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MESOLITHIC ULNA "DAGGERS" FROM DĄBKI SITE 9 – ON THE TRACK OF THEIR FUNCTION

ABSTRACT

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So-called "bone daggers" made from ulna bones of Cervidae are commonly found at Late Mesolithic hunter-gatherer sites of the western circum-Baltic area. The main objective of this paper is to showcase the results of the technological and functional analysis conducted on three tools found at the Dąbki 9 site in northern Poland. During the traceological analysis, technological traces facilitated the reconstruction of the chaîne opératoire of the tools' production process. The use-wear also points to the probable function of the artefacts. The results presented in this work are discussed in the context of other artefacts of a similar type known from various pre-historic contexts.

Keywords: Mesolithic, bone tool, ulna dagger, traceology, experimental archaeology, Dąbki 9
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1. INTRODUCTION

During the excavations carried out at the site Dąbki 9 in northern Poland (Fig. 1: A, B), bone tools made of the ulna bones of large *Cervidae* (red deer and elk) were discovered (Fig. 1: C). Due to the shape of the anatomical element from which these tools were made (which suggests that they were used for stabbing rather than cutting), they were commonly named "daggers" (see Płonka 2003, 108, 109, and references therein). Generally, their morphology is characterised by a broad natural base (proximal end of the bone),

Fig. 1. A, B – The location of Dąbki Site 9; C – analysed ulna "daggers" (photo W. Ochotny)

which most likely served as a handle, and a sharpened blade (the distal end of the bone was removed and shaped into a more or less pointed tip).

This type of artefact belongs to the typical set of tools produced by the Late Mesolithic hunter-gatherers of the western circum-Baltic area (Andersson 2004). Usually, in literature, they are described as "typical multipurpose tools that could serve during butchering, hide cleaning, fish processing, *etc.*" (Kabaciński and Terberger 2015, 145). However, their function has never been studied microscopically.

The primary objective of this paper is to present the results of the traceological analyses of three ulna "daggers" discovered at Dąbki Site 9, Darłowo commune. The microscopic studies reported in this paper were conducted to determine the production methods and to interpret the possible function of the analysed artefacts. The results are discussed in the context of current knowledge about "ulna daggers" in prehistoric times.

1.1. Dąbki Site 9

Dąbki Site 9 is located on a terrace monadnock located near a peaty water body. In 1978-1984, the site was excavated by Jolanta Iłkiewicz from the Museum in Koszalin (Ilkiewicz 1989; 1997). In 2003, a Polish-German research team led by Jacek Kabaciński and Thomas Terberger resumed work at the site (Kabaciński and Terberger 2009; Terberger *et al.* 2009; Terberger and Kabaciński 2010; Czekaj-Zastawny *et al.* 2013). This work has covered the parts of the settlement on the island terrace and on refuse layers within today's peaty marginal zone. Rich flint and ceramic materials, bone and antler products, and numerous fauna and plant macro remains (confirming intensive hunting, fishing and food gathering) were obtained. The long series of radiocarbon dates hitherto obtained indicate a more than thousand-year period of the development of the settlement in Dąbki, covering the period between about 5100 BC (KiA-26388: 5960±32 BP) and about 3700 BC (Poz-27412: 4920±40 BP). The results of the previous studies confirm the presence of two primary development phases at the site, characterised by a hunting-fishing-gathering type of subsistence strategy. The first of them, falling in the 5th millennium, is associated with the settlement of Mesolithic communities. In contrast, the second phase, from the end of the 5th and the beginnings of the 4th to the middle of the 4th millennium, is associated with the local evolution and development of the Funnel Beaker culture (Kabaciński 2001).

2. MATERIALS AND METHODS

For the needs of the presented study, three artefacts were available for traceological analysis. All pieces were found during excavations led by Jolanta Ilkiewicz from the District Museum in Koszalin in the early 1980s (Ilkiewicz 1989; 1997). They are stored in the Museum in Koszalin under the inventory numbers listed in Table 1, which contains other

Table 1. General description of all analysed artefacts from site Dąbki 9

No	Site	Museum Inv. No.	Date of recovery	Context of the recovery	Dimensions (cm)			Element, species	Current holding
					lenght	width	thickness		
1	Dąbki 9	MK/A/2621/1:1	1980	WKT II/80	15	7	4	Ulna bone, elk (*Alces alces*)	Museum in Koszalin
2	Dąbki 9	MK/A/2799/1:4	1985	WKT I/85	13	6,4	3,1	Ulna bone, red deer (*Cervus elaphus*)	Museum in Koszalin
3	Dąbki 9	MK/A/2685/5:1	1981	WKT III/81	15,5	6	3,2	Ulna bone, red deer (*Cervus elaphus*)	Museum in Koszalin

basic information about the analysed artefacts. These objects are dated to the 5th millennium BC, associated with the settlement of Mesolithic communities at Dąbki 9 (see Kabaciński and Terberger 2015).

