Daniel Groß · Harald Lübke · John Meadows · Detlef Jantzen (eds.)

Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe

10

Untersuchungen und Materialien
zur Steinzeit in Schleswig-Holstein
und im Ostseeraum

Untersuchungen und Materialien zur Steinzeit
in Schleswig-Holstein und im Ostseeraum

Band 10

Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum
aus dem Museum für Archäologie Schloss Gottorf und dem Zentrum für Baltische und Skandinavische Archäologie
in der Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf
Band 10

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Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe

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Laserscan of the wooden sign that was attached to the excavation hut during the Hohen Viecheln excavations ('To the sharp harpoon'; Laserscan: J. Nowotny, ZBSA).

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Vorwort der Herausgeber

Die Schriftenreihe „Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein“ wurde von dem ursprünglichen Herausgeber Jürgen Hoika vor mittlerweile 25 Jahren im Jahre 1994 begründet, um am damaligen Archäologischen Landesmuseum Schleswig (ALM) und heutigem Museum für Archäologie Schloss Gottorf (MfA) ein Publikationsorgan für die Veröffentlichung von Forschungsergebnissen zur Steinzeit Schleswig-Holsteins zu schaffen. Dabei sollte es sich zum einen um Sammelwerke mit Beiträgen von vorzugsweise auf Schloss Gottorf veranstalteten Symposien, Workshops und Tagungen mit steinzeitlicher Thematik und zum anderen um zumeist in Dissertationen zusammengestellte ausführliche Materialvorlagen handeln. Entsprechend enthielt der 1994 vorgelegte erste Band der Reihe die Beiträge zum 1. Internationalen Trichterbechersymposium, welches, von Jürgen Hoika gemeinsam mit Jutta Meurers-Balke initiiert, 1984 am Archäologischen Landesmuseum in Schleswig stattgefunden hatte. In der Folge wurden dann aber beginnend mit den Arbeiten der beiden heutigen Herausgeber nunmehr acht überwiegend am Institut für Ur- und Frühgeschichte der Christian-Albrechts-Universität zu Kiel fertiggestellte Dissertationen veröffentlicht, die ganz wesentlich mit der wissenschaftlichen Vorlage und Auswertung von Forschungsgrabungen in Schleswig-Holstein und – seit der Beteiligung des Zentrums für Baltische und Skandinavische Archäologie an der Herausgeberschaft – aus dem gesamten Ostseeraum befasst sind.

Deshalb ist es eine besondere Freude für die Herausgeber, mit dem vorliegenden Band 10 „Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe“ der Schriftenreihe „Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum“ wiederum einen Sammelband mit den Beiträgen eines Workshops vorlegen zu können, der vom 14. bis 16. März 2016 auf Schloss Gottorf stattgefunden hat. Dabei handelt es sich um den Abschlussworkshop des von der Deutschen Forschungsgemeinschaft geförderten Projektes „Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte“ (DFG-Projektnummer 271652103) unter Leitung von Daniel Groß, Harald Lübke, John Meadows (alle ZBSA) und Detlef Jantzen (Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie). Entsprechend enthält dieser Band neben dem Abschlussbericht des Forschungsprojektes insgesamt 17 Beiträge der eingeladenen Workshop-Teilnehmer, die entweder ergänzende Studien zum Fundplatz Hohen Viecheln enthalten oder sich grundsätzlich mit verwandten Themen zur Erforschung des frühholozänen Mesolithikums im nördlichen Europa befassen.

Alle Beiträge wurden nach internationalem Standard von jeweils zwei anonymen Gutachtern in einem Peer-review-Verfahren bewertet und danach den Autoren zur erneuten Überarbeitung übergeben, bevor die abschließende redaktionelle Bearbeitung der Manuskripte erfolgte. Die Textredaktion für alle Beiträge wurde von Gundula Lidke durchgeführt, Jana Elisa Freigang und Jorna Titel leisteten dabei unterstützende Arbeiten. Das Layout übernahm Daniel Groß, Titelbild und Umschlag entwarf Jürgen Schüller. Die meisten Karten und Zeichnungen wurden von den Autoren selbst bereitgestellt. In einzelnen Fällen erfolgte eine Überarbeitung durch Daniel Groß. Allen sei dafür an dieser Stelle herzlich gedankt.

Neu im Rahmen der Schriftenreihe ist, dass die Beiträge unmittelbar nach Fertigstellung und Freigabe der Autoren in einem „online-first“-Verfahren auf der Homepage des Verlages im Open Access zum freien Download bereitgestellt wurden. Für die Umsetzung dieser Forderung der Herausgeber danken wir dem Wachholtz Verlag, insbesondere Herrn Henner Wachholtz, sehr.

Besonderer Dank gilt dem Vorstand des Zentrums für Baltische und Skandinavische Archäologie Schleswig, besonders dem Direktor, Claus von Carnap-Bornheim, und der Forschungsleiterin, Berit Valentin Eriksen, die die Veröffentlichung dieses Bandes durch die Bereitstellung der erforderlichen Mittel für den Druck der Arbeit maßgeblich unterstützten.

Sönke Hartz und Harald Lübke
Schleswig, im Oktober 2019

Editors' Preface

The series 'Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein' was founded by its first editor, Jürgen Hoika, in 1994, 25 years ago, in order to establish a possibilty to publish Stone Age research results from Schleswig-Holstein at the then Archaeological State Museum (Archäologisches Landesmuseum [ALM]), today's Museum for Archaeology (Museum für Archäologie, Schloss Gottorf [MfA]). Publications should, on the one hand, reflect proceedings of symposia, conferences and workshops with Stone Age topics primarily held at Gottorf Castle, on the other hand, dissertations presenting comprehensive material. According to that, the first volume, published in 1994, contained the contributions to the 1st International Funnelbeaker Symposium, which, initiated by Jürgen Hoika and Jutta Meurers-Balke, had taken place at the Archaeological State Museum in 1984. Following that, eight dissertations, mainly accomplished at the Institute for Pre- and early History at the Christian-Abrechts-University Kiel, were published, starting with those by today's editors. All these volumes contributed substantially to the scientific presentation and analysis of excavation materials from Schleswig-Holstein and – since 2012, when the Centre for Baltic and Scandinavian Archaeology (ZBSA) also became involved in editig the series – the whole of the Baltic Sea area.

Therefore the editors are especially happy to once more present conference proceedings with volume 10 of the series 'Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum': 'Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe' collects contributions to a workshop held at Gottorf Castle on 14th–16th March, 2016. This represented the closing workshop of the DFG-funded project 'Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte' (DFG project no. 271652103), directed by Daniel Groß, Harald Lübke, John Meadows (all ZBSA) und Detlef Jantzen (Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie). In addition to the project's final report the volume contains 17 papers by researchers invited to participate in the workshop, representing either additional studies on material from the site Hohen Viecheln or related topics in research of the early Holocene Mesolithic in northern Europe.

Each paper was, according to international standards, peer-reviewed by two anonymous reviewers and then returned to the author for reworking before final editorial work. Copy-editing was performed by Gundula Lide, supported by Jana Elisa Freigang and Jorna Titel. Daniel Groß realised the layout; cover and cover illustration were designed by Jürgen Schüller. Most maps and figures were provided by the authors themselves, some were reworked by Daniel Groß. We express our sincere thanks to all involved!

It is a novelty for the series to have papers published online first immediately after completion and authors' approval in open access for free download on the website of Wachholtz Publishers. We would like to thank Henner Wachholtz, Wachholtz Publishers, very much for making this possible!

Special thanks are due to the board of the Centre for Baltic and Scandinavian Archaeology (ZBSA) Schleswig, particularly to the director, Claus von Carnap-Bornheim, and the head-of-research, Berit Valentin Eriksen, who substantially supported this publication by providing financial means for its printing.

Sönke Hartz and Harald Lübke
Schleswig, October 2019

Grusswort des Landesarchäologen von Mecklenburg-Vorpommern

Mit seinen großflächigen, oft noch weitgehend unberührten Niederungen und Binnengewässern bietet Mecklenburg-Vorpommern beste Voraussetzungen, um die gewässeraffinen Kulturen des Mesolithikums zu erforschen. Die Überreste ihrer Wohn- und Jagdstationen sind im feuchten Milieu hervorragend erhalten geblieben. Störungen durch Torfabbau, Begradigung von Gewässern oder Meliorationsmaßnahmen blieben im Wesentlichen auf das 19. und 20. Jahrhundert beschränkt. Sie haben zwar einen gewissen Schaden angerichtet, aber, weil sie zumindest im 20. Jahrhundert oft von aufmerksamen ehrenamtlichen Bodendenkmalpflegern beobachtet wurden, überhaupt erst zur Entdeckung vieler Fundstellen geführt.

Welche Fundstellen eingehender erforscht werden und damit das Bild einer Epoche besonders prägen, unterliegt oft dem Zufall. Hohen Viecheln rückte in den Fokus der Forschung, weil die Entdeckung mehrerer Knochenharpunen zu Beginn der 1950er Jahre auf eine günstige Konstellation traf: 1953 war aus der Vorgeschichtlichen Abteilung des Staatlichen Museums das Museum für Ur- und Frühgeschichte Schwerin entstanden, das auch für die Bodendenkmalpflege in den drei Nordbezirken der DDR zuständig war. Der ehrgeizige Direktor des Museums, Ewald Schuldt, hatte sich durch Ausgrabungen auf der Burgwallinsel Teterow einen Namen gemacht und war nun auf der Suche nach einem geeigneten Fundplatz für ein eigenes Forschungsprojekt.

Wegen der sehr guten Erhaltungsbedingungen versprach Hohen Viecheln, zusätzlich zu dem bekannten Spektrum an Steinartefakten auch ein umfangreiches Geräteinventar aus organischen Materialien bergen zu können. Die ebenfalls ausgezeichnet erhaltenen Tierknochen sollten Aufschluss über das Jagdwild geben. Hinzu kam die Aussicht, aus der Stratigraphie neue Erkenntnisse zur Chronologie und zu den Veränderungen der naturräumlichen Verhältnisse zu gewinnen. Diese Erwartungen wurden nicht enttäuscht: Hohen Viecheln entwickelte sich zu einem der bedeutendsten Plätze mesolithischer Forschung, gleichrangig mit Duvensee, und inspirierte weitere Forschungen, u. a. in Friesack und Rothenklempenow.

Hohen Viecheln gehört nach wie vor zu den legendären archäologischen Fundstellen in Mecklenburg-Vorpommern, auch wenn es aus heutiger Sicht nicht mehr so einzigartig dasteht. Dank einer intensiv betriebenen ehrenamtlichen Bodendenkmalpflege ist die Zahl der bekannten mesolithischen Fundplätze im Land deutlich gestiegen, von denen vermutlich mehrere ein ähnliches Potenzial wie Hohen Viecheln aufweisen. Verändert haben sich aber nicht nur die Verbreitungskarten, sondern auch die Möglichkeiten archäologischer Forschung. Es drängte sich deshalb geradezu auf, Hohen Viecheln noch einmal unter die Lupe zu nehmen, bisherige Erkenntnisse kritisch zu prüfen und neue hinzuzufügen. Der DFG und allen Projektpartnern gebührt herzlicher Dank dafür, dass sie das ermöglicht haben.

So wird Hohen Viecheln auch weiterhin als exemplarischer Fundplatz für das Mesolithikum in der norddeutschen Tiefebene stehen – eine hochinteressante Umbruchszeit, in der Klimawandel, Anstieg des Meeresspiegels und andere Veränderungen eine ständige Anpassung der Menschen an ihre Umwelt erzwangen.

