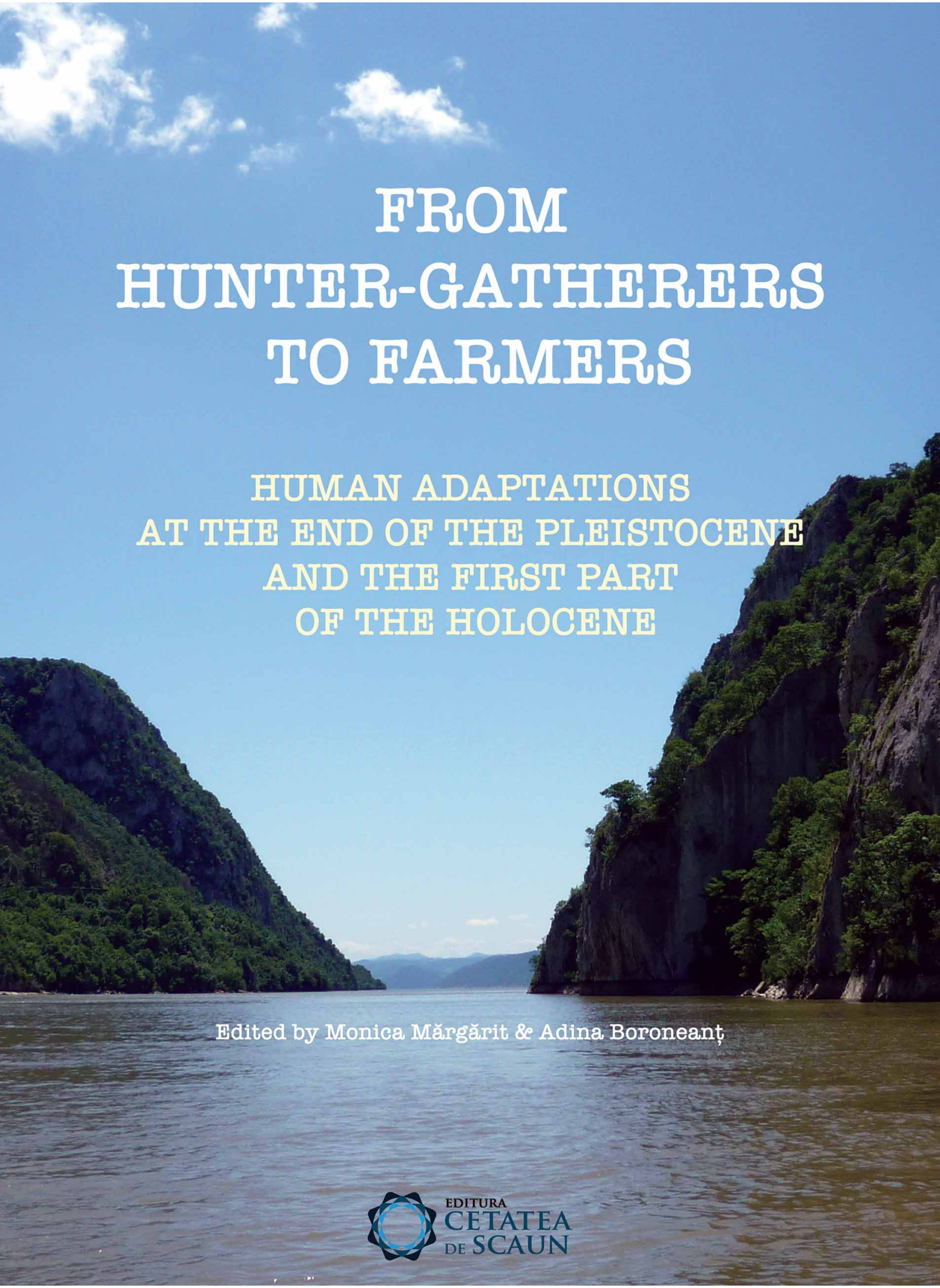

FROM HUNTER-GATHERERS TO FARMERS

HUMAN ADAPTATIONS AT THE END OF THE PLEISTOCENE AND THE FIRST PART OF THE HOLOCENE

Edited by Monica Mărgărit & Adina Boroneanț

EDITURA CETATEA DE SCAUN

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Papers in Honour of Clive Bonsall

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Photo cover: The Danube at Cazanele Mici (the Smaller Cauldrons) in the Iron Gates (photo Adina Boroneanț).

