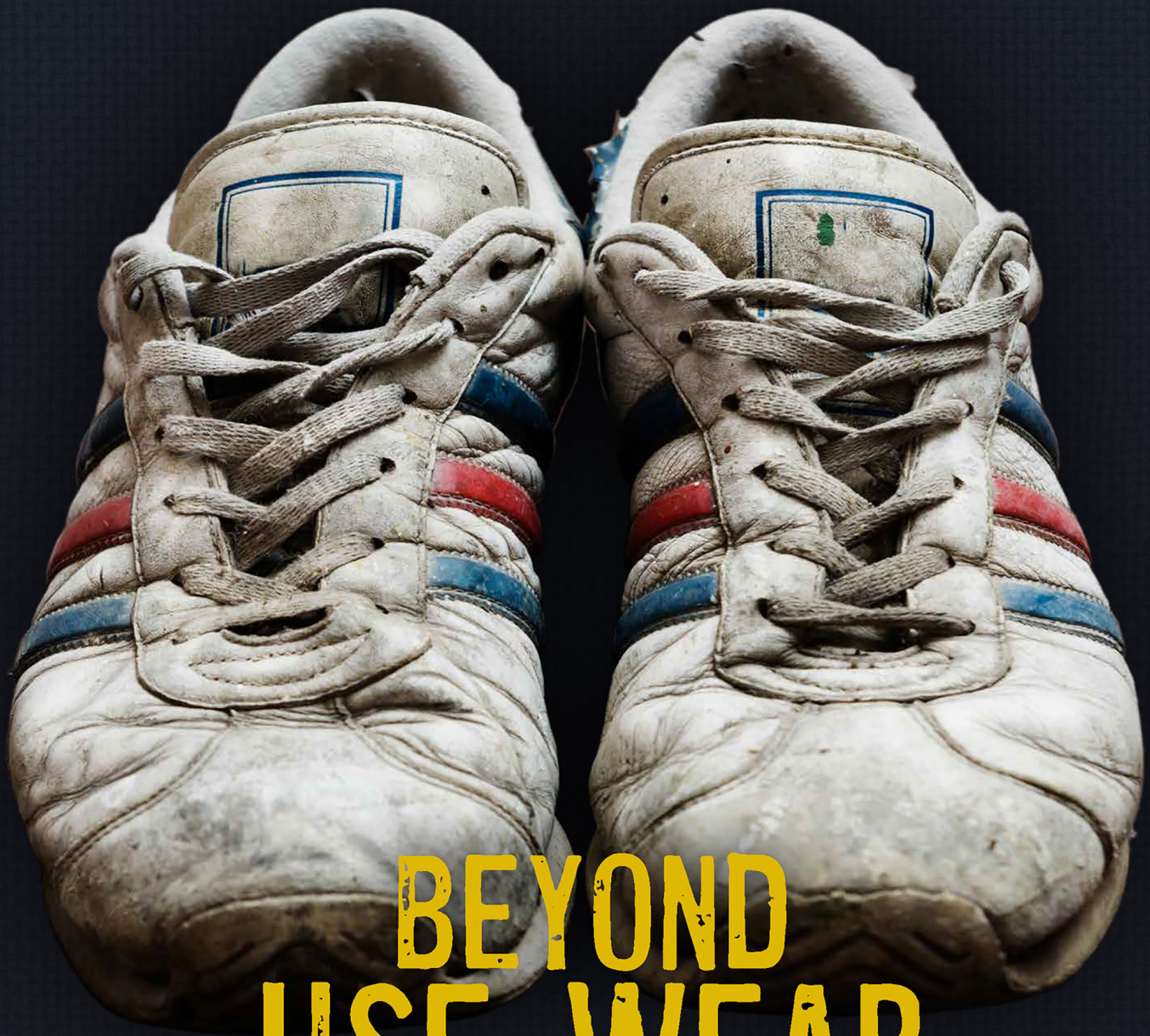

# BEYOND USE-WEAR TRACES

## GOING FROM TOOLS TO PEOPLE BY MEANS OF ARCHAEOLOGICAL WEAR AND RESIDUE ANALYSES

SYLVIE BEYRIES, CAROLINE HAMON
& YOLAINE MAIGROT (EDS)

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Published by Sidestone Press, Leiden
www.sidestone.com

Lay-out & cover design: Sidestone Press

Photograph cover: Stock media provided by Hitdelight/Pond5

Photographs sections: Stock media provided by Levkr, Martinotero, Maselkoo99/Pond5

ISBN 978-94-6426-000-7 (softcover)
ISBN 978-94-6426-001-4 (hardcover)
ISBN 978-94-6426-002-1 (PDF e-book)











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## AWRANA IN PICTURES

# Wild boar tusk artefacts from peat bog sites of north-western Russia and north-eastern Belarus (4th-2nd millennia BC): technology, function, context

Anna Malyutina and Maxim Charniauski

**Abstract**

In this paper, we present the results of experimental – traceological analysis of artefacts made from the tusks of wild boar (*Sus scrofa*), which are a significant feature of collections of remains from the peat bog sites of the north-western Russian plain (Upper and Middle reaches of the River Western Dvina (Daugava) and River Lovat'). Material from six sites was selected for analysis, relating to the 4th-2nd millennia BC (from the Middle Neolithic to the beginning of the Bronze Age). Due to the good state of preservation of the exterior surfaces of these objects, unique information could be obtained concerning methods of raw material processing and the usage of artefacts made from wild boar tusks. As a result of our analyses, we could reconstruct the technology of production of preforms and their subsequent processing.

For reliable identification of the technological and functional macro- and micro-traces found on the archaeological material, we carried out dedicated experiments on manufactured and utilised wild boar tusk artefacts. Following this study, all of the selected archaeological material (115 artefacts) was divided into seven techno-functional groups, representing a wide spectrum of the domestic activities of hunter-gatherers. The functional variation and variation in the form of the artefacts, seen together with standardisation of the primary methods of raw material processing, is an interesting cultural and territorial characteristic, showing temporal and geographical continuity.

*Keywords: North-Western Russian plain, Neolithic, Early Bronze Age, peat bog settlements, pile-dwelling settlements, boar tusks, technology, primary treatment, function, experiment*

in: Beyries, S., Hamon, C. and Maigrot, Y. 2021. *Beyond Use-Wear Traces: Going from tools to people by means of archaeological wear and residue analyses*. Leiden: Sidestone Press, pp. 211-224.