Detlef Jantzen
Schwerin, im September 2019

Welcome address by the State Archaeologist of Mecklenburg-Western Pomerania

Mecklenburg-Western Pomerania with its large, often unspoiled lowlands and inland waters offers outstanding possibilities for research into the water-oriented cultural groups of the Mesolithic. Remains of their settlement and hunting sites are often well preserved in wet conditions. Disturbances by peat extraction, straightening of watercourses or melioration measures mainly took place during the 19th and 20th centuries. They did some damage, but – as at least during the 20th century they were often supervised by vigilant amateur archaeologists – many sites were discovered this way in the first place.

But often it is left to chance which sites can be thoroughly investigated to largely characterise the picture of a whole timespan. Hohen Viecheln became the focal point of research interest under favourable circumstances: the discovery of several bone points there at the beginning of the 1950s fell together with the establishment of the Museum of Pre- and Early History in Schwerin (out of the former Department of Prehistory at the State Museum) which was also responsible for the preservation and care of field monuments in the three northern districts of the GDR.

The ambitious museum director, Ewald Schuldt, had already gained reputation through his excavations of the Slavic ring wall island near Teterow, and he was looking for a suitable site for another research project. Due to the very good preservation conditions at the site, Hohen Viecheln promised, in addition to the spectrum of artefacts known from other places, a substantial organic inventory. The well-preserved animal bones were expected to shed light on game species and hunting strategies. Furthermore, important results were expected concerning chronology and environmental changes. These hopes were not disappointed: Hohen Viecheln has become, alongside Duvensee, one of the most important sites for Mesolithic research, and research there has inspired further excavations, e.g. at Friesack or Rothenklempenow.

Hohen Viecheln is still one of the legendary archaeological sites in Mecklenburg-Western Pomerania, even if it no longer stands alone. Thanks to intensive voluntary archaeological surveys the number of Mesolithic sites has increased significantly; and several of these may have a potential similar to that of Hohen Viecheln. But not only distribution maps have changed during the last years, but also the possibilities of archaeological research. Therefore, the idea to have another look at Hohen Viecheln, to challenge old results and add new ones, suggested itself. I want to thank the German Research Foundation (DFG) and all project contributors for having made this possible. In this way, Hohen Viecheln will continue to be an exemplary North German Lowland site of the Mesolithic – a highly interesting time when climate change, sea-level rise and other changes enforced constant human adaptions to the environment.

Detlef Jantzen
Schwerin, September 2019

Acknowledgements

This volume of the series 'Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum' represents the proceedings of a workshop held at the Centre for Baltic and Scandinavian Archaeology (ZBSA) in Schleswig in March 2016. It is a part of the editors' project 'Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte', funded by the German Research Foundation (DFG) under the project number 271652103.

While the project was dealing with the re-evaluation of the site Hohen Viecheln 1 for chronological and stratigraphical aspects, this volume does not only cover its final publication but comprises additional modern studies about the site by different scholars. These are furthermore embedded into the international research landscape by adjacent studies covering an area from modern day Britain in the west to the Urals in the east.

All contributions are representing the authors' point of view and respective terminologies. Therefore differences in the vocabulary may appear to the careful reader. While a homogenisation of terms and data recording is relevant for comparative studies, it was beyond the scope and means of this project. As a consequence, terminologies may differ between the contributions, as exemplified by the terms 'uni-serial' and 'uni-lateral' bone points: both are characterised by barbs or notches on one lateral side. At the British site Star Carr those have ever since been named uni-serial, whereas uni-lateral is a more common term in other parts of Europe.

We, as editors, would like to thank all contributors for being part of this volume and their interesting and high-quality articles; also we are grateful for the voluntary support of all anonymous peer-reviewers and their help in improving the articles. Furthermore, we thank the German Research Foundation (DFG) for funding our research and the workshop as well as the Centre for Baltic and Scandinavian Archaeology represented by its director, Claus von Carnap-Bornheim, and the head-of-research, Berit Valentin Eriksen, for support of the project and its presentation in the current form. A tremendous help in the course of making this book was Gundula Lidke who was responsible for text editing, proof-reading, and correspondence with the authors and publishers. Thank you very much! Further editorial support was provided by Jana Elisa Freigang, Jorna Titel, Matthias Bolte, Isabel Sonnenschein and Jürgen Schüller. The latter is also responsible for the cover drawing. Much help and support was provided by Peter Teichert-Köster with respect to handling the finds and accessing them in the depot of the Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie in Schwerin. Close collaboration with Mathieu Boudin of the Royal Institute for Cultural Heritage, Brussels, improved our radiocarbon measurements and the analysis of the consolidant.

We thank all people, mentioned and unmentioned here, who were involved in this book and the different research projects, who helped by further pushing the boundaries of our understanding of the cultural remains and chronologies of the past.

Daniel Groß, Harald Lübke, John Meadows, Detlef Jantzen
Schleswig, October 2019

Bone and antler projectile points from the Meso-Neolithic site Zamostje 2, Moscow region, Russia

Olga Lozovskaya and Vladimir Lozovski†

Abstract
Projectile points as a major implement of the economic prosperity of ancient people have always been an important indicator for evaluating cultural traditions, chronological attributes, hunting and crafting skills. The Mesolithic and Neolithic (without agriculture) periods of the Eastern European forest zone are no exceptions either. Complex socio-economic processes of the 7th millennium cal. BC, which took place in the Upper Volga region before the expansion of pottery production and later in the Early and Middle Neolithic, were reflected in a wide variety of types of hunting weapons. The site Zamostje 2, located in the floodplain of the Dubna River, has a clear stratigraphy of Late Mesolithic and Neolithic layers; the wet deposition conditions of archaeological layers ensured a very good preservation of a large bone assemblage. Projectile points – 574 pieces in total – can be divided into three main categories: spearheads, arrowheads and harpoons. Besides, we also distinguish groups of barbed points and slotted tools. In this paper, we present in detail the variability of hunting equipment made of bone, as well as the principal types of points and their variants, we identify common and cultural-chronological traits as well as some characteristic features of production and use. This is the first complete summary and analysis of all currently available projectile points collected at this site.

1 Introduction

Projectile points reflect the results of adaptation of an ancient population to palaeo-ecological conditions in a socio-cultural ambience. In traditional societies with a stable economy, established types remain unchanged for centuries and become important cultural and historical features. In epochs of global changes – climatic, economic, or technical – cultural uniformity disappears. The first half of the Atlantic period in the vast expanses of Eastern Europe is characterised by a number of important events: the appearance of the first farmers and herders in the south, significant changes in the organisation of fishing activities in the forest zone (Lozovski/Lozovskaya 2016), and finally the emergence of ceramics and the widespread occurrence of pottery production. Complex cultural processes associated with possible migrations and a promotion of new technologies and ideas (Mazurkevich et al. 2013) are reflected by such an important part of the inventory as projectile points and thrusting weapons.

The lake settlement Zamostje 2, inhabited by different groups of hunter-gatherer-fishers for over two and a half millennia, with a few interruptions, is a good basis to observe dynamics of changes in equipment

for hunting and fishing and other activities. The place was attractive due to an abundance and balanced variety of food resources; the wetland ecological complex and the forest biotope were equally exploited (Lozovski et al. 2013). The economic system as a whole did not undergo significant changes from the Late Mesolithic to the Middle Neolithic (Lozovski 2003). The mechanism of the appearance of pottery under such conditions is still not fully understood.

In any case materials from the settlement – distinguished from many wetland sites by a sufficiently clear stratification of cultural layers – reflect overall and consistent changes in the material culture of the Upper Volga basin. Projectile points are represented in all cultural layers of Zamostje 2: two Late Mesolithic layers (Late Mesolithic Lower layer: LM LL, c. 7000–6600 cal. BC and Late Mesolithic Upper layer: LM UL, 6400–6000 cal. BC), a Final Mesolithic layer (FM, c. 5950–5750 cal. BC), an Upper Volga culture layer of the Early Neolithic (EN, c. 5700–5400 cal. BC) and a Lyalovo culture layer (a variant of pit-comb ceramics) of the Middle Neolithic (MN, c. 4800–3900 cal. BC) (Lozovski et al. 2013). The latter, also without agriculture, is synchronous to the Mesolithic Ertebølle culture (c. 5300–3950 cal. BC) in the periodisation of Northern Europe.

2 A morphological-typological analysis of projectile points in the Upper Volga region

Investigations of lake settlements in the forest zone of the Russian Plain with favourable conditions for the preservation of artefacts made of organic materials have revealed numerous bone projectile points of the Mesolithic and Neolithic periods. The Upper Volga (Volga-Oka interfluve) region is distinguished by a number of local features. The first attempt to systematise these materials was made by Vladimir Lozovski in the beginning of the 1990s (Lozovski 1993). On the basis of 450 artefacts from 22 sites he proposed a classification into 23 types, exhaustively reflecting the development of projectile weapons during the Mesolithic and Early (Upper Volga culture), Middle (Lyalovo culture) and Late (Volosovo culture) Neolithic. Points were divided into three main categories: arrowheads, spearheads with barbs, and harpoon heads. Almost half (205) of the examined artefacts came from the first excavations at Zamostje 2 (in the years 1989–1990).

Further more detailed analyses aimed to separate groups of points from the site, in particular items with grooves and inserts (Lozovskaya 2001), barbed points (Lozovskaya/Lozovski 2013), or separate Mesolithic (Lozovski 2008) and early Neolithic (Lozovski/Lozovskaya 2010) find complexes from the 1989–1991 excavations. Moreover, some of the published points from Zamostje 2 became part of a generalising typological scheme of Mesolithic bone projectile points in the forest zone of Eastern Europe by Mikhail Zhilin (Zhilin 2001), but in this study the total number of analysed projectile points for the whole Volga-Oka region, including Zamostje 2, is only 347 items (Zhilin 2001, 225–239).

As projectile points represent the category of bone and antler artefacts most susceptible to cultural (typological) and technological variability, it is important to consider these changes in a chronological sequence within a particular area, with the complete data set currently available.

3 The corpus of finds

The inventory of osseous materials from Zamostje 2 currently includes 574 projectile points (excavations of 1989–1991, 1995–2000, and 2010–2013). Flint arrowheads are also present, but in a much smaller number (slightly over 100 pieces), and there are several wooden arrowheads, too (Lozovskaya 2011, 19 fig. 2,2–5.13).

Table 1. Main types of arrowheads, spearheads and harpoon heads from Zamostje 2. LM LL – Late Mesolithic Lower layer; LM UL – Late Mesolithic Upper layer; FM – Final Mesolithic layer; EN – Early Neolithic layer; MN – Middle Neolithic layer; Indet. – Indeterminate (mixed and damaged underwater layers).