Initial traceological observations of the general state of preservation of artefacts and technological and use-wear traces were made using a Nikon SMZ–745T microscope with a magnification range of ×10 to ×63, fitted with a Delta PixInvenio6EIII camera. The photographs presented in Figs. 2: A-C, 3: A-C, and 4: A-C were taken with this equipment. Images of the use polish were recorded using a Zeiss Axioscope 5 Vario microscope fitted with an Axiocam 208 camera. This allows obtaining objective magnifications up to 50× (actual magnifications up to 500×). The photomicrographs of Figs. 2: D-J, 3: D-J and 4: D-K were made with this equipment.

The location, morphology and distribution of micro-wear on the artefacts' surface was recorded. The possible use of the implements for various activities and processing of different types of materials, for example, wood, soil and hide, was verified by comparative analyses of micro-wear traces observed on experimental bone and antler products from former experiments that can be found in the Institute of Archaeology NCU in Toruń (*e.g.*, Orłowska and Osipowicz 2017).

The terminology used for characterising the patterns observed through microscopic observations was based mainly on criteria established in the traceological and archaeological literature concerning osseous artefacts (*e.g.*, Legrand 2007; Buc 2011; Orłowska 2016) that was adjusted to the needs and requirements of the present study.

3. RESULTS OF TRACEOLOGICAL ANALYSIS

3.1. Results of technological studies

The identified technological traces are similar on all of the analysed artefacts. The proximal end of the bone was left in its natural form and was not modified in any way. The

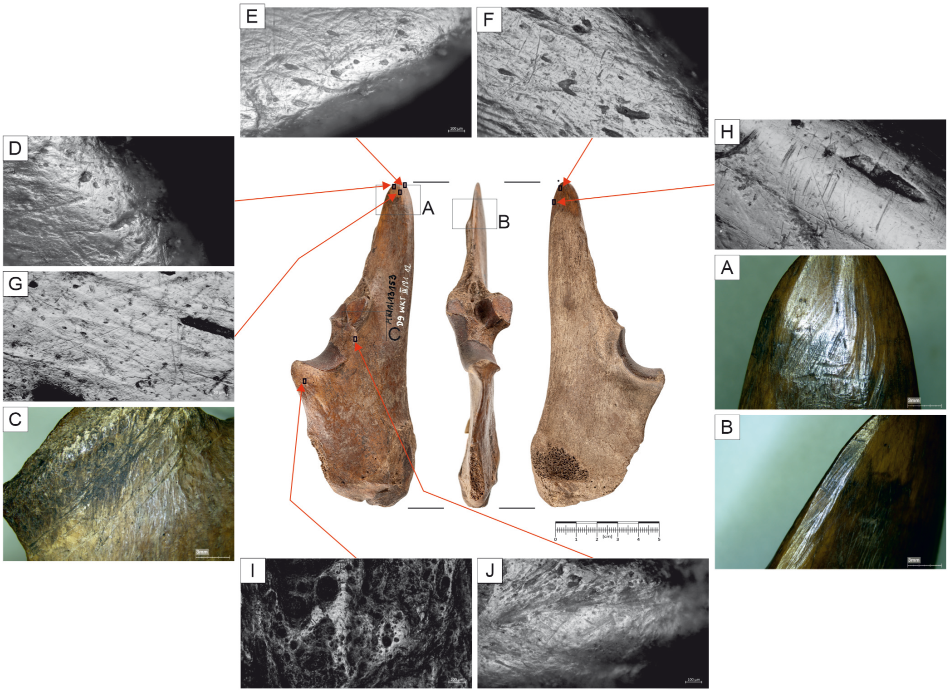

Fig. 2. Dąbki, Site 9.
Examples of the technological (A-C) and use-wear (D-J) traces discovered on the ulna dagger

visible difference in the morphology of the proximal part of the bone between Specimen 1 and two other ones (Fig. 1: C) is because we have the wholly preserved olecranon in the first case. In contrast, this part of the epiphysis has not been preserved in the other two cases.