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BEAVER MANDIBLE TOOLS DURING THE LATE MESOLITHIC AND THE EARLY NEOLITHIC AT ZAMOSTJE 2 (THE UPPER VOLGA REGION, RUSSIA)

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Abstract: Lake settlements of hunters-fishers during the Late Mesolithic and Early Neolithic in the forested zone of the European Russia are an integral part of the specific cultural and stable economic world of the "last hunters-gatherers". They relied upon hunting elk and beaver, water and wetland birds (Mannermaa 2003), and intensive fishing (Lozovski *et al*. 2013a; Radu and Desse-Berset 2013). Zamostje 2 is located at the centre of a wide lacustrine plain, formerly a glacial basin. The cyclic fluctuations of the paleolake water level and a gradual landscape change had minor impact on the subsistence strategies of the ancient inhabitants, despite the appearance of pottery production skills at the beginning of the 6th millenium BC. Beaver hunting always played a key role in the subsistence activities of the local inhabitants. In addition to procuring skin and meat, hunting aimed also at obtaining beaver mandibles, as most effective natural tools for woodworking. More than one thousand implements found on the site indicate the same technological modes of production, reshaping and final use of mandibles. But the narrow application of these numerous tools leaves open a series questions.

Keywords: Late Mesolithic, beaver exploitation, bone industry, lake settlement, Zamostje 2.

Introduction

In the forested zone of Eastern Europe beaver and elk, were the most common pair of hunted game, and their bones were also actively used as raw materials for tool production. At the same time, the adaptation of the complex natural forms of certain bones to use as composite tools is a rare phenomenon in the bone industries of the Stone Age. The tools made of the lower beaver jaws found in many Mesolithic and Early Neolithic lake sites of the Volga-Oka and East Onega regions (see Oshibkina 1997; Koltsov and Zhilin 1999; Zhilin 2001; Zhilin *et al.* 2002) are a prime example of such use. The most numerous series of tools from beaver mandibles (over 1000) was found at Zamostje 2 (Lozovskaya and Lozovski 2015). Mandibles were one of the key hunting targets, and the operational requirements for the maintenance of such tools (e.g. avoiding drying, preserving the inner ligaments as long as possible) could have influenced the hunting seasonality.

The archaeological assemblage

The Zamostje 2 multilayer lake settlement (Moscow region, Sergiev Posad district - Fig. 1/1) has been investigated since 1989.The area excavated at present covers 162 m^2 (Lozovski and Lozovskaya 2013). In a clear stratigraphic position, there are two Late Mesolithic (LM) layers (the Lower Layer (LL) dated to ca. 7000–6500 cal BC and the Upper

Layer (UL) to ca. 6400–6000 cal BC), and also an Early (EN) and a Middle Neolithic (MN) layer (the EN dated to ca. 5700–5300 cal BC and the MN to ca. 4800–4300 cal BC), separated on the northern area of the site by sediments assigned to a transition period (Final Mesolithic, ca. 5900–5700 cal BC). The assemblage resulted from the excavations has currently more than 100,000 artefacts, including at least 10,000 tools from various mammals bones and elk antler, as well as numerous other faunal remains, with beaver bones constituting a significant part. Most of the artefacts from Zamostje 2 are stored in the Archaeological Department of the Sergiev Posad State History and Art Museum Preserve.

Tools made of the lower beaver mandibles are represented in all archaeological layers; it is the most numerous category of tools within the bone industry. In terms of morphology and manufacturing technology a total of 1068 items were analyzed (from the 1989 to 2013 excavations): 158 (LM-LL) + 657 (LM-UL) artefacts from the Late Mesolithic layers, 89 (FM) from the Final Mesolithic layer, and 79 (EN) + 10 (MN) from the Early and Middle Neolithic layers; 75 items did not have a secure chronological context. Considering the number of the left and right jaws (552 and 516, respectively), there must have been no less than 552 hunted individuals.

