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Socketed antler toggle harpoon head – a unique hunter-gatherer fishing implement in western Lithuania's freshwater lake environment

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ABSTRACT

Daktariškė 5 is a hunter-gatherer site with organic preservation in western Lithuania. It is located on a former island of Lake Biržulis, where most finds were obtained in the lacustrine environment. The excavations revealed various osseous tools, such as axes and adzes, projectile points, barbed points, gouges and chisels, dating from the 6th to the 3rd millennium cal BC. Despite the abundance of finds in the vicinity of Lake Biržulis, including those at the Daktariškė 5 site, many remain unexplored in terms of presenting their typological diversity, technology and direct AMS ^{14}C dating. In this paper, we focus on a single case and present a study of a fully preserved socketed toggle harpoon head manufactured from antler. We provide the latest data on its technological assessments, direct AMS ^{14}C dating, species identification by ZooMS, and archaeological and ethnographic parallels. The latter suggest that such type of implement in northern latitudes was designed for hunting large aquatic mammals. Archaeozoological evidence of large freshwater fish, beavers and otters from Lake Biržulis suggests that this tool could have been adapted to the local environment. Consequently, we discuss the origin and possible use of the toggle harpoon head in the Lake Biržulis environment.

KEYWORDS

toggle harpoon head, antler technology, AMS ^{14}C dating, ZooMS analysis, Lake Biržulis.

Introduction

Bone and antler tools played a key role in the daily lives of the hunter-gatherer societies in the eastern Baltic region. The diversity of these tools and their production techniques can be traced back to the end of the Late Glacial. However, many new types of these tools emerged during the Early Holocene, gradually developing and changing in the later stages of the Holocene. Collections of scientifically important Stone Age osseous tools, featuring numerous diverse types, are known in this region (e.g. Puzinas 1938; Vankina 1999; Rimantienė 2005), yet many of these artefacts have only recently come under investigation through the application of new research methods. Therefore, plenty of new data concerning Stone Age osseous technologies in the eastern Baltic region are yet to be unveiled.

Western Lithuania is characterised by a young morainic landscape called the Samogitian Highland (e.g. Kabailienė et al. 2015). Wetlands and overgrown lakes are characteristic of this area, which is why in the 20th century, peat cutting, straightening of the riverbeds and drainage of wetlands were undertaken. Excavation works uncovered stray bone and antler tools, prompting archaeologists to start fieldwork in the most prominent locations. One of such areas is Lake Biržulis with 56 sites and single-find locations around its former shores and adjacent areas (Butrimas 2019). While the lake is primarily known for its Mesolithic and Neolithic burial sites (Butrimas 2012; 2016a), it has also yielded excavations of wetland sites with well-preserved organics. Daktariškė 5, situated in the northwestern part of the former lake, is one such site. Excavations were conducted between 1987 and 1990 (Butrimas 1998; 2019), with further exploration in 2016 (Piličiauskas 2018).

Bone and antler tools, constituting heavy-duty, hunting, fishing and various domestic implements, were found in the lacustrine layers. However, many of these tools have remained unstudied until now. In 2021, a research project focusing on direct dating, technological studies and zooarchaeology by mass spectrometry (ZooMS) analysis of osseous implements from western Lithuanian wetlands was initiated. As part of this project, a portion of tools from the Daktariškė 5 site were investigated. One particular artefact was found remarkable in terms of design and having no analogies in Lithuanian Stone Age archaeology – the toggle harpoon head. In this paper, we present the latest research results based on data obtained from accelerator mass spectrometry (AMS) ^{14}C dating, manufacturing technology and species identification by ZooMS. Along with these data, we discuss analogical finds from archaeological and ethnographic contexts, suggesting a long tradition of using toggle harpoon heads in marine and freshwater environments. Moreover, we provide six new AMS ^{14}C dates of directly dated osseous tools from the Daktariškė 5 site, which gives a better chronological understanding of certain types of implements.

Study area

A large part of Lake Biržulis was overgrown throughout the Holocene, whereas its water level was significantly reduced during the drainage campaigns that took place in the 20th century. The former eutrophic lake covered an area of 100 ha and, in different chronological stages, had waterway connections to the adjacent lakes. Although only minor evidence of the Final Palaeolithic lithic finds is currently available, archaeological data suggest that the shores of the lake were densely inhabited since the beginning of the Mesolithic and throughout the Neolithic (Ostrauskas 1996; Butrimas 2019). Palaeoenvironmental data suggest that during the Early Mesolithic, the lake water level experienced regression, providing people with access to new areas and moving them closer to the lower terraces and islands (Stančikaitė et al. 2006). While this period was characterised by a high percentage of *Pinus* and *Betula*, in the later stages of the Mesolithic, broadleaf forests emerged with the rapid warming of the climate. In the Neolithic, although the lake water level increased, the development of broadleaf forests continued. Hunter-gatherer societies adapted to the changing lakeshore environment (e.g. Guobytė & Stančikaitė 1998; Stančikaitė et al. 2006), showcasing long-term and continuous occupation of the lakeshore landscape as evident from the archaeological data.

The Daktariškė 5 site (55.791465, 22.393750) is situated on a former island elevated at 154–155 metres above sea level in the northwestern part of Lake Biržulis (Figs 1–2). According to palaeoenvironmental data, the site was located next to the former short channel that connected two parts of the lake during the Atlantic and Early Subboreal (Kunskas & Butrimas 1985). The site's surroundings are overgrown by wetland vegetation. The site was discovered in 1986 by local school students who collected surface finds in a ploughing field. The first excavations commenced in 1987 under the direction by Adomas Butrimas and continued until 1990 (Butrimas 1998; 2019). Archaeozoological data indicate that people pursued a mixed subsistence economy, engaging in both hunting large terrestrial animals and fishing (Girininkas & Daugnora 2015). Recent studies of ceramic food crust, however, suggest that before the arrival of the first husbandry societies, the site's occupants heavily relied on freshwater resources (Piličiauskas et al. 2018).

The site contains numerous bone and antler tools, primarily comprised of heavy-duty implements. Barbed points, perforators, knives and daggers are also present (Butrimas 2019; Rimkus et al. 2023b). It must be noted, however, that many of these tools have not been extensively studied yet.

Material and methods

TOGGLE HARPOON HEAD

The toggle harpoon head is manufactured from an antler tine. Compared to other known toggle harpoons, the specimen from the Daktariškė 5 site represents a

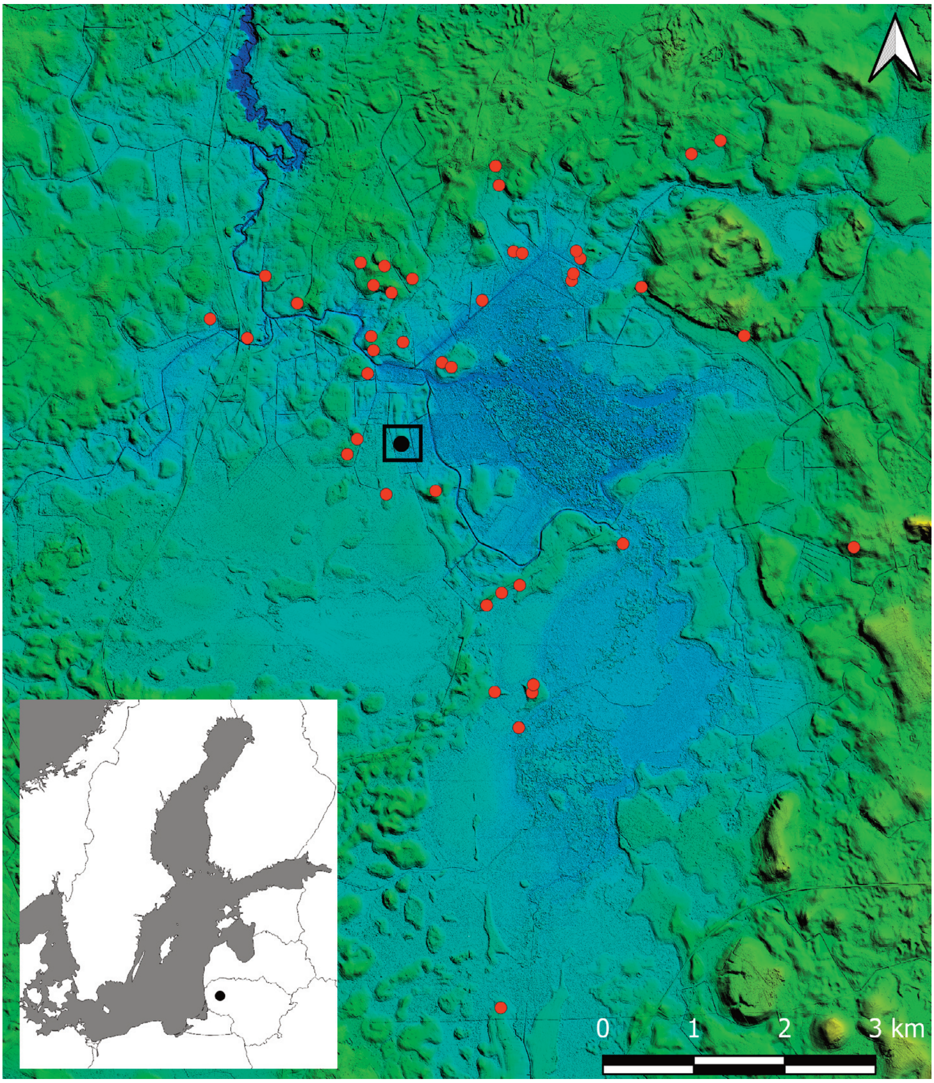

FIG. 1. Area of Lake Biržulis with Stone Age sites and single-find locations marked in red. The location of the Daktariškė 5 site is marked with a black dot and square. Compiled by Tomas Rimkus.

closed socketed type (Park & Stenton 1998). The artefact's length is uneven, measuring 59 mm on one side and 72 mm on the opposite side. The width of the artefact varies, ranging between 10 to 18 mm in different sections. Its cross-sectional shape is semi-quadrangular. In the proximal part of the longer side, the harpoon head features a spur with two pointy barbs of different lengths and sizes. An oval-shaped perforation, measuring 7.8–8.4 mm in diameter, is positioned through the artefact's centre part (Fig. 3).