		LM LL	LM UL	FM	EN	MN	Indet.	Σ
Spearheads / leister points								
Spearheads	complete	2						**2**
	fragments	2	26	7	6		4	**45**
Leister points	with barbs and hole		3	2	2			**7**
	with barbs	4	29	3	3		5	**44**
	with hole	5	13	3	3		4	**28**
		13	**71**	**15**	**14**		**13**	**126**
Barbed points								
Barbed points with 1–2 barbs		7	16	5	6	5	3	**42**
Barbed points with 3 and more isolated barbs		3	3	2	2	1	4	**15**
Uni-lateral small-barbed points		1	2	4	15		4	**26**
Barbed fragments and irregular points		2	15	6	15	8	6	**52**
		13	**36**	**17**	**38**	**14**	**17**	**135**
Harpoons								
Harpoon heads						**3**	**2**	**5**
Composite tools								
Javelin head with flint inserts			1					**1**
Spearhead with slots for inserts		1						**1**
Slotted arrowheads			9	1	1	1		**12**
		1	**10**	**1**	**1**	**1**		**14**
Sharp barbs from slotted arrowheads		**1**	**9**	**3**	**1**			**14**
Arrowheads								
Needle-shaped arrowheads, decorated (with fragments)			11	2				**13**
Needle-shaped arrowheads, >15 cm		1	8	1	2		2	**14**
Needle-shaped arrowheads, 10–15 cm		3	7	3	6	2	5	**26**
Needle-shaped arrowheads, <10 cm		3	10		10	2	1	**26**
Needle-shaped fragments		2	21	11	19	2	3	**58**
Needle-shaped arrowheads, type MN						14	1	**15**
Needle-shaped points with biconical heads, type LM			4	3			1	**8**
Blunt arrowheads		1	9	8		1	1	**20**
Leaf-shaped arrowheads			12	1	6		4	**23**
Figurative points (with shaped base with 2–3 thickenings)					31			**31**
Biconical arrowheads, type MN						18	1	**19**
Individually shaped arrowheads			3	2	1	3	2	**11**
Other biconical types				2	7	4	3	**16**
		10	**85**	**33**	**82**	**46**	**24**	**280**
Σ		**38**	**211**	**69**	**136**	**64**	**56**	**574**

Fig. 1. Zamostje 2. Wooden artefact with fragment of projectile point, Late Mesolithic Upper layer.

The most numerous series of bone points (Table 1) belongs to the Late Mesolithic Upper layer (LM UL) and the Early Neolithic layer (EN): 211 and 136 items, respectively, which generally correlate with formation conditions and the overall richness of archaeological horizons. No spatial patterning has been detected in the distribution of these artefacts. One arrowhead was found stuck in a tree (possibly a fragment of a totem pole?), where it was broken during point removal (Fig. 1).

Elk limb bones and antlers were the main raw material sources for the production of points in all layers. Bones of medium- and small-sized animals, e.g. badger, were also used, but in most cases these bones are indeterminable.

The preservation of bone surfaces is – due to the deposition in water-logged sediments – exceptionally good and enables an analysis of multiple technological traces and use-wear marks.

In general, the find complex is characterised by a rather high fragmentation rate of items, due to their intensive use. A high proportion of completely broken projectile points, including massive spearheads, indicates high pressure applied (i. e. hitting big game) and, indirectly, that butchering processes were carried out in the settlement area. Almost all items, including complete ones, show typical evidence of damage inflicted during projectile function, such as scarring (microchips), small-sized facets at point and barb ends, etc. There are also artefacts with traces of re-fitting and re-shaping, and some unfinished tools (blanks).

There are no traces of fire on the artefacts, except for a few small fragments retrieved during sieving; these are not included in the calculation and analysis.

Finally, the age of the artefacts was determined on the basis of complex dating of the archaeological horizons in which they were found.

3.1 Spearheads

Partly following the established tradition for analyses of Zamostje 2 materials, we divided all projectile points into three major categories: spearheads/leister points (?), arrowheads, and harpoons. But additionally we split barbed points and composite tools with a flint blade into separate typological groups (Table 1; Fig. 2).

The spearhead category is morphologically most homogenous (Figs. 3–4). These are massive items of up to 29 cm length with a semi-circular or convex-concave cross-section – on average 28 x 14 mm –, made from splintered bones of elk limbs, mainly metapodia. The main characteristics of spearheads include a large symmetrical pointed end, carefully polished on all sides, a middle section with parallel straight edges, and a worked base.

These tools were made following a chain of standard operations, starting from the longitudinal splitting of bones and aligning the edges of the blank by means of a regular rough retouch, and then carefully scraping the surface to form the required shape, and finally, if necessary, cutting barbs and making holes (using different methods). A re-shaping of broken or damaged items was also carried out with the help of flaking on edges and modelling by scraping. Secondary processing traces are often less regular and less clearly distinguished on the surface.

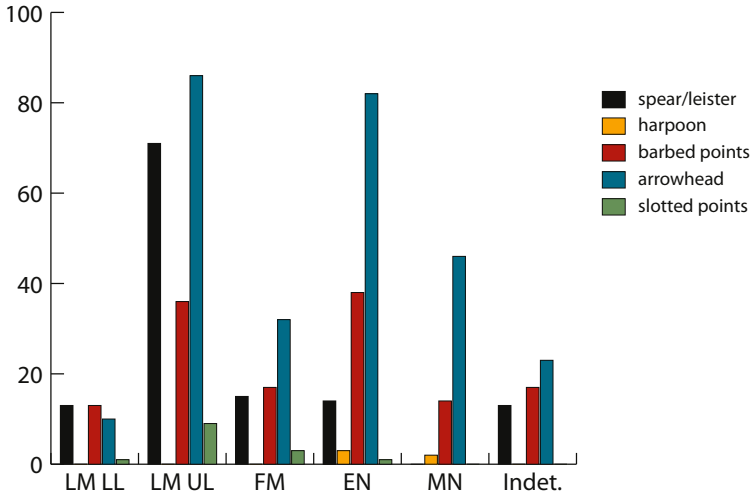

Fig. 2. Zamostje 2. Main categories of projectile points from Mesolithic and Neolithic layers. LM LL – Late Mesolithic Lower layer; LM UL – Late Mesolithic Upper layer; FM – Final Mesolithic; EN – Early Neolithic; MN – Middle Neolithic; Indet. – Indeterminate.

Analysis of the diversity of tools and their representation in the cultural layers is difficult because of a high percentage of fragmented artefacts. Among the twelve intact or almost intact tools (Fig. 5a) we found two pieces with a simple shape (Figs. 3,20; 4,1), as well as five items with barbs (Fig. 3,15–16.18–19), two items with holes in the area of the base, and three with both barbs and holes (Figs. 3,17; 4,2–3). The first two belong to the LM LL: one is a special specimen of 241 x 24 x 12 mm from an elk metacarpal, curved in profile, its base worked by retouch, the end rounded (Figs. 3,20; 4,1). Formally these items should be attributed to spears, as well as pieces with barbs only. At the same time, items with holes for attachment to the shaft are usually regarded as leister points. However, for most implements it is difficult to accurately determine their type, since the average length of fragments is 9–10 cm, hence the necessary information is usually absent.

Pointed fragments with barbs and without barbs in general do not differ much from each other. They possess a symmetrical, quite massive pointed tip, a sharpening angle within 35–45°, and a semi-circular, triangular or rhombic cross-section at the end. The surface is generally smooth and shiny due to careful working and use. At the very end of the tip we can often observe damage from penetrating operations: flat spalls, half-erased chipped facets, and transverse and oblique fractures (Figs. 3,2–4.6.11–12; 4,5–6.10–11).

Regardless of the sizes of tip fragments, which range from 2–14 cm, most of them (n = 25) possess barbs. The distance between the barbed zone and the pointed end is 3–12 cm. The barbs are large, rather massive, beak-shaped, or sub-triangular (Figs. 3,3–8; 4,10.18–19). On tip fragments, they are intact more often, although damaged examples also occur. Barbs on the medial fragments are for the most part completely destroyed (Fig. 4,13–14). Two types of damage are the most typical: in the first, a barb is broken along its base, and the direction of removal negatives indicates movement in reverse to the penetrating direction, suggesting that these damages were inflicted at the time of pulling the point out (Fig. 4,7–8.11). The second type includes ruptures of the support, starting from the base of the barb (Figs. 3,2.4.8; 4,4.6.9). Often there are only specific facets in place of barbs as well as scratches and cuts left over from shaping the barbs, indicating their former existence. Because there are numerous examples of locations of barb remains on the edges of fractures, it can be concluded that the barbs were the cause of the more intensive fragmentation of these points.

Although there are 51 artefacts with barbs in total, we have only fragmentary data about the number and arrangement of the barbs on the spearheads (Fig. 5b). Three items deserve special attention. The only item with three barbs – rather closely placed ones, 2.5–3 cm apart – was assigned to the LM UL; this, incidentally, is also the only example of projectile point remontage. Two complete points of a similar shape but different size – with barbs arranged asymmetrically on both sides of the tip – are from the same layer (Fig. 3,15.18). A similar specimen, but perhaps with the remains of a third barb next to the fracture, was found among surface material. Other intact tools show one or two uni-lateral barbs. Pointed and medial fragments often provide information about one barb, more rarely about two; the distance between barbs is from 3.5–7 cm.

Transverse incisions on the barbs or on their adjacent edges sometimes create an impression of ornamentation; this technique is observed on artefacts from the LM UL (n = 7), FM (n = 2) and EN layers (n = 3; Figs. 3,4–5.7.10; 4,9–11.16.18–19). Several tools (n = 7) have surface decoration in the shape of fine parallel or crossed scratches; it can also be located in the zone of the tip and barbs (Figs. 3,5; 4,12).

Base shapes are quite diverse and depend largely on the bone-blank. Most of them show a subtle symmetric narrowing and traces of rough scraping and shaving. The transverse end often has a slightly concave contour that corresponds to the natural surface of the bone epiphysis (Fig. 4,3.23.25–26). The concave bottom side almost always features a spongy mass. The edges of the base sometimes retain traces of knapping and retouching (Fig. 4,1). In profile, the base hardly stands out. Spearheads made from elk ulnae are distinguished by their pointed bases with a spongy structure (Figs. 3,14; 4,20).

More than half of all excavated fragments of bases have a perforation in form of a hole (25 with holes; 18 without). If we add complete items and medial fragments, data on 35 holes are available (Fig. 5c). It seems obvious that the presence of holes does not depend on the shape of the bone blank. They may be located in the centre (Figs. 3,22–23.25; 4,20.25–26), or shifted to any edge (Figs. 3,17.24; 4,2–4.9). A fragment with a hole in the side projection – decorated with incisions – is probably also related to a spearhead (Fig. 3,21). Holes were made, depending on the form of the blank, by bifacial perforation (n = 18; Figs. 3,13.21.24; 4,2–4.9.20.25), or by other means (n = 17; impacts, scraping, cutting; Figs. 3,23; 4,26), traces of which are often difficult to see. The latter are frequently confined to the beginning of the natural bone groove (Fig. 3,13.22.25).

Holes are located at different distances from the base end: those of the largest group are up to 3 cm distant (n = 20), others 3–6 cm (n = 9), or more than 8 cm (n = 5). The latter have been encountered only in the LM UL and the FM layer. In objects from the LM LL and the EN layer, the distance from base to hole does not exceed 3.5 cm. This means that different fixation systems were employed. One interesting base fragment has three holes, two of which (at the centre and at the side, 8.5 cm from the end) are bi-perforated, the third, only 1.5 cm from the end, was scraped from the inner side (Fig. 3,13). However, it should be emphasised that a pronounced smoothing of hole edges, which might be related to the tying line, has not been observed.

Two other fragments stand out. One of them is broken near the lower barb; in place of the hole it has a ledge along its perimeter 5 cm from the end. This element is practically unknown in the other Zamostje 2 materials. The second medial fragment is broken through two barbs oriented in different directions; technological traces below one barb probably indicate its function as a 'reverse' barb for tying the line (Fig. 4,13). Both fragments are from the LM UL.