The distal end of the ulna was removed in each case to create a sharp edge on the shaft of the bone. Due to the extensive processing of this part of the bone, we cannot determine whether the unwanted fragment was broken off or cut off to create the blade. However, in this case, a simple fracture was a more practical choice and partly gave a sharpened shape to the fractured bone. The basic techniques for shaping the artefact’s pointed end were based on whittling and scraping bone surfaces along the bone axis (Figs. 2: A, 3: A, 4: A). Scraping traces appear mainly as linear bands of variable width and depth. In most cases, these comprise a series of parallel striae of varying sizes. Traces of scraping/whittling preserved on distinct surfaces are characterised by the presence of ‘ridges’ of the worked surface (Fig. 2: B). Moreover, in many places, the so-called ‘chatter marks’ (traces typical for whittling activity) were preserved, *i.e.*, singular perpendicular lines occurring at regular intervals, most often resulting from a flint tool being forcefully passed across the worked surface (Figs. 3: B, 4: A; compare Olsen 1984; Orłowska 2016).

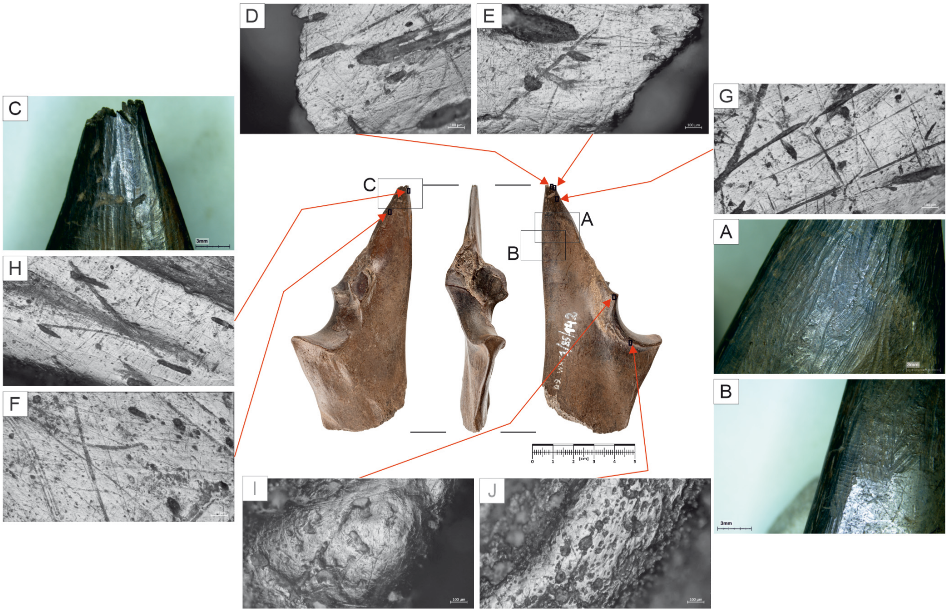

Fig. 3. Dąbki, Site 9.
Examples of the technological (A-C) and use-wear (D-J) traces discovered on the ulna dagger

Besides scraping and whittling, single-cut marks were also identified (Figs. 2: C, 4: C), mainly near the olecranon and the surface initially connected with the radius bone (places where ligaments and muscles were attached to the bone). These cuts were probably associated with cleaning the bones to make them ready for use. No other intentional surface transformations that could indicate the use of tools for processing the described items were recorded on their surface.

3.2. Results of functional studies

The microscopic analyses allowed the author to identify visible use-wear traces on the "daggers". In Specimen 1 (Fig. 1: C), looking with the naked eye, it is possible to see that the tip of the tool is slightly rounded and glossy. There is polish covering the whole surface of the tip of the tool and is most invasive at a distance of about 2-3 cm. Observed polish destroys (smoothens) the underlying technological traces very invasively (Fig. 2: A). Analysis under the higher magnifications shows that the polish is bright, and the micro-topography of the tool surface in that place is homogeneous (basically flat), leaving only the deepest parts of the bone unpolished (Fig. 2: D-F). Micro-relief is regular; high point topography is flat and smooth. Identified polish is accompanied by linear traces whose characteristics vary in different parts of the specimen. On the flat surfaces of the working edge, the distri-

