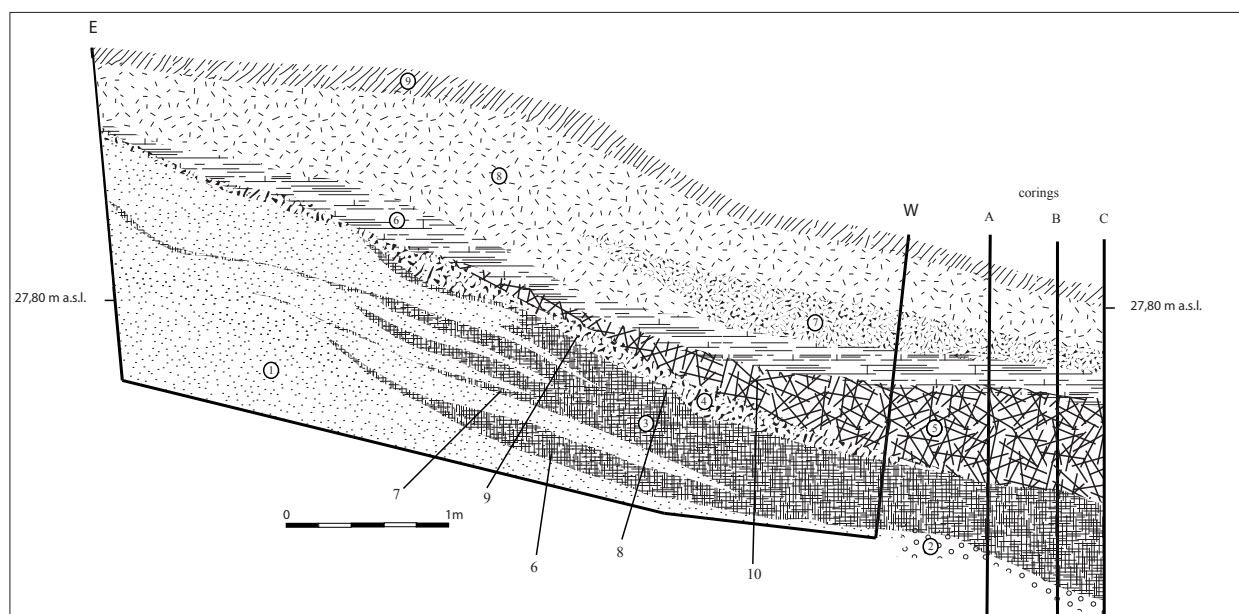


Fig. 3. Krzyż Wielkopolski, site seven. Trench 1/2007, section of the northern wall. After R. Schild, simplified (Kabaciński et al. 2008). 1 - medium to coarse alluvial sands of the lower Noteć terrace, partially laminated (10YR 6/4-7/3 to 10YR 6/2), no archaeological material recorded; 2 - coarse alluvial sands with gravels (10YR 5/1) and laminae of organic matter (thick detritus gyttja?), perhaps with charcoal (?), recorded in corings only; 3 - gyttja, from silty black (10 YR 2/1; dy?) in the channel, with numerous charcoal and charcoal dust, to fine- and thick-detritus gyttja in the beach zone (10YR 2/2), dark-brown. Artefacts of flint, bone and antler, as well as wood fragments, sometimes completely or partially charred, are interspersed within the gyttja. In the beach zone the gyttja can be divided into three main "tongues" which peter out toward the terrace and overlap with the beach sands; 4 - beach sands, greyish-brownish (10YR 3/2), with artefacts and charcoals; 5 - wood peat, brownish (5YR3/3) to grey-brownish (10YR 3/2) with detritus to the east. In the beach zone peat is sandy with numerous artefacts and charcoals; 6 - dark-grey peat, heavily decomposed, transformed into degraded paleosol in the beach zone and grey humus layer to the terrace. Numerous finds and charcoals; 7 - peat, dark-brown (5YR 3/1), heavily decomposed, dry and compacted. Numerous charcoals; 8 - ploughing layer, modern, dark grey - brown (10YR 3/2), composed of structureless, incompact sands with dry, decomposed detritus, artefacts and charcoals; 9 - black humic layer of modern initial soil.