The excavated part of the site is a coastal settlement zone also comprising the adjacent edge of the reservoir with remains of fish-traps and fish-fences (Lozovski *et al.* 2013b). The spatial distribution of beaver mandible tools generally corresponds to the overall artefact saturation of the cultural layers. On certain squares, the density of finds is quite high (up to 20–30 items per one square meter in the LM-UL layer), however, special accumulations have not been yet identified.

Beavers as hunting targets

Beaver, together with elk, formed the basis of the meat source of the population from the lake settlements in the Mesolithic-Neolithic forested zone of Eastern Europe. Beaver exploitation was very intense, as evidenced by the numerous marks observed on the corresponding bone remains: some were related to the removal and exploitation of furs, others were associated with the removal of meat (Chaix 2004; Leduc and Chaix 2014). Preliminary studies of the mammal remains distribution by layers indicated a ratio of beaver bones in the range of 20 to 55% (Chaix 1996; 2003; 2004; Chaix *et al.* 2001; Leduc and Chaix 2014).

According to these previous archaeo-zoological studies, some preliminary results can be drawn regarding the exploitation modalities of beavers:

- A first analysis of the hunting strategies indicates two main slaughtering ages, with the hunted animals ranging from 6 months to 2 years old, and from 7 to 15 years old. Such a distribution is close to the natural distribution observed for the contemporary Russian beaver populations during the summer.
- The distribution and nature of the anthropic marks on the bones refer to skinning, disarticulation and meat removal, suggesting fur exploitation and consumption of meat.
- All skeletal elements were present, indicating local exploitation. A possible lower representation of the autopodia has been firstly noted but has to be confirmed yet by exhaustive archaeozoological studies of the beaver bones, particularly on the sieved remains (mesh less to 2 mm). Moreover, the study of the beaver bones from the 2011 excavations also underlined an over-representation of mandibles (used as tools) in the beaver assemblage. From this sample, only 23% of the Minimum Number of Individuals (MNI) calculated from the number of lateralized mandibles is documented by postcranial elements. This phenomenon has to been confirmed by exhaustive studies of the beaver bones collected at Zamostje 2, in order to exclude biases due to the size of the studied samples.

Thus, in addition to skin and meat, the first aim of hunting was to obtain mandibles for making tools. Indeed, such a gap between the

number of mandibles and the other skeletal parts poses questions regarding the acquisition of such specific elements (for tool making) and the acquisition of beavers themselves.

In order to answer these questions, a specific research program has been set up focusing on beaver exploitation at Zamostje 2. Reconstruction of detailed slaughtering ages and sex-ratios from mandibles (teeth eruption and wear patterns) but also from other anatomical part (epiphysis fusion stages; osteometry) will be performed in order to evidence some possible specific behavior regarding the selection of beavers for dietary products exploitation and/or removal of mandibles for tools. Seasonality data is also expected in order to answer questions related to a possible cyclical exploitation. The examination of complete series of beaver remains would also allow to document other purposes in their exploitation, such as fur removal, meat consumption etc. Previous work (Chaix 2004) evidenced many cutmarks on the beaver anatomical parts, related to skinning, disarticulation and meat removal.

Lower beaver mandibles as tool blanks

Lower beaver jaws, which served as a raw materials for making tools, consist of two halves that are connected to each other through the symphysis. The natural form is characterized by the presence of two ascending processes: coronary and articular, and a wide angular process at the proximal end of the mandible. The solid row of molars with a flat surface and the protruding incisor are separated by a diastema. The incisor, enclosed in a long, curved in both directions, cavity begins at the level of the pit between the ascending processes (growth zone). The base of the incisor has the shape of a wide root opening, with thin and fragile walls. The distal end, subtriangular in section, with massive strong walls, has a cutting edge similar to a chisel; on the outside (convex side) is covered with a very hard enamel. Due to wear, the cutting edge of the incisor remains sharp throughout the life of the animal. The morphological features of the lower semi-jaw allowed – with a small adjustment – to make a very comfortable and ergonomic handle with a protruding sharp blade.

Techno-morphological study

All beaver mandibles found on the site show anthropic traces, which resulted from their processing and subsequent use.

Despite the more or less pronounced changes in the cultural traditions during over 2000 years, the main principles of the production, reshaping and final use of the tools made from beaver mandibles remained the same. They covered blank adaptation, hole-making, and incisor shaping.