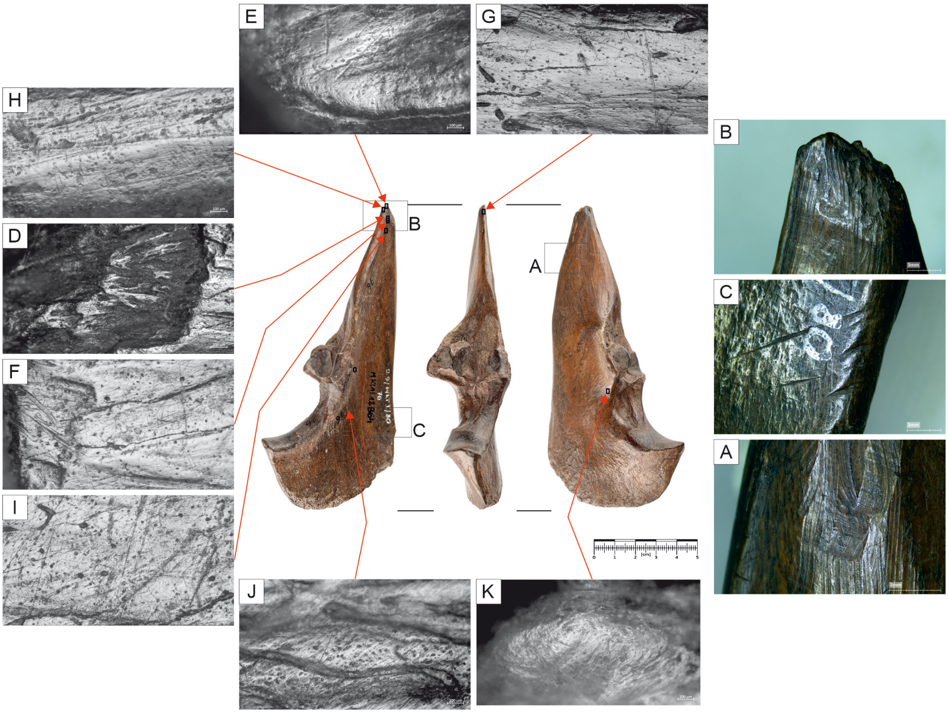

Fig. 4. Dąbki, Site 9.
Examples of the technological (A-C) and use-wear (D-K) traces discovered on the ulna dagger

bution of the linear traces is random, and they are arranged irregularly to each other (Fig. 2: G). Towards the sides, striations become more frequently parallel and transversally orientated to the axis of the tool (Fig. 2: H). Looking towards the distal end of the bone (at the base), well-developed polish and "etching" of the surface associated with holding the specimen in the hand were identified. In all cases, observed use-wear has heterogeneous micro-topography, irregular micro-relief, and flat, smooth high points (Fig. 2: I, J). This is associated with many prominent pits and craters (osteons and osteocytes). Multidirectional, often crossed, striations also accompany the identified polish.

Almost analogous use-wear traces were observed on Specimen 2 (Fig. 1: C). Unfortunately, in this case, the dagger blade is not entirely preserved. Its tip is broken; however, the fracture is "fresh" and must have occurred at the time or after the discovery of the artefact. Nevertheless, the microwear traces are consistent with those observed in Specimen 1. The traces of use overlap the blade at a length of about 3 cm. The micro-topography of the working edge is homogeneous; only the deepest parts of the bone are unpolished (Fig. 3: D, E). Micro-relief is regular; high point micro-topographyis primarily flat and smooth. Observed linear traces are mostly multidirectional. The morphology of the traces is the same along almost the entire length of the working surface (Fig. 3: F). However, closer to the side edges of the blade, the observed linear traces seem more parallel to each other (Fig. 3: G, H). Also, in this case, traces of use were identified on the proximal part of the bone. The identified polish has heterogeneous micro-topography, irregular micro-relief, and flat, smooth high points (Fig. 3: I, J) and is accompanied by multidirectional, varied in size but mostly very delicate striations.

The traces of use recorded on the last of the analysed items coincide with those described for the two previous objects. The only significant difference is that, in this case, we are dealing with a damaged tool (broken tip) that was repaired and used further. Traces of re-sharpening of the tip are visible in the form of scraping of the broken tip's surface (Fig. 4: B). After sharpening, the tool was still used, as evidenced by traces of use registered on the re-sharpened tip (Fig. 4: D). As before, the use-wear traces are characterised by regular micro-relief, with flat and smooth morphology of the high points (Fig. 4: E-G). Linear traces are mostly multidirectional. Towards the sides, striations become slightly more parallel and transversally oriented to the tool axis (Fig. 4: H). Further from the tip, the use-wear traces retain their morphology; however, they are slightly less developed (Fig. 4: I). As with the two previous tools, on the proximal part of the bone, well-visible use-polish was identified (Fig. 4: J, K).