It is impossible to establish a clear correlation between barbs and holes. Apart from the three complete (or almost complete) spearheads, there are three medial fragments (Fig. 4,4.9) with remains of both a hole and a barb (FM and EN layers). For the other fragmented items, which do not have one of these elements (a barb or a hole), their absence, however, is not obvious. On the other hand, if pointed or medial fragments with barbs can undoubtedly be attributed to the category of spearheads, the attribution of base fragments without holes sometimes raises questions, as theoretically they might also belong to

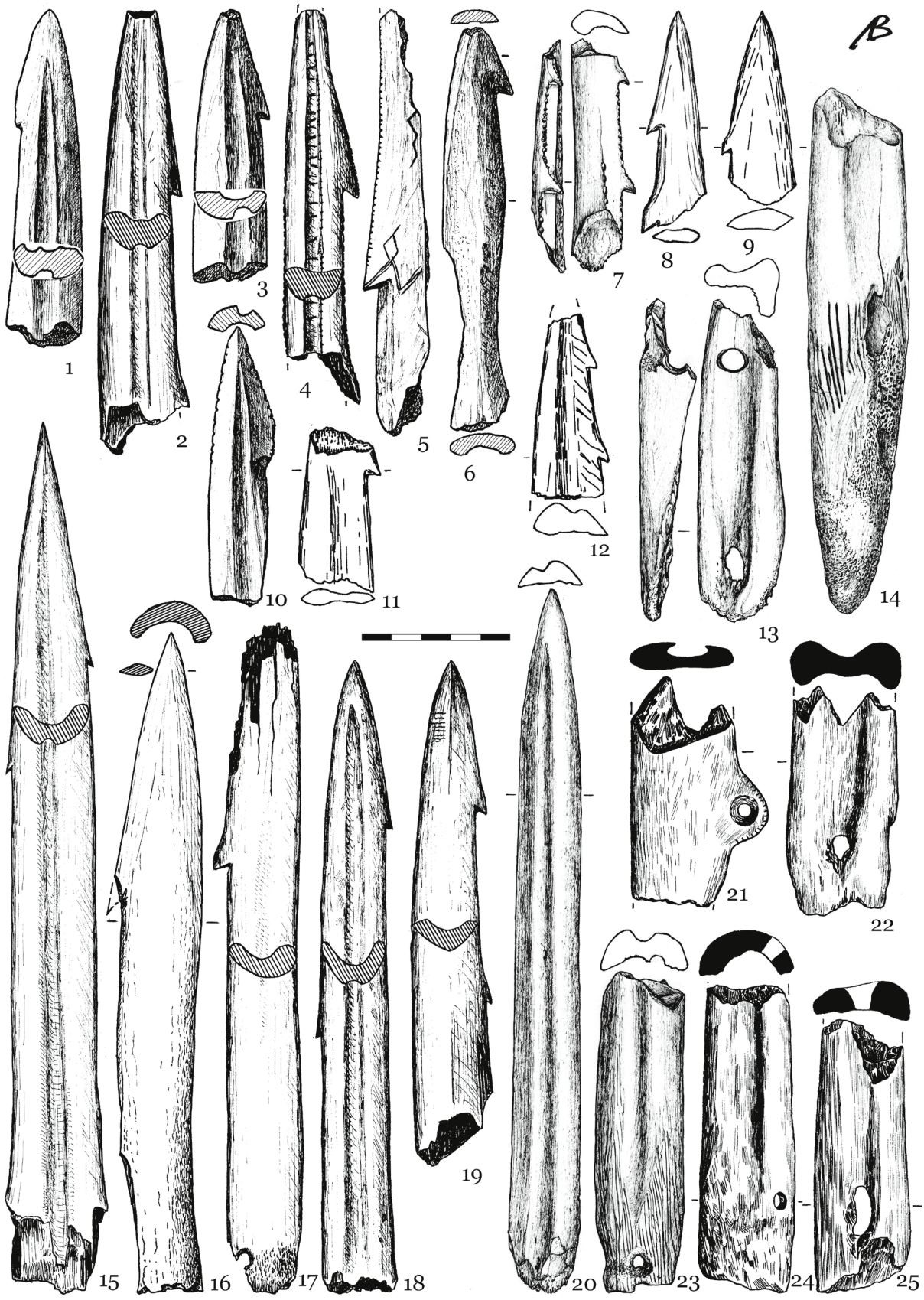

Fig. 3. Zamostje 2. Spearheads. Late Mesolithic Lower layer: 1–3.20.23; Late Mesolithic Upper layer: 4–9.11–18.24–25; Final Mesolithic layer: 21–22; Early Neolithic layer: 10; redeposited layers: 19.

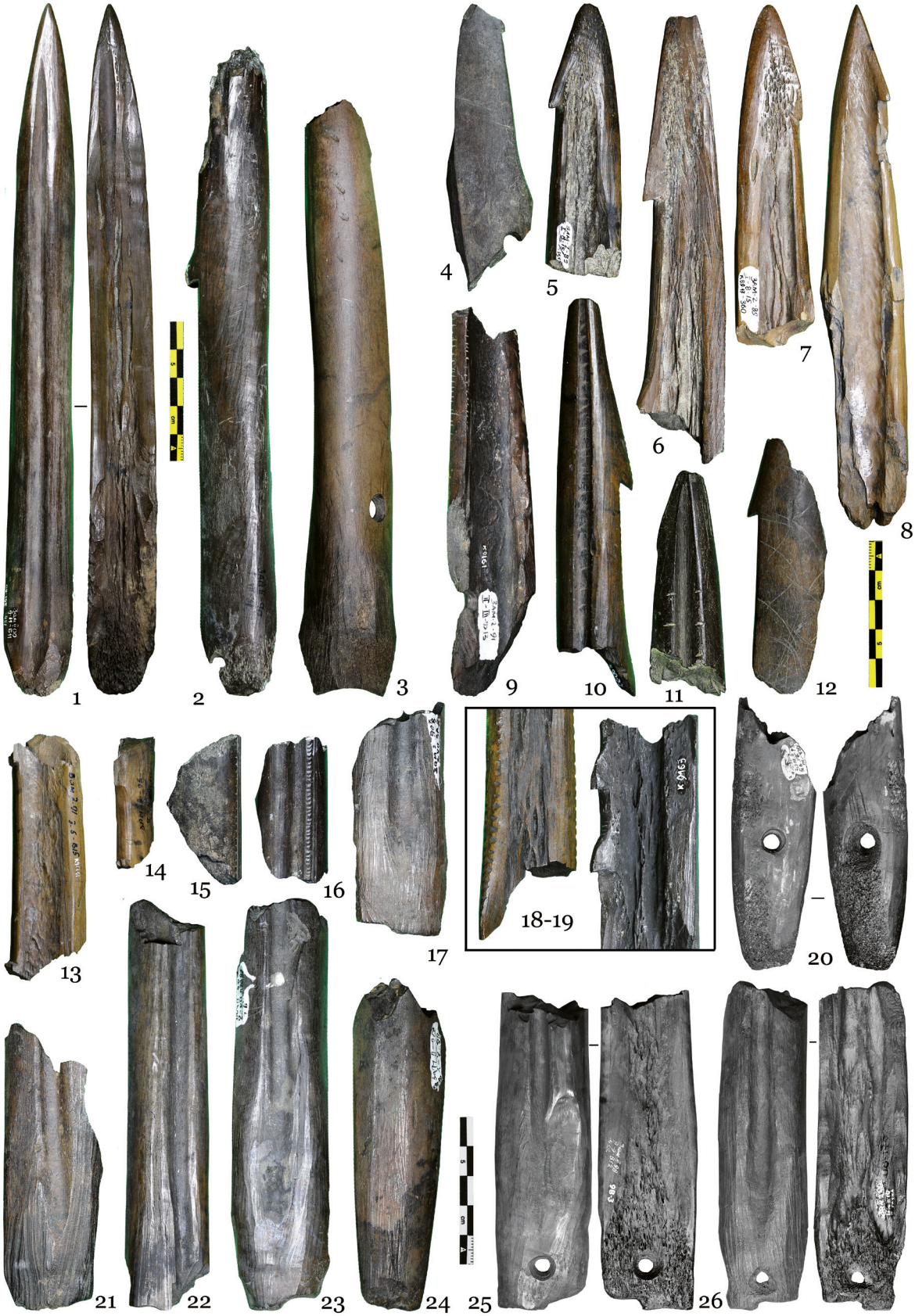

Fig. 4. Zamostje 2. Spearheads. Late Mesolithic Lower layer: 1.5–8.20.25–26; Late Mesolithic Upper layer: 2-3.10–13.17–19.21–24; Final Mesolithic layer: 14–16. Early Neolithic layer: 4.9.

other types of large tools made of metapodia or ulnae of elk, such as tools bevelled at 45°, but until now no intact tools with a hole have been found.

However, the very presence of the 'barbs and hole' feature on massive points is crucial in determining not only possible ways of fastening them to a shaft, but also of the scope of use in general. It is believed that these elements indicate pursuit of game in water. In this case, two main options are considered: 'harpooning' of big fish (sporadically documented in Zamostje 2, according to a study on ichthyological remains by Valentin Radu and Nathalie Desse-Berset [Radu/Desse-Berset 2013]), or elk hunting, as it is known that in summer elks spend a lot of time in the water to escape the heat and insects. There are many ethnographic parallels: traditional hunting methods of many northern peoples (Nenets, Yakut, Eskimo, etc.) include spearing of elks in the water throughout summer, in the season of gnats and midges. Although this option seems preferable, there is no indication these recent northern peoples used weapons with a detachable point. On the other hand, Kanozero petroglyphs dating from the 4th to 2nd millennia BC show scenes of boat hunting, featuring an elk and a hunter connected with a line (Kolpakov/Shumkin 2012, 322). Scenes of hunting elk on the frozen snow using a spear and a bow (?) are represented among Zalavruga images (groups IV and XXII; Savvateyev 1970; http://rockartbridge.com). Hunting with spears and javelins in the autumn/winter period was typical for Siberian peoples prior to the spread of firearms.

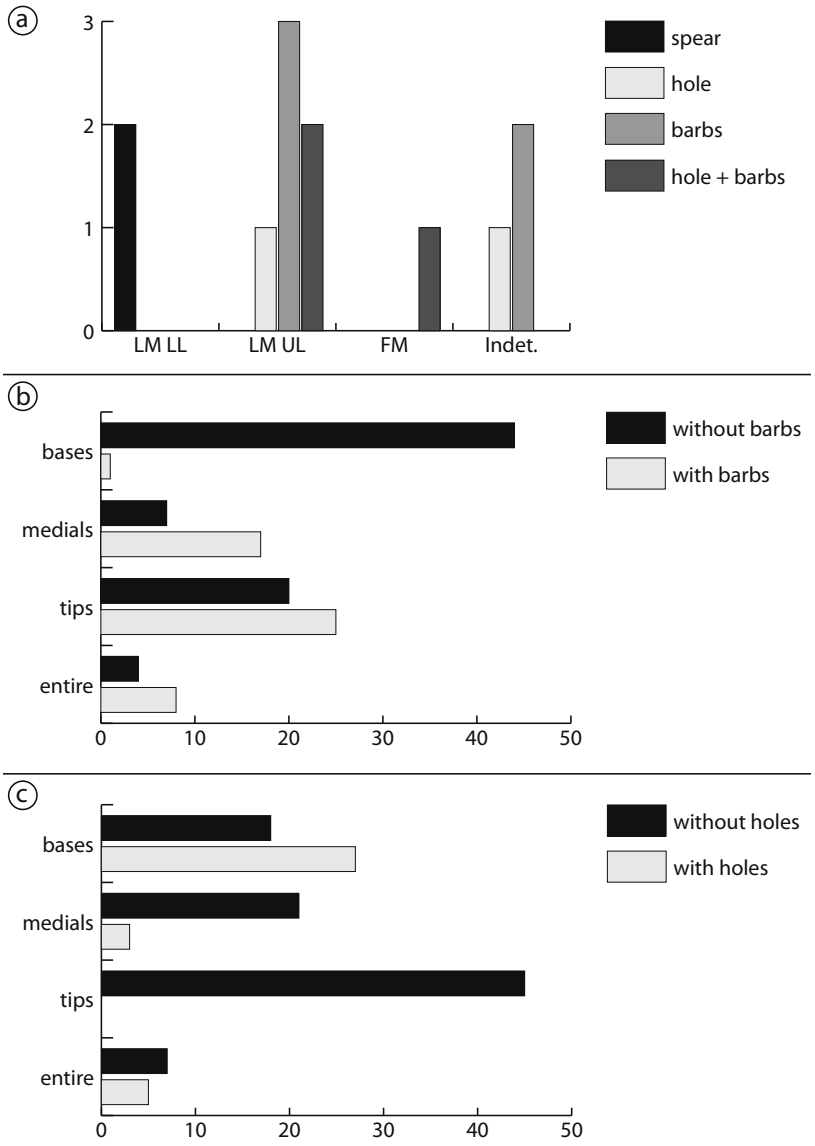

Fig. 5. Zamostje 2. Spearheads and leister points: a – combination of elements on intact items; b - representation of barbs on intact and fragmented items; c – representation of holes on intact and fragmented items. LM LL – Late Mesolithic Lower layer; LM UL – Late Mesolithic Upper layer; FM – Final Mesolithic; Indet. – Indeterminate.