Abb. 3. Krzyż Wielkopolski, Fundplatz sieben. Schnitt 1/2007, Ausschnitt der nördlichen Wand. Nach R. Schild, vereinfacht (Kabaciński et al. 2008). 1 - mittlere bis grobe Sande der unteren Noteć Terrasse, teilweise laminiert (10YR 6/4-7/3 to 10YR 6/2), ohne archäologische Funde; 2 - grobe Sande mit Schotter (10YR 5/1) und Lagen organischen Materials (Detritus-Gyttja?), vielleicht mit Holzkohle (?) (nur in Bohrungen erfasst); 3 - Gyttja, von tonig-schwarz (10 YR 2/1; dy?) im ehemaligen Flussbett mit zahlreichen Holzkohlen/Holzkohleflittern bis zu feiner und grober Detritus Gyttja in der Uferzone (10YR 2/2), dunkelbraun. In der gesamten Gyttja wurden Artefakte aus Flint, Knochen und Geweih sowie Holzfragmente, manchmal vollständig oder teilweise verbrannt, gefunden. In der Uferzone teilt sich die Gyttja in drei "Hauptzungen", die zur Terrasse auslaufen und mit den Ufersanden überlappen; 4 - Ufersande, grau-braun (10YR 3/2), mit Artefakten und Holzkohle; 5 - Holztorf, bräunlich (5YR3/3) bis grau-bräunlich (10YR 3/2) mit Detritus nach Osten. In der Uferzone ist der Torf sandig und enthält zahlreiche Artefakte und Holzkohlen; 6 - dunkel-grauer Torf, stark zersetzt, in der Uferzone umgebildet zu einem degradiertem Paläoboden und auf der Terrasse zu einer grau-humosen Schicht; mit zahlreichen Funden und Holzkohlen; 7 - Torf, dunkelbraun (5YR 3/1), stark zersetzt, trocken und kompakt. Zahlreiche Holzkohlen; 8 - moderne Pflugschicht, dunkelgrau-braun (10YR 3/2), bestehend aus strukturlosen Sanden mit trockenem, zersetztem Detritus, Artefakten und Holzkohlen; 9 - schwarz-humose Schicht der modernen, beginnenden Bodenbildung.

the recorded traces of Mesolithic settlement. There is no question, however, that the main settlement phase of the site is related to bed three.

Chronology

Site chronology is based on 11 AMS radiocarbon dates measured at the Poznań Radiocarbon Laboratory (Fig. 4). These dates were made on three different kinds of material and extracted from various contexts. The first series of dates - on charcoal - were taken directly from the northern wall of trench 1/2007 in order to provide a chronological frame for the main stratigraphic events. Of five samples three are related to bed three and date three main events ("tongues") in the development of that bed (Fig. 3): Whereas a sample (Fig. 3: no. 6) from the lowest "tongue" was dated to 8 520 ±100 calBC, one from the middle sub-

bed (no. 7) has provided a date of 8 430 ±90 calBC, and one from the upper "tongue" of bed three (no. 8) has been dated to 7 730 ±90 calBC. A fourth charcoal sample extracted from bed four (no. 9) dates to 7 590 ±30 calBC, and a final date (no. 10) from bed five is 7 220 ±80 calBC.

From the above results it is evident that 'gyttja' accumulations from bed three were deposited over a long period of time (a minimum of 800 calendar years), with initial deposition at the transition from the Preboreal to the Boreal period (around 8 500 calBC). The youngest date from bed three indicates that the development of the 'gyttja' was still in progress in the second half of the Boreal period. At around 7 600 calBC the deposition of beach sands (bed four) above the 'gyttja' stopped its further sedimentation. The development of wood peat (bed five) is related to the early Atlantic period (ca. 7 200 calBC).

Sample no.	Sample name	Lab. no.	Material dated	Age ¹⁴ C BP	Age cal BC	Remarks
1	Krzyż, stan. 7 inw. 26A	Poz-12336	collagen	8 520 ± 50	7 560 ± 30	Red deer antler adze from the pond. Fig. 6
2	Krzyż, stan. 7 inw. 26A/BIS	Poz-12593	collagen	8 530 ± 50	7 560 ± 30	Red deer antler adze from the pond. Fig. 6
3	Krzyż, stan. 7 inw. 26B	Poz-12337	wood	8 760 ± 50	7 820 ± 110	Wooden handle from red deer antler adze from the pond. Fig. 6
4	Krzyż, stan. 7 inw. 31/ CARB	Poz-12959	carbonate	8 660 ± 50	7 680 ± 60	Adze of metapodial aurochs bone; in situ. Fig. 5
5	Krzyż, stan. 7 inw. 32/ CARB	Poz-12919	carbonate	8 590 ± 50	7 620 ± 50	Adze of metapodial aurochs bone; in situ
6	Krzyż-7/2007/1	Poz-27405	charcoal	9 290 ± 60	8 520 ± 100	From layer 3 from the N wall of the trench 1/2007 (inv. no. 1/2007). For sample location - see Fig. 3
7	Krzyż-7/2007/2	Poz-27406	charcoal	9 210 ± 50	8 430 ± 90	From layer 3 from the N wall of the trench 1/2007 (inv. no. 4/2007). For sample location - see Fig. 3
8	Krzyż-7/2007/3	Poz-27487	charcoal	8 690 ± 60	7 730 ± 90	From layer 3 from the N wall of the trench 1/2007 (inv. no. 6/2007). For sample location - see Fig. 3
9	Krzyż-7/2007/4	Poz-27416	charcoal	8 560 ± 50	7 590 ± 30	From layer 4 from the N wall of the trench 1/2007 (inv. no. 9/2007). For sample location - see Fig. 3
10	Krzyż-7/2007/5	Poz-27418	charcoal	8 210 ± 40	7 220 ± 80	From layer 5 from the N wall of the trench 1/2007 (inv. no. 12/2007). For sample location - see Fig. 3
11	Krzyż-7/2007/6	Poz-27419	collagen	8 980 ± 50	8 150 ± 110	Zoomorphic object of red deer antler (bird?, elk ?) From layer 3 of the N profile of trench 1/2007. Found in situ in 2008 season. Fig. 10-11

Fig. 4. Krzyż Wielkopolski, site seven. AMS radiocarbon datings. Calibrated using CalPal_2007_HULU, March 2007 (B. Weninger & O. Jöris 2004; B. Weninger, O. Jöris & U. Danzeglocke 2007).