Blank adaptation

For a more comfortable grip, the ascending processes (coronoid and condyloid) were removed; they were either broken or chipped off, sometimes taking advantage of previously engraved lines or incisions – traces of previous debitage (13 tools have such striping marks preserved) (Fig. 1/7–8, 10). This adaptation technique appears in 92% of tools.

The edge formed due to the removal of the rami was sometimes additionally aligned by rough retouching. No doubt that the resulting straight edge approximately at the level of the molars got in touch with the hand; it is indicated by significantly smoothed ridges as well as by polished negative contours of the flakes and the exposed/high relief (Fig. 1/2; Fig. 2/1–7, 9, 19, 25.).

Molars always remained in place, no intentional modifications were observed.

The proximal end, on the contrary, played an insignificant role in the prehension, that is why its edges - either complete (28%) (Fig. 2/1, 5, 16–17, 23; Fig. 3/1–2, 4) or with a broken off angular process (Fig. 1/2–5, 10–11; Fig. 2/3, 7, 9, 14, 18–20, 22, 24–25; Fig. 4/ 1) - do not show any traces of smoothing or detrition, with the exception of a very short series from the Lower Layer. The shape of the butt was not regulated and was

determined by the contours of large and small fractures and damages. Only 11 items showed intentional retouching. Complete proximal ends were more characteristic for the LM-LL (47%).

The lower edge, seldom with traces of scraping (Fig. 1/9, 11), and the buccal side of the mandible commonly look very shiny and polished, which was likely caused by a prolonged contact with the hand.

This should also indicate both the use of the tool with no additional binding (unlike the artefact from Veretje 1 which was wrapped in birch bark -Lozovskaya and Lozovski 2013: 74), and a clean bone surface with no meat remains. This is also indirectly suggested by the existing ornamentation.

Ornamentation

Generally, ornamentation is atypical for these beaver mandible tools. Only ten artefacts reveal a fully or partially decorated buccal surface (and in one case a lingual surface). The majority belong to the Upper Mesolithic layer (7 pieces).

The ornamentation consists of geometric decoration that looks like a net (Fig. 1/3) or a diagonal crosshatchings (Fig. 1/4) made of thin engraved lines; an elongated hatched triangle near the perforation composed of short broad cuts going into different directions (Fig. 1/5). On another artefact, a row of deep elongated incisions diagonally cross the outer perforation which occurred at a later date, after the decoration (Fig. 1/12); one mandible from the EN layer is decorated with "scratchings" (Fig. 1/6) etc. Thus, with the exception of the first mentioned tools, the remaining decorated items are characterized by different compositions and decoration techniques. But at the same time, they fully correspond to the repertoire of the ornamentation techniques used to decorate other bone objects at Zamostje 2.

Morphology of the holes

A typical feature of the beaver mandible tools from Zamostje 2 is the presence of man-made holes in the growth zone of the incisor (83.7%) (only 9.3% of artefacts, predominantly from the LM-LL do not possess such holes). In most cases they were located on the inner side and quite frequently on the external buccal side, thus creating a through hole (47-76% depending on the layer) (Fig. 1/1–4, 10–12; Fig. 2/1–14, 17, 20). This was obtained through simultaneous punching of the thin walls of the incisor base (Fig. 2/23; Fig. 3/2–3). Blind external holes are rare (5 pieces in total).

The inner holes were the result of pressure or percussion followed by edge alignment. The shape of the holes is oval, often with an uneven or a micro denticulated contour (Fig. 1/11; Fig. 2/23; Fig. 3/2). The average dimensions are 11 to 15 x 6–8 mm. Quite frequently the original contour of the inner hole disappeared when the cavity was completely opened (Fig. 4/1). The external holes (including the complete ones), on the contrary, are distinguished by a wide variety of forms and pitting methods such as: pressure, retouching, percussion, cutting, scraping, perforation (more typical for the Early Neolithic layer), and their combinations. Tool analysis for the Zamostje 2 assemblage identified, based on the manufacturing characteristics, eight types of holes (Lozovskaya and Lozovski 2015):

- Type A – pressure holes: without any traces of intentional regularization, with a natural uneven contour (Aa) or with retouches on the inner side and isolated small microflake negatives on the exterior surface (Ab) (Fig. 2/1–2; Fig. 3/4, 19).