The artefact was discovered in square 7b of trench No. 10 under the gyttja layer, at a depth of 105–115 cm from the ground surface (Fig. 4). The artefact is kept at the National Museum of Lithuania (EM 2245: 3092).

FIG. 2. Daktariškė 5 site with the approximate location of the 1987–1990 excavation trench. Compiled by Tomas Rimkus.

The toggle harpoon head from the Daktariškė 5 site has been briefly mentioned in the literature a few times before discussing hunter-gatherer sites around Lake Biržulis and different types of organic tools (Butrimas 2016b; 2019). A more detailed study regarding the artefact's parallels and function was published by Butrimas and Butrimaitė (2010). In the present study, we approach the finding from a different perspective, applying multiple research methods.

FIG. 3. Socketed antler toggle harpoon head from the Daktariškė 5 site. Photo by Marius Iršėnas.

MICROSCOPIC STUDIES

Characteristic technological features of the toggle harpoon head were examined with a ZEISS Stemi 508 stereoscopic microscope. Observations were made under magnifications ranging from 0.63 to 5 times, adjusting the magnification handle on the microscope, with 1.5x attached objective lenses and 10x binoculars. The images were captured with a ZEISS Axiocam 208 colour camera. Measurements and other adjustments on the images were processed with ZEISS Labscope software.

ZOOARCHAEOLOGY BY MASS SPECTROMETRY

The analysed harpoon head is manufactured from antler, so it was quite clear that it should belong to one of the Cervidae species. ZooMS is an efficient method for identifying animal species with minimal samples. However, the method struggles to differentiate between the results for different Cervidae species, as unique peptide markers for each species are not yet available. A recent study by Jensen

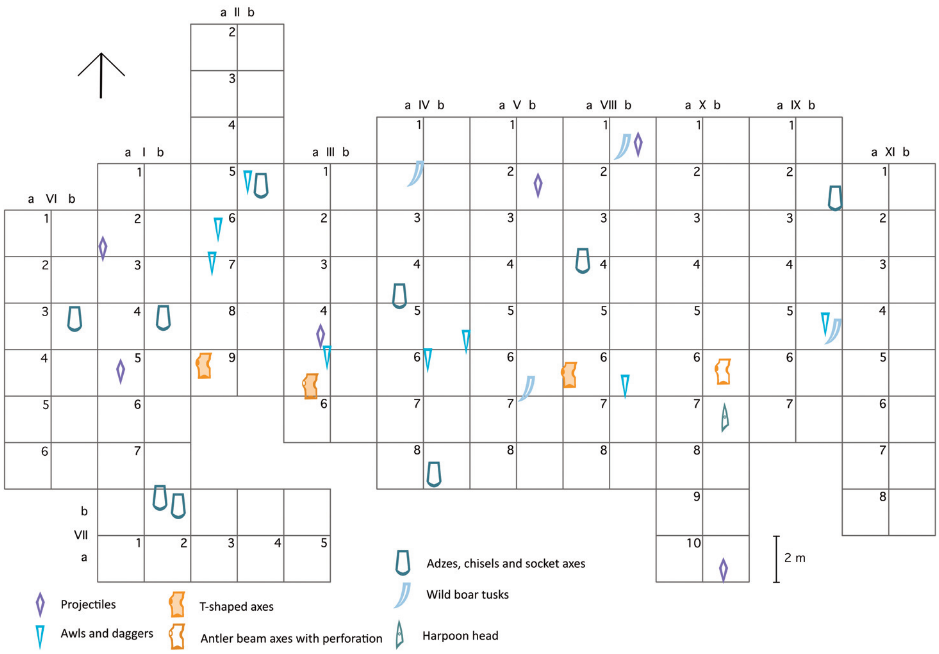

FIG. 4. 1987–1990 excavation trench of the Daktariškė 5 site with major find locations. Compiled by Adomas Butrimas.

et al. (2020) has provided the first unique peptide markers for red deer (*Cervus elaphus*). In light of this development, for the present study we decided to apply ZooMS analysis on the toggle harpoon head from the Daktariškė 5 site and test if the red deer antler could have been one of the raw materials used for this tool.

A 26.7 mg powder sample extracted from the inner part of the harpoon was analysed at the Bioarchaeology Centre (BioArch) at the University of York, UK, using a non-destructive buffer extraction method (van Doorn et al. 2011). In brief, 200 μL of ammonium bicarbonate (AmBic) was added to all samples, which were left at room temperature for four hours to remove any surface contamination. The AmBic was subsequently removed and another 200 μL of AmBic was added to all samples. The samples were then gelatinised for one hour at 65 °C to denature and release any available collagen into the solution. The samples were divided in two, 100 μL of the supernatant was transferred to a new microfuge tube, and the remaining sample was stored at –20 °C for potential future analysis. Following this, 1 μL of 0.5 μg/μL porcine trypsin in trypsin resuspension buffer (Promega, UK) was added to all samples for overnight digestion at 37 °C. The digestion was stopped by the addition of trifluoroacetic acid (TFA) at a concentration of 0.5–1% of the total solution. C18 zip-tips were used to desalt the samples, which were then eluted in 100 μL of 50% acetonitrile (ACN) / 0.1% TFA (v/v).

For the MALDI-TOF mass spectrometry analysis, all samples were spotted in triplicate onto a MTP384 Bruker ground steel MALDI target plate. 1 μL of sample was pipetted onto each sample spot before being mixed with 1 μL of α-cyano-4-hydroxycinnamic acid matrix solution (1% in 50% ACN / 0.1% TFA (v/v/v)). The samples were run on a Bruker UltrafleXtreme MALDI-TOF/TOF instrument. The resulting spectra were analysed using mMass, an open-source mass spectrometry tool (Strohalm et al. 2010), and compared against a list of published markers (Buckley et al. 2009; Welker et al. 2016).

AMS ^{14}C DATING AND STABLE ISOTOPE ANALYSIS

A powder sample extracted from the inner part of the harpoon head was analysed for AMS ^{14}C and stable isotopes at the Laboratory of Chronology (HELA) at the University of Helsinki, Finland.

For radiocarbon analysis, the pretreated sample was packed inside a silver cup (Elemental Microanalysis D2001) and combusted with an elemental analyser (Thermo Scientific FLASH 2000 NC) to extract carbon dioxide. The resulting CO_2 samples were cryogenically collected, chemically reduced to carbon following the methods of Slota et al. (1987) and Palonen et al. (2013), and pressed into AMS cathodes. The ^{14}C concentrations were then measured from the cathodes using the AMS facility at the University of Helsinki (Tikkanen et al. 2004; Palonen & Tikkanen 2015). The results were reported following the method of Millard (2014).

For stable isotope analyses following the procedures outlined by Etu-Sihvola et al. (2019), the elemental content and stable isotopic composition of carbon and nitrogen were measured on an elemental analyser (CE NC2500) coupled with an isotope ratio mass spectrometer (Thermo Scientific DELTA V Plus). The raw isotope data were normalised with a two-point calibration using international reference materials with known isotopic compositions (USGS-40, USGS-41). Replicate analyses of a quality control reference, analysed alongside the unknown samples, indicated a 1σ internal precision of ≤ 0.1 for both δ^{13}C and δ^{15}N.

In this study, we also, for the first time, publish six new radiocarbon dates for other types of osseous implements found at the Daktariškė 5 site. All six samples were dated at the Vilnius Radiocarbon Laboratory at the Centre for Physical Sciences and Technology (FTMC). The acid–base–acid procedure, followed by gelatinisation, was used for bone collagen extraction as outlined by Molnár et al. (2013). A single-stage accelerator mass spectrometer (SSAMS, NEC, USA) was used for radiocarbon (^{14}C) measurements, and the parameters can be found in the paper by Ežerinskis et al. (2018). Besides new radiocarbon dates, two previously published dates for T-shaped axes are referred from the papers published by Lübke et al. (2024) and Rimkus et al. (2023a).

The dating results of the toggle harpoon head and eight osseous tools from the Daktariškė 5 site were calibrated using the IntCal20 curve (Reimer et al. 2020) and OxCal software, v4.4.4 (Bronk Ramsey 2017). The results are presented in 95.4% probability.

Results

TECHNOLOGICAL FEATURES

The toggle harpoon head has an irregular triangular shape and is manufactured from an antler tine by removing its proximal part, while the distal part has been shaped into the tip. When the proximal part was removed, the inner antler's spongy tissue was exposed. Most likely the soft tissue was cut out to make space for the wooden shaft, as the detachable harpoon head was socketed into it.

Heavy cut and whittling marks are evident on the entire surface of the artefact (Fig. 5: 1), resulting from the removal of the antler cortex. The removal technique for tool manufacturing is also known on one of the adzes from the Smeltė site, located in coastal Lithuania (Rimkus 2022; Rimkus & Daugnora 2021). This tool was dated to 5894–5721 cal BC (Piličiauskas et al. 2015), indicating that this removal technique was employed much earlier than the dating of the toggle harpoon head from the Daktariškė 5 site.