Considering that the basic shapes, weight and proportions of spearheads with barbs and without barbs, bases with holes and without them in Zamostje 2 do not differ, it may be assumed that this category of projectile points was entirely intended for elk hunting, with adaptation to seasonal specifics and catching methods. The faunal data do not contradict this assumption; the hunting period around the site lasted all summer, autumn, and winter (Chaix 2009).

Chronological features of spearheads are manifested only in details. Thus, in the LM LL two complete simple spearheads are present, but separate fragments of bases with holes and parts of tips with barbs are more numerous. All holes are located in the centre of the base, at a distance of up to 3.5 cm from the end. The LM UL shows examples (10 of 17) of decorated barbs, adjacent edges, or surfaces made by incisions or hatching. There are two complete points, single items with bi-lateral barbs, as well as tools with a ledge and a 'reverse' barb. The location of the holes is least regulated here in comparison with other layers. In the FM transition layer, as well as in the underlying layer, holes on points are positioned 2–8 cm from their ends; items without barbs are represented by small tip fragments (n = 4). A fragment with a hole at the lateral projection has also been found in this layer. In EN layer objects, all holes are located at the end of the base, and nearly all of them were made by bifacial perforating. In the MN layer this type of weapon is not present anymore.

3.2 Barbed points

Barbed arrowheads or other types of projectile points – we cannot say for sure whether such are present due to the lack of completely preserved weapons – include all artefacts with a piercing tip and barbs / a barb at the edge, with the exception of massive spearheads, harpoons and composite points with a 'pin' (a long needle-shaped barb).

Barbed points are present in all cultural layers of the site. Altogether there are 135 intact points and their fragments, including 13 items from LM LL, 36 from LM UL, 17 from FM, 38 from EN, and 14 from MN layers; the remaining 17 items are from disturbed layers (Table 1) (Figs. 6–7). The series is characterised by a significant variety of shapes, small dimensions, and a medium degree of fragmentation. Whereas only 9.5 % of spearheads are intact or nearly intact, the figure for barbed points is 40 %. Complete items less than 12 cm long dominate (60 %), and only in the LM LL the average size amounts to 14–16 cm. Few barbed points are over 20 cm in length (207, 225, 235, and 238 mm; for details see Lozovskaya/Lozovski 2013).

Despite a high variability of shapes, we will try to identify the main common features for each of the cultural layers. The LM LL is characterised by needle-shaped forms with two or three large, delicately carved beak-like barbs (Fig. 6,32–33.41C), or bent down, long straight 'pins' (three items), placed in the medial part of the point or near the base (Fig. 6,30–31.41A/B). These types are not present in the other layers. In addition, the base of the complete point with a pin is marked with superficial incisions around the perimeter, and the point with three beak-shaped barbs reveals remains of deep grooves and remains of glue with binding traces. Other points from the LM LL, also needle-like but shortened in proportions, have one or two sub-triangular barbs near the tip (Fig. 6,35–36.39), which brings them closer to some samples from the LM UL. There are also some artefacts with a number of unusual, slightly profiled barbs (Fig. 6,38), which we regard as individual specimens. All points are made of big elk bones.

In the LM UL, large three-barbed points are rare, but distinctive; all three items have a short conical base (tang), highlighted by a ledge (typical only for this layer; Fig. 6,20–22); one point has remains of bindings made of birch bark (Fig. 6,20.1D). The barbs are asymmetrically triangular (Fig. 6,1A/B); the lower ones are slightly larger. They differ from the previous ones due to the lack of fine details and a pronounced sharp edge. Single-barb points (n = 10) with shortened dimensions prevail in this layer; the shapes of blanks and barbs are different (Fig. 6,11.15.18–19.24–27.1A). There are also tiny flattened points (n = 10) with one to three barbs, made of small tubular bones; one is cut from an elk's rib (Fig. 6,13–14.28–29). This type is unknown in the lower layer and appears here first. Points of individual forms include a multi-barbed single-row needle-shaped artefact, with ten barbs separated by notches; the wide side near the barbs is decorated with transverse incisions (Fig. 6,16–17). A second short

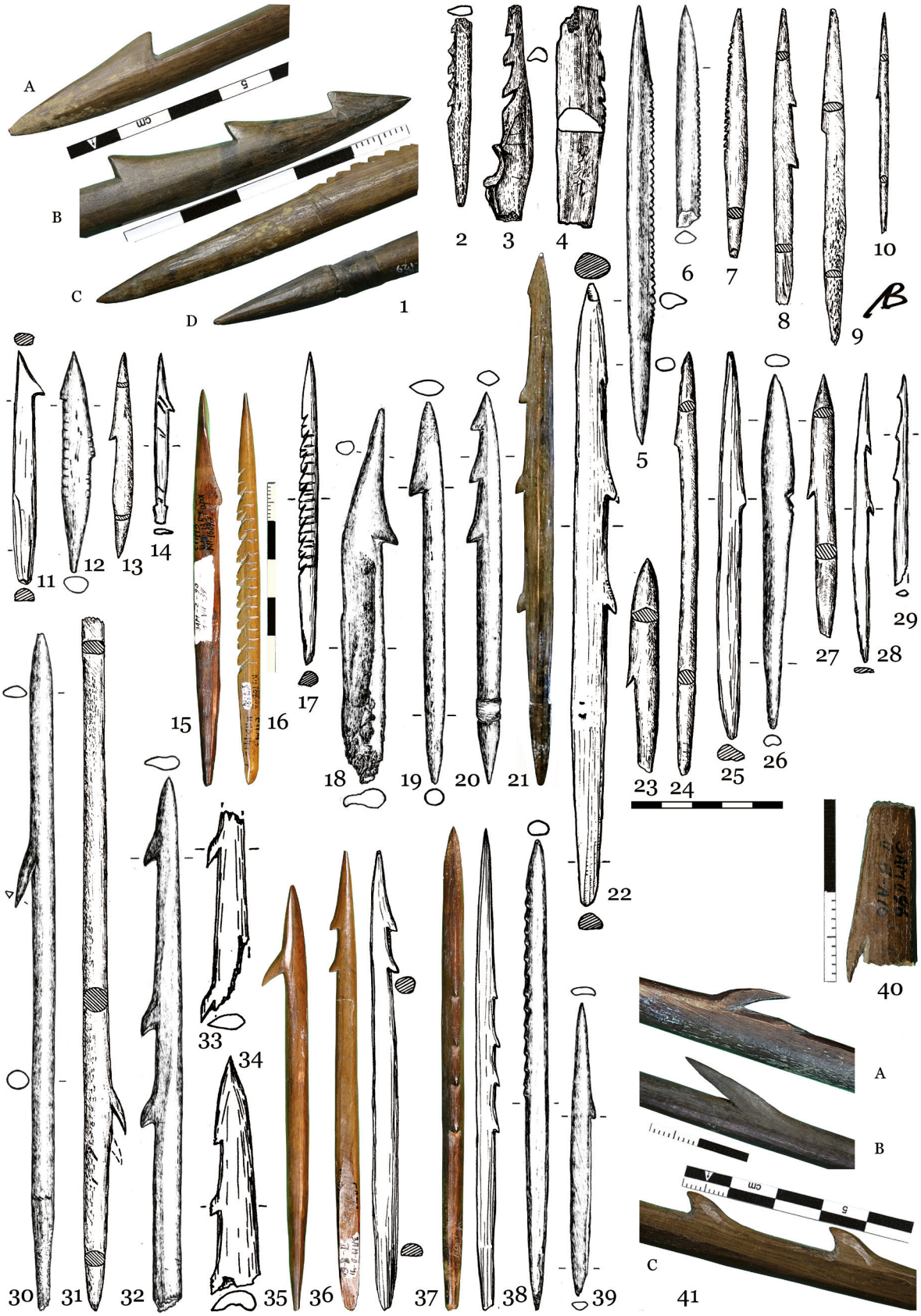

Fig. 6. Zamostje 2. Barbed points. Late Mesolithic Lower layer: 30–39.41; Late Mesolithic Upper layer: 1A–B,D.11–29; Final Mesolithic layer: 1C.2–10.40.

Fig. 7. Zamostje 2. Barbed points. Early Neolithic layer: 20–42; Middle Neolithic layer: 1–6.8–10; redeposited layers: 7.11–19.

massive point with two low-profiled barbs asymmetrically placed on both sides is also covered at the edges with regular transverse incisions (Fig. 6,12). In general, the strong fragmentation of artefacts should be noted; most fractures may be associated with their utilisation.

The FM layers are characterised by a heterogeneous series of barbed points. Single-row small-barbed points (n = 3) with a drop-shaped or lenticular cross-section – typical for the Upper Volga culture – are represented by two nearly identical objects (Fig. 6,5–6); one of them is complete, it is 14.6 cm long. The barbs were shaped by asymmetrical triangular cuts 0.5–1 mm deep (the Early Neolithic technique of barb shaping), their spacing varies from 1.5 to 3 mm, and their shape changes from triangular to trapezoid-like. The intact row (8 cm) includes 33 barbs. The tang is symmetrical, and sharpened.

The most impressive find is a kind of harpoon (?) made of a badger's ulna (Fig. 6,3). This is a uni-lateral point with widely spaced barbs and a natural asymmetrical tang; natural projections might have been used for the loose attachment to the shaft. Three small trapezoidal barbs are carved with deep cuts. The form of this tool is unique for Zamostje 2 and the Volga-Oka region. Small needle-shaped points with one or two barbs (n = 4) are very similar to specimens from the LM UL (Fig. 6,8–10). The others are fragmented.

The EN layer of the Upper Volga culture has yielded the most homogeneous assemblage of barbed projectile points. More than 15 of 38 whole and fragmented objects can be attributed to the same type (Fig. 7,22–24.25–34). These are uni-lateral, small-barbed points with a sub-triangular (18–24 cm long items) or flat (8–9 cm long items) cross-section. They are characterised by the standard method of barb carving (on objects of various sizes), i. e. by means of deep asymmetrically triangular cuts along the sharpened (in the cross-section) edge, which sometimes is additionally flattened by shallow longitudinal cuts (Fig. 7,20). The result was a continuous row of small barbs, the number of which ranged from 10 to 45.