- Type B – holes expanded by retouching from the inside, with deep multi-layered outer facets along the circumference.

- Type C – punched holes with impact traces (Fig. 2/3–4). They are defined by the accumulation of impact negatives around or on the side of the hole, usually on a small area of 9-17x7-14 mm. The shape of the negatives varies: dotty, polygonal or crescentic negatives, depending on the configuration of the tip. The depth and frequency of the

negatives also indicate the difference of strength and intensity of the impact.

- Type D – holes made through burin cutting or scraping (Fig. 2/5–7). This very specific type of hole exhibits expressive traces taking the shape of a series of deep curved grooves, longitudinal or diagonal, emerging from the hole or going through the hole.

- Type E – holes scrapedon a flattened (Ea) (Fig. 2/9-11) or short concave (Eb) (Fig. 2/13-14) platform. They differ only in the preliminary preparation of the platform: either a flat/ slightly concave area with a smooth surface (up to 31 x 12 mm), or a small concave one (to 20 x 9 mm).

- Type G – drilled holes (Fig. 2/17–20). This type includes both drilled-only holes (unilateral drilling, often in massive bone, sometimes obliquely); and those adjusted afterwards by reaming, usually in a limited area of their circumference. The holes are circular with a diameter of 5-6 mm. They are more numerous in the EN layer.

- Type K – deep holes with manufacturing traces around the circumference (Fig. 2/12).

In addition to the completely finished holes, there are items with unfinished, test-like, or misplaced "holes" (Fig. 2/24–26). These exhibit platforms (flattened or concave), areas with traces of impact or of intense scraping located either in the growth zone (preforms) or indicating a misplacement (technological error), sometimes near the finished hole. In a few cases, the "hole" mistakenly hit the end of the root of the fourth tooth.

The shape of the holes varies: oval or circular, less often almost triangular or square. Their contours in most cases are uneven and angulated. Their edges are rounded, smoothed or very rarely shiny (clearly visible only on 20 artefacts) (Fig. 1/2), usually at the proximal end of the hole or above it. However, in no case is there sufficient evidence (i.e. diagnostic use-wear traces) to claim that these holes were manufactured or served for suspension.

The unique instance of four tools that preserved a wooden stick fragment inserted at the proximal end along the incisor and fixed in the internal hole (Fig. 2/21–22), allowed us to assume that they were intended to fix the incisor in a specific position during utilization.

The time when the hole was made is unclear—possibly during the very period of tool utilization. It is also possible that internal and external holes were made at different moments in time.

Another type of holes are those located in the area of the angular process (Type У) (Fig. 1/7; Fig. 2/15–16; Fig. 3/1). However, their occurrence is rare (16 artefacts), predominantly in the Lower Mesolithic layer. The question of their functionality is still a matter of discussion.

Thus, the holes, located mostly in the area of the incisor growth, were an indispensable element of these tools throughout the Late Mesolithic, Early and Middle Neolithic periods, which can be explained only by a functional necessity.

Incisor shaping

The incisor itself and the adjacent bone were subjected to minimal technological modifications. The assemblage of Zamostje 2 features tools at various stages of their shaping, reshaping or final use of the working edge.

The identified operation sequence (*chaîne opératoire*) is as follows:

- The bone was opened up along the incisor from the beginning of the tooth row either at the lingual or buccal side; the left mandibles were mostly reshaped on the buccal side (over 50%) (Fig. 1/3–5, 18; Fig. 3/4–5), while the right mandibles were reshaped on the lingual side (35 - 40%) (Fig. 3/2, 12).
- The lower edge was chipped off together with the tuberosity and a part of the symphysis area (Fig. 3/13a), the upper bone edge was thoroughly retouched by pressure (Fig. 3/1, 3, 9, 13, 18). The incisor was cut on the lateral side from the beginning of the tooth row (Fig. 3/8, 12, 18), a part of the wall was removed, and the divergent cutoff edges were thoroughly scraped.

- The working edge was shaped at the enameled incisor end, mostly transversal and thin (3 - 4 mm, angle 25 - 35°) (Fig. 3/1a, 2a, 3a).