An oval-shaped conical perforation is located in the central part of the tool (Fig. 5: 2–3). Most likely it was shaped by perforating the antler from both sides, as the conical shape is observed on both surfaces of the perforation. The diameter of the perforation reaches up to 8.4 mm, measured from edge to edge, suggesting the use of precise drilling techniques and a special tool to make it even on both

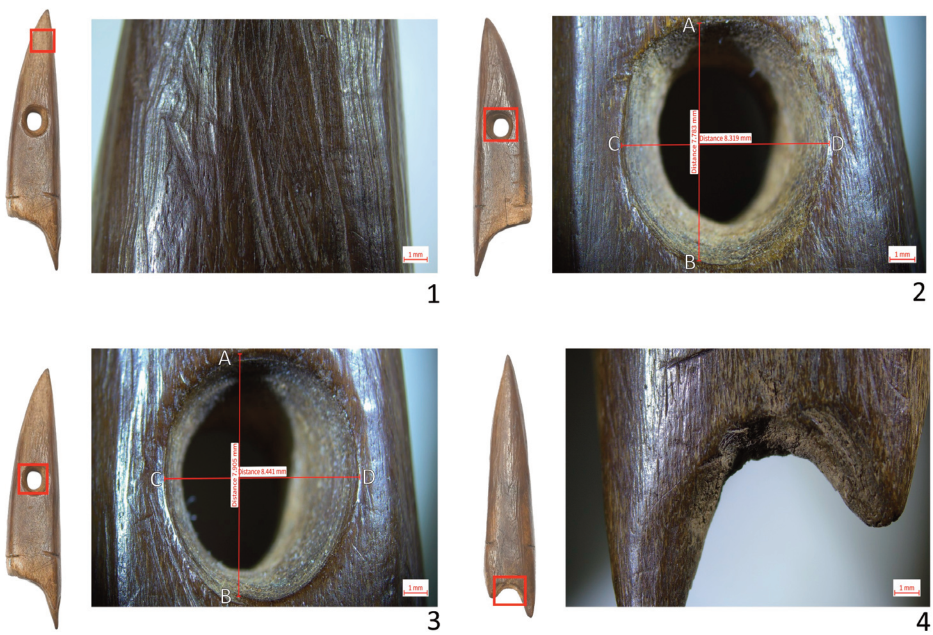

FIG. 5. Microscopic observation of the toggle harpoon head. 1 – cutmarks and whittling on the surface (0.63x); 2–3 – perforation and its measurements from both sides (both images captured at 0.63x); distances in 2: A–B: 7.783 mm, C–D: 8.319 mm; 3: A–B: 7.905 mm, C–D: 8.441 mm; 4 – fragment of the perforation on the spur (0.63x). Photos by Tomas Rimkus.

sides. The surface of the harpoon head and the perforation walls are smoothed, indicating the application of smoothing techniques to remove manufacturing marks.

Another perforation was made in the proximal part of the tool, specifically on the spur located on the lateral part of the tool (Fig. 5: 4). It appears that either the hole broke accidentally, or it was intentionally shaped to produce two pointy barbs. Perforation traces are visible on the fragment of the shorter barb. However, on the edge of the longer barb, there are traces similar to abrasion or scraping, indicating that this part was shaped on purpose.

The basal part of the harpoon head is characterised by four horizontal incisions (Fig. 6). These incisions are present on each corner of the tool and on one entire lateral surface. On the corners, the incisions were made by simple deeper cuts, each measuring 0.6 and 0.7 mm in width. However, the long incision horizontally shaped along the lateral surface resulted from multiple cuts, making it between 1 to 2 mm in width. Apparently, in this particular area, it was attempted to make the incision as wide as possible. Published reconstructions suggest that the harpoon head might have been fastened around the produced groove, with some kind of string (e.g. Torke 1993).

SPECIES IDENTIFICATION

ZooMS results suggested that the artefact was likely manufactured from one of the cervid species. During the 4th millennium cal BC, Eurasian elk (*Alces alces*), red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*) were present and

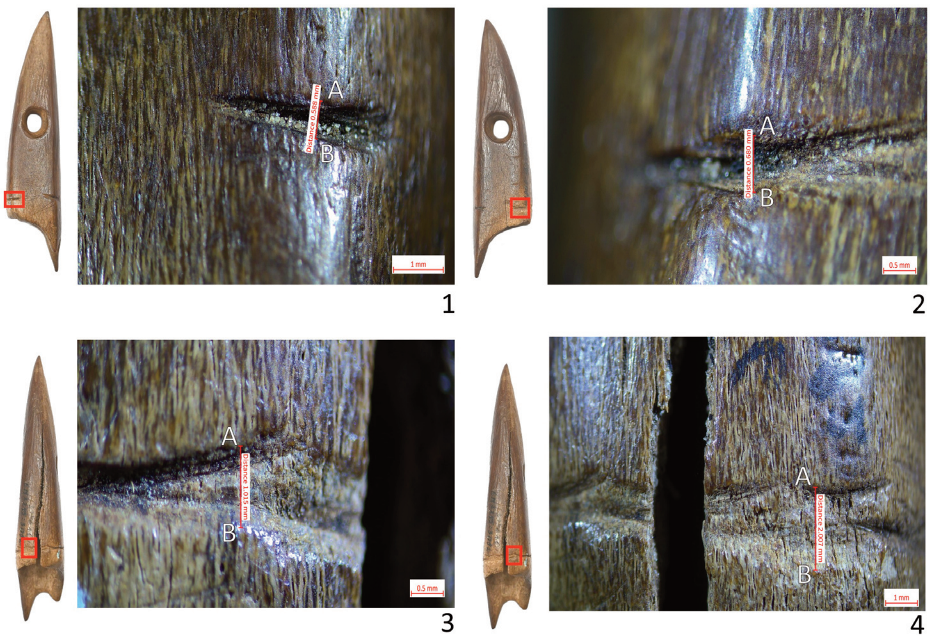

FIG. 6. View of each incision with measurements, shaped around the toggle harpoon head. 1 – 1.25x, distance A–B: 0.588 mm; 2 – 1.6x, distance A–B: 0.680 mm; 3 – 1.6x, distance A–B: 1.015 mm; 4 – 0.8x, distance A–B: 2.007 mm. Photos by Tomas Rimkus.

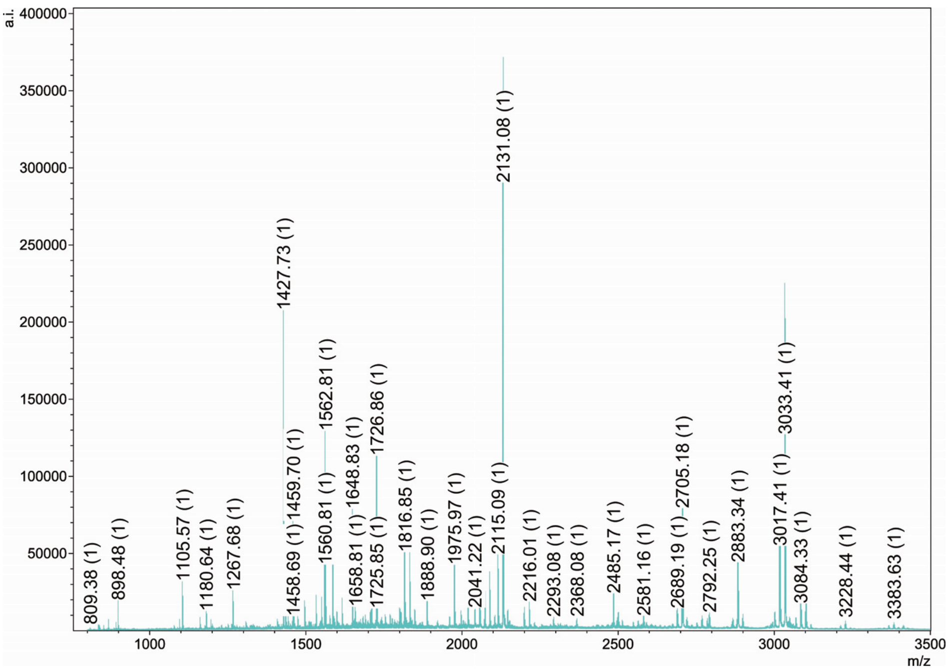

FIG. 7. ZooMS spectra of the toggle harpoon head.

hunted in the territory of Lithuania, as evident from the archaeozoological data (e.g. Daugnora & Girininkas 2004). While the ZooMS method does not enable to clearly distinguish between different cervid species due to similar peptide markers in their collagen (e.g. Buckley et al. 2009), the study by Jensen et al. (2020) managed to identify a 2216 peptide marker, which is typical of red deer and occasionally appears in ZooMS spectra. The toggle harpoon head also bears a peak at the 2216 marker, showing that it was most likely manufactured from the antler tine of a red deer (Fig. 7).

