

A Preliminary Report on the Results of the Lovas Archaeological Project (LAP) in Eastern Croatia. Seasons 2011, 2017, and 2018

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ABSTRACT

The archaeological heritage of the Lovas Municipality, located in eastern Croatia (western Sarmia), has been known to the wider archaeological public since the middle of the 20th century, when a Middle Bronze Age (MBA) hoard of gold and bronze finds was discovered. However, apart from the importance of the hoard for the definition of the MBA in Croatia, any detailed systematic research in the area was not attempted until 2011, when the Archaeological Museum in Zagreb conducted its initial research season in the Lovas Municipality. The project was restarted in 2017, in cooperation with the Lovas Municipality and the Institute of Classical Archaeology of Charles University in Prague, and has been continuously running ever since. In the last five years, research in the Lovas Municipality included a systematic field survey, targeted trial excavations, geophysical surveys, as well as a re-evaluation of the data collected through previous research and in 2011. Moreover, the project included the re-study of the MBA Lovas and Vukovar hoards. This paper presents preliminary results of the 2011, 2017, and 2018 seasons, focusing primarily on the current insight into the archaeological topography of the Lovas Municipality. Additionally, the paper brings the preliminary results of scientific analyses of the Lovas and Vukovar hoards that were conducted in 2020.

KEYWORDS

Eastern Croatia; Lovas; Bronze Age; excavation; systematic field survey; archaeometallurgy.

INTRODUCTION

Lovas is a small municipality in eastern Croatia (historical western Sarmia), located on the elevated right bank of the Danube River, between the larger towns of Vukovar and Ilok. The municipality further consists of two villages / cadastral areas – Opatovac to the north, and Lovas to the south. Sarmia, located in the proximity of the River Danube – an important communication route since the earliest prehistory, with its loess plateaus that dominate the landscape, is one of the most fertile regions in Europe, and its geographical features make it a promising prehistoric region for future in-depth investigations.

Various overviews of Croatian prehistory regularly list the territory of the Lovas Municipality as one of the archaeologically most significant parts of western Sarmia. However, the reputation Lovas holds among Croatian and European prehistorians is largely a result of the accidental discovery of the Middle Bronze Age (MBA) ‘hoard’ of gold and bronze finds (see VINSKI 1958), rather than systematic research. The archaeological finds from Lovas became first known at the turn of the 19th / 20th centuries, but the knowledge of archaeological material from the Lovas area was based mostly on chance and sporadic finds that had been given

over to the experts.¹ A similar situation continued until October 1939, when the valuable MBA hoard of gold and bronze finds was accidentally ploughed out of the ground. The hoard itself did not become widely known instantly and it was published in greater detail only in 1958 (VINSKI 1958, 1–2). The importance of the Lovas Hoard for the definition of the MBA in Croatia has since then been acknowledged by various scholars discussing the period (e.g. MAJNARIĆ-PANDŽIĆ 1984b).

Unfortunately, no large-scale systematic research has been carried out in the Lovas area until fairly recently, although it is important to mention the systematic field surveys of 1970 and 1972 (BUNČIĆ 2007, 46), as well as those of 2008 (DIZDAR – LOŽNJAK DIZDAR 2009). Other than the sites of Kalvarija, Orlinac and Staro Groblje, which are registered as cultural heritage, older publications rarely refer to other sites. The first attempt to systemize archaeological research in the Lovas area was made in 2011, when the Archaeological Museum in Zagreb conducted a field survey at various locations and opened several test trenches at the sites of Kalvarija and Staro Groblje. The aim of the project was to map all the archaeological sites in the municipality, and improve the knowledge about the archaeological topography of the area. In the protected zone, the field survey included the intensive collecting of surface finds in 5 × 5 m quadrants, while other areas were covered extensively (MIHELIĆ 2012, 63–64). Test trenches were opened at Kalvarija and Staro Groblje in order to examine the state of preservation of archaeological layers.

Unfortunately, after the successful 2011 season, the project did not receive funding for the following five years. The project was restarted in 2017 as a cooperation between the Archaeological Museum in Zagreb and the Lovas Municipality, while the Institute of Classical Archaeology of Charles University in Prague joined as a project partner in 2018. The project is currently ongoing and the end of the first phase is planned for 2023, resulting in a final publication of the results. The main goal of the project is to fully define the archaeological topography of the Lovas Municipality. Systematic field surveys are conducted on a yearly basis in order to digitally map all previously-discovered sites, as well as new ones. Individual sites are examined through test trenches and geophysical surveys.

The project also includes the contextual, isotopic and metallographic (re-)evaluation of the Lovas and Vukovar hoards, as well as the study of unpublished material from the Lovas Municipality, which is kept at the Archaeological Museum in Zagreb. The following report offers the preliminary results of the 2011, 2017, and 2018 seasons, as well as the preliminary results of the analyses of the Lovas and Vukovar hoards.

THE ARCHAEOLOGICAL TOPOGRAPHY OF THE LOVAS MUNICIPALITY

SURVEY METHODOLOGY

In 2017, the research team of the Lovas Archaeological Project (LAP) re-examined the results gathered in 2011, targeting not only the finds collected during the 2011 field surveys and excavations, but re-visiting also all of the discovered and documented sites. This re-evaluation helped to define both the future goals of the project, and to improve the technique of the field survey as such. The 2011 extensive collecting did not work with standardised survey units but rather within local cadastral units of different shapes and sizes, without any additional subdivisions or indications of the direction of movement. The collecting strategy was also not unified and

1 For a detailed overview of the earlier research conducted in the area of Lovas see BUNČIĆ 2007, 46.

it seems that some of the walkers focused more on diagnostic sherds, while undecorated body sherds were only of secondary interest. Therefore, the total number of collected sherds does not say much about either the spatial distribution or the surface density of the finds. Rather, it represents a random sample collected by a different number of walkers.

Since the numbers of sherds retrieved from the individual sites in 2011 significantly differed from each other, the 2017 team re-visited all of the previously identified sites, and determined that those which produced the highest number of surface finds in 2011 were indeed those of the largest size, and with the highest density of surface finds. The said sites were not systematically surveyed again, but are in the process of being mapped in more detail.

In 2017 and 2018, a new methodological approach was introduced. Surface finds were collected in standardised units or tracts, measuring 70 m in the east-west direction, and 100 m in the north-south direction. Each tract was surveyed in six straight lines (north-south direction), which were additionally divided into five equal smaller segments. All the sherds discovered within individual segments were collected. This was done for two main reasons: first, no diagnostic sherds were visible on the surface in many cases, and, second, a rough chronological evaluation of individual sites could also be made on the basis of undecorated body sherds. It has to be noted that it is not our intention to present the methodological approach in more detail in this paper, as this will be done in the forthcoming publications emerging from the project results.

HABITATION PATTERNS

Research conducted by the LAP in the Lovas Municipality in 2011, 2017, and 2018 helped define 21 points of interest with traces of human activity dating to various archaeological periods (see **Fig. 1**). Sites documented during the field survey in 2011, 2017, and 2018 include: Kragino Voće (1), Brzovac (2), U Mjestu-Ulica Vladimira Nazora/Vladimir Nazor Street (3), Staro Selo (4), Čajer (5), Čot (6), Šljivici (7), Orlinac (8), Gradac (9), Staro Groblje (10), Kalvarija (11), Sv. Mihovil (12), Kovači (13), Srednje Brdo-Sjever/North (14), Srednje Brdo-Centar/Centre (15), Srednje Brdo-Jug/South (16), Kavane-Sjever/North (17), Orašje (18), Bečka-Jug/South (19), Bečka-Istok/East (20), Čopinac (21). Additional sites are also known from the results of earlier research in the area, namely Opatovac-Fruškogorska ulica 6/Fruškogorska Street 6 (22), Opatovac-Trščanik, Sokolovac, Šanac and Beljinac (23),² Vinograd Friedricha Königsdorfera/the Vineyard of Friedrich Königsdorfer (24), and Opatovac – unknown location (25). It has to be noted that the field surveys in the three mentioned seasons, as well as the earlier surveys conducted in the 1970s (BUNČIĆ 2007, 46), and in 2008 (DIZDAR – LOŽNJAK DIZDAR 2009), covered around 85% of the municipality's area. The remaining 15% will be covered by the field survey in 2021 (the Lišće position north of the village of Lovas) or were already surveyed by the Museum in Vukovar (area south of the village of Opatovac). The results of the latter field survey are still unpublished.