## Introduction

The wild boar (*Sus scrofa*) (proportion of faunal remains: 11.8-13%), together with such animals as the elk (*Alces alces*) (41-62.3%) and the brown bear (*Ursus arctos*) (8.6-14.1%) was a principal alimentary and raw material resource for hunters of the middle to Late Neolithic and the beginning of the Bronze Age on the territory of the north-western Russian plain (Upper and Middle reaches of the River Western Dvina and River Lovat') (Sablin *et al.* 2011; Razluckaya 2010). This is demonstrated not only by numerous remains of wild boar, but also by various tools made from the long bones and teeth of this animal (Malyutina and Sablin 2014; Charniauski 2007; Mazurkevich *et al.* 2010; Rimantiene 2005; Vankina 1999). In this article we focus on the material from the sites of the Kryvina peat bog in the Republic of Belarus (Asaviec 2, Asaviec 7, Kryvina 1, Kryvina 3) and finds from excavations of peat bog sites in Russia (Usviaty IV, Dubokray V).

Utilitarian and non-utilitarian artefacts made from wild boar tusks constitute a distinct category in the collections from the six sites of this region. Specially prepared preforms-plates-were used for the creation of artefacts from this tooth, which were then transformed into various artefacts by secondary treatment. The methods of creation and further use of these artefacts are the subject of the present article.

## History of investigation, dates and materials

The peat bog site of Usviaty IV (fig. 1) on the shore of Usviatskoe lake (Pskov region, Russia) is a key site for the study of archaeological cultures of the Upper reaches of the River Western Dvina and River Lovat' (Miklyaev 1971). The open-air site of Usviaty IV revealed an interesting culture of construction of lake pile-dwelling settlements. Today, researchers regard the appearance of pile-dwelling settlements of this type as one of the types of environmental adaptation associated with the most effective exploitation of natural resources (Mazurkevich 2013; Kittel *et al.* 2018). The Usviatskaya archaeological culture of pile-dwelling settlements, dating from the 4th millennium BC to the turn of the 4th-3rd millennia BC (Mazurkevich *et al.* 2016).

The site of Dubokray V, discovered in 1983, is located on the shore of the Sennica lake (Pskov region, Russia) (Mazurkevich and Miklyaev 1998) as shown in figure 1. The materials from Dubokray V relate to the period around the end of the 4th millennium BC, and the Usviatskaya archaeological culture (Mazurkevich *et al.* 2016).

Four artefacts made from boar tusks were identified among the 159 items in the collection of bone, antler and tooth artefacts from the Usviaty IV site (n° 2419, Department of Archaeology of Eastern Europe and Siberia, State Hermitage Museum) and two others were identified in the collection of 60 bone, antler and tooth artefacts from Dubokray V (n° 2754). They all relate to the Usviaty culture, 4th-3rd millennia BC.

The Kryvina peat bog is a key site for the study of archaeological cultures of the Middle reaches of the River Western Dvina, in the Republic of Belarus (Charniauski and Kryvaltsevich 2011) (see fig. 1).

Asaviec 2 (Biešankovičy district, Vitebsk region) (fig. 1) is one of the best-studied peat bog sites in this area (Charniauski and Charniauski 2010). The main part of the materials from Asaviec 2 derive from three

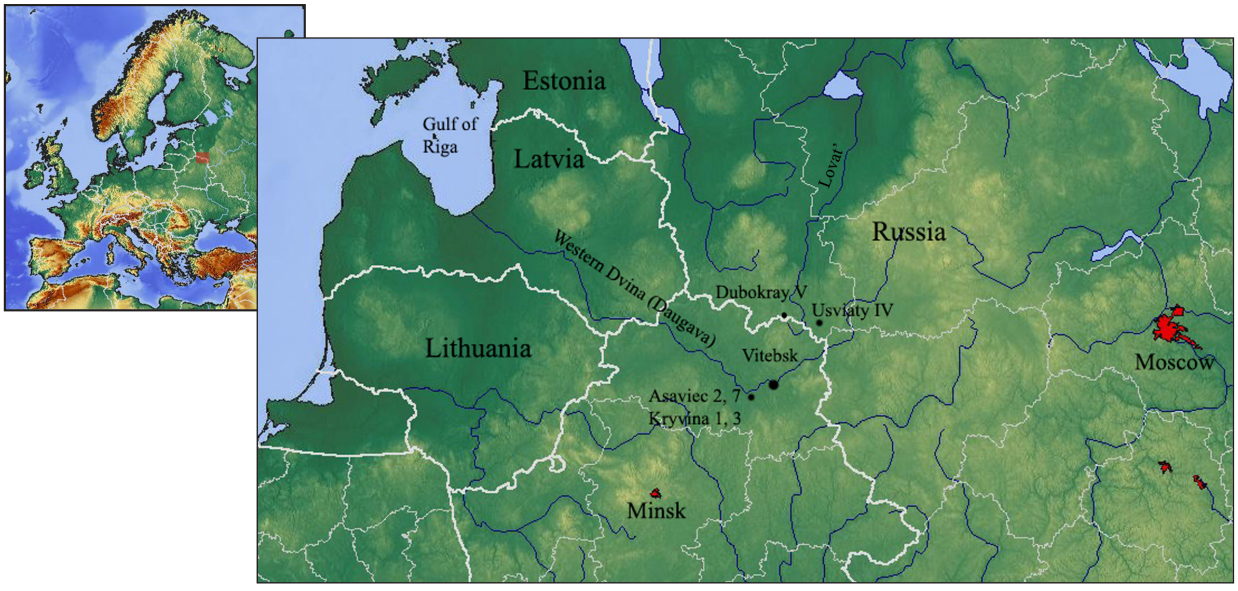


**Figure 1:** Map of the research area.


**Figure 2:** Items made of boar tusks. Technological traces, 1- Dubokray V, 2, 4, 5, 6, 7- Asaviec 2, 3- Usviaty IV, 1, 3- Macro-traces of planing and scraping, 2, 4, 5, 6, 7- Macro-traces of sawing and planing (photo: A. Malyutina).

studied chronological horizons; the first horizon relates to the end of the Middle Neolithic (Usviatskaya culture, 4th – first half of the 3rd millennium BC), the second is transitional, and the third relates to the Late Neolithic and beginning of the Bronze Age (the Zhyzhyca-Kryvina stage of the Northern Belarusian culture, middle of the 3rd – first half of the 2nd millennium BC) (Charniauski 2014; Charniauski 2016).