CHRONOLOGY

The toggle harpoon head was dated to 3633–3380 cal BC (95.4% probability; Table 1). The date is associated with the northeastern European Neolithic hunter-gatherer societies, as further evidenced by the pottery types found at the site (e.g. Iršėnas & Butrimas 2000; Piličiauskas 2018). Summarised radiocarbon dating of

TABLE 1. AMS ^{14}C dating results of the antler toggle harpoon head. δ^{13}C and δ^{15}C values would indicate a diet of a terrestrial herbivore animal, which would support the results of ZooMS analysis

Lab. index	Museum ID	δ^{13}C IRMS (‰)	δ^{15}N IRMS (‰)	C%	N%	C/N	^{14}C age BP	cal BC (95.4%)
HELA-4936	EM 2245: 3092	–23.9	7.4	41.3	14.1	3.4	4744 ± 31	3633–3380

the Daktariškė 5 site indicates continuous settlement in the area between the 5th and 3rd millenniums cal BC, with many dates falling into the 4th and especially 3rd millenniums cal BC, when the first husbandry societies appeared (Piličiauskas 2018, 61). Therefore, the dating of the toggle harpoon head not only provides chronological information about this particular implement but also contributes to the broader context of the site's history, giving one more radiocarbon-based date, which belongs to the hunter-gatherer phase.

Discussion

TECHNOLOGY AND ANALOGIES

The entire harpoon consisted of a wooden shaft, a water-resistant interim rod – probably made of antler, as wooden ones were unsuitable due to expansion when in contact with water – and a toggle harpoon head. Another integral part of the implement was a catching string. The distal end of the harpoon head was sharpened to a point by whittling the entire surface of the antler tine. The spur of the head branches off into two pointy protrusions of uneven length. This particular feature on toggle harpoon heads is also known in southwestern Europe (Torke 1993; Auler 1994). A socketed tube with a slightly rounded tip was formed by scooping out the porous antler substance at the wider end of the socketed head. Above the tube, at the corners of the longer wing, there are two short incisions, and the shorter end contains a groove surrounding it. A catching string was probably fastened around this groove, but it is not entirely clear, as microscopic observation did not reveal any heavy suspension traces around the harpoon's corners. A perforation was shaped perpendicularly almost in the very centre of the artefact (positioned slightly closer to the tip) by perforating the antler from both sides. The hole tapers toward the middle and was used to fasten a string. Thanks to the diagonally cut base, the socketed harpoon head would detach from the interim rod once the string was tightened, as the harpoon was thrust into an animal, twisting horizontally in the animal's wound and getting firmly stuck into the body. To prevent the catch from escaping, the string leading from it was attached to the shaft.

According to the ZooMS data, the harpoon head from the Daktariškė 5 site was manufactured from a red deer antler. Zooarchaeological data confirm that red deer antler was one of the main raw materials used for producing heavy-duty tools at the site (Daugnora & Girininkas 1996; Girininkas & Daugnora 2015; Piličiauskas 2018). However, no other harpoon heads of this type were found during the excavation. In fact, in Lithuanian archaeology, this is the only example of a socketed toggle harpoon head. Toggle harpoons are known from Neolithic and Bronze Age coastal sites in the eastern Baltic region; however, they all differ, as none are of the socketed type (e.g. Rimantienė 1979; 2005; Zagorska 2000; Luik et al. 2011; Luik 2013).

The artefact from the Daktariškė 5 site is analogous to socketed toggle harpoon heads that are prevalent in southeastern and southwestern Europe. Vogt (1947) described them in the 1940s, referring to the description of pile-dwelling settlements published in 1876, which featured such harpoons. Studies by Auler (1994) and Winiger (1992) suggest that this type of tool was mostly prevalent in southeastern and southwestern European regions, particularly in the bog of Laibach in Slovenia near Ljubljana, the Lower Danube, and primarily in regions of Switzerland and southern Germany: the Forschner settlement near Lake Federsee and the Auvernier area near Lake Neuchâtel (Rychner 1979; Torke 1993). Similar socketed antler harpoon heads were found in the Buchau Water Castle in southern Germany (Kimmig 1992) and near River Don, Dnipropetrovsk, Ukraine, at the Strelča Skelia site (Telegin 1971; Nenrina 1991). They are also known at the Pietrele site in Romania's Lower Danube region (Benecke et al. 2013) and in Hungary, where specimens made of bronze were discovered (Tarbay 2022).

Compared to the southern European territories, socketed toggle harpoon heads are less in number in northern latitudes. They are mostly known from the hunter-gatherer sites in the Kola Peninsula (Gurina 1987; Kiseleva & Murashkin 2019).

The harpoon heads from the abovementioned territories in Europe lack direct radiocarbon dating. However, contextual dating provides some data about their chronology. In all discussed regions, they share very similar dates, but variations occur based on the differences in prehistoric periodisation in different European areas. For example, in the Lower Danube region, based on data from the Pietrele site, these harpoons date to the second half of the 5th millennium cal BC (Benecke et al. 2013). In southern Germany and Switzerland, located in the Federsee basin, the toggle harpoon heads belong to the 3rd millennium cal BC (Torke 1993). In Ukraine, these harpoons are ascribed to the Chalcolithic Period and date to the 4th–3rd millenniums cal BC (Nenrina 1991). In the Kola Peninsula, they are ascribed to the 3rd–2nd millenniums cal BC (Kiseleva & Murashkin 2019).

We conclude that the earliest artefacts of this group, developed in the Neolithic cultures of the Lower Danube from the beginning of the 5th millennium, later spread to the territories of southern Germany and Switzerland, the eastern Baltic region and Fennoscandia. Recent strontium isotope analyses of hunter-gatherer burials in the territory of Lithuania confirm contacts and human mobility across large territories (Piličiauskas et al. 2022). Only one toggle harpoon head, with no larger assemblages of the same tool type, was found in the Lake Biržulis area, prompting the interpretation of its possible emergence at the site in relation to contacts between hunter-gatherer groups. However, further interpretations are currently obstructed by the lack of data from adjacent regions, especially direct dating of socketed toggle harpoon heads in northeastern Europe.

Various studies demonstrate that this was a well-known type of socketed harpoon among ethnographic tribes of hunters in northern latitudes. Mason (1902) demonstrated the variety of toggle harpoon head types among Eskimo groups in Greenland. Socketed harpoon heads, combined with barbs, metal blades or chipped lithics, were used for hunting large aquatic mammals, such as seals and whales. Lewis (1995) and Quimby (1946) showed typological variations of these harpoons among hunters in the Bering Sea archipelago, each type adapted to different hunting strategies (e.g. hunting on or under the ice, or from a log boat) and some being decorated (e.g. Mason 2009). Socketed toggle harpoon heads were also found in male grave No. 212 in the Ekven burial ground in the Chukchi Peninsula (the Bering Strait) as part of the grave goods made of metal. The grave is dated to the 5th–7th century AD (Leskov & Müller-Beck 1993, 206–207).

Although the mentioned archaeological cases are similar to each other in design and shape, some technological aspects differ. The harpoon head from the Daktariškė 5 site has a semi-quadrangular cross-section extending from its middle part. The perforation is shaped at the centre of the artefact, and the branching of two barbs on the spur is not very expressive. In contrast, those from the Federsee basin and southeastern Europe have their line holes shaped much closer to the basal part, their cross-section is oval, and the spur is much larger. More similarities with the harpoon head from the Daktariškė 5 site can be seen in the single perforated artefacts from Tószeg-Laposhalom, Hungary (Tarbay 2022), which have similar designs in perforation, spur and cross-section.

FUNCTION

Socketed toggle harpoons are perceived as hunting weapons used in aquatic environments, as supported by ethnographic parallels indicating their use for hunting large aquatic mammals in northern regions. However, in archaeological studies, their use extends to catching large freshwater fish (catfish, pikes), semi-aquatic animals (beavers, otters) and marine mammals (seals) (Benecke et al. 2013; Torke 1993; Tarbay 2022). According to the published studies, the hunt was most effective when these implements were used from a slow-moving log boat, with the sharp end of the harpoon kept on or slightly under the water surface (Torke 1993). This tool could have been very effective for hunting small water game, such as otters (*Lutra lutra*), beavers (*Castor fiber*) and large fish. At the Daktariškė 5 site, beaver bones accounted for 8.75% and otter bones for 1.25% of the total amount of bones (Girininkas & Daugnora 2015). Besides these, the bones of pike (*Esox lucius*) were found at the site (Daugnora & Girininkas 2004). The animal bones from the site lack direct dating; thus, it is difficult to ascribe each of them to a particular occupation phase. Yet, as seen from the variation of species, basically all of them belong to hunted animals, and some of them could have been captured using harpoons with toggle heads.

While the presence of a sole harpoon head suggests its use for hunting aquatic animals, it does not necessarily imply full adaptation to freshwater lake environments. No similar harpoons have been found in other inland Lithuania sites with sufficient evidence of fishing. For example, the Neolithic sites around

Lake Kretuonas in eastern Lithuania contained different types of harpoons (Girininkas 1990). Multiperiod riverine sites in eastern Lithuania also contained different types of harpoons, but in general, it seemed that wooden fishing constructions were preferred and more efficient in the riverine environment (Piličiauskas et al. 2020). Interestingly, the same could be said about the Neolithic sites in coastal Lithuania. Although the sites in Šventoji demonstrate seal hunting and intense fishing (e.g. Luik & Piličiauskienė 2016), no socketed toggle harpoons were found there. Similarly, sites in Estonia and Latvia demonstrate the use of different types of harpoon heads for catching sea mammals and fish during the Neolithic and Bronze Age (Zagorska 2000; Luik et al. 2011).