3.3. The experimental programme

The origin of the use-wear traces observed on the ulna "daggers" from site Dąbki 9 was interpreted against a reference collection of tools made of osseous materials stored at the Institute of Archaeology at Nicolaus Copernicus University in Toruń. Additionally, some new experiments were conducted associated with hypothesised functions from literature of this type of tool. During these experiments, the osseous tools were used for cutting fish and removing bark from deciduous and coniferous trees to obtain the bast.

Four large fresh tench fish (genus *Tincatinca*) were prepared for the needs of the fish-cutting experiments. The experiment was conducted as fish remains are a significant part of the collection of bones from the Dąbki 9 site (Zabilska-Kunek *et al.* 2015). Moreover, some researchers link ulna "daggers" to fish processing and suggest that they could have been used "to open the flesh to cut fish skin from the inner side (removing the eggs?)" (David 2015, 161). The experiment began with an attempt to cut the fish with a bone dagger from the ventral side. Unfortunately, this attempt failed. The blade was unable to cut through the fish skin. It was, therefore, decided to make an incision with a flint blade to facilitate fish processing. From that moment on, the experimental dagger was used to remove the entrails and separate the fish skin from the meat (Fig. 5: A). Unfortunately, due to the work's low efficiency, the test was terminated after 30 minutes.

The experiments with the debarking of the trees were based on the characteristics of the wear traces observed on the bone tools and archaeological data, as well as suggestions about possible methods of using analogous morphological forms by prehistoric and modern

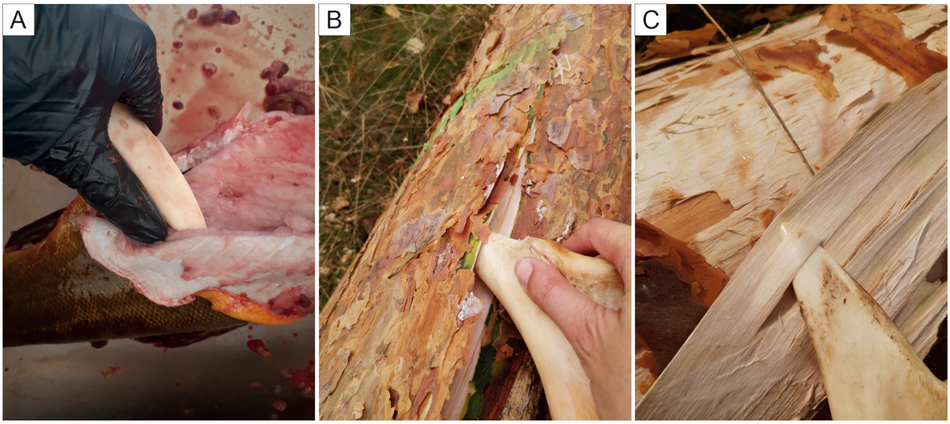

Fig. 5. Experimental work:
A – fish-slitting; B – debarking coniferous tree; C – separating bast from a fresh coniferous tree

archaic communities (*e.g.*, Keddie 2012). For the needs of this experiment, two tools were prepared from elk ulna. One tool was used to remove bark and separate the bast from the fresh coniferous tree (pine; Fig. 5: B, C), and the second was used for a deciduous tree (lime). Each tool was used for an hour. The tools proved highly effective. It should be noted that during the debarking process, the trees started to release a significant amount of plant juices, and in the case of coniferous trees, resin was also present. As a consequence, the surface of the experimental tools became coated with these juices, extending beyond just the working edge to other parts of the tools.

3.4. Use-wear observed on the working edges of experimental tools

The microscopic analysis of the tool's working edge used to cut fish showed that the tool's surface was modified mainly on the highest points of the bone's micro-topography. The polish is dull; it has a heterogeneous micro-topography. Micro-relief is irregular; high points are slightly rounded and have a rough texture. The polish is accompanied by sparse, delicate linear traces arranged irregularly to each other (Fig. 6: A).

The situation looks different when we examine the tools used to debark trees. The traces made on tools working on deciduous and coniferous material have a similar morphology. The polish is bright, and it has, in general, homogeneous micro-topography. Micro-relief is regular, and high points are flat but have a rough texture (Fig. 6: B, C). The distribution of striations is random. They are variable in size; at the tips of the working edges, they are narrower, but further from the tip, they begin to be broader and deeper and mostly crossed, irregular aligned to each other. On the sides of the working edge, striations are more parallel to each other and transverse to the axis of the tool (Fig. 6: C: b).