To date traceological analysis has been carried out on 1213 bone, antler and tooth artefacts from the six Kryvina peat bog sites (stored at the Institute of History of the National Academy of Sciences of the Republic of Belarus in Minsk). Of these, 109 artefacts were made from boar tusks, from Asaviec 2 (n=95), Asaviec 7 (n=12), Kryvina 1 (n=1) and Kryvina 3 (n=1). The majority of artefacts (n=85) relate to the Late Neolithic and beginning of the Bronze Age. Two artefacts were found in the transitional layer. Eight artefacts relate to the final stage of the Usviatskaya culture of the Middle Neolithic (end of the 4th – first half of the 3rd millennium BC). Material from the sites of Asaviec 7, Kryvina 1 and Kryvina 3 relates to the middle of the 3rd – first half of the 2nd millennium BC.

Altogether in this article we present traceological analysis of 115 boar tusk artefacts, relating to the 4th – first half of the 2nd millennium BC.

## Methods

### *Analysis of archaeological material*

Thanks to the excellent preservation of the outer surface of the majority of the artefacts, techno-functional/traceological analysis was possible. Analysis focused on the macro- and microscopic study of manufacture and usage traces: specifically, traces formed as a result of contact between stone, bone, and antler artifacts and various materials (Semenov 1957; Peltier and Plisson 1986; Christidou 1999; Maigrot 2003).

The analysis was conducted using a binocular MBS-9 microscope (inclined light, up to x98 magnification) and Olympus metallographic microscope (built-in light, up to x500 magnification) at the Laboratory of the Experimental traceology (Institute for the History of Material Culture, Russian Academy of Sciences, Saint-Petersburg, Russia). Simultaneous photography of microwear traces was conducted using the CANON EOS Utility program, with further processing using the Helicon Focus 5.2 program (magnification during the photographic process was x25, x50, x100, and x200).

### *Experiments*

The creation and usage of experimental copies of archaeological artefacts and study of deformations on the experimental artefacts (macro- and micro-transformations of the outer surface) are essential prerequisites for traceological analysis. The data obtained is compared with the results of analysis of archaeological materials (Semenov 1957).

When starting work with the current category of materials-boar tusk artefacts-we faced several tasks:

- Determination of the methods of manufacture of preforms from boar tusks (primary treatment) based on analysis of archaeological materials;
- Determination of the methods of secondary treatment of the created preforms based on analysis of archaeological materials;
- Determination of the methods of use of the finished boar tusk artefacts based on analysis of archaeological materials.

| n° | Raw material | State | Category | Activity | Material | Use time |
|---|---|---|---|---|---|---|
| n° 1 | lower boar tusk | fresh | planing knife | debarking/planing | fresh wood | 60′ |
| n° 2 | lower boar tusk | soaked | planing knife | debarking/planing | fresh wood | 60′ |
| n° 3 | lower boar tusk | soaked | drill/awl | drilling | bark | 60′ |
| n° 4 | lower boar tusk | fresh | drill/awl | drilling | bark | 60′ |
| n° 5 | lower boar tusk | soaked | planing knife | cutting and cleaning | fresh fish | 45′ |
| n° 6 | lower boar tusk | fresh | planing knife | cutting and cleaning | fresh fish | 45′ |
| n° 7 | lower boar tusk | soaked | scraper | scraping | fresh wood | 45′ |
| n° 8 | lower boar tusk | fresh | scraper | scraping | fresh wood | 65′ |
| n° 9 | lower boar tusk | fresh | planing knife | planing | dry wood | 60′ |
| n° 10 | lower boar tusk | soaked | planing knife | planing | dry wood | 65′ |
| n° 11 | lower boar tusk | fresh | drill/awl | drilling | pottery | 90′ |
| n° 12 | lower boar tusk | soaked | drill/awl | drilling | snail shells | 60′ |
| n° 13 | lower boar tusk | fresh | drill/awl | piercing | skin | 60′ |