Once the harpoon was thrust into the hunted animal, it would twist horizontally in the wound and get firmly stuck into the body (Fig. 8). The string leading from the spearhead was attached to the shaft held by the hunter, possibly fastened to the wooden shaft, which would twist horizontally, trailing behind the

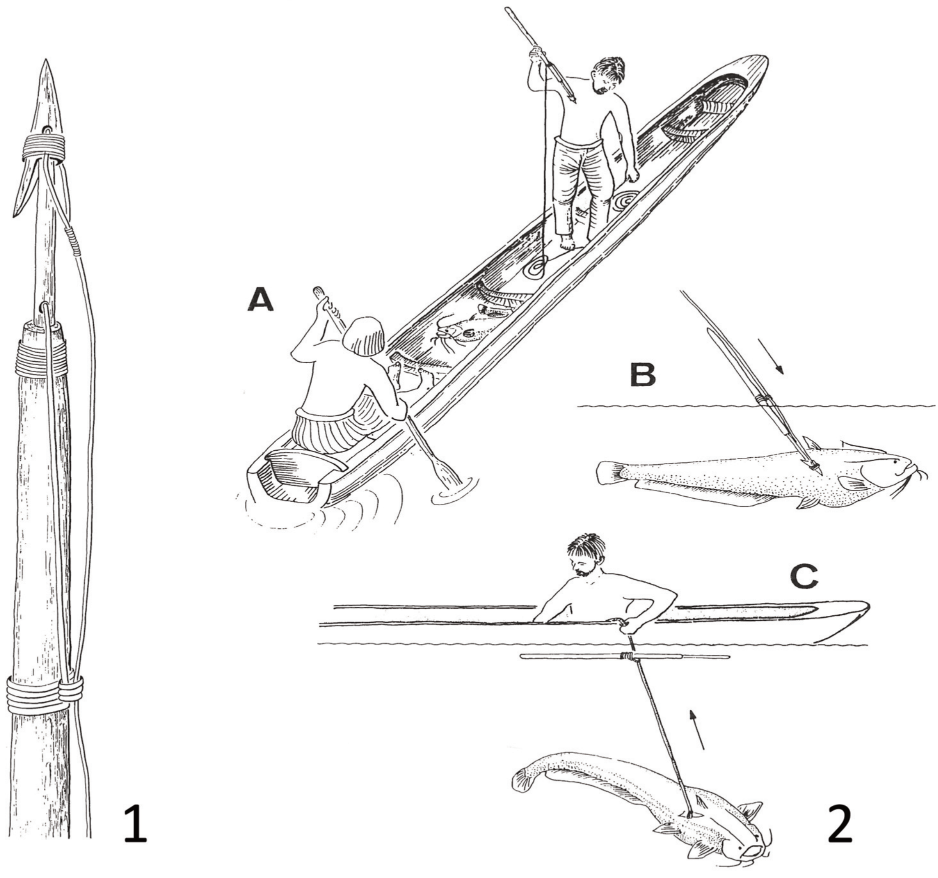

FIG. 8. Reconstruction of the socketed toggle harpoon head in the wooden shaft (1), used for catching catfish (2) from a log boat. A–C – catching prey with the harpoon. Reproduced from Torke 1993.

animal and preventing it from escaping. This sophisticated implementation suggests that both the Neolithic and Bronze Age people were skilled in aquatic animal hunting.

The experiments described by Auler (1994) revealed that simply placing socketed toggle harpoon heads onto a sharpened wooden shaft did not produce good results. The shaft was swollen because of water, preventing the spearhead from moving and eventually crushing it. A conclusion was reached that a water-resistant interim rod was an important precondition to ensure the smooth movement of the harpoon head. A diagonally cut wooden shaft was connected to a diagonally cut interim rod made of antler. The connection point was glued by applying birch tar. A string was wrapped around it before applying another layer of birch tar. The catching string, woven from hemp fibre and impregnated with grease, was tied over the cut-out of the harpoon head and interwoven into the rope, increasing the thickness of its 10-cm segment below the harpoon head.

The use of these heads in harpoons and spears is also explained by their great variety of sizes. Besides their use in hunting otters and beavers, the reconstruction experiments confirmed that these implements were effective in instantly killing all types of fish (pike, catfish, tench), including large ones weighing up to 6 kg (Auler 1994). It is believed that the reconstructed implement, measuring nearly two metres in length, most closely resembles the complex hunting tool used during the Stone Age.

THE LATEST DATING OF OSSEOUS TOOLS

There are currently 40 known radiocarbon dates at Daktariškė 5 (see summarised data in Piličiauskas 2018, 61). The dates were obtained by sampling ecofacts (charcoal and hazelnut shells), food crusts from pottery, animal bones and antlers. However, a large proportion of the osseous artefacts found at the site have not been directly dated yet. To gain a better understanding of the dating of individual artefact types, six additional artefacts were dated, and two dates were included from recently published works. The summarised data on the dating results are presented in Fig. 9 and Table 2.

Heavy-duty tools made of antlers are prevalent at the site. Two T-shaped antler axes, artefacts No. EM 2245: 3081 and EM 2245: 3080, were dated to the earliest phase of the site, ranging from 5375–5213 and 5210–4999 cal BC, respectively (Fig. 10: 1–2). These T-axes are considered among the oldest in the eastern Baltic, with similar examples found at the Melnragė II beach (Lithuania) and the Sise site (Latvia), dating to the end of the 6th millennium cal BC (Zagorska et al. 2021; Rimkus 2022). The T-axes at Daktariškė 5 were made of red deer antler beams and were widespread among Late Mesolithic societies in the western, southern and southeastern Baltic regions. A recent study by Lübke et al. (2024) indicates that some of the T-axes in the Latvian and Lithuanian territories predate those from Ertebølle and Swifterbant contexts, with their technological roots likely traced to southeastern European territories.

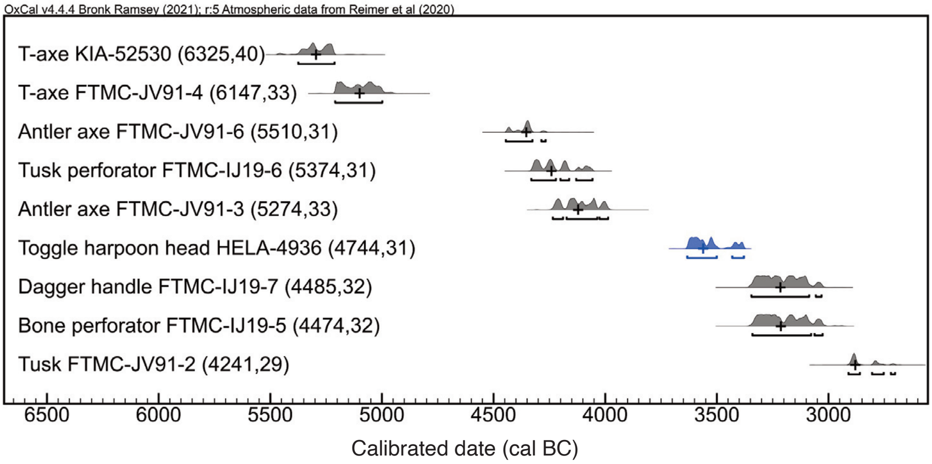

FIG. 9. New AMS ^{14}C dates of bone and antler tools from the Daktariškė 5 site. The socketed toggle harpoon head is marked in blue (HELA-4936). The dates were calibrated by OxCal v4.4.4 (Bronk Ramsey 2017) and the IntCal20 atmospheric curve (Reimer et al. 2020).

A different type of antler axe (EM 2245: 3102) from the Daktariškė 5 site was dated to 4446–4268 cal BC (Fig. 10: 3). Manufactured from a red deer antler beam, this axe is distinct in its technological features compared to T-axes. Unlike T-axes, where the perforation is shaped through the trez tine, this type of axe features a perpendicular perforation through the antler beam.

Another axe (EM 2245: 3089) at the site was dated to 4235–3988 cal BC (Fig. 10: 4). Unlike the abovementioned cases, this tool is of the socketed type, lacking a perforation, and also made of a red deer antler beam.

Two more dated artefacts from the Daktariškė 5 site are made of wild boar (*Sus scrofa*) tusks. Implements crafted from this raw material were commonly used in the Neolithic hunter-gatherer societies of northeastern Europe. The first artefact (EM 2245: 3084) is a longitudinally split wild boar tusk with no clear traces of modification (Fig. 10: 5). Its sample was dated to 2911–2703 cal BC. Comparable examples from other hunter-gatherer sites suggest that a half-split tusk like this could have served as a preform for a pendant (Kashina & Macāne 2020; Macāne 2022) or another functional tool.

The second wild boar tusk tool is a perforator (EM 2245: 3075), and it was dated to 4332–4058 cal BC, making it much older compared to the previously discussed tusk artefact (Fig. 10: 6). Crafted from a longitudinally split tusk, the entire surface of the tool is heavily worked with many observable cuts. A small pointy end is shaped at the distal part, which most likely was used for perforating. Such tools are common in the Neolithic hunter-gatherer sites. Microwear studies have shown that they were used for perforating and piercing various materials, such as shells, wood, pottery and skin (Malyutina & Charniauski 2021).