The shaped incisors preserved *in situ* (305 pcs.) were most common in the Lower Mesolithic layer (75 items or 47.4%). In other layers, the majority had been damaged or broken in prehistoric times; intact working edges are pretty rare.

The recovery of a damaged incisor could lead to a new shape: rounded, faceted, knife-shaped, etc. (Fig. 3/4a, 5a, 6, 7a, 9, 13, 16a) which achieved through various methods: scraping, cutting, retouching or abrasion; sometimes the support bone was reshaped as well (Fig. 3/13a, 14–15, 17–19). Generally, there is an unlimited number of forms of working the edges and options for using the tools, which partly explains their universality and indispensability in the economic life of the ancient population.

The bone edge along the incisor often reveals traces of use (Clemente Conte and Lozovska 2011).

As the working area worn out, the notch was commonly widened, which led to further bone breaking along the incisor cavity (Fig. 2/21; Fig. 3/2, 12). Finally, in some instances, the lower edge was fully removed and the incisor was taken away to be used in some other way (Fig. 4/1).

Thus, the mandibles had been continuously modified until the final moment of the incisor removal, tool break-off or loss.

As there is no evidence of incisors being used outside the mandibles or in combination with any other composite tools, we may assume they were taken away in order to make pendants.

Pendants from beaver incisors

Pendants made of beaver incisors are numerous in the Upper Mesolithic and Early Neolithic layers totaling over 500 pieces. However, in the Lower Mesolithic layer they are scarce; in general it correlates with a higher share of incisors preserved *in situ*.

Most pendants are made of longitudinally split incisor fragments with a length of 2—4 cm or more (Fig. 4/3). Many but not all of them indicate traces of longitudinal cuts remaining from incisor shaping inside jaws and even worn and blunted incisor blades (Fig. 4/2).

Shapes differ not only due to the diverse semi-product types but also due to the secondary shaping including head finishing and side trimmings (1 to 4).

Functional analysis

It is likely that 'fresh' mandibles were used, with the incisor still firmly fixed but the mandible surface completely cleaned of meat and tendon remains. This is suggested by the multiple manufacturing traces left on the surface, the regular retouches as well as the diverse wear and ornamentation patterns.

Functional analysis of the micro traces was carried out on 40 artefacts with preserved incisor blades, indicating that wear traces were concentrated both on the incisor edge and the adjacent bone sections (Clemente Conte and Lozovska 2011).

Most tools exhibited specific traces related to woodworking; others were likely related to the processing of hard animal materials (e.g., elk antler). Given the diversity of the working edge shapes, tools were used for numerous operations: such as production of dishes and spoons, engraving items, etc., as well as for grooving antler and other hard materials.

A small series of experiments on beaver jaws and the analysis of modern beaver jaws that were used on the surface treatment and making small depressions on wood (trying to replicate the circular depressions of the wooden spoons from the EN layer) were carried out within the *Program on Wood Processing on the base of the Experimental-Traceological Expedition of the Institute for the History of Material Culture RAS in 2006 – 2009, directed by E. Girya* (Fig. 4/5). In the latter case, the kinematics of the working edge was defined as outward movement in a circle or in depth. The incisor blade could easily cut small

long slices, the negatives of which were often recognizable on the lateral surface of the smoothed depressions; if the cuts were transversal to the fibers, then the surface became slightly rough; in some areas there were isolated deep scratches left by the lateral angle of blade edge. Traces of the wood-processing operations resulted from these experiments were used in the interpretation of the traces on the archaeological wooden artefacts.

The isolated traces on the wooden surface have the appearance of cut negatives with clear contours, a concave cross-section and a clean base. When comparing them to the natural traces left by the living beavers, they appear to differ in their location and orientation. Use of the tools showed almost unlimited possibilities in modifying a wooden surface, including a high efficiency in making holes and cavities and a sufficiently long operating life without need for revival or reshaping.

Thus, beaver incisor traces were found on both sides of the ornamented wooden plate from the Upper Mesolithic layer (Fig. 4/7). The traces have the form of short sub-rectangular cuts (up to 1 cm long) with a slightly concave base. They appeared both separately (in a certain order) or in long longitudinal bands. Unfortunately, the state of the surface preservation of the hollows and holes on wooden artefacts (including the wooden sleeves for the adzes) along with the overlapped use-wear does not allow to reveal the traces of shaping. It is very probable that they were manufactured using a beaver incisor, fact also suggested by the analogies to certain wooden objects of the Veretje 1, where the negatives of the relevant traces were quite expressive (Lozovskaya and Lozovski 2013. fig. 6: 17–19).