**Table 1:** Experimental database.

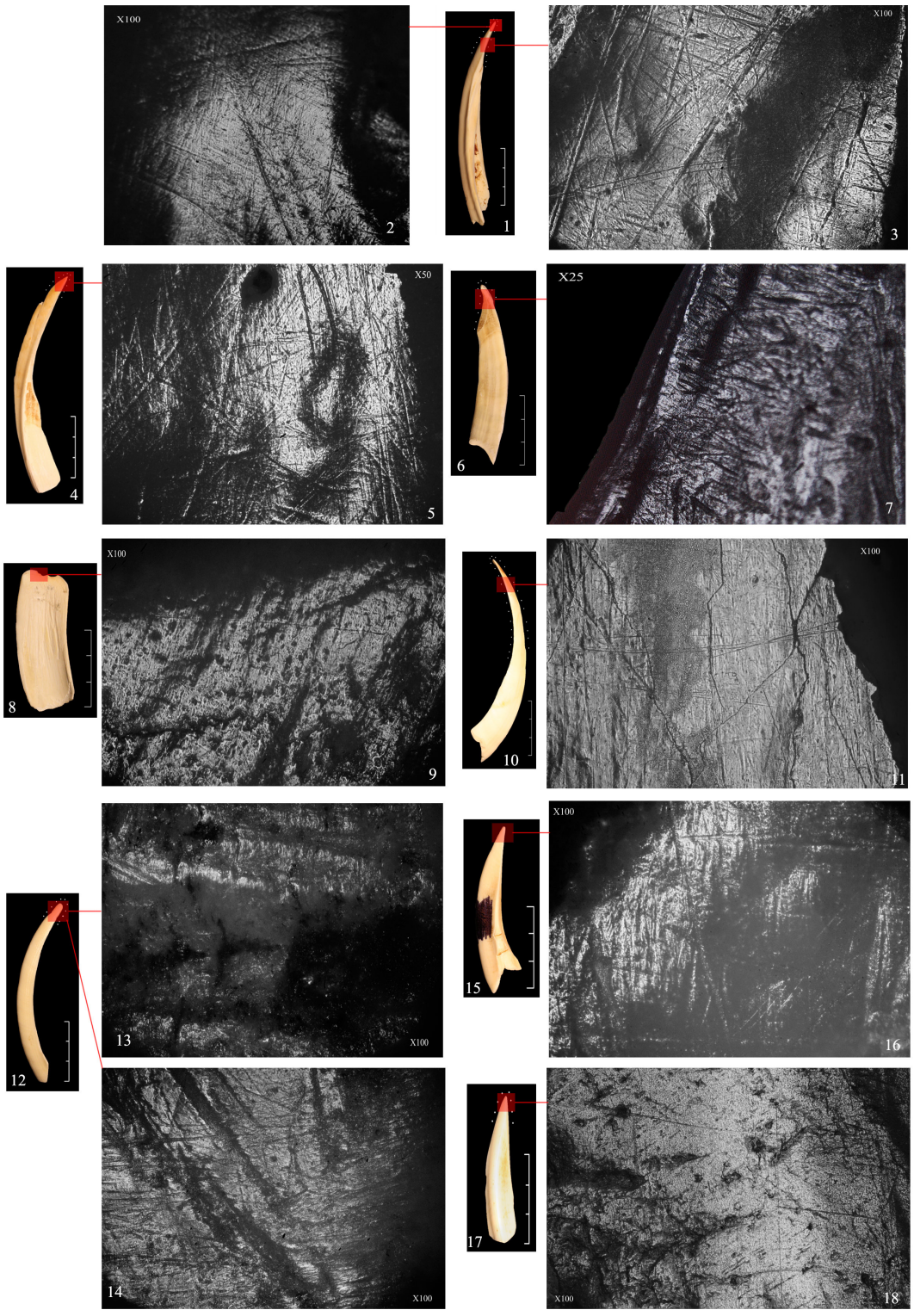


**Figure 3:** Experimental tools and their use, 1- n°1 Debarking and planing fresh wood, 2- Micro-traces of use on the dentine side (x100), 3- Micro-traces of use on the enamel side (x100), 4- n°3 drilling bark, 5- Micro-traces of use on the enamel side (x100), 6- n° 5 Cutting and cleaning freshwater fishes 7- Micro-traces of use on the dentin side (x25), 8- n° 7 Scraping fresh wood, 9- Micro-traces of use on the dentine side (x100), 10- n° 10 Planing dry wood, 11- Micro-traces of use on the enamel side (x100), 12- n° 11 Drilling pottery (making holes), 13- Micro-traces of use on the dentine side (furrows) (x100), 14- Micro-traces of use on the enamel side (x100), 15- n° 12 Drilling snail shells (making holes), 16- Micro-traces of use on the enamel side (x100), 17- n° 13 Piercing skin, 18- Micro-traces of use on the dentine side (x100) (photo: A. Malyutina).

The analysis of archaeological material from the peat bog sites of the Upper and Middle reaches of the River West Dvina and River Lovat' revealed an interesting feature: here, the tusks were not used whole for working, but in the form of plates obtained by splitting the tusks along pre-cut grooves. The grooves, as a rule, follow the convex edge of the tooth (fig. 2.2) and the opposite surface. Plates obtained in this way were standard for working this type of raw material. On one (outer) face of this blade the tooth enamel was preserved, while the opposite (inner, dentine) face of the tusk was used for the principal working. Signs of working include deep traces of planing, sawing, scraping and abrasive polishing (fig. 2).

Using planing, the uneven parts of the dentine-negatives from the longitudinal splitting of the tooth-were smoothed (fig. 2.1). With rare exceptions, traces of abrasive polishing were identified on the enamel surface of the artefacts (fig. 5.3). In order to identify the methods for obtaining long plates from boar tusks and the subsequent creation of the required tools, we carried out a series of experiments (tab. 1).

Lower tusks of modern wild boars were used for the experiments. In order to determine the probability that preparatory processing of the raw material took place, for the purpose of softening it for further processing, some of the tusks were soaked in a solution of water and ash for a period of three months; the second group of tusks was simmered over a low heat (for one day). The third group of tusks was worked in a fresh state. Old boar tusks (which were taken from jaws of an animal long ago) were excluded as possible raw materials for experimental copies because of their extreme fragility. Grooves were cut on the teeth using a flint burin, along which splitting was carried out. The tusks had to be split using a flint blade, used as a wedge, which was hit with a small stone. Due to the internal cavity the tusks broke into relatively smooth and large fragments. Grooves were cut on these plates from the dentine side, removing an excess fragment of tusk. The negatives were flattened and the points were sharpened by planing, scraping and abrasive polishing. Additional abrasive polishing effectively sharpened the working edge formed by the border of the enamel and the adjacent dentine.

As a result of the experiments carried out, it was found that the teeth that had been boiled for one day became fragile due to mineral loss, so that further work in them caused chipping, which was not identified on the archaeological material. Such materials were not used in further work. Soaking the tusks in a solution of water and ash softened the thin top layer of dentine, making it much easier to process. The density and hardness of the tooth dentine did not change visually.

Thus, we can suggest based on the results obtained from the experiments, observations of the properties of the raw material, and comparisons between technological traces identified on archaeological samples and those formed on experimental copies, that lower tusks of wild boar were processed in a fresh state without preparatory processing. The result of the boar tusks softening in the solution of water and ash cannot be proven by traceological analysis, so we cannot infer this operation in ancient times.

Another stage of our experiments involved the creation of tools using the obtained preform-plates. Based on the forms of the working edges of the archaeological artefacts and the archaeological contexts of the sites, we used the experimental tools for the following purposes: cutting, debarking and planing fresh wood (trunks and branches of willow and rowan), planing dry wood, drilling bark (birch), drilling snail (*Helix pomatia*) shells, drilling ceramics, piercing hide, and cutting and cleaning freshwater fish (*Perca fluviatilis*, etc.) (tab. 1). All experimental tools were used without handles. Analysis of macro- and micro-traces of use on instruments made of fresh boar tusks and instruments made of raw material softened in a solution of water and ash no difference in traces morphology revealed. The macro- and micro-traces of use obtained in the experiments (fig. 3) were used for the functional interpretation of archaeological use-wear.

## Categories of artefacts made from boar tusks

Based on the artefacts' distinctive morphological features, the results of traceological analysis, and the experimental results, we can propose the following classification of boar tusk artefacts (fig. 4).