TABLE 2. The latest direct AMS ^{14}C datings of osseous tools from the Daktariškė 5 site

Lab. index	Tool type	Museum ID	Sample type	^{14}C age BP	cal BC (95.4%)	Reference
FTMC-IJ19-5	Perforation tool made of bone	EM 2245: 3100	Powder	4474 ± 32	3341–3027	This study
FTMC-IJ19-6	Perforation tool made of *Sus scrofa* tusk	EM 2245: 3075	Solid piece	5374 ± 31	4332–4058	This study
FTMC-IJ19-7	Fragment of bone dagger (?) handle	EM 2245: 3068	Powder	4485 ± 32	3346–3032	This study
FTMC-JV91-2	*Sus scrofa* tusk	EM 2245: 3084	Solid piece	4241 ± 29	2911–2703	This study
FTMC-JV91-3	*Cervus elaphus* socketed antler axe	EM 2245: 3089	Powder	5274 ± 33	4235–3988	This study
FTMC-JV91-4	*Cervus elaphus* T-shaped antler axe	EM 2245: 3080	Powder	6147 ± 33	5210–4999	Rimkus et al. 2023a
FTMC-JV91-6	*Cervus elaphus* perforated antler beam axe	EM 2245: 3102	Powder	5510 ± 31	4446–4268	This study
KIA-52530	*Cervus elaphus* T-shaped antler axe	EM 2245: 3081	Powder	6325 ± 40	5375–5213	Lübke et al. in press

FIG. 10. Directly dated bone and antler tools from the Daktariškė 5 site. 1 – T-shaped antler axe (EM 2245: 3081), 2 – T-shaped antler axe (EM 2245: 3080), 3 – perforated antler beam axe (EM 2245: 3102), 4 – socketed antler axe (EM 2245: 3089), 5 – wild boar tusk (EM 2245: 3084), 6 – wild boar tusk perforator (EM 2245: 3075), 7 – fragment of a bone tool (EM 2245: 3068), 8 – perforator (EM 2245: 3100). Photo by Jogailė Butrimaitė.

The last two tools are made of animal bones. One of them, EM 2245: 3068, is a fragment of a tool (Fig. 10: 7), crafted from a split long bone. The broken upper part of the artefact appears wider, as indicated by two provenances on both sides, separating the lower and upper parts of the tool. It is possible that this fragment is a handle of a bone dagger, similar to another tool found at the site (Butrimas 2019). The artefact dates to 3346–3032 cal BC.

The final dated bone tool, EM 2245: 3100, is ascribed to the perforation-type tool (Fig. 10: 8). Its entire surface is smoothed, with only the upper part shaped as a pointy blunt end. These artefacts are likely to have been used for piercing softer materials, such as animal skins. However, further studies are necessary to determine its exact function. The sample was dated to 3341–3027 cal BC.

Conclusions

So far, only one socketed toggle harpoon head is known in the territory of Lithuania. The excavated material from hunter-gatherer wetland sites does not provide clear evidence of the production or use of such harpoon heads in the eastern Baltic region. Thus, it is still questionable how and for what purpose the antler toggle harpoon head appeared on the shores of Lake Biržulis. It is difficult to assume whether the tool was manufactured on-site, in adjacent areas, or imported from other regions. Yet it is made of the antler of a red deer, whose bones and antlers were also discovered at the Daktariškė 5 site. However, the limited spread of red deer in the region during the Stone Age suggests that imports from northern latitudes may be less likely (e.g. Niedziałkowska et al. 2021). Therefore, if the find could be related to the imports and exchange system, it might be more likely associated with southern European areas.

The radiocarbon dating results place the find within the timeframe of 3633–3380 cal BC, when hunting and fishing dominated in the subsistence economy in the territory of Lithuania. The date corresponds well with the majority of the radiocarbon dates from the Daktariškė 5 site, many of them falling to the 4th millennium cal BC. However, new radiocarbon dates from additionally dated tools also confirm that some of the osseous implements date to the earlier phases of the site.

Socketed antler toggle harpoon heads are frequently found in the southwestern and southeastern European Neolithic and Bronze Age sites. In these regions, such harpoon heads are often associated with fishing and hunting smaller fur animals. However, in the northern latitudes, similar implements are used for seal hunting. This is also evident from ethnographic parallels, where tribes from Alaska and Greenland used such implements in seal hunting.

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References

Auler, J. 1994. Bronzezeitlichen Harpunen mit Tüllenknebelspitzen. – Archäologie der Schweiz, 17: 1, 134–139.

Benecke, N., Hansen, S., Nowacki, D., Reingruber, A., Ritchie, K. & Wunderlich, J. 2013. Pietrele in the Lower Danube region: integrating archaeological, faunal and environmental investigations. – Documenta Praehistorica, 40, 175–193. https://doi.org/10.4312/dp.40.14

Bronk Ramsey, C. 2017. Methods for summarizing radiocarbon datasets. – Radiocarbon, 59: 6, 1809–1833. https://doi.org/10.1017/RDC.2017.108

Buckley, M., Collins, M., Thomas-Oates, J. & Wilson, J. C. 2009. Species identification by analysis of bone collagen using matrix-assisted laser desorption/ionisation time-of-flight mass spectrometry. – Rapid Communications in Mass Spectrometry, 23: 23, 3843–3854. https://doi.org/10.1002/rcm.4316

Butrimas, A. 1998. Biržulio baseino ir Žemaičių aukštumos akmens amžiaus tyrinėjimų apžvalga. – Lietuvos Archeologija, 15, 107–131.

Butrimas, A. 2012. Donkalnio ir Spigino mezolito–neolito kapinynai. Seniausi laidojimo paminklai Lietuvoje. Vilniaus dailės akademijos leidykla, Vilnius.

Butrimas, A. 2016a. Biržulis Lake islands Donkalnis and Spiginas Mesolithic cemeteries (west Lithuania). – Mesolithic Burials: Rites, Symbols and Social Organisation of Early Postglacial Communities. Eds J. M. Grünberg, B. Gramsch, L. Larsson, J. Orschiedt & H. Meller. Landesmuseum für Vorgeschichte, Halle (Saale), 195–217.

Butrimas, A. 2016b. Stone Age in west Lithuania. – A Hundred Years of Archaeological Discoveries in Lithuania. Eds G. Zabiela, Z. Baubonis & E. Marcinkevičiūtė. Society of the Lithuanian Archaeology, Vilnius, 86–95.

Butrimas, A. 2019. Biržulis. Medžiotojai, žvejai ir senieji žemdirbiai X–II tūkst. pr. Kr. T. I. Paminklų tyrinėjimai. Vilniaus dailės akademijos leidykla, Vilnius.

Butrimas, A. & Butrimaitė, D. 2010. Unikalus raginio žeberklo (ieties) įmovinis antgalis iš Daktariškės 5-os neolito gyvenvietės prie Biržulio ežero. – Florilegium Lithuanum: in honorem eximii professoris atque academici Lithuani domini Eugenii Jovaiša anniversarii sexagesimi causa dicatum. Eds G. Blažienė, S. Grigaravičiūtė & A. Ragauskas. Vilniaus pedagoginio universiteto leidykla, Vilnius, 53–60.

Daugnora, L. & Girininkas, A. 1996. Osteoarcheologija Lietuvoje. Vidurinysis ir vėlyvasis holocenas. Savastis, Vilnius.

Daugnora, L. & Girininkas, A. 2004. Rytų Pabaltijo bendruomenių gyvensena XI–II tūkst. pr. Kr. Lietuvos veterinarijos akademija, Kaunas.

Doorn, N. L. van, Hollund, H. & Collins, M. J. 2011. A novel and non-destructive approach for ZooMS analysis: ammonium bicarbonate buffer extraction. – Archaeological and Anthropological Sciences, 3, 281–289. https://doi.org/10.1007/s12520-011-0067-y

Etu-Sihvola, H., Bocherens, H., Drucker, D. G., Junno, A., Mannermaa, K., Oinonen, M., Uusitalo, J. & Arppe, L. 2019. The dIANA database – resource for isotopic paleodietary research in the Baltic Sea area. – Journal of Archaeological Science: Reports, 24, 1003–1013. https://doi.org/10.1016/j.jasrep.2019.03.005

Ežerinskis, Ž., Šapolaitė, J., Pabedinskas, A., Juodis, L., Garbaras, A., Maceika, E., Druteikienė, R., Lukauskas, D. & Remeikis, V. 2018. Annual variations of ^{14}C concentration in the tree rings in the vicinity of Ignalina nuclear power plant. – Radiocarbon, 60: 4, 1227–1236. http://dx.doi.org/10.1017/RDC.2018.44

Girininkas, A. 1990. Kretuonas. Vidurinis ir vėlyvasis neolitas. (Lietuvos archeologija, 7.) Mokslas, Vilnius.

Girininkas, A. & Daugnora, L. 2015. Ūkis ir visuomenė Lietuvos priešistorėje, I. Klaipėdos universiteto leidykla, Klaipėda.

Guobytė, R. & Stančikaitė, M. 1998. Traces of human activities in pollen diagrams from Biržulis Lake with a short review of geological and geomorphological conditions in the Biržulis area. – Archaeologia Baltica, 3, 121–130.

Gurina, N. N. 1987. The main stages in the cultural development of the ancient population of the Kola peninsula. – Fennoscandia Archaeologica, IV, 35–48.

Iršėnas, M. & Butrimas, A. 2000. Daktariškės 5-osios gyvenvietės keramikos su organinės kilmės priemaišomis ornamentika. – Lietuvos Archeologija, 19, 125–138.

Jensen, T. Z. T., Sjöström, A., Fischer, A., Rosengren, E., Lanigan, L. T., Bennike, O., Richter, K. K., Gron, K. J., Mackie, M., Mortensen, M. F., Sørensen, L., Chivall, D., Iversen, K. H., Taurozzi, A. J., Olsen, J., Schroeder, H., Milner, N., Sørensen, M. & Collins, M. J. 2020. An integrated analysis of Maglemose bone points reframes the Early Mesolithic of southern Scandinavia. – Scientific Reports, 10: 17244. https://doi.org/10.1038/s41598-020-74258-8

Kabailienė, M., Vaikutienė, G., Macijauskaitė, L., Rudnickaitė, E., Guobytė, R., Kisielienė, D., Gryguc, G., Mažeika, J., Motuza, G. & Šinkūnas, P. 2015. Lateglacial and Holocene environmental history in the area of Samogitian Upland (NW Lithuania). – Baltica, 28: 2, 163–178. http://dx.doi.org/10.5200/baltica.2015.28.14

Kashina, E. & Macāne, A. 2020. Wild boar tusk adornments and tools from the Neolithic hunter-gatherer sites in the Volga-Oka interfluve (central Russia). – Beauty and the Eye of the Beholder. Personal Adornments Across the Millennia. Eds M. Mărgărit & A. Boroneanţ. Cetatea de scaun, Târgovişte, 151–162.