2 In earlier publications, only finds of the Vučedol culture are mentioned along the Danube shoreline near Opatovac (BUNČIĆ 2007, 47). The results of the recent field surveys conducted along the Danube (LOŽNJAK DIZDAR – HUTINEC – DIZDAR 2014) confirmed the presence of the Vučedol culture at Trščanik-East. It is important to note that the same surveys confirmed that at least 11 separate locations along the Danube around Opatovac were settled (including smaller sections of the Trščanik, Sokolovac, Šanac and Beljinac positions) (see LOŽNJAK DIZDAR – HUTINEC – DIZDAR 2014, 162). Subsequent trench excavations carried out at Šanac (LOŽNJAK DIZDAR – DIZDAR 2015, 12) confirmed that the site was settled in the periods of Starčevo, Sopot, Baden and Kostolac cultures.

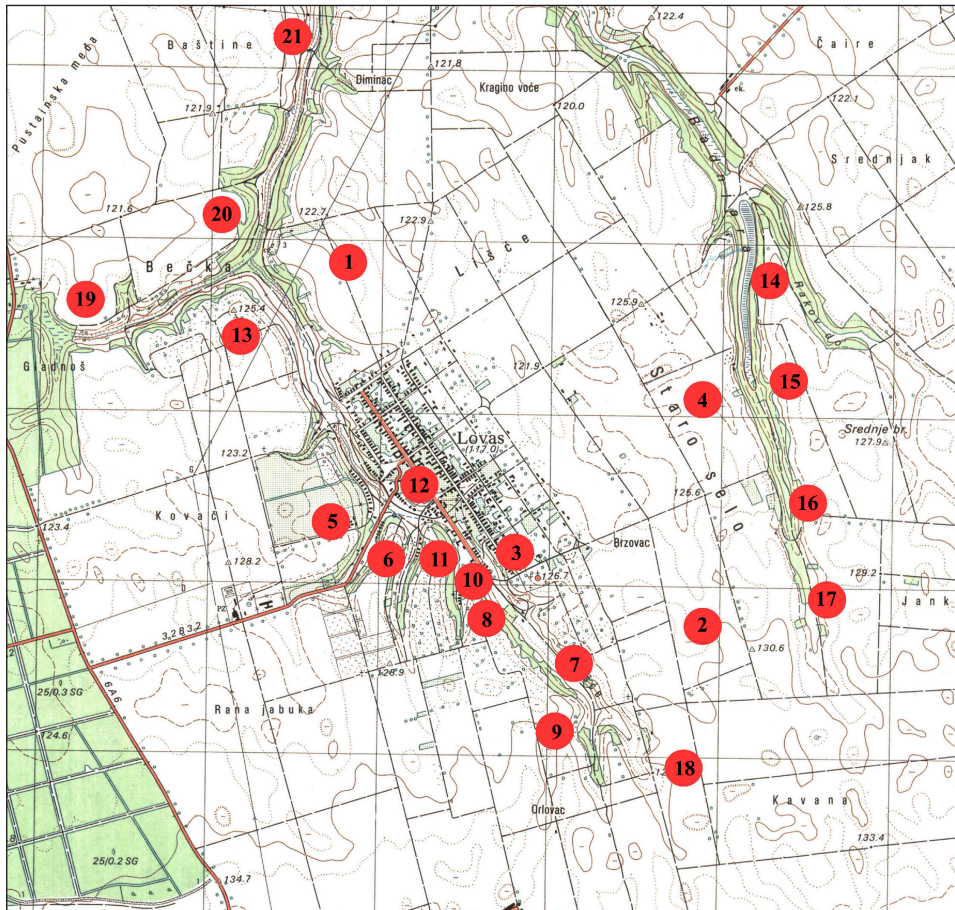


Fig. 1: Spatial distribution of sites in the Lovas Municipality (Lovas and Opatovac cadastral areas). The numbers on the map match the numbers of sites as listed in the text.

Most of the sites yielded material from several archaeological periods, with the exceptions of Kragino Voće (1) (prehistory), Brzovac (2) (the Middle Ages) and Srednje Brdo-Sjever/North (14) (Neolithic/Copper Age). Unfortunately, at many of the sites, material dated to early prehistory appears alongside modern-day finds, which might suggest deep destruction of the archaeological layers as a result of intensive agricultural activities. Nevertheless, the fact that many of the sites were repeatedly inhabited in different periods of the human past suggests that similar locations in the landscape were favoured for habitation due to their natural characteristics. The landscape is dominated by loess plateaus and the documented archaeological sites in the Lovas Municipality are mostly located on the edges of such loess plateaus, on the banks of old streams – Čopinac, Bečka and Badnjara, which flow directly to the Danube in the north.

The Čopinac stream, several kilometres long, is located southeast of the village of Lovas, and it flows into the Danube near Opatovac. The Bečka stream flows into Čopinac at about the middle of its flow (see Fig. 1). Already after the 2011 survey, certain regularities were noted in the selection of locations that revealed traces of human activity from different periods. The previously-known sites of Kalvarija (11), Orlinac (8), and Staro Groblje (10) are located on elevated plateaus on the western bank of the Čopinac stream. A number of other sites were discovered on the western bank of the Čopinac stream, namely Čot (6), Čajer (5), Kovači (13), Bečka-Istok/East (20), and Čopinac (21). A similar pattern was noted on the eastern bank of

the stream, where sites were discovered at Kragino Voće (1), U Mjestu (3), Sv. Mihovil (12), Šljivici (7), and Orašje (18).

The same pattern was recorded alongside the Bečka stream. For example, Bečka-Jug/South (19) is located just north of the mentioned stream, on a plateau that descends towards the stream to its south (see **Fig. 1**). Kovači (13) is opposite Bečka-Jug/South (19), on the southern bank of the Bečka stream. As mentioned before, the site of Kovači (13) is located west of the Čopinac stream, and is bordered by both watercourses. The Bečka-Istok/East (20) site is located on the eastern part of an elevation north of the Bečka stream, and Čopinac flows alongside its eastern boundary. Other than along the listed streams, some of the sites (Srednje Brdo-Sjever/North (14), Srednje Brdo-Centar/Centre (15), Srednje Brdo-Jug/South (16), Kavane-Sjever/North (17), and Staro Selo (4)) are located next to the Badnjara stream in the eastern part of the Lovas Municipality.

It is important to note that the spatial distribution of pottery significantly decreases as one moves away from the streams, which indicates that the sites probably did not significantly expand towards the centres of the loess plateaus. It seems more likely that the activities were focused on a relatively narrow, elongated area following the streams. The only two sites that are not situated right alongside a stream, but are in the centre of the plateau, are Brzovac (2) and the southern part of the Kavane (see DIZDAR – LOŽNJAK DIZDAR 2009, 119–120; ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 186).

Research conducted in 2017 in the western part of the Lovas cadastral area at the positions Bijela Lenija,³ Rana Jabuka and Bijeli Dol did not yield any archaeological remains. In comparison to the high frequency of surface finds in other parts of the municipality (e.g. Kovači (13), Kalvarija (11), Orlinac (8) and Staro Groblje (10)), it is possible that there are no archaeological sites in the western part of the Lovas cadastral area. The Rakov Do and Janka Pusta positions in the eastern part of the Lovas cadastral area did not yield any finds either.

The analysis of all of the material collected in systematic field surveys shows that Kovači (13) and Čopinac (21) yielded the most numerous material, while Kalvarija (11), Čopinac (21) and Bečka-Jug/South (19) yielded material from the most periods (see **Tab. 1**). Pottery sherds are certainly the most common group of finds at all sites, with the exception of Srednje Brdo-Sjever/North (14), where only one ceramic fragment and one blade made of grey flint were found. The chronological attribution of individual sites was determined on the basis of diagnostic ceramic fragments. With no diagnostic pieces at hand, the dating was based on the fabric, when possible. Fragments that display characteristics typical of several periods (fabric, mode of production, vessel shape, or decoration) were placed in more general categories: prehistory, Neolithic/Copper Age, prehistory/Antiquity, and Antiquity/Middle Ages. Other than pottery, the sites yielded pieces of daub, with and without wattle traces, a significant quantity of chipped stone tools, polished stone tools, stone tools with an abrasive surface (cubic handstones, pieces of grindstones), fragments of iron slag, spindle whorls, a ceramic polisher, a small ceramic sphere, glass fragments, and two fragments of clay tobacco pipes of the Mediterranean type.