### *Planing knives (drawknives with piercing functions) and their fragments*

This group is one of the most distinctive categories of boar tusk artefacts (fig. 4.1 to 16). As unbroken or fragmentary artefacts they are found at four sites in the region; however, the technology of creation of these artefacts differs. Hence, at the sites of Asaviec 2 (n=5) and Asaviec 7 (n=1), standardised manufacture of these tools was carried out using plates (fig. 4.1 to 5). On one end, a groove was cut at an acute angle, from which excess material was then removed. The final sharpening of the cutting edge and point was carried out by scraping and abrasive polishing. The lateral edge of the plate was flattened by planing to smooth the negatives from primary treatment of the tusk. This produced a tool that was comfortable and effective to use, and with which it was possible to scrape, cut and pierce material.

It was previously believed that these distinctive tools were used for cutting and cleaning fish (Charniauski 1991; Charniauski 2007) but the traceological analysis carried out on the working surface of the artefacts showed that they were used for removing bark and scraping fresh wood

(fig. 3; fig. 5.1 and 2). In addition, the point of the knife served both for piercing and for cutting bark (fig. 5.1a and 1b). The use-wear observed microscopically is, as a rule, clearest on the enamel side of the cutting edges and the points. The border of the enamel has microfractures here. Long and short transversal scratches with uneven borders extend from the cutting edge (fig. 5.1a and 1b). Longitudinal scratches extend from the sharp point (fig. 5.1a and 1b). On the tip of the point there may be chips whose edges are polished as a result of use. In aggregate the linear traces create a thick network on the enamel side of the artefact. A narrow strip of wear on the dentine side adjoins the enamel border of the cutting and piercing edge. Here we identified a gently smoothed surface, intense shine, even, pervasive polish and many linear traces in the form of short and long scratches (fig. 5.1a). Outside this strip the traces of scraping and planing consist only of insignificant levelling wear. In this category of artefacts the protruding

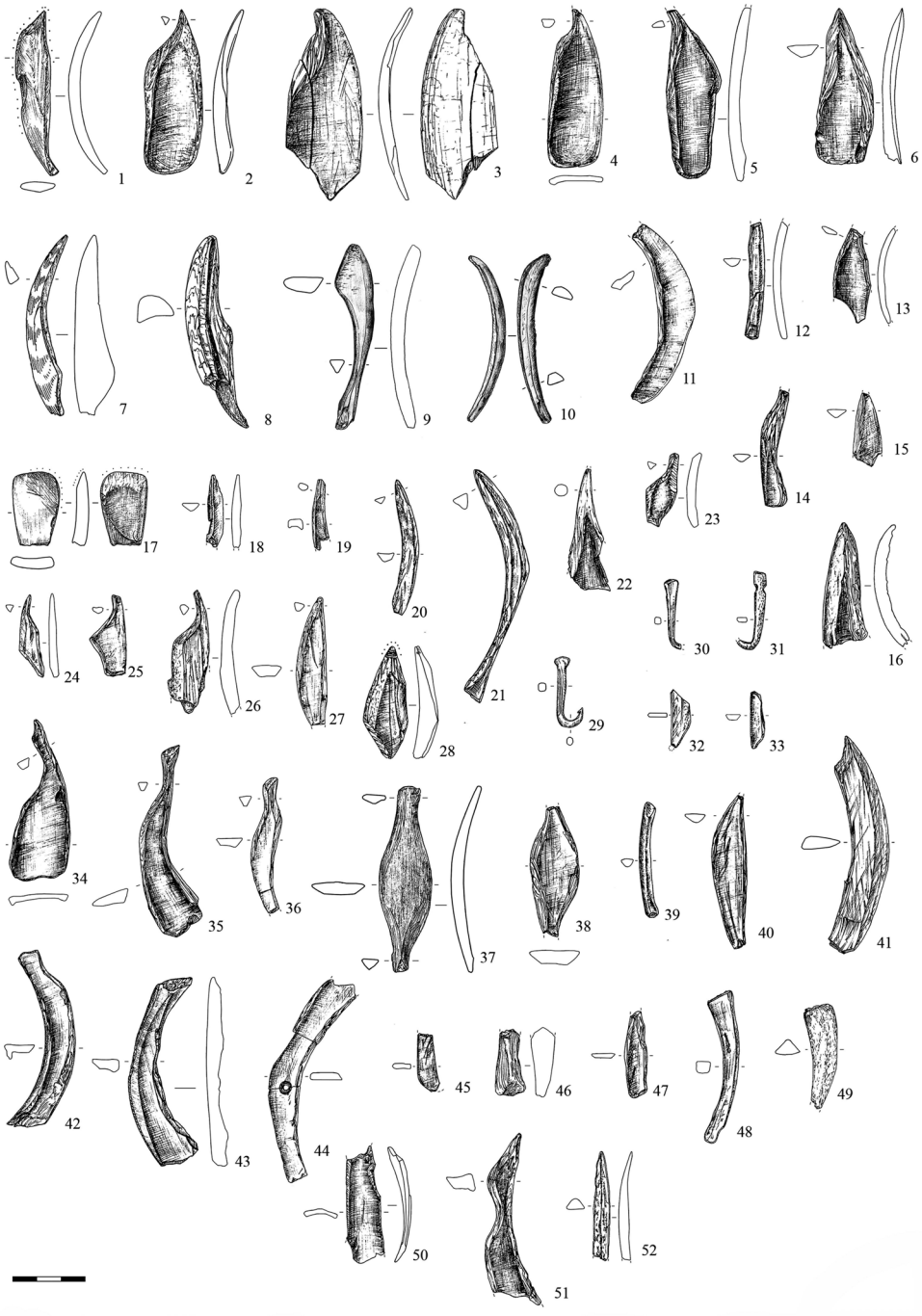

**Figure 4:** Wild boar tusk artefacts from peat bog sites from north-western Russia and north-eastern Belarus (4th-2nd millennia BC), Categories. 1-4, 6, 7, 8, 11, 12, 14, 16, 17-19, 21-23, 24, 25, 27, 29, 30, 32, 33, 34-36, 38-46, 48-52- Asaviec 2, 5, 13, 15, 26, 31, 47- Asaviec 7, 9- Dubokray V, 10, 37- Usviaty IV, 20- Kryvina 1, 28- Kryvina 3, 1-16- Planing knives 17- Scraper, 18-28- Awls/drills, 29-33- Fish hooks and their production wastes, 34-39- Pendants, 40-44- Preforms, 45-52- Fragments (drawings: A. Malyutina).

areas of dentine on the opposing wide end of the object are strongly rounded and shiny. Such wear arose as a result of contact with a hand or clothes-this is the handle of the tool.