Similarly cuts negatives were also revealed on two elk antler tools (axe shaped), on the inner walls of the broad through-hole used for inserting the shafts (Fig. 4/6, 6a). In one instance, rows of short cut negatives - fully cover the external surface of the tool and give the impression of a decoration (Fig. 4/4, 4a).

Conclusions and discussion

Natural-composite tools made of beaver mandibles are – to some extent – a unique type, which was extensively popular in the Mesolithic and Neolithic of the Eastern European forested zone.

Even if the species was abundant in the site environment surrounding the human occupations during the Mesolithic and Neolithic times, the over-representation of these tools in the present assemblage arise some important archaeozoological issued related to beaver exploitation, cycle of human occupations and the modalities of artefact accumulation.

In what the use of the tools made is concerned, their primary function appears to be certain: a multi-purpose woodworking tool. Broad possibilities of modifying the working edge are apparent; the main stages of production, reshaping and utilization were identified indicate the tool-type has undergone no changes through the millennia. However, there are a number of characteristics regarding both the production and the use that remain open to discussion:

First of all, specialization. Even if we consider the full scope of the possible operations, all of them belong to fine finishing; the corresponding demand - does not reflect in the number of tools that we have found. The technological study of the wooden artefacts of Zamostje 2 showed that, for example, in the Mesolithic layers the shaping operations (adzing, rough planning dominated), while finishing work was used only on a few items (Lozovskaya 2011; Lozovskaya and Lozovski 2013); the artefacts with holes are also rare. Thus, we are facing a question: what operations required the use of beaver incisors, were of similar importance for hunter-fishermen of lake settlements both in the Mesolithic and the Neolithic and left no visible traces on the surface of finished wooden tools?

Besides, there is uncertainty regarding the moment of the hole-making in the growth areas. The role of the external holes, let alone the angular holes, is still debatable and requires further discussion.

Certain conflicting factors were observed: on the one hand, the need to avoid the desiccation of the tool, and maintenance on its original state, of essence to the functionality of the tool; on the other hand, the need for a fast and complete cleaning of the surface for further processing (retouching, scraping, cutting bones and incisor) and turning the mandible into a tool.

Beaver mandible tools - used for more than two millennia at the hunter-fishermen settlement of Zamostje 2 represent a rather uniform type characterized by dynamic transformation and multiple shapes used throughout their lifecycle. Hence, there is not enough evidence for the diversity of their types. All the main modification stages of the raw products are typical for all cultural layers. Still, there are some insignificant differences in the intensity of use or preferred methods of finishing the external or angular holes. In both cases, the Lower Mesolithic layer looks more individual. In the resharpening process, the incisor shape was evidently dictated by operation specifics.

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Figure 1. Zamostje 2. 1 – Location of Zamostje 2 and map of the excavation area. 2–12 – Beaver mandible tools. Late Mesolithic: Lower layer – 7, 9–10; Upper layer – 2–6, 8, 11–12.

Figure 2. Zamostje 2. Beaver mandible tools, growth zone and external holes in detail. Late Mesolithic: Lower layer – 2–3, 5–6, 10–12, 16; Upper layer – 4, 7–9, 14, 17, 20–21, 23–26; Final Mesolithic – 1; Early Neolithic – 15, 19, 22; undefined layer – 13, 18.

Figure 3. Zamostje 2. Beaver mandible tools, incisor working edges and adjacent bones (details). Late Mesolithic: Lower layer – 1–3, 5–6, 8, 12, 17, 19; Upper layer – 4, 7, 9–11, 13–16, 18.

Figure 4. Zamostje 2. 1 - Beaver mandible tool; 2–3 Beaver incisor pendants and parts of lost incisors; 4, 6 – "Elk heads"; 5 – Hole making with an experimental beaver mandible tool; 7 – Ornamented wooden plate. Late Mesolithic: Upper layer – 1, 3–4, 6; undefined layer – 7; various layers – 2.