Most of the sites included in the 2011 and 2017 systematic field survey yielded, however, just a relatively small number of pottery sherds, with only six sites yielding over 100 pieces (see **Tab. 1**). Cumulatively, the largest number of collected sherds (5882) can be dated to prehistoric periods, while a significantly smaller number was ascribed to the Roman period (329), the Middle Ages (439), and the Modern Age (252). Although the relative relationship between

3 This position is sporadically associated with Bronze Age finds (see DIZDAR – LOŽNJAK DIZDAR 2009, 119).

the numbers seems to be reliable, it is worth remembering that the absolute numbers (see **Tab. 1**) should be taken cautiously, due to the not completely standardised collection strategies employed in 2011.

| No. | Position | Pre-history | Neolithic | Neolithic/ Copper Age | Copper Age | Bronze Age | Late Iron Age | Prehistory/ Roman Period | Roman Period | Roman Period/ Middle Ages | Middle Ages | Modern Age |
|-----|----------------------------|-------------|-----------|-----------------------------|---------------|---------------|---------------------|--------------------------------|-----------------|---------------------------------|----------------|---------------|
| 1 | Kragino voće | + (1) | | | | | | | | | | |
| 2 | Brzovac | | | | | | | | | | + (6) | |
| 3 | U mjestu | | | + (4) | | + (3) | | | | | + (1) | |
| 4 | Staro selo | | | | | | | | + (5) | | + (2) | + (2) |
| 5 | Čajer | | | + (5) | | + (5) | | | | | | |
| 6 | Čot | | | + (12) | | | | | | | | |
| 7 | Šljivici | + (4) | | + (13) | | + (22) | | + (15) | + (21) | + (16) | + (1) | + (7) |
| 8 | Orlinac | | | + (1) | | | | | + (5) | | + (3) | |
| 9 | Gradac | | | + (1) | | | | | + (13) | + (12) | | |
| 10 | Staro groblje | | | + (15) | | + (57) | + (16) | + (23) | | | + (1) | + (3) |
| 11 | Kalvarija | | | | + (139) | + (133) | + (98) | + (175) | + (45) | + (22) | + (39) | + (3) |
| 12 | Sv. Mihovil | | | | | + (240) | + (139) | + (16) | + (32) | | + (107) | + (141) |
| 13 | Kovači | | | | + (625) | + (1067) | + (180) | + (72) | + (23) | | + (19) | + (8) |
| 14 | Srednje Brdo-Sjever/North | | | + (1) | | | | | | | | |
| 15 | Srednje Brdo-Centar/Center | | | | | + (1) | + (1) | | | + (1) | | |
| 16 | Srednje Brdo-Jug/South | + (3) | | | | + (1) | + (3) | | + (4) | | + (12) | + (5) |
| 17 | Kavane-Sjever/North | | | | | + (2) | | | | | + (3) | |
| 18 | Orašje | | | + (1) | | + (2) | | + (5) | + (6) | | + (2) | + (7) |
| 19 | Bečka-Jug/South | + (154) | + (27) | + (281) | + (63) | + (174) | + (8) | + (3) | + (57) | | + (10) | + (3) |
| 20* | Bečka-Istok/East | + (1) | | | + (2) | + (9) | + (1) | + (1) | | | + (2) | |
| 21 | Čopinac | + (459) | + (31) | + (225) | + (284) | + (507) | + (102) | + (2) | + (103) | + (38) | + (191) | + (66) |

Tab. 1: Chronological attribution of finds from the newly discovered and previously noted sites in the Lovas Municipality. Numbers in brackets represent the total number of collected pottery fragments attributed to individual periods (* = the site was not entirely included in the field survey, so the listed data only provides a partial insight into the situation).

THE NEOLITHIC AND THE COPPER AGE

Pottery dated generally to prehistory was discovered at Kragino Voće (1), Šljivici (7), Srednje Brdo-Jug/South (16), Bečka-Jug/South (19), Bečka-Istok/East (20) and Čopinac (21). Pottery dated generally to the Neolithic/Copper Age was recorded at 11 sites (ĐUKIĆ – FRANKOVIĆ – MIHELIĆ 2020, 178–179), namely, U Mjestu (3), Čajer (5), Čot (6), Šljivici (7), Orlinac (8), Gradac (9), Staro Groblje (10), Srednje Brdo-Sjever/North (14), Orašje (18), Bečka-Jug/South (19) and Čopinac (21). Neolithic pottery, more specifically, was discovered only at Bečka-Jug/South (19)

and Čopinac (21). Some of the fragments can be possibly ascribed to the late Neolithic Sopot culture (ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 179).

Copper Age pottery was discovered at Kalvarija (11), Kovači (13), Bečka-Jug/South (19), Bečka-Istok/East (20) and Čopinac (21). However, only a few sherds were diagnostic and can be ascribed to individual Copper Age cultural groups. The majority was widely dated to the Copper Age on the basis of the fabric. Pottery that was ascribed to the middle/late Copper Age was discovered at Kalvarija (11), Kovači (13), Bečka-Jug/South (19), Bečka-Istok/East (20), and Čopinac (21). At Čopinac (21), rounded fragments of rims and bodies of pots and bowls, decorated with deeply incised lines that form fishbone motifs (**Fig. 2:6, 9**), point to the middle/late Copper Age. A ceramic polisher (**Fig. 2:11**) discovered at the same site probably dates to the late Copper Age and might be associated with the Vučedol culture (ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 179). A similar unpublished example from Opatovac is kept at the Archaeological Museum in Zagreb.

Various fragments from Kovači (13) have parallels at other sites (see also ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 179). The fragment shown in **Fig. 3:1** is decorated in the same manner as a fragment of the Baden culture from Vučedol (see TEŽAK GREGL 1985, fig. 3, 4, 6:2), while the fragment shown in **Fig. 3:2** is decorated in a similar way to a sherd from Sarvaš (see BALEN 2005b, fig. 23, cat. no. 27). The fragments shown in **Fig. 3:5, 7** resemble decorated finds of the Kostolac culture from Vučedol (BALEN 2005a, pl. 1:1 and 6, 2:3) and Sarvaš (BALEN 2005b, fig. 25, cat. no. 39), while the fragment in **Fig. 3:4** resembles fragments ascribed to the Vučedol culture from Ervenica (MILOGLAV 2007, pl. 3:6) and Sarvaš (BALEN 2005b, pl. 26:1–3). At Kovači (13), habitation during the period of the Kostolac culture was confirmed by the 2017 and 2019 excavations.

THE BRONZE AGE

Bronze Age sites are the most numerous in our systematic field survey. Relevant pottery was collected at 14 sites (see **Tab. 1**): U Mjestu (3), Čajer (5), Šljivici (7), Sv. Mihovil (12), Staro Groblje (10), Kalvarija (11), Srednje Brdo-Centar/Centre (15), Srednje Brdo-Jug/South (16), Kavane-Sjever/North (17), Orašje (18), Kovači (13), Bečka-Jug/South (19), Bečka-Istok/East (20) and Čopinac (21). However, despite a relative abundance, the majority of Bronze Age material did not contain diagnostic features, and a more precise dating of the material was, in many cases, impossible. Early Bronze Age pottery was discovered at Sv. Mihovil (12) (**Fig. 4:10**) (ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 179–180). It resembles finds from the Tržnica site in Vinkovci (MARKOVIĆ 2010, t. 5:4), and those from Sotin, Vučedol, and Petrovci (LOŽNJAK DIZDAR – POTREBICA 2017, 81, fig. 36). Finds from the transition between the early and the late phases of the Early Bronze Age were not recorded at any of the sites included in the systematic field survey of the Lovas Municipality, although their existence cannot be excluded, due to the large frequency of finds decorated with comb-like motifs (ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 180).