Abb. 4. Krzyż Wielkopolski, Fundplatz sieben. AMS-Radiokarbondatierungen, Kallibration mit CalPal_2007_HULU, März 2007 (B. Weninger & O. Jöris 2004; B. Weninger, O. Jöris & U. Danzeglocke 2007).

A second series of AMS dates were made directly on artefacts (Fig. 4), three of which were found during the 2005 and 2008 excavation seasons in bed three, which could not be directly correlated with the N-profile of trench 1/2007. The oldest date of 8 150 ±110 calBC was made on collagen extracted from a zoomorphic object of red deer antler. Two further measurements were made on carbonates from two adzes on metapodial aurochs bones (Fig. 5); these are 7 680 ±60 calBC and 7 620 ±50 calBC, and most probably represent minimum ages for these tools.

Three further dates are related to a red deer antler adze found during the excavation of the pond. A fragment of its wooden shaft was found still preserved, thus providing the opportunity for direct comparison of AMS datings on different materials (Fig. 6). For obvious reasons it is impossible to correlate directly the artefact to the stratigraphic sequence discovered in trench 1/2007. Two further measurements were made on collagen extracted from the antler adze itself, their radiocarbon ages differing by just 10 years (8 520 ±50 BP and 8 530 ±50 BP) but



Fig. 5. Krzyż Wielkopolski, site seven. Hammer adze made on metapodial aurochs bone, found in distinct stratigraphic position (drawn by J. Balcerzak).

Abb. 5. Krzyż Wielkopolski, Fundplatz sieben. Hammeraxt aus Ur-Metapodium, gefunden in eindeutiger stratigraphischer Position (Zeichnung: J. Balcerzak).



Fig. 6. Krzyż Wielkopolski, site seven. Hammer adze made on antler with remnants of a wooden shaft. Found when digging the pond (photo by M. Jórdeczka).

Abb. 6. Krzyż Wielkopolski, Fundplatz sieben. Hammeraxt aus Geweih mit Resten des Holzschafte, gefunden bei der Anlage des Teiches (Foto: M. Jórdeczka).

which after calibration gave an identical age of 7560 ± 30 calBC. However, the wooden shaft – 7820 ± 110 calBC – is ca. 250 calendar years older. This leads to two hypotheses: either the handle was made of a substantially older piece of wood, or the dates on the adze are too young, possibly suggestive of collagen rejuvenation processes as already observed at other

sites (Fiedorczuk et al. 2007). In a former publication (Kabaciński et al. 2008) we considered both these hypotheses equally likely; however, in the light of the more recent AMS dates for the stratigraphic sequence in trench 1/2007, we now consider the second hypothesis the more plausible. Similar problems have recently been discussed for AMS-dates from the Late Glacial period measured at the Oxford Radiocarbon Accelerator Unit. Bone samples treated by ultrafiltration pretreatment technique produced higher results than on the same pieces some time earlier (Higham & Jacobi in press). In the case of Krzyż the older date fits better with the stratigraphic position of the same kind of antler adze found in bed three of trench 1/2007 during the 2008 season, adjacent to the zoomorphic object dated to 8150 ± 110 calBC.

In summary, on the basis of stratigraphic and chronological data, we may expect initial Mesolithic activity at the Krzyż seven site as early as the Preboreal. Although no direct evidence of this occupation has been preserved (i.e. radiocarbon dated objects), this claim is supported by the observation of charcoal in bed two that is evidently older than the main occupation layer in bed three, which developed at the transition from the Preboreal to Boreal period. This earliest settlement phase is followed by a period with more evident occupation activity that coincides with the early stage of the Boreal at the latest, as



Fig. 7. Krzyż Wielkopolski, site seven. Hammer adzes and axe on antler, recovered during construction of the pond (photo by M. Jórdeczka).

Abb. 7. Krzyż Wielkopolski, Fundplatz sieben. Hammeraxt und Beil aus Geweih, gefunden bei der Anlage des Teiches (Foto: M. Jórdeczka).



Fig. 8. Krzyż Wielkopolski, site seven. Hammer adze made of aurochs radius bone. Found when digging the pond (drawn by J. Balcerzak).

Abb. 8. Krzyż Wielkopolski, Fundplatz sieben. Hammeraxt aus einem Ur-Radius, gefunden bei der Anlage des Teiches (Zeichnung: J. Balcerzak).

indicated by the direct AMS date on the antler zoomorphic object, and which continued through the Boreal. We may also expect some evidence of an early Atlantic settlement, as might be indicated by the presence of lithics and charcoals in bed five dated to that period, but this is still pending confirmation from further studies.

The finds

Finds include flint artefacts as well as tools made of organic materials, i.e. bone and antler, and waste from the manufacture of the latter. Lithics were recovered from all excavations, while bone and antler inventories include objects found accidentally in 2003 and during excavations.