Kimmig, W. 1992. Die "Wasserburg Buchau" – eine spätbronzezeitliche Siedlung. Forschungsgechichte – Kleinfunde. Materialhefte vor- und Frühgeschichte Baden-Württemberg. (Heft, 16.) Konrad Theiss Verlag, Stuttgart.

Kiseleva, A. M. & Murashkin, A. I. 2019 = **Киселева, А. М. & Мурашкин, А. И.** Морская охота и рыболовство на побережье северной Фенноскандии до рубежа ЭР. – Самарский научный вестник, 8: 2, 171–179.

Kunskas, R. & Butrimas, A. 1985. Biržulio ežero krantų ir akmens amžiaus gyvenviečių kaita holocene. – Lietuvos Archeologija, 4, 66–79.

Leskov, A. M. & Müller-Beck, H. 1993. Arktische Waljäger vor 3000 Jahren. Unbekannte sibirische Kunst. Hase & Koehler, Mainz, München.

Lewis, M. A. 1995. Technological Development and Culture Change on St. Lawrence Island: A Functional Typology of Toggle Harpoon Heads. Doctoral dissertation. University of Alaska, Fairbanks.

Lübke, H., Rimkus, T., Meadows, J., Vashanau, Zagorska, I., A., Bērziņš, V., Butrimas, A., Charniauski, M., Daugnora, L. & Piezonka, H. 2024. The chronology and T-shaped antler axe technology in northeastern Europe. – Praehistorische Zeitschrift. https://doi.org/10.1515/pz-2023-2040

Luik, H. 2013. Seals, seal hunting and worked seal bones in the Estonian coastal region in the Neolithic and Bronze Age. – From These Bare Bones. Raw Materials and the Study of Worked Osseous Objects. Proceedings of the Raw Materials Session at the 11th ICAZ Conference, Paris, 2010. Eds A. Choyke & S. O'Connor. Oxbow Books, Oxford, Oakville, 73–87.

Luik, H., Ots, M. & Maldre, L. 2011. From the Neolithic to the Bronze Age. Continuity and changes in bone artefacts in Saaremaa, Estonia. – Written in Bones. Studies on Technological and Social Contexts of Past Faunal Skeletal Remains. Eds J. Baron & B. Kufel-Diakowska. Uniwersytet Wrocławski, Instytut Archeologii, Wrocław, 243–261.

Luik, H. & Piličiauskienė, G. 2016. Bone tools at the Neolithic sites of Šventoji, Lithuania: raw materials and working methods. – Close to the Bone: Current Studies in Bone Technologies. Ed. S. Vitezović. Institute of Archaeology, Belgrade, 188–200.

Macāne, A. 2022. Stone Age Companions. Humans and Animals in Hunter-Gatherer Burials in North-Eastern Europe. Doctoral dissertation. University of Gothenburg, Gothenburg.

Malyutina, A. & Charniauski, M. 2021. Wild boar tusk artefacts from peat bog sites of north-western Russia and north-eastern Belarus (4th–2nd millennia BC): technology, function, context. – Beyond Use-Wear Traces: Going from Tools to People by Means of Archaeological Wear and Residue Analyses. Eds S. Beyries, C. Hamon & Y. Maigrot. Sidestone Press, Leiden, 211–224.

Mason, O. K. 2009. "The multiplication of forms:" Bering Strait harpoon heads as a demic and macroevolutionary proxy. – Macroevolution in Human Prehistory. Eds A. Prentiss, I. Kuijt & J. C. Chatters. Springer, New York, 73–107. https://doi.org/10.1007/978-1-4419-0682-3_4

Mason, O. T. 1902. Aboriginal American Harpoons: A Study in the Ethnic Distribution and Invention. Government Printing Office, Washington.

Millard, A. R. 2014. Conventions for reporting radiocarbon determinations. – Radiocarbon, 56: 2, 555–559. http://dx.doi.org/10.2458/56.17455

Molnár, M., Janovics, R., Major, I., Orsovszki, J., Gönczi, R., Veres, M., Leonard, A. G., Castle, S. M., Lange, T. E., Wacker, L., Hajdas, I. & Jull, A. J. T. 2013. Status report of the new AMS ^{14}C sample preparation lab of the Hertelendi Laboratory of Environmental Studies (Debrecen, Hungary). – Radiocarbon, 55: 2–3, 665–676. https://doi.org/10.1017/S0033822200057829

Nenrina, V. I. 1991 = **Ненрина, В. И.** Рыболовство в мезолите-энеолите Украины. – Рыболовство и морской промысел в эпоху мезолита-раннего металла. Ed. Н. Н. Гурина. Ленинград, 109–115.

Niedziałkowska, M., Doan, K., Górny, M., Sykut, M., Stefaniak, K., Piotrowska, N., Jędrzejewska, B., Ridush, B., Pawełczyk, S., Mackiewicz, P., Schmölcke, U., Kosintsev, P., Makowiecki, D., Charniauski, M., Krasnodębski, D., Rannamäe, E., Saarma, U., Arakelyan, M., Manaseryan, N., Titov, V. V., Hulva, P., Bălășescu, A., Fyfe, R., Woodbridge, J., Trantalidou, K., Dimitrijević, V., Kovalchuk, O., Wilczyński, J., Obadă, T., Lipecki, G., Arabey, A. & Stanković, A. 2021. Winter temperature and forest cover have shaped red deer distribution in Europe and the Ural Mountains since the Late Pleistocene. – Journal of Biogeography, 48: 1, 147–159. https://doi.org/10.1111/jbi.13989

Ostrauskas, T. 1996. Vakarų Lietuvos mezolitas. – Lietuvos Archeologija, 14, 192–212.

Palonen, V., Pesonen, A., Herranen, T., Tikkanen, P. & Oinonen, M. 2013. HASE – the Helsinki adaptive sample preparation line. – Nuclear Instruments and Methods in Physics. Research Section B: Beam Interactions with Materials and Atoms, 294, 182–184. https://doi.org/10.1016/j.nimb.2012.08.056

Palonen, V. & Tikkanen, P. 2015. A novel upgrade to Helsinki AMS: fast switching of isotopes with electrostatic deflectors. – Nuclear Instruments and Methods in Physics. Research Section B: Beam Interactions with Materials and Atoms, 361, 263–266. https://doi.org/10.1016/j.nimb.2015.04.053

Park, R. W. & Stenton, D. R. 1998. Ancient Harpoon Heads of Nunavut: An Illustrated Guide. Canadian Heritage, Parks Canada.

Piličiauskas, G. 2018. Virvelinės keramikos kultūra Lietuvoje 2800–2400 cal BC. Lietuvos istorijos institutas, Vilnius.

Piličiauskas, G., Luik, H. & Piličiauskienė, G. 2015. Reconsidered Late Mesolithic and Early Neolithic of the Lithuanian coast: the Smeltė and Palanga sites. – Estonian Journal of Archaeology, 19: 1, 3–28. http://dx.doi.org/10.3176/arch.2015.1.01

Piličiauskas, G., Skipitytė, R. & Heron, C. 2018. Mityba Lietuvoje 4500–1200 cal BC maisto liekanų keramikoje bendrųjų mėginių izotopinių tyrimų duomenimis. – Lietuvos Archeologija, 44, 9–37.

Piličiauskas, G., Matiukas, A., Peseckas, K., Mažeika, J., Osipowicz, G., Piličiauskienė, G., Rannamäe, E., Pranckėnaitė, E., Vengalis, R. & Pilkauskas, M. 2020. Fishing history of the East Baltic during the Holocene according to underwater multiperiod riverine site Kaltanėnai, northeastern Lithuania. – Archaeological and Anthropological Sciences, 12: 279. https://doi.org/10.1007/s12520-020-01233-9

Piličiauskas, G., Simčenka, E., Lidén, K., Kozakaitė, J., Miliauskienė, Ž., Piličiauskienė, G., Kooijman, E., Šinkūnas, P. & Robson, H. K. 2022. Strontium isotope analysis reveals prehistoric mobility patterns in the southeastern Baltic area. – Archaeological and Anthropological Sciences, 14: 74. https://doi.org/10.1007/s12520-022-01539-w

Puzinas, J. 1938. Naujausių proistorinių tyrinėjimų duomenys. Kaunas.

Quimby, G. I. 1946. Toggle harpoon heads from the Aleutian Islands. – Fieldiana Anthropology, 36: 2, 15–23.

Reimer, P. J., Austin, W. E. N., Bard, E., Bayliss, A., Blackwell, P. G., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kromer, B., Manning, S. W., Muscheler, R., Palmer, J. G., Pearson, C., Plicht, J. van der, Reimer, R. W., Richards, D. A., Scott, E. M., Southon, J. R., Turney, C. S. M., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S. M., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S.,

Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A. & Talamo, S. 2020. The IntCal20 northern hemisphere radiocarbon age calibration curve (0–55 cal kBP). – Radiocarbon, 62: 4, 725–757. https://doi.org/10.1017/RDC.2020.41

Rimantienė, R. 1979. Šventoji. Narvos kultūros gyvenvietės. Mokslas, Vilnius.