Another variant form of planing knives (n=15) are plates with an asymmetrical point on one end, but without a clear point cut at an angle (fig. 4.6 to 16). In these cases, the naturally concave shape of the tusk plates created an excellent working tool. Here, use-wear was distributed both on the enamel surface and the dentine face (fig. 5.2a) and was associated with the working of fresh wood.

In this category are also included tools which have fresh traces of planing on the dentine face (fig. 4.4). As well as this, one end of the artefact (the handle) has wear due to contact with the hand. Hence, we can suppose, that the tool was resharpened. On the enamel faces of these artefacts a thick network of linear traces, not localised in a particular area, can be observed.

### *Scrapers*

There is one case in the collection from Asaviec 2 where a scraper was identified using traceology (fig. 4.17).

The rectangular base of the artefact was cut from the preform-plate with transversely incised grooves. On one end of the base the bevelled working edge was sharpened by abrasive polishing. The lateral edges and wide surface of the dentine face were polished using abrasion. On the enamel face, closer to the working edge of the tool, there are also areas with regular rough scores from abrasive polishing (fig. 5.3).

On the wide bevelled end of the artefact, well-developed use-wear was recorded. On the microphoto of this area it can clearly be seen that wear from working has smoothed the technological traces of scraping the working edge. Apart from that, the border of the working edge is lightly rounded. Multiple regular, longitudinal, oblique linear traces in the form of thin and wide scratches with even edges extend from the edge onto the enamel and dentine (fig. 5.3a to c). It is as if the linear scratches “tighten” the lightly smoothed and even microrelief of the surface of the working edge of the artefact. The polish is uniform, light, and smooth. The artefact, on the whole, is very shiny. On the end opposite the working edge the entire edge of the artefact is lightly smoothed and has an intense shine-the handle part of the tool.

Based on the macro- and micro-traces, which we can use to picture the kinematics of movement of the artefact during use, as well as the artefact’s form, we believe that this was a scraper. Analysis of use-wear on the experimental boar tusk scraper used for scraping fresh wood (fig. 3.8 and 9) and comparison with the archaeological example identified significant differences in the macro- and microfeatures of the wear (for example, no chipping on the wide end). For determination of the use-wear on the scraper from Asaviec 2 we turned to other experimental references: bone tools for hide processing. Here, we could provisionally see similarity in the wear micro-traces taking into account the differences in raw materials that were used for the tools. Certainly, for a more precise interpretation of the recorded wear micro-traces it will be necessary for us to continue and widen our experiments with boar tusks.

### *Awls/drills and their fragments*

The category of boar tusk artefacts that is second most common is the group of awls/drills (Asaviec 2: n=12; Asaviec 7: n=1; Kryvina 1: n=1; Kryvina 3: n=1).

The technology of preparation of awls/drills is distinguished by its simplicity, while the forms of the artefacts show an interesting diversity (fig. 4.18 to 28). As a rule, they are longitudinally split fragments of boar tusk preform-plates, on one end of which a point is sharpened by planing (fig. 4.18 to 22). The work-related wear is located over the entire sharp end and is characterised by the following features: intensive shine and light smoothing, a flat dentine surface, multiple linear traces in the form of thin, longitudinal and transversal overlapping scratches with even edges (fig. 5.5a), and a smoothed enamel border. The traces of wear smooth and cover the marks of planing. The tip of the point may be fractured but the edges of the chips are lightly smoothed as a result of use.

In one case an awl was identified (maximum length 3.5 cm) that was manufactured using waste from the production of a fish hook (fig. 4.24). The lateral edge of the artefact bears traces of incised grooves from which the fragment was detached during the creation of a fish hook. Normally, these excess elements were discarded, but in this case a point was sharpened on one end of the fragment. Traceological analysis of the surface of the point revealed wear linked with the artefact’s use. A lightly smoothed relief, smoothing of the enamel border, and multiple thin linear traces on the enamel and dentine in the form of longitudinal and transversal overlapping scratches with even edges were recorded.

Based on the analysis of the wear micro-traces on the experimental boar tusk artefacts (fig.3.17 and 18), and comparisons with traces of wear on archaeological tools, we believe that this type of awl (total number: 8) was used in the working of soft materials (hides).

Another variety of awl consists of the artefacts cut on the asymmetrical axis of the preform-plate (fig. 4.23, 25 and 26). Externally these artefacts resemble the cutting edge and points of planing knives/drawknives, discussed above but traceological analysis revealed a difference in the method of use of these artefacts. The surface of the dentine on the point has intense shine, the edges are lightly smoothed, and the surface is covered in numerous thin longitudinal and transversal, both short and long linear scratches with even edges (fig. 5.4a). The enamel border