Artefacts of bone and antler

Tools made of organic material include nine red deer antler hammer adzes and one antler axe, of which only one adze was found in a distinct stratigraphic context (Fig. 7); three hammer adzes made on aurochs bones, two of which were found in stratigraphic context (Fig. 5 & 8); one zoomorphic antler object; and a few dozen waste products, including antler and bone fragments, such as tines, ribs, long bones fragments and complete jaws or teeth. The material used for the production of the tool set required the exploitation of two different animals: red deer (*Cervus elaphus* L. 1758) and aurochs (*Bos primigenius* Boj. 1827). Whereas red deer is represented only by antler, the aurochs is noted by both radius and metapodial bones (Fig. 9 & 10).

Antler adzes were made from the base of the brow tine, a hole being perforated at the cut end, and the cutting edge placed parallel to the lesser diameter of the tine. Antlers from hunted males were used as well as cast-off pieces. One of the tools, a kind of blade axe, was made of a middle tine section. There is no doubt that adzes were produced on the spot. Adze

production technology, encompassing a number of stages, started with clearing all waste from the tines, followed by prepared breakage. Beams and tines were removed either by sawing or nicking (linear nicking of

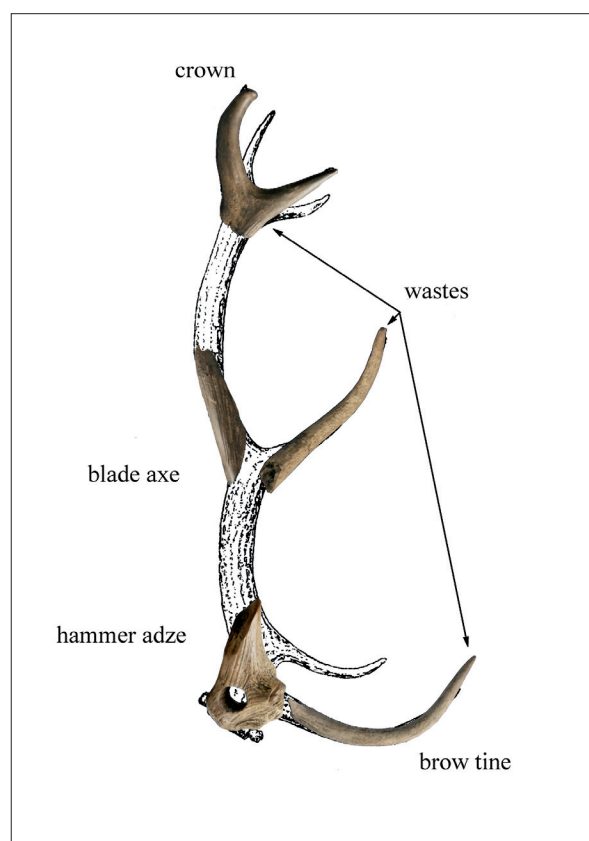


Fig. 9. Krzyż Wielkopolski, site seven. Drawing of deer antlers with superimposed photographs of objects from Krzyż Wielkopolski, illustrating the antler parts used by Mesolithic man (after E. David 2007; photos by M. Jórdeczka).

Abb. 9. Krzyż Wielkopolski, Fundplatz sieben. Darstellung von Rothirschgeweihen mit Einpassung der Objekte von Krzyż Wielkopolski, die die verwendeten Geweiheteile illustrieren (nach E. David 2007; Fotos: M. Jórdeczka).

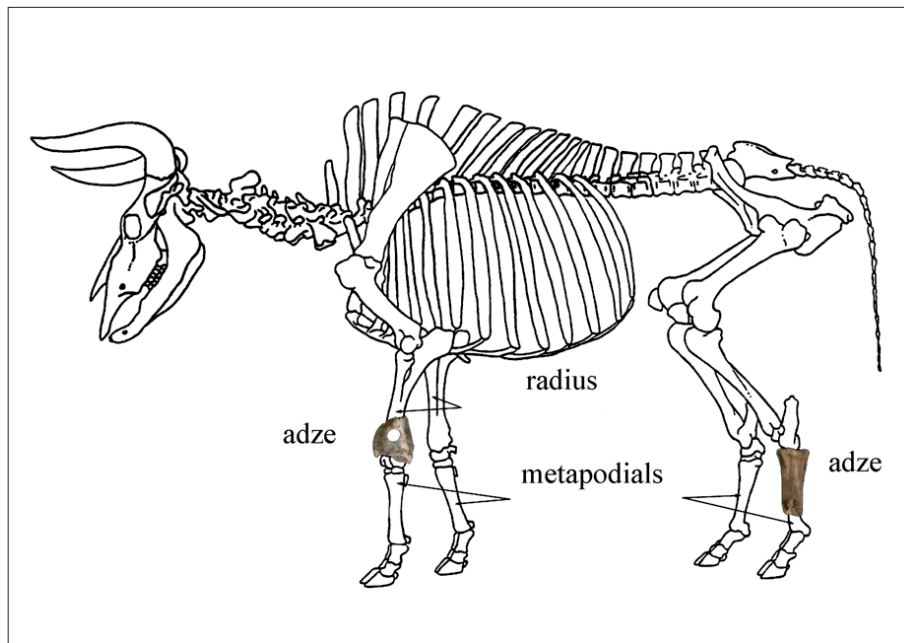


Fig. 10. Krzyż Wielkopolski, site seven. Drawing of the skeleton of an aurochs with superimposed photos of objects from Krzyż Wielkopolski, illustrating the skeletal parts of the animal used by Mesolithic man (after E. David 2007; photos M. Jórdeczka).