Rimantienė, R. 2005. Die Steinzeitfischer an der Ostseelagune in Litauen. Forschungen in Šventoji und Būtingė. Litauisches Nationalmuseum, Vilnius.

Rimkus, T. 2022. Hunter-gatherer bone and antler implements in Lithuanian coastal area: recent studies in chronology, technology and decoration patterns. – Journal of the University of Latvia. History, 13/14, 26–47. https://doi.org/10.22364/luzv.13.14.02

Rimkus, T. & Daugnora, L. 2021. Akmens amžiaus kaulo ir rago dirbinių technologija Lietuvos pajūrio regione. Papildant Palangos ir Smeltės kolekcijų duomenis. – Kretingos rajono archeologiniai tyrimai ir perspektyvos. Kraštotyrininko, archeologo Igno Jablonskio 110-osioms gimimo metinėms. Mokslinių straipsnių rinkinys. Ed. E. Rimkienė. Kretingos muziejus, Kretinga, 83–94.

Rimkus, T., Butrimas, A., Lübke, H. & Meadows, J. 2023a. T-shaped antler axes in Lithuania: previously unrevealed Middle Holocene hunter-gatherer technology. – Archaeologia Baltica, 30, 41–57. https://doi.org/10.15181/ab.v30i0.2563

Rimkus, T., Eriksen, B. V., Meadows, J. & Hamann, C. 2023b. Bone points in time: dating hunter-gatherer bone points in the territory of Lithuania. – Radiocarbon, 65: 5, 1118–1138. https://doi.org/10.1017/RDC.2023.97

Rychner V. 1979. L'âge du bronze final à Auvernier (Lac de Neuchâte, Suisse, Lausanne). Typologie et chronologie des anciennes collections conservées en Suisse. Bibliothèque historique vaudoise, Troyes.

Slota Jr, P. J., Jull, A. J. T., Linick, T. W. & Toolin, L. J. 1987. Preparation of small samples for ^{14}C accelerator targets by catalytic reduction of CO. – Radiocarbon, 29: 2, 303–306. https://doi.org/10.1017/S0033822200056988

Stančikaitė, M., Baltrūnas, V., Šinkūnas, P., Kisielienė, D. & Ostrauskas, T. 2006. Human response to the Holocene environmental changes in the Biržulis Lake region, NW Lithuania. – Quaternary International, 150: 1, 113–129. https://doi.org/10.1016/j.quaint.2006.01.010

Strohalm, M., Kavan, D., Novák, P., Volný, M. & Havlícek, V. 2010. mMass 3: a cross-platform software environment for precise analysis of mass spectrometric data. – Analytical Chemistry, 82: 11, 4648–4651.

Tarbay, J. G. 2022. Late Bronze Age bronze detachable barbed harpoons with line hole and spur from Hungary. – Archäologisches Korrespondenzblatt, 52: 3, 331–361. https://doi.org/10.11588/ak.2022.3.96435

Telegin, D. 1971. Seredniostogivska kultura. – Archeologija Ukrainskoj RSP, 1, 221–231.

Tikkanen, P., Palonen, V., Jungner, H. & Keinonen, J. 2004. AMS facility at the University of Helsinki. – Nuclear Instruments and Methods in Physics. Research Section B: Beam Interactions with Materials and Atoms, 223–224, 35–39. https://doi.org/10.1016/j.nimb.2004.04.011

Torke, W. 1993. Die Fischerei am prähistorischen Federsee. – Archäologisches Korrespondenzblatt, 23: 1, 49–66.

Vankina, L. 1999. The Collection of Stone Age Bone and Antler Artefacts from Lake Lubāna. History Museum of Latvia, Riga.

Vogt, E. 1947. Zum Problem des urgeschichtlich-völkerkundlichen Vergleiches. – Beiträge zur Kulturgeschichte. Festschrift R. Bosch, Freiburg, 44–57.

Welker, F., Hajdinjak, M., Talamo, S., Jaouen, K., Dannemann, M., David, F., Julien, M., Meyer, M., Kelso, J., Barnes, I., Brace, S., Kamminga, P., Fischer, R., Kessler, B. M., Stewart, J. R., Pääbo, S., Collins, M. J. & Hublin, J.-J. 2016. Palaeoproteomic evidence identifies archaic hominins associated with the Châtelperronian at the Grotte Du Renne.

– Proceedings of the National Academy of Sciences of the United States of America, 113: 40, 11162–11167. https://doi.org/10.1073/pnas.1605834113

Winiger, J. 1992. Beinerne Doppelspitzen aus dem Bielersee: ihre Funktion und Geschichte. – Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte, 75, 65–99.

Zagorska, I. 2000. Sea mammal hunting strategy in the eastern Baltic. – Lietuvos Archeologija, 19, 275–285.

Zagorska, I., Lõugas, L., Lübke, H., Meadows, J., Pettitt, P., Macāne, A. & Bērziņš, V. 2021. East meets west in the 6th millennium: Mesolithic osseous tools and art from Sise on the Latvian seaboard. – Praehistorische Zeitschrift, 96: 1, 1–18. https://doi.org/10.1515/pz-2021-0003

Sarvest pöördharpuuniotsik – küttide-korilaste haruldane kalapüügivahend Lääne-Leedu mageveejärve keskkonnast

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RESÜMEE

Lääne-Leedule on iseloomulik moreenne maastik märgalade ja kinnikasvanud järvedega, kust on juhuleidudena saadud arvukalt luust ja sarvest tööriistu. Biržulise järve endistelt kallastelt ja nendega piirnevatelt aladelt on teada ligi 60 asulakohta ja juhuleidu. Daktariškė 5. asula paikneb endise järve loodeosas. Järvesetete kihtidest on leitud raieriistu, jahi- ja kalapüügivahendeid ning mitmesuguseid majapidamistöödega seotud esemeid, millest paljud on siiani veel uurimata.

Daktariškė 5. asula orgaanilistest materjalidest tööriistu uuriti hiljuti AMS ^{14}C dateeringute ja ZooMS-analüüside abil. Artiklis tutvustame sarvest valmistatud putkega pöördharpuuniotsiku uurimise tulemusi, mis põhinevad eseme AMS ^{14}C dateerimisel, valmistusviiside määratlemisel ja eseme valmistamiseks kasutatud loomaliigi ZooMS-analüüsi andmetel.

Asulakoht paikneb endisel saarel. Selle ümbrus on märgaladele iseloomuliku taimestikuga kinni kasvanud. Mesoliitikumis ja neoliitikumis seal elanud kogukonnad tegelesid suurte maismaaloomade küttimise ja kalapüügiga. Asulakohast leitud tööriistade hulgas on enim suuri raieriistu, kuid ka kiskudega teravikke, naaskleid, nuge ja pistodasid.

Pöördharpuuniotsik on valmistatud sarveharust. Ese leiti transeest nr 10 järvemuda kihi alt, 105–115 cm sügavuselt. Seda säilitatakse Leedu rahvusmuuseumis.

Kogu eseme pinnal on näha lõike- ja kaapimisjälgi. Ovaalne kooniline auk asub lähemal eseme distaalsele otsale. Augu läbimõõt servast servani on kuni 8,4 mm. Teine auk on tehtud eseme proksimaalsesse, pikemalt välja ulatuvasse otsa ühel küljel. Võimalik, et ese murdus augu kohalt või siis tehtigi auk selleks, et moodustuks kaks teravaotsalist kisku. Harpuuniotsiku proksimaalses osas on horisontaalne sisselõige, mis viitab sellele, et ese oli kinnitatud ümber soone seotud nööriga.

ZooMS-analüüsi spektri tipp peptiidi markeri 2216 juures näitab, et tegu on punahirve sarvega. Harpuuniotsik dateeriti ajavahemikku 3633–3380 aastat kal eKr ja seda saab seostada Kirde-Euroopa neoliitikumi küttide-korilastega.

See jahirelv koosnes puidust varrest, niiskuskindlast vahevardast, mis oli tõenäoliselt tehtud sarvest, sest puit paisub veega kokkupuutel, ning pöörduvast harpuuniotsikust. Jahiriista osaks oli veel kinnitusnöör. Kui harpuun tungis saaklooma kehasse, eraldus nööri pingule tõmbudes putkega harpuuniotsik vahevardast ja pöördus haava sees sisenemise suunaga võrreldes põikiasendisse, jäädes sinna kindlalt kinni. Et saakloom ei saaks põgeneda, oli otsiku külge kinnitatud nööri teine ots seotud puidust varre külge. Sellised harpuuniotsikud olid 5.–3. aastatuhandel kal eKr levinud Euroopa kagu- ja edelaosas; põhjapoolsetel aladel (nt Koola poolsaarel) pärinevad need 3.–2. aastatuhandest kal eKr. Seda tüüpi putkega harpuunid olid põhjapoolsetel laiuskraadidel hästi tuntud ka etnograafiliste kütihõimude hulgas.

Putkega pöördharpuune peetakse veelises keskkonnas kasutatud jahirelvaks. Etnograafiliste paralleelide põhjal võib öelda, et neid kasutati põhjaaladel suurte veeimetajate küttimiseks. Arheoloogilised uuringud aga näitavad, et nende abil jahiti nii suuri mageveekalasid (säga, haugi), poolveelise eluviisiga loomi (kopraid, saarmaid) kui ka mereimetajaid (hülgeid).

Daktariškė 5. asulakoha luust tööriistade uued radiosüsinikudateeringud annavad täiendavaid andmeid konkreetsete tööriistatüüpide kronoloogiate kohta ning kinnitavad, et asulakohta kasutati peamiselt 4. ja 3. aastatuhandel kal eKr.