Finds that could most likely be ascribed to the MBA Belegiš I culture were collected at Čopinac (21) and Kovači (13), and more of them were discovered at Kovači (13) in the course of the 2017 excavations. It seems that both sites, based on the ceramic evidence, were intensively used during the MBA (ĐUKIĆ – FRANKOVIĆ – MIHELIC 2020, 180). The most interesting MBA find from Čopinac (21) is a stone arrowhead, which can be connected to the Bronze Age production of chipped stone tools identified at sites in Serbia (ŠARIĆ 2005, pl. 6:3, 5, and 14). Similar finds were discovered in Bronze Age contexts at the Jela and 'Ekonomija 13. Maj' sites in Zemun, and at the Slatina Motel site in Paraćin (ŠARIĆ 2005, t. 6:3, 5, and 14). Another ex-

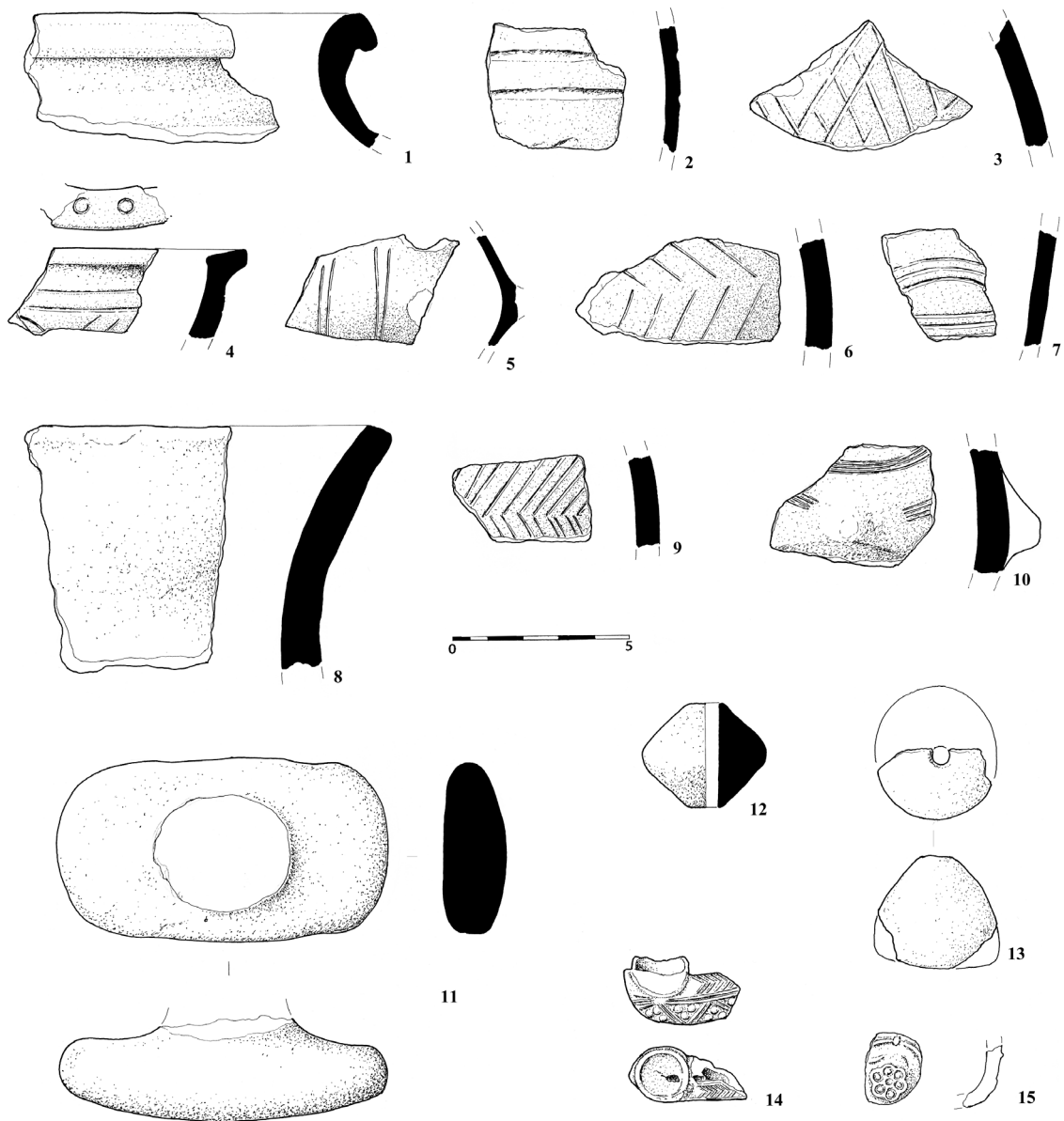


Fig. 2: Selection of finds collected in the Lovas Municipality in 2018. Čopinac: 1-12, 14, 15; Bečka-Jug/South: 13.

ample was discovered during the 2020 excavations at the U Mjestu (3), and can be associated with a pure deposit of MBA pottery (Belegiš I).

Finds from the early phase of the Late Bronze Age (LBA) from the area under study should probably be ascribed to the Belegiš II culture. These finds include a certain quantity of neck fragments of large pots decorated with wide shallow horizontal cannelures (such as finds from Kalvariija (11) (Fig. 5:10) and Sv. Mihovil (12) (Fig. 4:5) that appear all across eastern Slavonia and western Syrmia (LOŽNJAK DIZDAR – POTREBICA 2017, 81, fig. 36), e.g. at Aljmaš, Batina, Dalj, Erdut, Klisa, Osijek, Privlaka-Gradina, Sarvaš, Sotin, Vinkovci (FORENBAHER 1991, 60, fig. 3:1, 2, and 4, 7:1), and Vučedol (FORENBAHER 1990, pl. 1:1-2, and

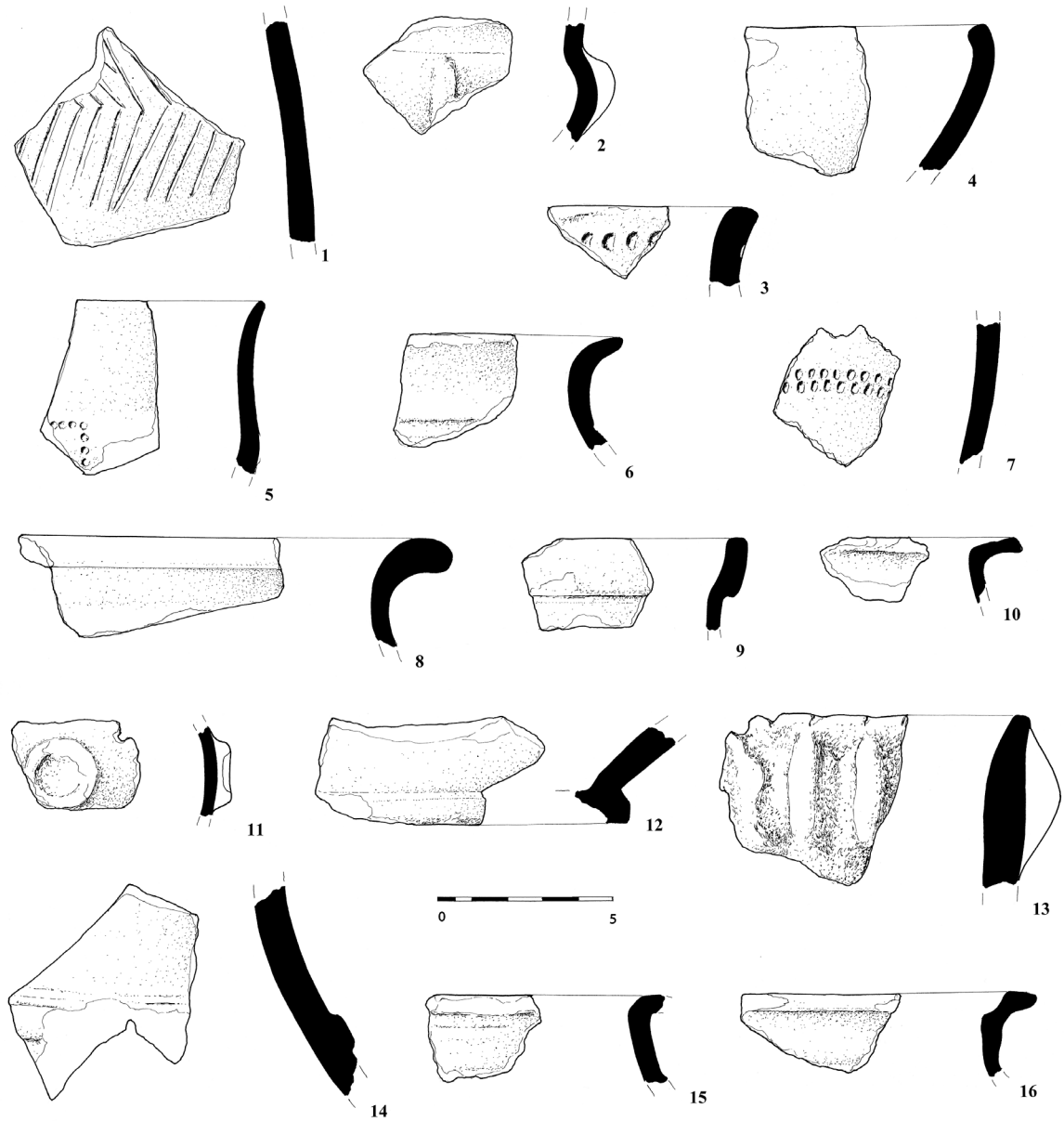


Fig. 3: Selection of material collected in the Lovas Municipality in 2017 and 2018. Kovači: 1-13; Srednje Brdo-Centar/Centre: 14-16.