A point with three adjacent barbs at the end of the unilateral 'wing' (Fig. 7,25) as well as larger items with a drop-shaped cross-section, a longitudinal groove and incisions along the edge of trapezoidal barbs (Fig. 7,21.35) were also made using this technique. A similar technique was used for cutting large, closely spaced barbs with a convex upper contour and flat sides, made on a blank with a rhombic cross-section (Fig. 7,37). Points with sparsely spaced barbs are rare, among them there is one item with two barbs and a uni-laterally flattened tang (Fig. 7,42) as well as one shortened needle-shaped object with double barbs near the tip (Fig. 7,40). Points with one barb are absent. A uni-laterally flattening of the base (tang) on some massive artefacts is not inconsistent with the possibility of their attachment to the shaft at a sharp angle, but we do not have a sufficient basis for a reconstruction of composite multi-point weaponry (for example, fishing spears/leisters).

The bone toolkit of the Lyalovo culture (Middle Neolithic) is rather poorly known, due to bad preservation of organic materials in the upper part of the sequence. There are miniature uni-lateral points with numerous barbs of different shapes, made of tubular bird bones with a curved cross-section or of thin bone blanks (Fig. 7,2–5). A series of points with one barb each, made of different blanks, was found, three of which are about 7 cm long (Fig. 7,8–10). Barbs are separated from the main part of the tool by a shallow notch and are directed sideways and downwards; their upper part, like the tip of the point, is curved. In two cases tangs are wide and flat, the third tang has been reshaped. Two unusual points are made of laurel leaf-shaped blanks (Fig. 7,1). In general, all barbed points from the Lyalovo layer are rather carelessly worked and retain substantial areas of bone surface unaffected by any processing; the barbs were made with the help of a limited number of operations. The Early Neolithic technique has completely disappeared.

Occasional finds from the bottom of the river and from the mixed layers there (results of the regulation of the Dubna River in the 1920s, carried out with a 'Floating Power Shovel') revealed a number of items the cultural and chronological attribution of which is difficult. In particular there are two points

(10 cm and 15 cm, resp.) with three and four isolated barbs and a flattened and asymmetrically broadened tang, one with a small step (Fig. 7,17–18); a needle-shaped uni-laterally barbed tool (17.5 cm) with eight barbs, oval in cross-section, and a short sharpened tang (Fig. 7,16). All these objects have atypical tang forms in terms of the complexes considered here. A miniature barbed point, 5.6 cm long, with three broken barbs and a flat spade-shaped tang is a unique artefact (Fig. 7,7). Three points with a row of closely spaced small barbs each could be on the contrary attributed to the Early Neolithic, despite their atypical appearance (Fig. 7,11.14–15), and a needle-shaped one with one or two barbs to the Late Mesolithic (Fig. 7,12–13).

Thus, the assemblage of barbed objects from Zamostje 2 reveals a considerable variety of forms and sizes, which can be explained by a narrow specialisation in points and the existence of a large number of composite tools and attachment modes. The underlying purpose of barbed points is not univocal.

In most cases the tang is symmetrical: it is either conical (n = 11) or evenly narrowed and/or flattened (n = 29), or flat on flat supports (n = 11). Less frequent are asymmetrically flattened tangs, which are typically either plano-convex (n = 3) or triangular (n = 6) in cross-section. There is only one instance (EN layer) of a flattened tang being positioned at right angles to the plane of the barbs and tip; we assume it could have been attached to the shaft at some angle. As for the line attachment in the case of detachable points, we can consider the natural relief of the bone (coronoid process of beaver's ulna) for the tool from the FM layer; in other cases we can talk about a usually firm fixation of points.

Despite the heterogeneity of assemblages within each layer, it is possible to track some changes over time in design and number of barbs, as well as size and shape of supports. In the LM layers, points with one to three isolated barbs dominate. However, in the EN layer points with a continuous row of small sharp barbs (their number varies from 10–15 to 45) become typical. In this context, they can be considered as the diagnostic type for the Upper Volga culture. Later layers lack this kind of artefacts. In the Middle Neolithic, points with one barb at the tip re-appear, as well as tiny items with three to five denticles. It is also important to accentuate that almost all points from Zamostje 2 have just one row of barbs.

Generally, ornamentation is uncommon. The single item with a complex geometric pattern is a fragment of a big point from the EN layer (Fig. 7,38); in other cases several artefacts possess additional engravings in form of transverse incisions on either their wide faces (n = 3) or edges and barbs (n = 7).

3.3 Harpoons

This type of distance weapon is not typical for the Mesolithic and Early Neolithic at Zamostje 2. We have classified five items into this category: three were found in the MN layer, the other two come from redeposited layers.

The former are massive uni-lateral harpoon heads of shortened proportions with large curved barbs (n = 3). The only intact object (10.3 cm long) provides the general idea of this type (Fig. 8,23). It was carved of a big bone, its cross-section is sub-rectangular, and the only undamaged barb is located in the middle of the lateral edge. The barb is massive and bent downwards at a right angle; its lateral edges are slightly concave, the end is sharpened. The surface around the barb is covered with numerous deep transverse and oblique grooves/incisions, separating smoothed projections. They look like attempts to eliminate remains of other – broken – barbs: originally there seem to have been three or four of them. The tang is flattened from both faces; adjacent to the 'row' of barbs there are two pointed projections separated by a deep notch, which indicates the option of a loose attachment. The second object lacks the tip, all its barbs are 'cut off', the last one – near the tang – is broken off (Fig. 8,19B), and the tang with remains of spongy tissue is evenly narrowed. In the broadest part of the artefact – beneath the 'barbs' – there is a big projection (reversed barb), separated from the 'row of barbs' by a semi-hole. The tang of the third artefact is broken off (Fig. 8,19A).

Fig. 8. Zamostje 2. Slotted arrowheads: 1–18.20.24; dart point: 25; slotted spearhead: 26; harpoon heads: 19.21–23. Late Mesolithic Upper layer: 1–4.9–13.15–18.20.24–25; Final Mesolithic layer: 7–8.14; Early Neolithic layer: 5; Middle Neolithic layer: 6.19.23; redeposited layers: 21–22.

All three artefacts, on the one hand, differ significantly from all of the above-described barbed points; on the other hand, they are very similar to each other in their rough workmanship, compared to other items from the MN layer. Particularly surprising is the fact that the massive harpoon heads are heavily worn with nearly all their barbs broken and the corresponding surfaces levelled. It is evident that despite this, the tools continued to be used and were discarded only after destruction of their corpus.

The other two harpoon heads are very similar and differ only in size (14 cm, and 22.5 cm, respectively; Fig. 8,21–22). These are uni-laterally barbed points with big beak-shaped barbs (two and four) and an asymmetrical broad tang with a steep hollow and a step. The bigger tool has deep incisions on the surface of the narrowed part, made to secure the hafting attachment. The workmanship in both cases has been very careful. Similar tools are present among surface finds from Zamostje 3, as well as in other collections from the Volga-Oka region. At Sakhtysh II similar objects were assigned to the Lyalovo culture (Gadziatskaya 1966), but it seems more likely that they date to the Late Neolithic.

3.4 Slotted projectile points

The presence of composite flint blades or at least of grooves deliberately cut for flint inserts seems a sufficient basis for an allocation of this group of points into a separate category, as the technology of their production and operating characteristics were significantly different. Slotted tools were not widespread at Zamostje 2, which is consistent with general trends in the development of projectile weapons in the first half of the Atlantic period (Zhilin 2001, 265). Moreover, they apparently had a specific function in the spiritual or social sphere and can be interpreted as prestigious or cult objects. This is supported by a large amount of ornamented tools in this category.

Of 40 currently known tools with slots and inserts, 14 items can be described as projectile points including a complete point with two grooves and preserved inserts (Fig. 8,25; Lozovskaya 2001); one re-shaped spearhead with a barb and remains of a groove with glue (Fig. 8,26); and twelve mainly fragmented arrowheads (one of them is intact with two slots and flint inserts).

The most interesting series consists of miniature arrowheads of lenticular or rhombic cross-section, with a uni-lateral slot for flint inserts, with a width of up to 2 mm and a depth of 2–4 mm; resin residues are preserved in all slots. The opposite edge ends with a long, thin and sharp pin (Fig. 8,1–3.10–11). The tangs of all arrowheads are broken in the zone of barb attachment. The edge of the barb bears transverse incisions which make it appear wavy (Fig. 8,11). Surfaces of two arrowheads including pins are decorated with continuous or intermittent zigzags; the third one has only incisions at the edge. These pins are so typical that 14 items found separately (seven of them also with zigzag or incisions) were attributed to the same type of tools (Fig. 8,7.14–16); pin length ranges from 22 mm to 50 mm. Furthermore, there are three fragments of arrowheads with ornaments (zigzag, sloping ladder, and lines with knots) and a fragment of a tang (zigzag), which are similar in proportions, groove shape, and the presence of incisions or ornament (Fig. 8,4.9.13.17). All these tools belong to the LM UL.

Another interesting specimen was found in the LM UL: it is a piece of a tip with a short slot and a symmetrically located bone imitation of a flint insert (Fig. 8,18).

Three small fragments without ornament and one with a preserved flint insert date to the Final Mesolithic, Early and Middle Neolithic (Fig. 8,5–6.8). Their slots are much closer to the tip of the point than in the Late Mesolithic artefacts.

Finally, the last arrowhead, 8 cm long, with two flint blades (Fig. 8,20.24) was found during underwater investigations near the Late Mesolithic fish-screen (Lozovski et al. 2013, fig. 21). A very similar object is known from materials of cultural layer IV at the site Ivanovo 7 (Zhilin 2014, 180).

The item (Fig. 8,25) made of elk antler (24.8 x 1.8 x 1.4 cm) possesses two flint blades of equal length (12.6 cm), both slots are 4 mm wide and 6 mm deep. The base of the grooves is flat, 1–1.5 mm wide,

which indicates the use of a burin in the final manufacturing stage, preceded by the application of a sharp cutting edge (indicated by a cluster of thin scratches below the grooves). Based on the four inserts preserved *in situ* and the imprints in resin from the separated ones, we can say that each blade was composed of five flint sections, which had been placed with their ventral sides up, the proximal ends down; they protruded from the groove by 2–4 mm. Interestingly, the thickness of the sections was less than the groove width. Thus, the inserts were 'buried' in the resin; a part of resin also went beyond the slot, creating a nearly continuous strip of 1.5 mm; the cutting edge is 3–4 mm high. Use-wear analysis of the flint blade revealed diagnostic traces of its shock-penetrating function (Lozovskaya 2001).

3.5 Arrowheads

Bone arrowheads – tallying as many as 280 complete items and diagnostic fragments (Figs. 9; 11) – constitute more or less well-established types, as well as some random and transitional shapes (Table 1; Fig. 10). They were produced of antlers and large elk bones, as well as bones of smaller animals.

The LM LL is poor in arrowheads (n = 10 items). Typologically they are quite homogeneous, although not very expressive (Fig. 9,1–5). All intact items but one are similar in their needle-like shape, and differ just in minor details. These are arrowheads of medium length (10–17 cm) with a shank of 6–8 mm in diameter. Two very small pieces (7–8 cm long) have narrowed ends; one of them possesses a faceted tip (Fig. 9,4), another reveals uni-laterally flattened ends and lateral incisions on the tang (Fig. 9,2). Another one is made from a flat blank, but its tang is also smoothly cut. With slight variations, these forms exist in all layers of the site. A tiny item with a blunt end is considered a separate arrowhead type (Fig. 9,6); from later similar tools it differs by its small size, shape of head, and a figured tang.