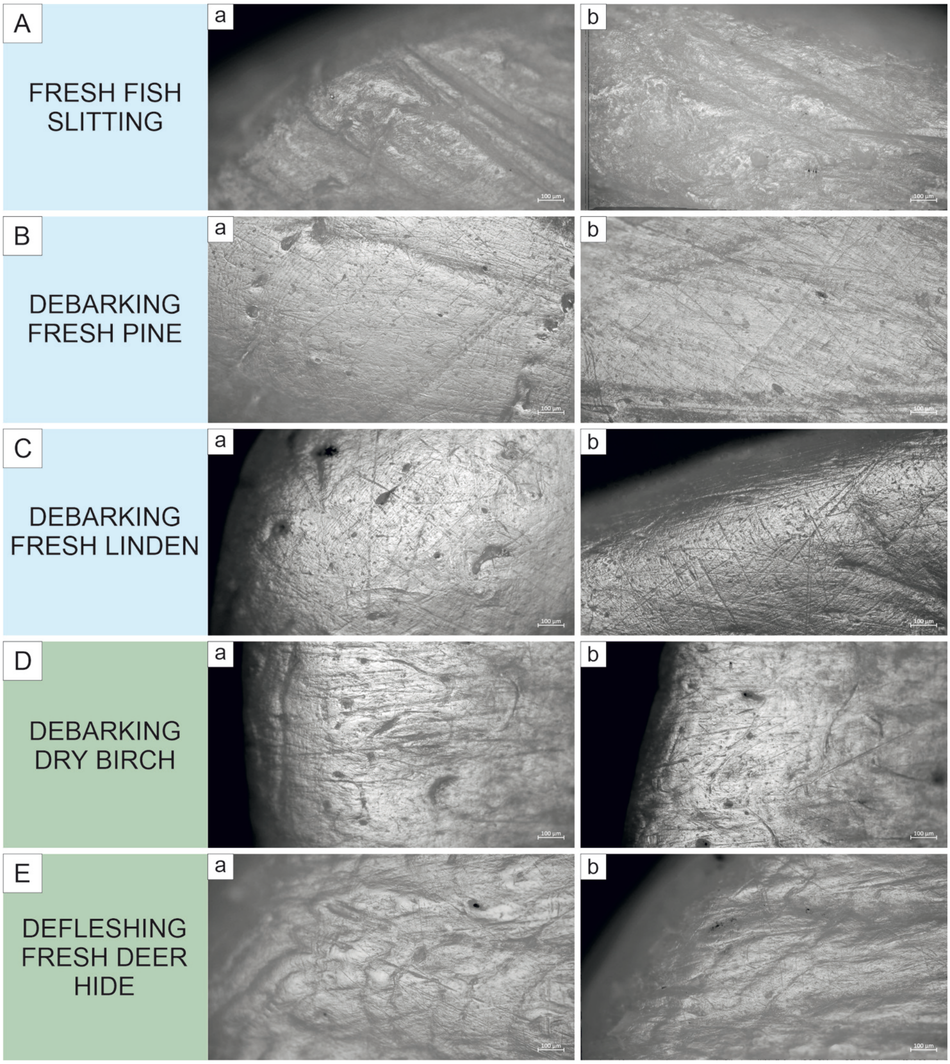

Fig. 6. Examples of use-wear traces on bone tools resulting from contact with various materials (photo J. Orłowska)

4. DISCUSSION

In prehistoric Europe, the vast majority of ulna "daggers" made from red deer or elk bones have been discovered in Denmark, at Late Mesolithic sites such as Bloksbjerg, Level D, Dyrholm I and Kolind, Layer I (Mathiassen *et al*. 1942, 71,73; Andersen 1972, 97; Brinch Petersen 1973, 105, fig. 4) dated to the early stage of the late Atlantic period. "daggers" found at the Ertebølle site (about 4710-3800 BC), Ralswiek-Augustenhof (about 4450-4120 BC) and Sølager (about 4490-4250 BC) came from the late stage of this period. Similar artefacts from Nivå and Kolind, Layer III, are broadly dated to the late Atlantic period (Płonka 2003, 109). However, single specimens were also found at Mesolithic sites dated to the Boreal period like Mullerup 1 in Denmark (Sarauw’s Island; David 2005, 479, pl. 5: 9); Hohen Viecheln, Horizon C (David 2005, 516, pl. 42:10) and Friesack 4, Phase II in Germany (David 2005, 529, pl. 55: 12). Single discovered specimens have ornaments engraved on their surface. Usually, these are motives composed of fine, skilfully incised lines (Płonka 2003, 108-109). In the case of the Polish territories, we have data on only eight such artefacts, the ones from Site 9 in Dąbki, Darłowo commune (Ilkiewicz 1989; 1997; Kabaciński and Terberger 2015). Using ulna bones from other animal species, *e.g.*, *Ovis/Capra* or *Bos taurus*, to make analogous morphological tools is also known from later periods. A good example is the Italian sites Farneto and Sa Osa, dated to the Late Copper Age (Thun Hohenstein *et al.* 2020). In addition, tools of this type were widely used outside Europe. Rich collections of them come from, *e.g.*, North America, where analogous forms made from red deer were utilised by Paleo/Archaic Native Americans (*e.g.*, Keddie 2012).