Abb. 10. Krzyż Wielkopolski, Fundplatz sieben. Darstellung eines Ur-Skelettes mit Einpassung der Objekte aus Krzyż Wielkopolski, die die verwendeten Skeletteile des Tieres illustrieren (nach E. David 2007; Fotos M. Jórdeczka).



Fig. 11. Krzyż Wielkopolski, site seven. Zoomorphic object made of red deer antler (photo: P. Szejnoga).

Abb. 11. Krzyż Wielkopolski, Fundplatz sieben. Zoomorphes Objekt aus Rothirschgeweih (Foto: P. Szejnoga).



Fig. 12. Krzyż Wielkopolski, site seven. Close-up of zoomorphic object made of red deer antler (photo by P. Szejnoga).

Abb. 12. Krzyż Wielkopolski, Fundplatz sieben. Nahaufnahme des zoomorphen Geweihobjektes (Foto: P. Szejnoga).

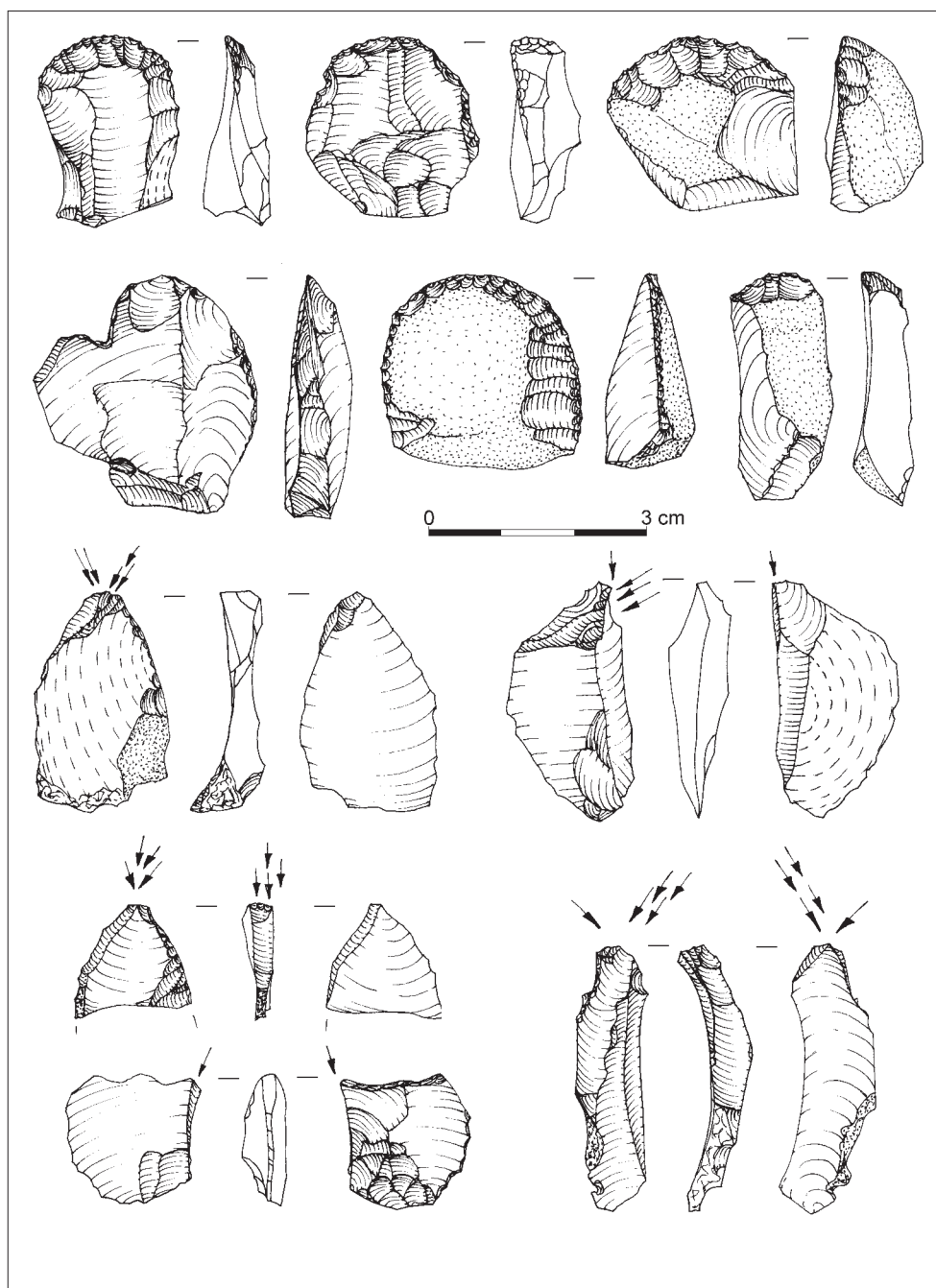


Fig. 13. Krzyż Wielkopolski, site seven. End-scrapers and burins (drawn by M. Józwiak).
 Abb. 13. Krzyż Wielkopolski, Fundplatz sieben. Kratzer und Stichel (Zeichnungen: M. Józwiak).

the antler with a stone tool around the circumference). This was a characteristic technique among Mesolithic communities in north-western Europe, albeit applied in a specific manner at the site in Krzyż Wielkopolski where the lateral antler ends were removed by making a groove on either side of the antler (David 2007). The holes, all perforated in the same way, differ depending on the material, being bigger if the antler had been cast off and smaller if it came from a hunted animal. All the cutting edges of the adzes were made in exactly the same way, that is, by a gradual thinning of the antler bone by scraping at an oblique angle (Kabaciński et al. 2008).