The LM UL produced the largest series of arrowheads (n = 85) and the largest variability of forms. Long needle-like points (over 20 cm) differ in the shape of the tip. An intact arrowhead (28 cm) with a straight shaft (9 mm in diameter) has an asymmetrical triangular tip (Fig. 9,38). A single artefact features lowered wings at the triangular end (Fig. 9,42). We can note the appearance of persistent forms of the flattened triangular diamond-shaped tip, which is also observed on the short needle-like items and fragments (n = 9; Fig. 9,40–41.52). A broken but re-shaped arrowhead has its tip sharpened to the cone; the tang bears remains of resin (Fig. 9,50). The longest item with a broken tip has a full-length 'snakes' decoration, i.e. short segments of double zigzag lines separated by bands of transverse incisions (Fig. 9,39). An ornament featuring a simple zigzag or dot rows is present on two medium-length (15 cm) points (Fig. 9,45–46). All these objects represent shafts (in the sense of middle sections of arrowheads) with a standard diameter of 6–7 mm. Hence, a series of small fragments of the same size with such ornamental elements as 'ladder', 'lines with eyelashes', and zigzag can also be attributed to this type of long needle-shaped arrowheads (Fig. 9,19–22).

However, intact ornamented arrowheads are missing in other layers. All the above mentioned points possess a symmetrically narrowed short tang. One short needle-shaped item has a pentagonal cross-section and incisions along the edges for better fastening (Fig. 9,7). Three tools preserve in their medial parts remains of technical grooves and unworked edges; the faceted tip is a single carefully finished element. In total, intact needle-like arrowheads include 16 items over 12 cm long, and ten items less than 10 cm in length. At least 16 small fragments of tangs were also found, the largest one, made of elk antler, is 10 cm long with a tapered pointed end. Among others, slightly narrowed or symmetrically flattened shapes dominate; three tangs are pointed in profile, with an asymmetrically concave cut in one instance. However, some of them could belong to needle-like barbed points. Many broken items show traces of re-shaping and re-use.

A small series of blunt arrowheads (n = 9) is also present; these are traditionally associated with the hunting of fur-bearing animals and birds. Four of them are standardly shaped with a transverse enlargement and a gradually narrowed tang (Fig. 9,32–34). In two other cases, the impact end is shaped as a broad

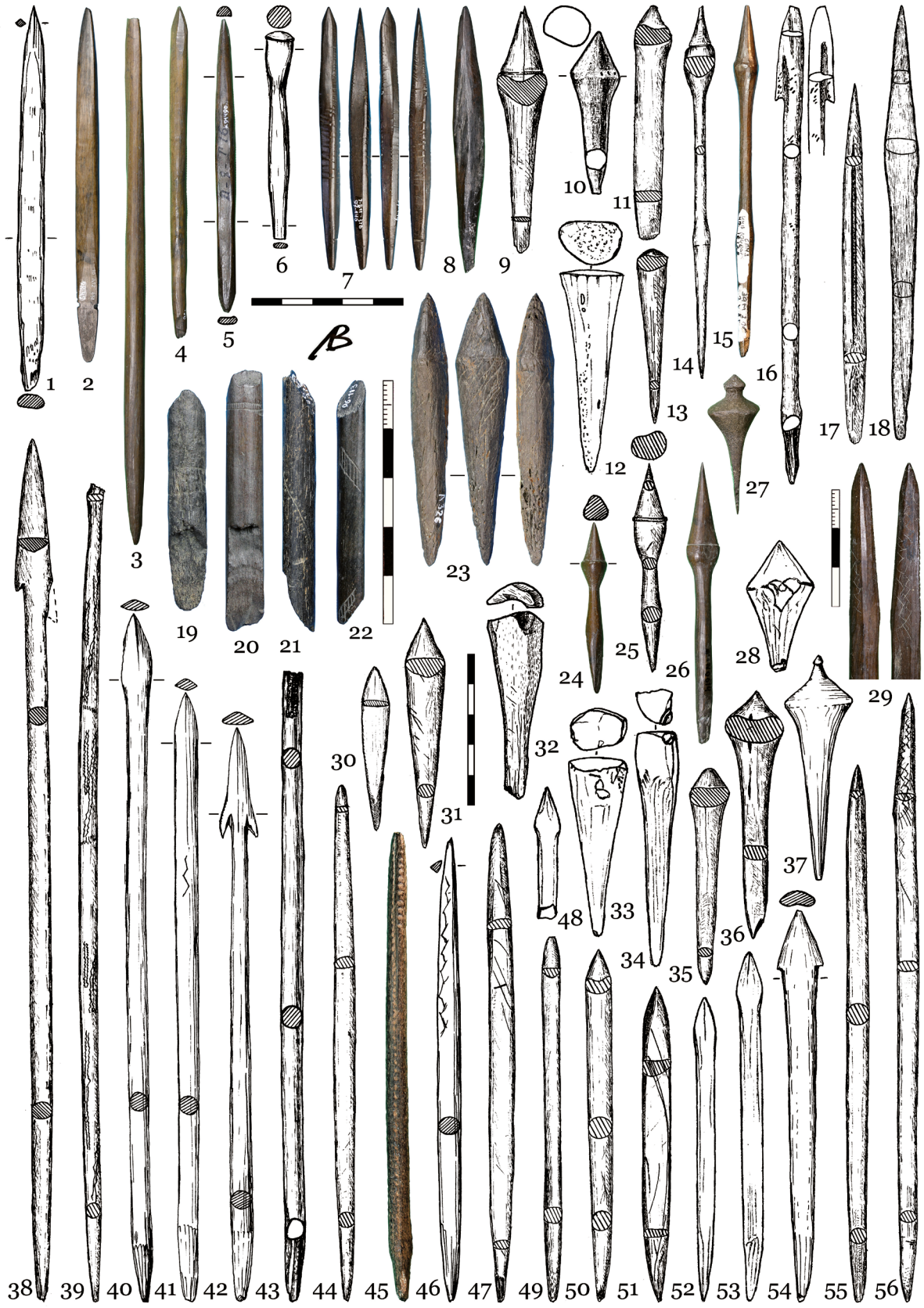

Fig. 9. Zamostje 2. Arrowheads. Late Mesolithic Lower layer: 1–6; Late Mesolithic Upper layer: 7.19–22.24–28.30–47.49–52; Final Mesolithic layer: 8–18.23.29.48.53–56.

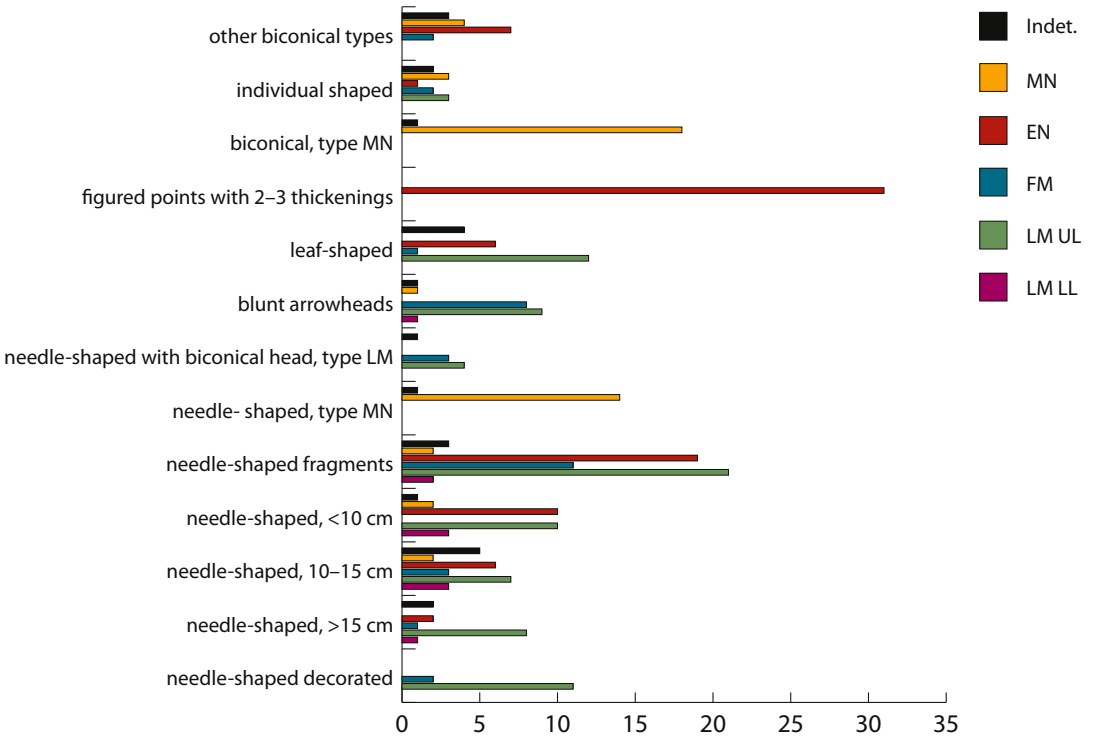

Fig. 10. Zamostje 2. Representation of the major types of arrowheads from Mesolithic and Neolithic layers. LM LL – Late Mesolithic Lower layer; LM UL – Late Mesolithic Upper layer; FM – Final Mesolithic; EN – Early Neolithic; MN – Middle Neolitic; Indet. – indeterminate.

short cone (Fig. 9,28); both are made of elk antler. The first one is 6–8 cm in length, the second one 4.5 cm. Besides, three items with a blunt end were made from flattened blanks (Fig. 9,31.35–36). Two arrowheads represent a peculiar type with a short knob on the end of the blunt cone (Fig. 9,27.37). Both items, made of elk antler, are complete, suggesting their non-utilitarian purpose. Four points – one of them very small (5.5 cm) – have a carefully worked biconical head of sub-triangular cross-section; the long tang is slightly widened in the middle and pointed at the end (Fig. 9,24–26). Their style of manufacturing differs from Early Neolithic items of similar construction. Finally, the last group of arrowheads (n = 12) includes small items, mostly willow leaf-shaped, made of flat blanks (whole or split bones), of different processing stages (Fig. 9,30). Their length is c. 6 cm (but for three of 8–10 cm), the tip section is lenticular, diamond-shaped, or triangular. One has a laterally pointed tang.

The FM layer includes – as usual – some transitional forms, often deposited close to the adjacent layers. This goes for example for two small needle-like points with a pronounced diamond-shaped tip that resemble some artefacts from the LM UL (Fig. 9,48.53). In contrast, another tool is of an original type with a lateral wing on the natural edge of the blank, which is covered on both sides with a series of short oblique incisions (Fig. 9,16). Another ornamented needle-shaped arrowhead has a thin asymmetric tip, with both sides engraved with a simple and double zigzag line as well as slight incisions on the edge; in the medial part it is slightly flattened (Fig. 9,29.56). The third point of this simple needle-like shaped type has a shank of circular cross-section (Fig. 9,55). All three objects are longer than 15 cm; another one is 12 cm with pointed and flattened ends. Shortened items are absent.

Tang fragments (4–5 cm long) cannot be easily linked to the needle-shaped arrowheads type, because in all intact specimens the tangs are evenly narrowed along the perimeter. Fragments, in contrast, have a variety of shapes: from elongated sharpened cones or smoothly flattened ends to bevelled or diagonally cut asymmetrical terminations; one massive tang is cylindrical with a rounded end.