In the literature, numerous suggestions regarding the function of Mesolithic ulna “daggers” can be found. One of the earliest references to them dates back to the first half of the twentieth century, suggesting that due to their shape, the nature of the working edge, and their size, they were most likely tools used for stabbing (Westerby 1927; Mathiassen *et al.* 1942; Płonka 2003, 108, 109). Over time, it began to be suggested that they are most likely multipurpose tools (Kabaciński and Terberger 2015, 145). Some researchers linked them to fish processing (David 2015, 161). Interesting information in this regard is also provided by researchers focusing on materials from Paleo/Archaic Native American contexts from Northern America. Among the potential functions that tools of this type could fulfil, suggestions include those associated with piercing holes in various materials, cutting fish, splitting bark, and pressing fibres (Keddie 2012). Other interpretations connect these tools with digging (Griffitts 2001, 187), working in wood, or bark stripping (Penders 1997, 136, 158).

Despite the relatively large number and versatility of the studies carried out so far, the contemporary knowledge of the probable function of these objects still needs to be completed. The problem arises primarily from the need for a more detailed characterisation of the damage observed on these tools, which should be made through a proper microscopic use-wear analysis. In the context of prehistoric tools from Europe, use-wear analysis of ulna “daggers” was recently published regarding tools from the Copper Age sites Farneto and Sa Osa. Results showed that pointed ulna tools discovered at these sites were probably used to pierce animal hides (Thun Hohenstein *et al.* 2020). Unfortunately, no such analyses have been made in the context of tools found at Mesolithic sites until now.

In the case of the analysed tools, we can reconstruct only a part of the activities associated with their production, mainly related to their shaping and finishing stage. No unambiguous traces could be seen on any of the specimens, which could be the remains of, for example,

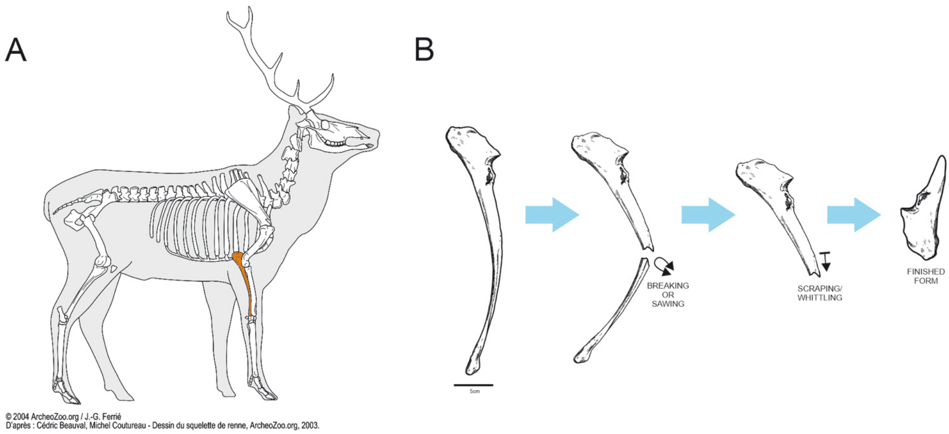

Fig. 7. A – a deer skeleton and a schematic representation showing the skeletal elements used to produce ulna "daggers"; B – an operational chain illustrating the probable steps in making ulna "daggers"

bone splitting to obtain the appropriate semi-finished product, which results from the intense processing of the distal part of the bone in further stages of its processing. For this reason, we are unable to say whether the removal of the unwanted part of the bone consisted of breaking or sawing it off (Fig. 7). After obtaining the appropriate fragment of the partially finished product, the tools were given the required shape as a result of surface treatment of the distal bone fragment using two basic techniques: scraping and whittling. Entire objects were not subjected to this treatment, but only their specific fragments, *i.e.*, blades. This way of treatment and the techniques used find analogies among other products of this type from Mesolithic contexts (see, for example, David 2005). What is interesting from a technological perspective is that it was not possible to identify grinding marks on the analysed artefacts. This technique was, however, observed on the other three ulna "daggers" from this site that were discovered after the resumption of excavations in Dąbki 9 in 2003 (Kabaciński and Winiarska-Kabacińska 2023).