The site in Krzyż Wielkopolski yielded two types of tools made from aurochs bone: a hammer adze fragment from the distal part of the left radius bone and two hammer adzes from the metapodials. Having found no waste products it is uncertain whether these tools were produced on the spot. The radius-bone adze is extremely rare for this period, having been found so far almost exclusively in north-western Europe, e.g. at Hohen Viecheln in northern Germany and at Mullerup on Zealand, Denmark (David 2004). Complete examples are almost always decorated (see adze from Højby; Sørensen 1979: fig. 20).

A unique object was found during the 2008 season.

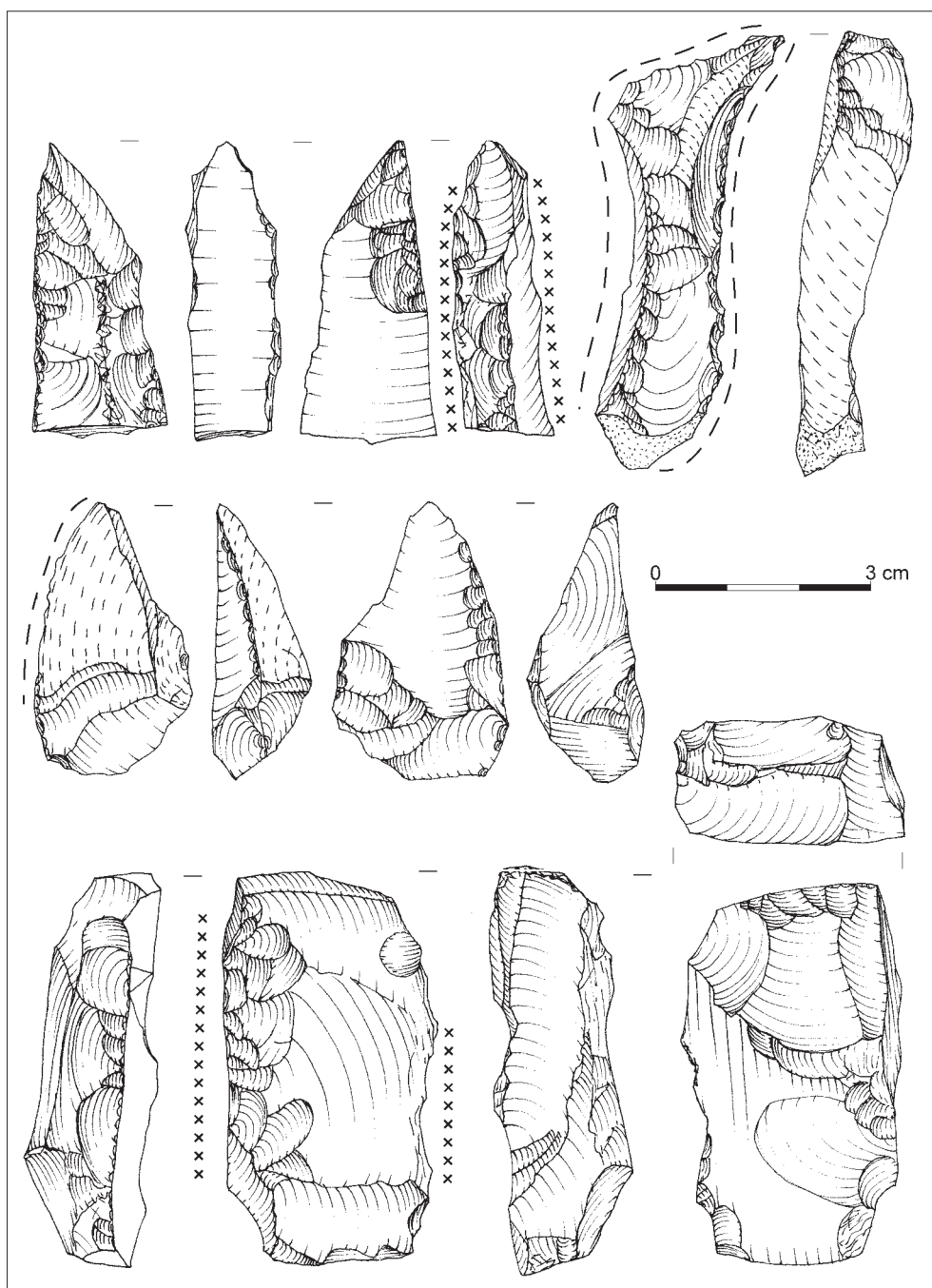


Fig. 14. Krzyż Wielkopolski, site seven. Flake axes and pices (--- traces of use; x x x – traces of hafting) (drawn by M. Józwiak).

Abb. 14. Krzyż Wielkopolski, Fundplatz sieben. Scheibenbeile und Pices (--- Gebrauchsspuren; x x x – Schäftungsspuren) (Zeichnungen: M. Józwiak).