9, 2:1, 3:2, and 11-12, 4:9-12, 5:1, 6:7 and 9, 7:1-3, 8:1-2, 9:1). Due to the fragmentation of the material from Lovas, as well as the fact that comb-like decorations sometimes appear on the lower part of the vessel (such as on vessels from Staro Groblje (10), Kalvarija (11), and Kovači (13)), it is possible that some of this material can actually be ascribed to the later Bosut cultural group that was noted in nearby Ilok (BUNČIĆ 2007, pl. 6:1). Some of the fragments from Sv. Mihovil (12) and Kalvarija (11) (Fig. 4:2, 4) can possibly be ascribed to the late phase of the LBA. However, finds of LBA pottery sherds, dating after 1100 BCE, are rather rare in the Lovas Municipality.

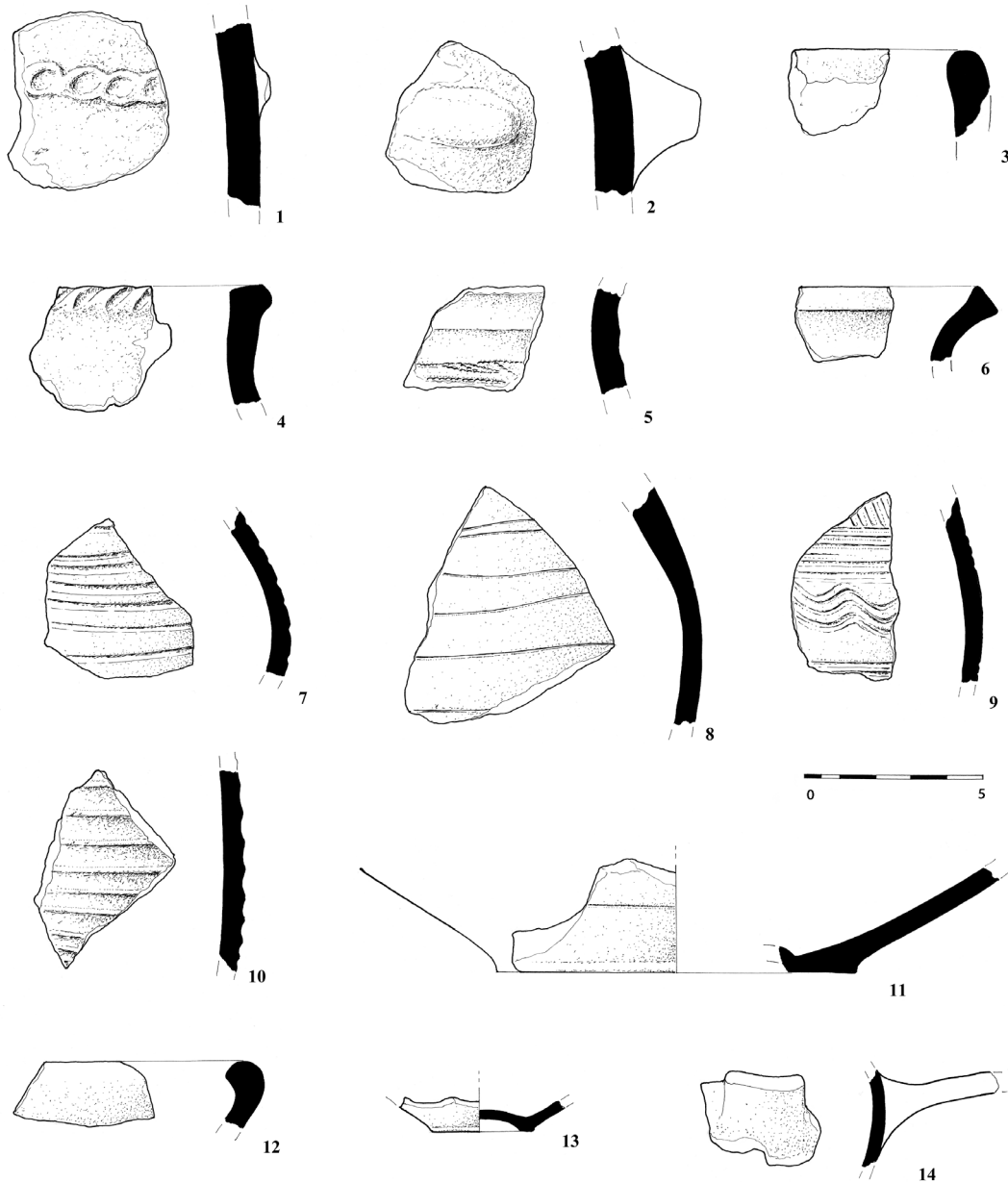


Fig. 4: Selection of material collected at Sv. Mihovil in 2011.

THE IRON AGE AND THE ROMAN PERIOD

Only a handful of sherds collected during the field surveys at Sv. Mihovil (12) and Kalvarija (11) in 2011 could potentially be dated to the period between the late phase of the LBA (after 1100 BCE) and the Early Iron Age (EIA). These are also the only finds discovered in the surveys that could be linked to human activity in the EIA. Even the previously-recorded EIA finds from Ulica Vladimira Nazora/Vladimir Nazor Street in Lovas, i.e. U Mjestu (3), were not confirmed during the 2011 survey and the 2020 excavation. Therefore, the EIA is the least represented prehistoric period in Lovas Municipality.