The use-wear traces observed on the Dąbki "daggers" are similar to those observed on experimental tools used for processing plant materials. At the same time, they differ from the traces observed on experimental tools used to gut fish (Fig. 6: A) or those used in defleshing animal hides (Fig. 6: E). The degree of intrusion of the observed polish, its morphology and the accompanying linear traces indicate that these objects were not used to stab, pierce or drill a given raw material. The activities performed with them were related to levering and separating parts and layers of worked material. Similar traces were identified on tools used during experimental work for debarking trees (Fig. 6: B, C, D). Differences in intensity and nature of polishes on tools used to work plant materials like wood can be seen as a result of the diversity of hardness and moisture of the raw material, which depends, among other things, on its species. Another significant factor is the devastating effect of organic acids in hemicellulose, which occurs in higher levels in young wood (Krzysik 1997, 120-122). That is the reason why the surface of the tools can be slightly etched on the areas adjacent to the surfaces in direct contact with the processed raw material. The tool's surface was covered by the vegetable juices that were released during processing. Additionally, this effect may be enhanced by post-depositional effects in the environment in which the artefacts were deposited (Orłowska 2018).

In the Dąbki 9 site, there are many indications that bark was an important raw material for the people using it. In 2011, large remnants of bark, measuring c. 4.0 × 1.8 m, with numerous traces of cutting and grooving, were recorded in the peat-bog close to the beach zone. They are interpreted as remains of a bark canoe flattened by the pressure of about 1 m of overlying sediments (Czekaj-Zastawny *et al.* 2013). The bark, about 4 cm thick, came from pine or spruce (Kabaciński and Terberger 2015, 150, 151). The collection of bark at the site is also evidenced by, among others, a unique find of a double cord string, c. 30 cm long, made of the phloem of lime tree bast, which was found in the upper part of the Late Mesolithic layer (Kabaciński and Terberger 2015, 148).

Considering the previously quoted information regarding the purpose of this type of tool (*e.g.,* Thun Hohenstein *et al.* 2020), it can be assumed that they could be used for multiple activities. However, in the case of the three tools analysed here, we are dealing with one analogous way of using them. Traces associated with holding them in the hand were also identified on each archaeological specimen. However, handling wear was sometimes difficult to distinguish from use-wear documented on the pointed edge of the tool. Nevertheless, we must remember that hands are not sterile during work. Experimental work proved that, during debarking, fresh trees begin to release juices or even resin. This, in turn, causes intense hand soiling and the transfer of wood acids to the parts of the tool held in the hand. Thus, the visible traces may be challenging to distinguish from the damage visible on the usable edges.

To summarise, it is highly probable that the use-wear traces observed on the ulna "daggers" from the Dąbki 9 site were formed by contact with plant material. The repeatability of the observed use-wear traces and the very form of the tools may suggest that they could constitute some specialist tools related to performing a specific type of activity. However, to fully understand the purpose of the discussed type of objects, it would be necessary to carry out traceological analyses for other artefacts of this type known from Mesolithic contexts.

CONCLUSIONS

This research is the first detailed traceological analysis of ulna "daggers" discovered at Site 9 in Dąbki, Poland. It is worth noting the high uniformity in the technological procedures employed during the production of the discussed type of artefacts. Simultaneously, their degree of standardisation – limiting activities to only those necessary to achieve the goal of forming the working edge of the artefact – is noteworthy. The functional analyses carried out, in turn, made it possible to conclude with high probability that the analysed tools from Dąbki were used to work plant material, probably for debarking trees. Traceological studies of this type of artefact should be considered prime research postulates in future studies on using osseous raw materials by hunter-gatherer societies in prehistory. Undoubtedly, many researchers automatically assume the function of this type of artefact, based mainly on their shape, forgetting that actual interpretation of their function is impossible without proper traceological analysis. The presented study shows how much precious information we can obtain and how easily we can verify the ideas of others, which are very often reproduced unreflectively in the literature.

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