It was made of a red deer antler cast-off and is in excess of 50 cm in length. It appears to be shaped into a zoomorphic creature with a carefully worked rose part and thinned brow tine. No other decoration was recorded on the piece except for a few cut-marks. This piece (Fig. 11 & 12) might be interpreted as either the representation of a bird or the head of an elk, although this is still open to debate. Be this as it may, there is no question that we are dealing with the oldest directly AMS dated example of early Mesolithic sculpture from the area of Poland (to $8\,150 \pm 110$ calBC).

Indeed, the elk has been a frequently recurring

motif in art from the lowlands since the Late Glacial, as is demonstrated by an elk amber figurine from Weitsche, Lower Saxonia (Veil & Terberger in press). Instances of Mesolithic art connected with the Maglemosian are known from the Pomeranian area, north of the Noteć river valley. For example, there are so-called "Magic sticks" of polished antlers decorated with geometric patterns and sometimes abstracts of animal or human figures from Ugoszcz, Szczecin-Grabowo and Szczecin-Podjuchy (after Galiński 1992; Kobusiewicz 1976); in fact it is highly likely that the specimen from Krzyż had a similar function. Further, a

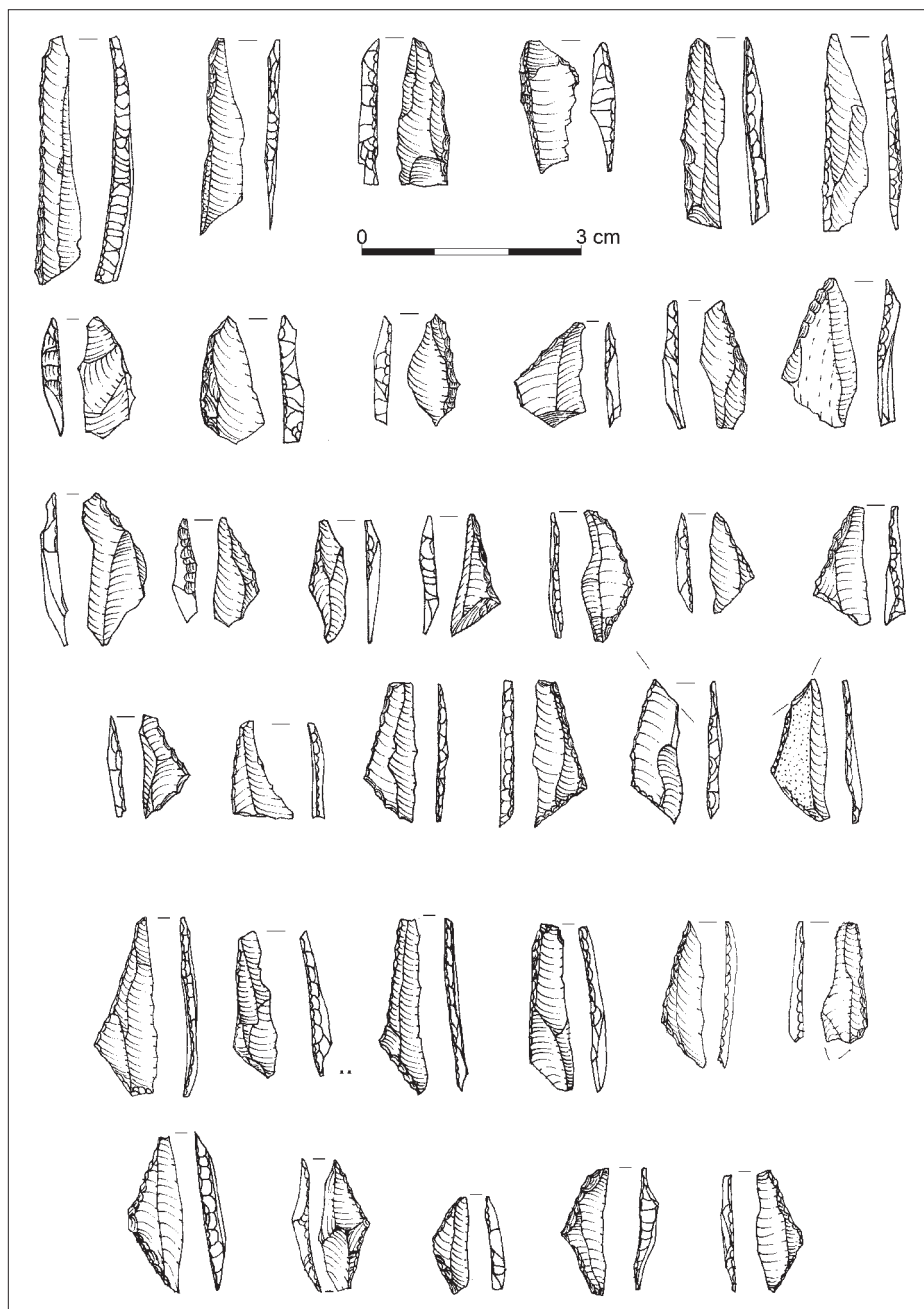


Fig. 15. Krzyż Wielkopolski, site seven. Microliths (drawn by M. Józwiak).