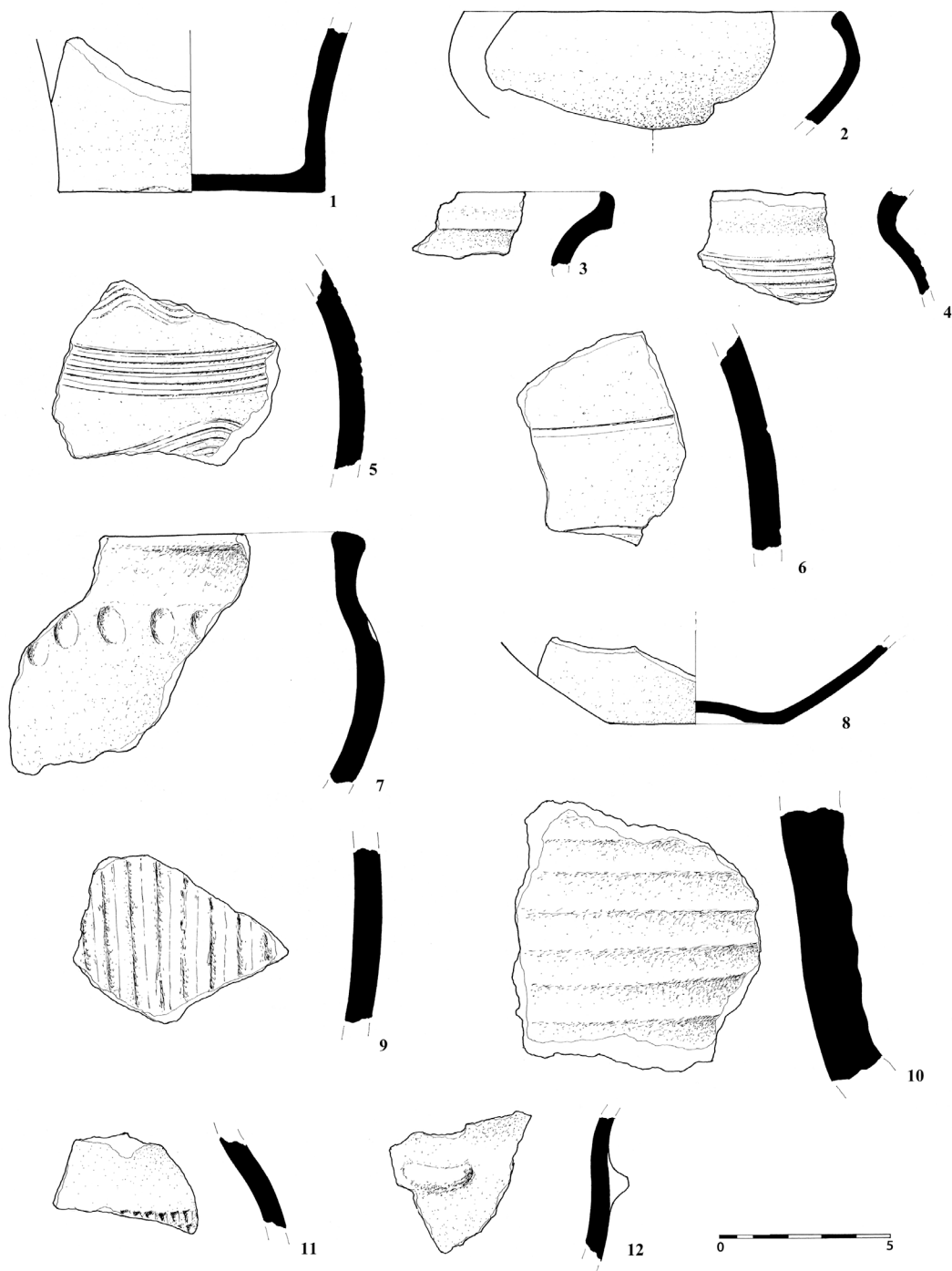


Fig. 5: Selection of material collected at Kalvariija in 2011.

Material dated to the Late Iron Age (LIA) was recorded at nine sites included in the field surveys. The sites include Staro Groblje (10), Kalvariija (11), Sv. Mihovil (12), Kovači (13), Srednje Brdo-Centar/Centre (15), Srednje Brdo-Jug/South (16), Bečka-Jug/South (19), Bečka-Istok/East (20), and Čopinac (21). Pottery that can be connected with the LIA mostly includes standardized grey fine ware made on the potter's wheel. The finds include fragments of bowls with an everted

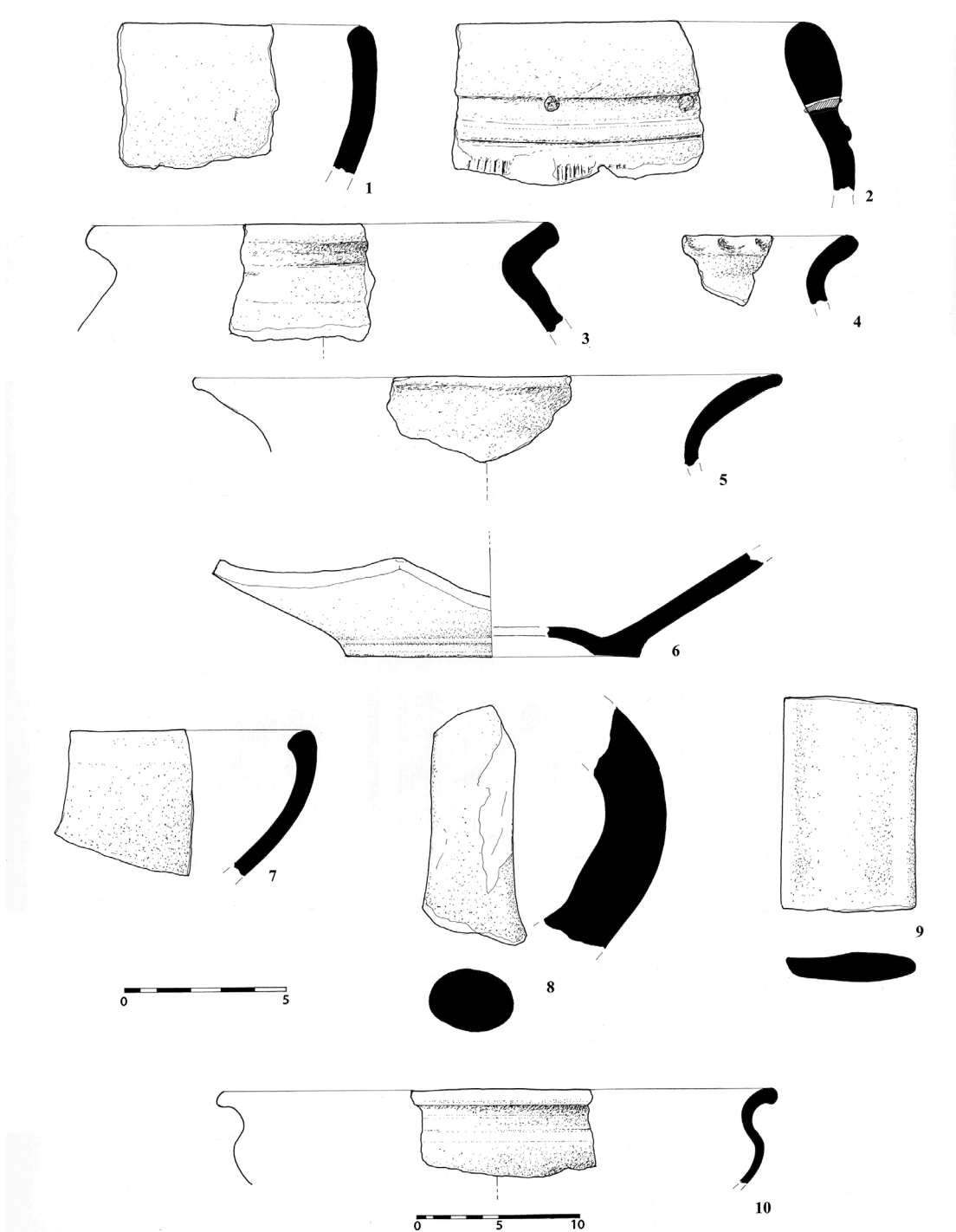


Fig. 6: Selection of material collected at Kalvarijska in 2011.

rim (**Fig. 3:8, 6:10, 8:8**) or a slightly inverted one (**Fig. 4:12**), jugs with ribbon-like handles (**Fig. 4:14, 6:9**) or oval ones (**Fig. 6:8**), and pots (**Fig. 3:9, 14, 6:2**) that have been discovered at La Tène settlements throughout the region, e.g. at the sites of Privlaka and Orolik (DALIĆ 1998). LIA sites in the surrounding area include those at Berok, Borovo, Petrovci, Svinjarevci, Sotin, and Vukovar (BUNČIĆ 2007, 67).