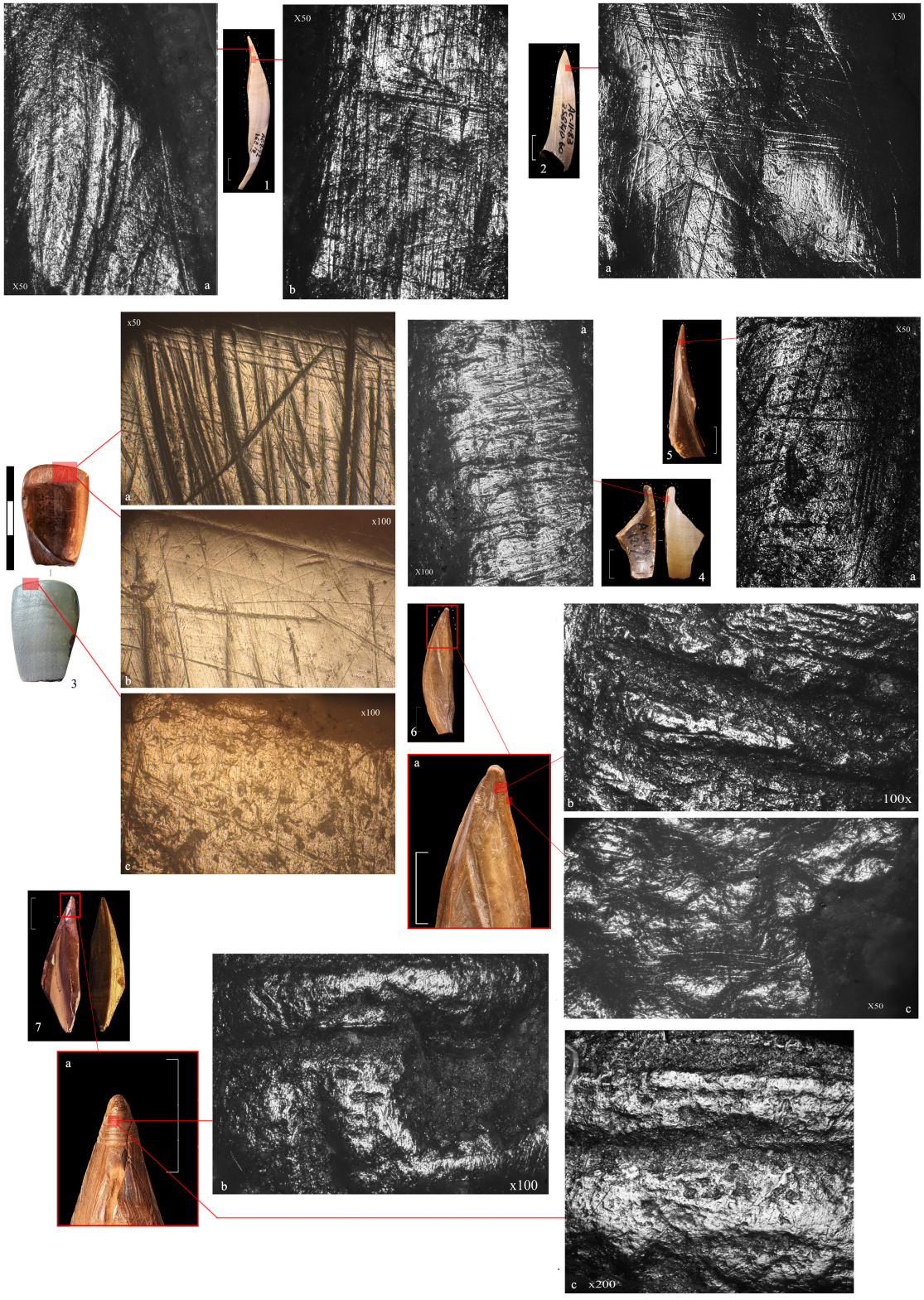


**Figure 5:** Wild boar artefacts, 1 – 6- Asaviec 2, 7- Kryvina 3, 1, 2- Planing knives, 3- Scraper, 4-7- Awls/drills, 1a- Micro-traces of use on the dentine side (x50), 1b- Enamel side (x50), 2a- Micro-traces of use on the enamel side (x50), 3a- Micro-traces of use on the dentine side (x50), 3b- Dentine side (x100), 3c – Enamel side (x100), 4a- Micro-traces of use on the dentine side (x100), 5a- Micro-traces of use on the dentine side (x50), 6a- Macro-traces of use (furrows), 6b- Micro-traces of use on the dentine side (x100), 6c- enamel side (x50), 7a- Macro-traces of use (furrows), 7b- Micro-traces of use on the dentine side (x100), 7c – x200 (photo: A. Malyutina).

is softly smoothed and worn. Clear transversal linear scratches with even edges extend from the edge onto the enamel. Longitudinal scratches, similar in nature, extend from the tip of the point over the enamel. The opposite end, uneven in outline, is shiny, and its edges are lightly smoothed-the result of contact with the hand. After the use-wear on the experimental tools was studied (fig. 3.4 and 5), it became clear that at the Asaviec 2 and Asaviec 7 settlements (n=3 in total) this type of artefact was used for piercing and drilling plant material (bark).

Clear traces of use-wear distinguish two artefacts (fig. 4.27 and 28), which, by all appearances, are linked not so much with piercing as with drilling. In one case, a fragment from the splitting of a tusk with a point sharpened on one end of the preform bears a narrow strip of wear in the form of a rough semi-circular score located on the dentine face (fig. 5.7a to c). The scoring does not continue onto the enamel. The tip of the point is strongly blunted and the surface is shiny. The microsurface of the scores differs in smoothness and in rare linear longitudinal scratches (fig. 5.7b and c). In the second case (fig. 4.27; fig. 5.6a to c) a leaf-shaped artefact was cut out from a preform-plate with one sharpened end. Well-formed wear was recorded on the point in the form of coarse, circular, transversal, regular scratches (fig. 5.6a and b). The tip is blunted, with a perceptible thinning of one edge (asymmetry). The border of the enamel is strongly worn at the end (fig. 5.6c). The microsurface of the grooves differs in the smoothness of the microrelief, on which rare longitudinal thin scratches are seen (fig. 5.6b). The polishing is pervasive. Based on the analysis of the traces of use, we suppose that both artefacts were used for drilling coarse material, or drilling with an abrasive, as a result of which coarse scores were formed. However the results of the experiments with drilling shell, ceramic and bark (fig. 3) did not provide similar results, and therefore the definition of the function of the wear traces on the archaeological artefacts currently remains in question.

### *Fish hooks and their production waste*

Fish hooks, manufactured on plates from boar tusks, are represented in the material from two sites (Asaviec 2: n=7; Asaviec 7: n=1) in significant numbers (fig. 2.7; fig. 4.29 to 31). It is worth noting directly that at these sites bone was the principal raw material for creating fish hooks (Charniauski 1991; Charniauski 2007; Charniauski *et al.* 2018). The types of fish hooks from bone identified by the researchers working on material from these sites also include the artefacts made from boar tusk.