Abb. 15. Krzyż Wielkopolski, Fundplatz sieben. Mikrolithen (Zeichnungen: M. Józwiak).

large sculptured antler piece has also been discovered recently at the early Mesolithic site Ivanovskoe seven in the Upper Volga region (Zhilin 2006). On the other hand, there are also small figurative pieces of art made of amber. Such pieces (mostly representations of bears) are known from the western Baltic from Gdańsk, Dobiegniewo and Słupsk (after Kozłowski & Kozłowski 1977: table 70; Terberger & Ansorge 2000).

Flint industry

Lithic artefacts, of which over 8000 pieces have been recovered from the sandy terrace and from beds three to nine of the beach zone, are made solely on a locally available erratic Baltic cretaceous flint. This assemblage

includes close to 7500 pieces of debitage, 92 cores and core fragments, 493 tools and waste from tool production. The debitage encompasses mainly small chips, blades and flakes. Among the cores, which never exceed 4-5 cm in length, those used for striking blades and bladelets prevail insignificantly. Single-platform cores for blades are the most numerous, double-platform pieces and those with changed orientation being markedly rarer. Slightly less cores for flakes occur; the ratio of single- and double-platforms to pieces with changed orientation is rather similar.

The tool inventory includes different kinds of end-scrapers, numerous burins (Fig. 13), a small

number of perforators, groovers, borers and notched tools, retouched blades and flakes, flake axes and picks (Fig. 14), as well as numerous microliths (over 150). In the latter group, triangles are predominant; there are several backed points, mainly of the Stawinoga type (Kozłowski 1972: 18, tabl. Ia); lanceolate and Maglemosian points also occur. Microtruncations of Komornica type (Kozłowski 1972: 22, tabl. Ic) are also numerous (in Fig. 15 the last three pieces in the third row from the top and the first three pieces in the fourth row). A few dozen microburins and burin spalls are connected with tool production.

The relative chronology of the inventory can be established on the grounds of a number of features: the predominance of flake end-scrapers, coupled with a total absence of scrapers; big and typologically varied group of burins; a relatively large group of Stawinoga- and Maglemosian backed points; Komornica micro-truncations and various triangle points; and finally a large percentage of flake axes and picks. These characteristics place the Krzyż Wielkopolski occupation in the older Mesolithic, connecting it with the Maglemosian complex that influenced northern Poland from the Boreal Period (Bagniewski 1997). It fits well into the chronological framework of the occupation as indicated by AMS dating of the site.

Traseological analysis of 41 selected objects, mainly retouched blades picks and flake axes, has revealed mostly traces of processing antler, mainly scraping, more seldom cutting, boring and chiseling. Bone processing is rarer, mostly encompassing scraping and boring. Four tools show signs of having been used for wood working (for details see Kabaciński et al. 2008).

Final remarks

In the Boreal period, around the middle of the 9th millennium calBC, the north of Europe was divided into two areas in terms of bone tool production techniques. Whereas north-western parts of the continent are associated with "Maglemosian" traditions, in the northeast, in the circum-Baltic area, the Kunda culture was the dominant influence. The border between these two provinces runs from the Øresund strait in the north to the Vistula at the southern edge of the European Plain (David 2004).

Interestingly, no production waste related to hammer adzes from aurochs metapodials, so characteristic for the Maglemosian (culture) zone, is observed in the transitional zone. This could be either indicative of an exchange of finished Maglemosian tools into regions outside the scope of Maglemosian occupation, or it could suggest forays undertaken by Maglemosian groups into foreign territories. Here, the latter hypothesis appears more likely due to the lack of any products of the "Eastern" tradition this far west.

Further insights concerning this situation might be deduced from some of the finds made at Krzyż Wielkopolski where the hammer adzes from site seven were made of the same skeletal parts of an aurochs but using a technique different from that identified as Maglemosian. This could indicate a certain distinctness of the Mesolithic communities inhabiting the territory west of the Vistula compared to other cultural groups forming the Maglemosian complex, at least with regard to methods of bone and antler tool production (David 2007; Kabaciński et al. 2008).

In summary, site seven in Krzyż Wielkopolski has already contributed some important data for the analyses of territories and paths of communication during the Mesolithic. Already, at this very early stage of research, it has become a reference point for the basic description of the Early Mesolithic bone and antler industry of western and northern Poland. Previously existing and future direct AMS radiocarbon dating of bone and antler tools have permitted a precise localisation in time and respective of the appearance of specific tool types. Long series of Mesolithic bone and antler tools mean that we can now better understand the technology involved in production, both from an individual and regional perspective. This will create a basis for the reconstruction of cultural entities on the basis of bone and antler production, which could differ from previously observed divisions based on lithic assemblages. Finally, specific traditions of bone and antler production, combined with precise individual AMS dating, might tell us more about the dispersal of related technological ideas and facilitate the study of communication networks within large areas of Northern Europe related to the Maglemosian tradition.

The demonstrated research potential of Krzyż Wielkopolski, site seven stems not only from a unique and growing collection of antler and bone tools with production waste, but also from examples of an early Mesolithic art, together with a developed stratigraphical sequence from the Preboreal to Atlantic period. As such this site can be put on a par with Mesolithic sites like Star Carr and Friesack which are among the most famous sites from this period in the European Plain.

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