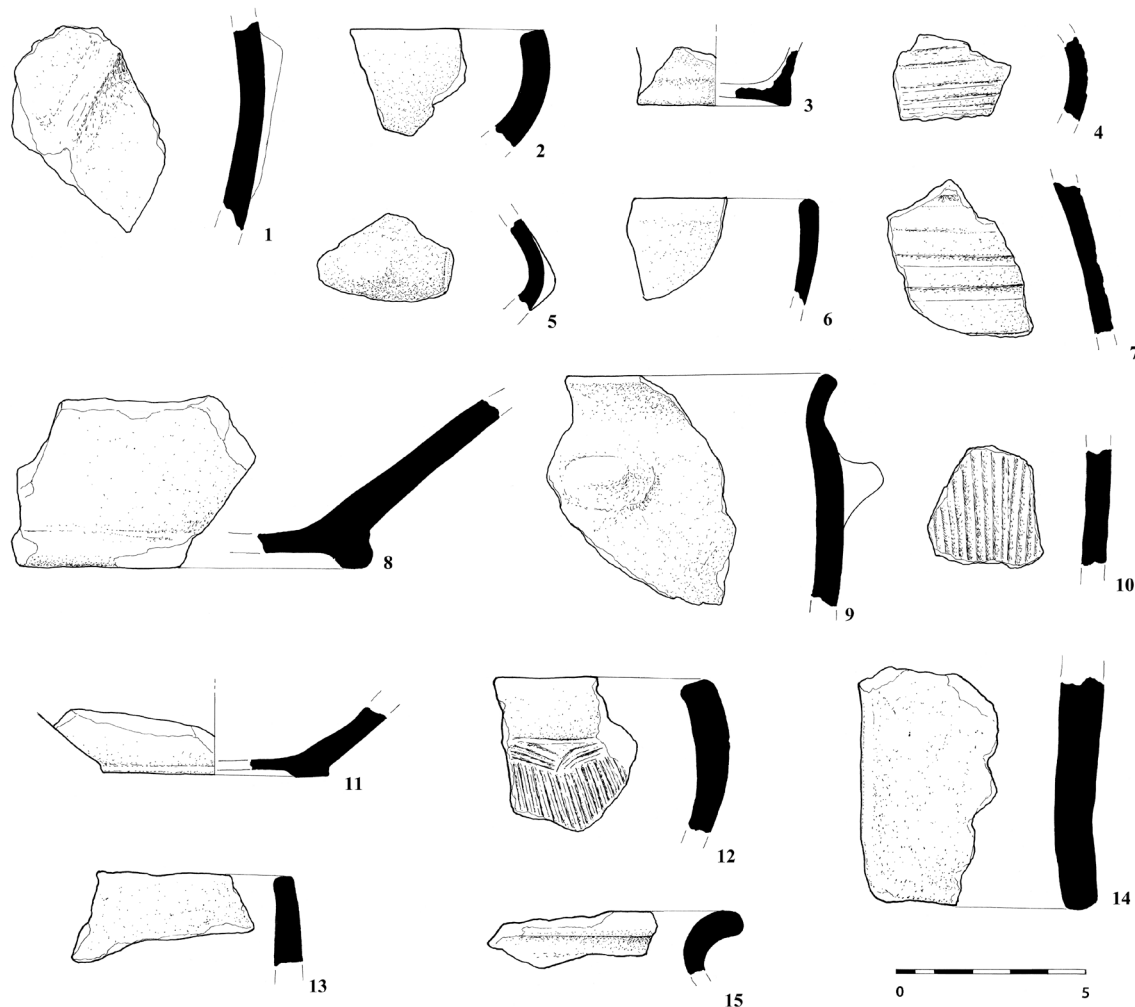


Fig. 7: Selection of material collected at Staro Groblje in 2011.

Material that displays both LIA and Roman characteristics was discovered at nine sites, namely at Šljivici (7), Staro Groblje (10), Kalvarija (11), Sv. Mihovil (12), Kovači (13), Orašje (18), Bečka-Jug/South (19), Bečka-Istok/East (20), Čopinac (21). The most problematic vessel form that made it difficult to classify this pottery is the S-shaped bowl (**Fig. 3:8, 6:10, 7:15, 8:8**), which is sometimes decorated with horizontal lines made by a thin stick or some other thin object. Such vessels were used from the 3rd century BCE until the second half of the 4th century AD (OŽANIĆ ROGUJIĆ 2009, 81). In La Tène contexts, analogous examples were discovered at Dirov Brijeg, Ervenica, and Damića Gradina (DIZDAR 2001, 58, 63, pl. 8:7, 9:3, 10:5, 13:4, 15:2, 16:1-2, 19:1, 21:1-3, 25:4, 28:4, 34:2, 37:2), Gradina near Orolik (MAJNARIĆ-PANDŽIĆ 1970, 55-56, fig. 53:3, 54:2; MAJNARIĆ-PANDŽIĆ 1996, 260, fig. 3:1-2, 4, 7, 9, 12-13, 16-18, 34, 36, 49-50), Gradina in Privlaka (MAJNARIĆ-PANDŽIĆ 1984a, 25, pl. 3:1), Ivanovci Gorjanski-Palanka (DRNIĆ 2007, 170, pl. 4:1-7), Donji Grad in Osijek (BULAT 1977, 18-19, pl. V:1-3, 7), Vukovar (MAJNARIĆ-PANDŽIĆ 1970, 52, pl. 50:6, 51:3-4), and Ciglana-Zelena polje in Osijek (DRNIĆ – SKELAC 2008, pl. 2:1-10). In the early Roman period, this type of vessel appeared in several variants, but still displayed strong local La Tène influences that can be seen in the form and mode of production (TODOROVIĆ 1974, 66; ŠARANOVIĆ-SVETEK 1981, 24; BRUKNER 1981, 91, pl. 77; OŽANIĆ 2004, 78, 79; DRNIĆ 2007, 171).

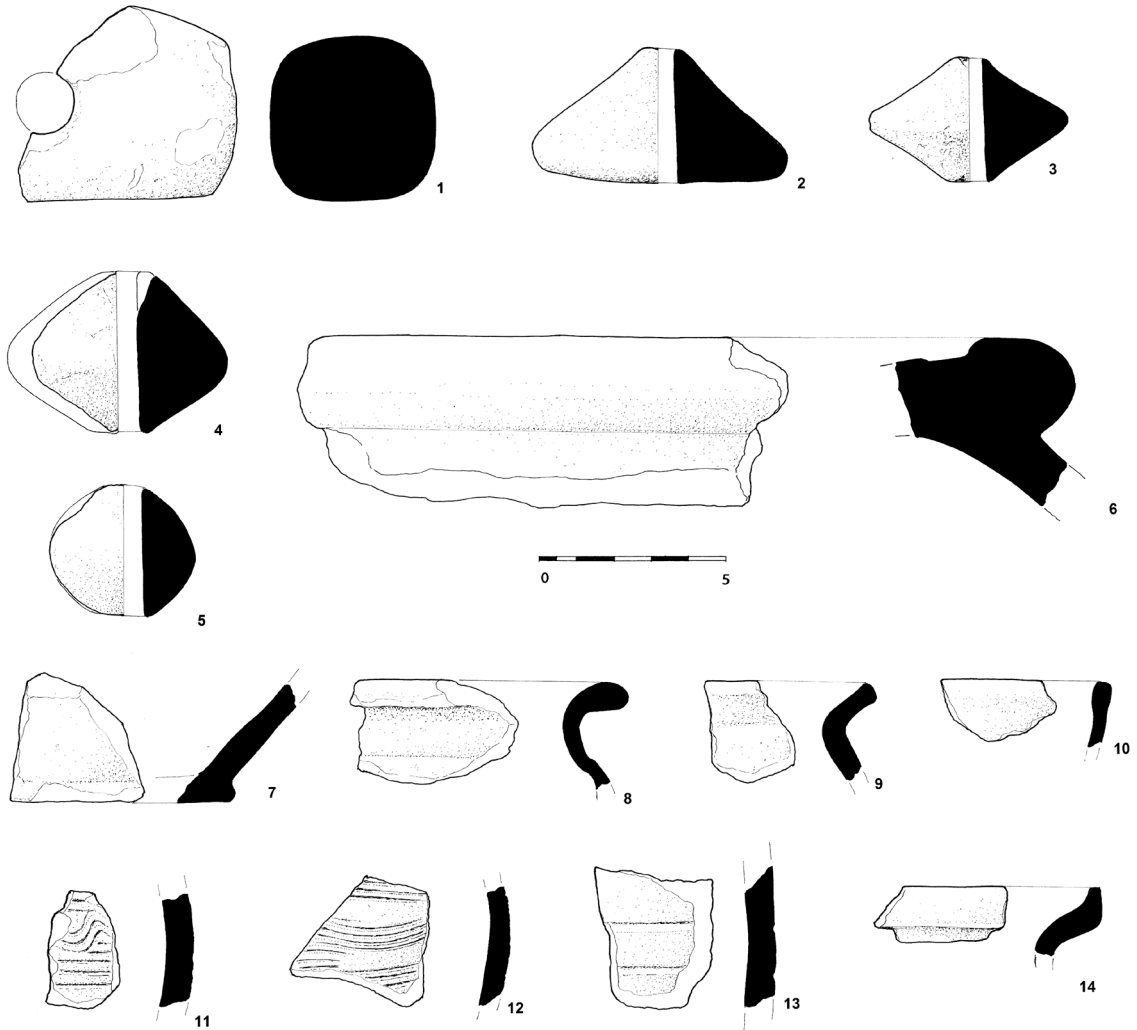


Fig. 8: Selection of finds collected in the Lovas Municipality in 2018. 1 - Sv. Mihovil; 2-5 - Kovači; 6-14 - Šljivici.