Two needle-like arrowheads featuring a biconical head with a rim and an accentuated tang resemble tiny points of the underlying LM UL, but have a much more elongated outline (11 cm; Fig. 9,14–15), closer to figurative Early Neolithic items.

Blunt arrowheads (n = 7) are diverse, featuring a transverse, rounded or tapered massive head (Fig. 9,9–10.12–13). One head has a circular groove, which is typical for Neolithic points (Fig. 9,9). All these products are distinguished by smoothly pointed tangs. Three items are made of elk antler (Fig. 9,10). One irregular artefact with a wide and flat base and a bulbous head is very similar to objects of this group (Fig. 9,11).

Furthermore, we can observe the following atypical items: a willow leaf-shaped flattened point 10 cm long; another one with a large flat triangular tip (Fig. 9,54); an elongated rhombic-shaped arrowhead with a flat section (Fig. 9,18). One simple biconical item was also found, it displays remains of the rim in the widest part and hatch-like zigzag lines around the perimeter (Fig. 9,23); it has an oval cross-section and is 5 cm long. It is markedly different from biconical objects from the overlying layers.

The Early Neolithic at Zamostje 2 and around the Volga-Oka region is associated with a massive spread of figurative arrowheads (Fig. 11,44–58). Their main characteristics are three (sometimes two) thickenings: the middle and biggest thickening is marked by a circular groove or a ledge, which is often crossed by a short deep longitudinal scratch (Fig. 11,50.55). The tangs are always highlighted (lower thickening) and often faceted. The cross-section is usually slightly flattened, sometimes convex-concave according to the curve of the bone, sometimes almost flat. The tip at the end of the upper thickening is narrow, flat, sometimes diamond-shaped, and sometimes sharpened. Despite the obvious existence of a manufacturing standard for this type of arrowheads and the existence of almost identical items, in general the series is not uniform and varies in size (8–16 cm), proportions, and contours of bends. In total, this type includes 21 artefacts, apart from unfinished or partially re-shaped items.

Among artefacts close to this type of arrowheads, we can also name points with a small smooth thickening, a needle-thin tip and pronounced tang, and a circular cross-section; the length of intact items is about 9 cm (n = 5; Fig. 11,37–38). There are also points (n = 5) with a large spindle-shaped head, circular groove, and similar tang; one object also has a needle-thin tip (Fig. 11,39–41).

Individual shapes include a small point with a feather-shaped head and a stepped tang (Fig. 11,35).

Needle-shaped arrowheads in the Upper Volga culture layer are represented by a series (n = 10) of intact artefacts, 9–12 cm long, including one preform with remains of a technological slot, a point with a triangular faceted flat tip, one with a bevelled tang and needle-sharp tip, etc. Small needle-like artefacts (n = 4), 7–8 cm long, have pointed ends (Fig. 11,31–33). The longest objects include one almost intact point, 16 cm long (Fig. 11,42), and a slightly curved shaft, 15.5 cm long. Large needle-like arrowheads, similar to those found in the Mesolithic layers, are absent. Shaft and tip fragments of needle-shaped (?) arrowheads with a diameter of 4.5–8 mm indicate the possible existence of thin as well as large pieces. Among tang fragments, there are both thin tapered shapes and massive specimens including one with a rounded end and imprints in the glue.

Finally, simple willow leaf-shaped arrowheads are represented by six items (Fig. 11,34); two of these are made of animal ribs; there is also a non-standard flattened point with a very long triangular tip.

Arrowheads from the Middle Neolithic Lyalovo settlement highlight a quite abrupt change of certain types and of the fastening system in general, which manifested itself in two main tang types: a flat spatula-shaped one and a small sharpened one.

Shortened and short needle-shaped points of the Early Neolithic period, usually with a slightly narrowed tang, were replaced by massive straight items up to 20 cm long, with a rounded cross-section, gradually narrowing at the tip (n = 10; Fig. 11,12–17). Short and flat spatula-like tangs, limited by ledges on two sides (sometimes on four sides), were often decorated with geometric ornaments (mesh) or 'property signs', e.g., isolated crosses (Fig. 11,12.24).

Fig. 11. Zamostje 2. Arrowheads. Early Neolithic layer: 31–58; Middle Neolithic layer: 1–30.

The wide flat tang can be observed on four short wide points with a flattened cross-section (Fig. 11,9–11); two larger ones possess a sub-triangular faceted tip. An unusual massive bullet-like point displays a similar spatula-tang shape (Fig. 11,8). Two simple needle-like arrowheads look odd in this context: the first one is of medium length and the second one is short and bi-pointed, like items in the lower layer (Fig. 11,18–19). One long tang has been re-shaped.

Among the figurative arrowheads two types are most popular. The first is biconical with sharp ends, a faceted surface and a belt in the widened part (n = 9; Fig. 11,2–7); dimensions range from 8–12 cm. The second type, a spindle-shaped point with an accentuated small conical tip (n = 9), has a tang worked as a small thin shaft or a pointed tip (Fig. 11,25–30). Here dimensions are between 5 and 7 cm.

The only blunt arrowhead is cylinder-shaped with a laterally pointed tang (Fig. 11,1). Finally, we found one large flat arrowhead with a long willow leaf-shaped tip and a short tang, 15 cm long.

Thus, the typological diversity of available arrowheads is very large, but they do not always reflect traditional forms. Even concerning such typical Mesolithic and Neolithic shapes as needle-shaped points, each period's type is characterised by countless variations in size, proportions, and forms of tip and tang. We believe it is not reasonable to allocate these variations into separate types, as they – with a few exceptions (see long points with an ornament or a triangular tip from the LM UL, although these are yet again different, or items with a flat scapula-like tang from the MN layer) – lack clear cultural and chronological contexts. Some types of figurative and biconical arrowheads, in contrast, have a pronounced relationship to a certain time period, which does not exclude a large number of transitional forms smudging the big picture. In this case, it is important to note that despite both singularity and similarity, it is difficult to identify the actual development of any form, so we note only their appearance, existence (non-recurrent, or extended in time) and disappearance. This is most clearly manifested by tang shapes in the Early and Middle Neolithic. All these peculiarities are observed despite an apparent continuity in economic activities, and are visible in most tool types, including spearheads. In other words, we can speak about a long-term presence of certain constant components (a certain population?), or a constant execution of the same economic tasks that caused, on the one hand, the long-lasting existence of needle-like points; on the other hand, the introduction of apparently new shapes and ideas in arrow production.

4 The typological and chronological structure of projectile points at Zamostje 2

A detailed study of the whole complex of projectile (and thrusting) points made of elk bone and antler during the Late Mesolithic, Early and Middle Neolithic at Zamostje 2 allows us to specify the main typological forms and identify some trends.

Thus, in the first half of the 7th millennium cal. BC (LM LL), hunting equipment consisted mainly of spears and possibly leisters. Among the barbed points, long needle-shaped items with thin pins and tools with isolated large beak-shaped relief-cut barbs are the most characteristic. In the second half of the 7th millennium cal. BC (LM UL) we observe the popularity of long needle-shaped arrowheads with differently formed tips (triangle, diamond, wings), often decorated with ornaments in form of zigzag, ladder or net patterns. Medium and short needle-shaped specimens often have individual features. Point tangs are usually slightly narrowed and symmetrical. A small series of needle-like forms with a biconical head appears for the first time. Blunt arrowheads with a massive conical head are an important part of the hunting equipment. Richly ornamented slotted arrowheads with a long pin directed downwards are a distinguishing feature. A new point type with three barbs and a tapered tang with a ledge appears among the barbed points. Massive spearheads and leister (harpoon) points for elk hunting remain essential. This category includes objects with bi-lateral barbs; some points are decorated with incisions and engraving.

The transition to the Early Neolithic period (FM layer, c. 5950–5750 cal. BC) is marked by a number of individual point forms: a needle-shaped arrowhead with one wing, a barbed point made of a badger bone (in both cases, specific natural blanks), a flat artefact with a big triangular tip, a needle-shaped item with a bevelled tip and ornamentation. Short needle-like forms are absent. Arrowhead forms with a blunt or massive tip are diverse. Massive spearheads include items with a barb and a hole.

During the period of the Upper Volga culture (c. 5700–5400 cal. BC) new technologies appear. Firstly, innovative manufacturing methods of barbs appear, i. e. the standardisation and wide-spread occurrence of multi-barbed points of two main types: small flat ones and large ones with a triangular cross-section. Secondly, new methods of arrowhead attachment emerge; this is indirectly confirmed by the existence of different types of figurative arrowheads with the same type of tang: broad and faceted. Figurative points with three thickenings become the dominant type of arrowheads. Needle-shaped items continue to exist, but mostly in shortened proportions. Massive spearheads remain unchanged.

The advent of the Middle Neolithic Lyalovo culture (c. 4800–3900 cal. BC) led – as it seems – to an abrupt change in traditions of tang shaping and in point types as a whole. The period is dominated by large needle-shaped arrowheads with a flat short spatula-like tang as well as biconical faceted items and spindle-shaped items with a flat conical tip, both types displaying a thin pointed tang. Harpoons come into existence: short, massive, with large curved barbs and projections for the attachment of the fishing line. Spearheads are not present. However, it cannot be excluded that a part of the finds from mixed layers and underwater squares might be related to this period.

5 Conclusion and discussion

The Zamostje 2 material shows an unusually large typological variety of projectile points, which reflects relevant cultural processes and a yet unknown development of hunting techniques, tools and structures. It should be noted that synchronous sites of the Volga-Oka region, in particular Mesolithic settlements (including Nushpoly 11 as well as Okaemovo 4, 5 and 18a in the same archaeological micro-region), demonstrate a similar picture, and the majority of types identified by M. Zhilin at these sites is represented only by 1–2 items each (Zhilin 2001, 225–239).

This picture changed with the coming of the Neolithic (i. e., the appearance of pottery), when some types of barbed points and figurative arrowheads – typically needle-shaped and biconical ones in the MN – acquired new features of serial and mass production (Krainov/ Khotinsky 1977). The Zamostje 2 material helps to clarify their chronology. These two major trends find undeniable confirmation in hunting weapon complexes, but they are not apparent in terms of analysing other aspects of the material culture and bone industry.

Compared to other geographically more distant settlements (Ivanovo sites, Ozerki 5), the typological uniqueness of Zamostje 2 is confirmed. In particular, many forms of needle-like composite arrowheads with grooves from Zamostje 2 are not present at the more distant sites (Zhilin 2001, 57). On the other hand, the variability of subtypes, for example needle-shaped or blunt points, is much higher at Zamostje 2. Many points possess unique shapes.

A few general remarks can be made about the series profile: Firstly, the number of ornamented tools is very small, except for certain specific types of arrowheads, primarily slotted tools. Wear and fragmentation rates, on the contrary, are very high; these patterns are consistent with the role of Zamostje 2 as a base camp. Secondly, we found no reliable evidences of widespread use of multi-pronged spears/leisters for fishing. Tangs have mainly a symmetrical shape relative to the longitudinal axis and a rounded or flattened cross-section; bevelled tangs are very rare. Thirdly, a reconstruction of projectile point attachments is still a theoretical issue, because we do not possess any shafts of arrows with hafting remains.

Finally, the exact purpose and application of all types of arrowheads and even of whole object categories (spearheads and barbed points) remains undetermined, due to the obvious lack of the evidence base. Realistic imitative experiments (elk, beaver and bird hunting, fish harpooning, rituals and military conflicts) are too complicated to carry out, while biomolecular analysis is still not able to resolve such problems.

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