Another interesting point is the discovery during the excavations of the Asaviec 2 and Asaviec 7 settlements of a significant quantity of production waste and preforms of fish hooks made of both bone and boar tusk (fig. 2.4 and 6; fig. 4.32 and 33). The presence of a large quantity of preforms and manufacturing waste of fish hooks in the materials from the sites has allowed the reconstruction of the chain of technological operations from the preform-plate (as a rule, the wall of a diaphysis of a long bone worked by planing from both sides) to the prepared tool. The technology of fish hook manufacture was established in a process of experimental modelling (Charniauski 2013). The manufacture of fish hooks from boar tusks was practically the same as the examples where animal bone was used as a raw material. The only distinguishing feature is the absence of working on one of the two faces of the preform-plate.

Waste from the manufacture of fish hooks (Asaviec 2: n=7; Asaviec 7: n=2) is in the form of triangular or trapezoidal fragments of plates with traces of incised grooves on two or three sides and traces of drilling of a hole on the dentine side. In one case such a fragment was transformed into an awl (fig. 4.24), as described in detail above.

### *Pendants*

Three artefacts made from boar tusk preform-plates are, in our opinion, ornaments-pendants in the form of stylized depictions of birds (fig. 4.34 to 36). On the rectangular base-plate the outline of the future artefact was carved, then the excess fragments were broken off. The edges were worked by scraping and abrasive polishing. As a result, a defined narrow "neck" was formed on one end, smoothly transitioning to a sharpened "head". All of the edges of the artefacts are lightly smoothed and shiny. In the area of the "neck" there is wear on the dentine in the form of multiple short and thin multidirectional scratches, polish and intensive shine. On the enamel face regular transversal clustered scratches extend from edge to edge. The enamel border, moreover, is jagged. The entire surface of the "head" of the pendant is shiny and lightly smoothed.

In three examples (Asaviec 2: n=2, Usviaty IV: n=1) boar tusk pendants have symmetrically incised notches-places for fastening-on both ends of the preform-plate (fig. 4.37 to 39). In one case (fig. 4.39), this small (maximum 6 mm in width) fragment was split along the preform-plate, on both ends of which notches – places for fastening – were incised. The surfaces of both "heads" are shiny, and the entire edge of the artefact is lightly smoothed in this area. Around both notches wear is recorded in the form of a worn enamel border, intensive shine and transversal linear scratches extending from the edge onto both faces. In the two other cases (fig. 4.37 and 38) rather wide (up to 2 cm in the widest place) preform-plates were used, on whose lateral edges traces of scraping are well preserved. On one artefact both ends are broken around the notch. On the second we recorded the same wear in the form of scouring and transversal scratches on the enamel border and intensive shine on the protruding areas of the "head". No other traces linked with possible use-wear were found.

### *Preforms*

We would like to briefly discuss the artefacts which do not have traces of use but which are preforms for various categories of boar tusk artefacts (fig. 2.3 and fig. 4.40 to 44). At Asaviec 2 in one example a whole preform of a fish hook was found (fig. 2.4), abandoned after the removal of excess fragments (waste), and without undergoing subsequent polishing of the edge of the blank. Preform-plates with traces of planing were also found here-preforms for planing knives/drawknives (fig. 4.40 and 41), plates with traces of planing on the lateral edges or sharpening of one end (fig. 4.42 and 43) and drilling (fig. 4.44). In the materials from the Usviaty IV site, two large plates with traces of planing along all the lateral edges are placed in the preform category (fig. 2.3). No traces of use were recorded on these artefacts.

### *Fragments*

As a result of the traceological analysis, we created a separate category for the various boar tusk fragments with traces of processing that, due to their fragmentation and absence of use-wear, cannot be assigned to one of the functional groups described above (fig. 4.45 to 52). The main group (n=29) consists of fragments of plates with traces of processing on one or both lateral edges. The traces of processing include signs of planing, scraping, cutting and abrasive polishing, covered partially or fully by intensive irregular wear in the form of shine and strong smoothing of the protruding edges (fig. 4.45 to 47). This type of wear, caused by contact with a hand or clothing, is characteristic for the grip part of tools. Nine items from the Asaviec 2 settlement comprise waste from the production of various categories of artefact. On all of them are traces from longitudinal or transversal cut grooves, along which their detachment took place during the production of the required artefacts (fig. 2.5; fig. 4.48 and 49). The remaining 8 items (Asaviec 2: n=7; Asaviec 7: n=1) are fragments of boar tusk plates on which traces of planing, cutting and abrasive polishing were recorded, but where there are no traces of use in the form of utilitarian or non-utilitarian wear (fig. 4.50 to 52). Here are also included those objects which have significant damage to the surface (including as a result of restoration).

## Discussion and conclusions

To conclude, we briefly summarise our results. Traceological analysis of 115 artefacts made of boar tusks has shown that the principal preforms used were plates obtained by longitudinal splitting along a preparatory cut groove. Based on our experimental observations, we propose that the raw material was in a fresh state. The plates obtained in this manner were then transformed into various tools. All of the material was divided into 7 techno-functional groups, including utilitarian artefacts, their preforms and manufacturing waste, as well as ornaments in the form of pendants. The tools were used for the working of wood and bark, skin, and the drilling of abrasive materials. This functional diversity, along with the variety of forms of tools and the standardisation of the primary methods of working the raw material, constitute an interesting cultural and territorial characteristic, augmenting our conceptions of the period of hunter-gatherers from the time of the Neolithic to the beginning of the Bronze Age.

The tradition of use of wild boar lower tusks on settlements of the Upper and Middle reaches of the River West Dvina and River Lovat' originates during the Early Neolithic period (Asaviec 4) and continues until the beginning of the Early Bronze Age. At the same time we see how the quantity and variety of products gradually increases.

Boar tusks, as a result of their natural strength and convenient curved form were used as drawknives at many Stone Age sites in Europe (Zhilin 1998; Maigrot 1999; 2003), but only at a few archaeological sites were boar tusks used to make plates which were then transformed into tools-drawknives and drills (Sidera 1993; 2012; Marquebielle 2014), and knives (Vankina 1999; Schibler 2013). Furthermore, the functional (Maigrot 1999) or technological (Marquebielle 2014) analysis of boar tusk tools has only occasionally been an object of detailed study, either along or combined with the analysis of other archaeological materials (Malyutina *et al.* 2018).

## Acknowledgements

This work was supported by the Program of Fundamental Scientific Research of the Russian State Academies of Sciences, State Assignment n° 0184-2019-0008: "Production and usage of labour tools in the Paleolithic, the Neolithic, and the Bronze Age (technological, traceological, and experimental studying of archeological materials)".

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