In Vinkovci, the use of the type was dated to the 1st-2nd century AD (ŠARANVIĆ-SVETEK 1981, 24). In Srijemska Mitrovica, it was discovered both in the oldest Roman layer and in the layer associated with the Flavian period (BRUKNER 1982/1983, 19, pl. III:3; BRUKNER 1987, 31, pl. 25:2-7). Phase VIc of the settlement at Gomolava, dating to the 1st century AD, contained similar vessels (JOVANOVIĆ - JOVANOVIĆ 1988, appendix 5, 13; BRUKNER 1992, pl. 10). At Liskovac, such vessels were dated to the second half of the 1st century AD (OŽANIĆ ROGULJIĆ 2009, 79, pl. 8:19, 9:20, 10:5, 16:6, 18:9, pl. 24, 26, 27), while examples from Ruma, Šimanovci, and Srijemska Mitrovica in Syrmia were dated to the 1st century AD (BRUKNER 1995, 100-103, pl. XIX:192, XXII:224).

Roman pottery was recorded at 11 sites, namely Staro Selo (4), Šljivici (7), Orlinac (8), Gradac (9), Kalvarija (11), Sv. Mihovil (12), Kovači (13), Srednje Brdo-Jug/South (16), Orašje (18), Bečka-Jug/South (19), and Čopinac (21). Finds mostly include handmade and poorly-fired coarse pottery, as well as fine ware produced on the potter's wheel. Vessel types include dolia, i.e. vessels used to preserve/store firm and liquid food, such as the find from Šljivici (7) (Fig. 8:6). Other than dolia, the finds include fragments of pots (Fig. 8:11), the shape of which

resembles prehistoric production and which can, therefore, be dated to the period between the middle of the 1st century AD and the middle of the 2nd century AD (JELINČIĆ 2015, 132–133). Decorations, in the form of wavy and straight lines made by a thin stick or some other sharp tool, were recorded on finds from Šljivici (7) (**Fig. 8:11–12**) and Kalvarija (11) (**Fig. 5:4–5**).

THE MEDIEVAL PERIOD AND THE MODERN AGE

Medieval archaeological remains were discovered at 15 sites, namely Brzovac (2), U Mjestu (3), Staro Selo (4), Šljivici (7), Staro Groblje (10), Kalvarija (11), Sv. Mihovil (12), Kovači (13), Srednje Brdo-Jug/South (16), Kavane-Sjever/North (17), Orašje (18), Bečka-Jug/South (19), Bečka-Istok/East (20), and Čopinac (21). This mostly includes coarse ware with quartzite inclusions, decorated with a series of horizontal lines made by a wheel, or a series of more-or-less wavy lines (**Fig. 4:8, 5:6, 8:13**) and/or wavy lines. The most common form at Brzovac (2), Staro Selo (4), Šljivici (7), Sv. Mihovil (12), Orlinac (8), Kalvarija (11), Kavane-Sjever/North (17), Orašje (18), and Kovači (13) is the late-medieval cooking pot with rounded body and everted profiled rim (**Fig. 5:1 and 3, 6:3, 8:9 and 14**). In addition to the vessel form, most decorations also suggest that the pottery should be dated to the late Middle Ages (**Fig. 4:7–9, 5:6, 7:4, 8:13**). However, motifs such as bundles of straight horizontal lines and comb-like wavy lines appear from the 8th century. Therefore, the finds from Šljivici (7) (**Fig. 8:13**) and Staro Groblje (10) (**Fig. 7:7**) and Kalvarija (11) (**Fig. 5:6**) could also be dated to the earlier phases of the Middle Ages (TKALČEC 2016, 55, fig. 11).

Modern Age material was discovered at 10 sites, namely Staro Selo (4), Šljivici (7), Staro Groblje (10), Kalvarija (11), Sv. Mihovil (12), Kovači (13), Srednje Brdo-Jug/South (16), Orašje (18), Bečka-Jug/South (19), and Čopinac (21). Certainly, the most interesting Modern Age finds are two ceramic pipes discovered at Čopinac (21) (**Fig. 2:14, 15**). The pipes can be ascribed to the eastern (i.e. Mediterranean) type, with a larger bowl and a smaller shank, and can be dated to the 19th century (ĐUKIĆ 2017, 324–326).

TRIAL EXCAVATIONS

One of the goals of the LAP is to determine the state of preservation of individual sites discovered during the field survey, as well as to determine the potential for future systematic excavations. In order to examine individual sites, test trenches of smaller dimensions were opened at different locations at several sites. The sites of Kalvarija (11) and Staro Groblje (10) were examined in 2011. In 2017, test trenches were opened at Orlinac (8) and Kovači (13). Excavations at Kovači (13) continued in 2019, as the 2017 excavations determined that the site might have potential for future systematic excavations. In 2020, a test trench was opened at U Mjestu (3), in Vladimir Nazor Street.

KALVARIJA

Five trenches were opened at Kalvarija (11) in 2011. The trenches, covering a surface of 55 m², were opened on the northern edge of the plateau, located next to the Čopinac stream. Archaeological material collected from the test trenches opened at Kalvarija dates to a variety of different periods, namely the Neolithic, the Copper Age, the Bronze Age, the Iron Age, and the Medieval period. Unfortunately, the trenches did not yield any direct evidence of preserved vertical stratigraphy, and it seems that archaeological layers were destroyed prior to the excavation through agricul-

tural and building activities. Excavation documentation from 2011 suggests that undisturbed stratigraphical relations were discovered in the southernmost Trench 3. Therefore, it was suggested that preserved stratigraphic relations might be found towards the south of the plateau.

However, the re-evaluation of pottery retrieved from Trench 3 does not allow for such a conclusion. Although Trench 3 contained mostly Bronze Age pottery, even the deepest layers in the trench yielded evidence of contamination with later material. Unfortunately, the southern part of the plateau has not been examined through test trenches yet, largely due to problems with the acquisition of an excavation permit for the plots. A more detailed examination of Kalvarijsa is planned for the forthcoming seasons.

STARO GROBLJE

Two trenches were opened at Staro Groblje (10) in 2011, covering a surface of 27 m². The trenches were opened on the northern part of the plateau. Similar to Kalvarijsa (11), excavations in the two trenches did not reveal any evidence of undisturbed stratigraphy. Bronze Age, Roman, and Medieval pottery fragments, as well as human skeletal remains, were discovered in the trenches. In Croatian, the name Staro Groblje means 'Old Cemetery'. Therefore, the discovery of the human skeletal remains is not surprising. However, it seems that graves might have also been destroyed by agricultural activities in more recent times.

ORLINAC

Orlinac (8) is located just to the south of Staro Groblje (10), on the same loess plateau. Together, they make up the same entity within the landscape. There were three main reasons why test trenches were opened at Orlinac in 2017. First, the site produced significant quantities of surface finds during the 2011 season. Second, we believed that, by examining Orlinac, we could get a more complete insight into the state of preservation of layers at the plateau on which both Staro Groblje and Orlinac are located. Third, the results of the 2011 excavations at Kalvarijsa (11) suggested that preserved archaeological layers might be found further away from the edges of the plateaus. As Orlinac is located more towards the centre of the plateau than Staro Groblje, we hoped that opening test trenches in this area might uncover undisturbed archaeological layers.

Three smaller test trenches were opened at Orlinac in 2017, covering a surface of 18 m². The trenches were opened in the part of Orlinac which produced the highest density of surface finds during the 2011 field survey. Similar to the results of research at Staro Groblje in 2011, the trenches did not yield abundant evidence of preserved stratigraphy. Trench 3 contained pottery dated to the Bronze Age, LIA-Roman period, Medieval period, and Modern Age. Pottery was mixed with contemporary rubbish. A similar situation was encountered in Trench 1, which also produced a piece of pottery that could potentially be dated to the Neolithic or the Copper Age. Unfortunately, the layers within this trench were also heavily disturbed by recent agricultural activity. Several pits cut into the bedrock were discovered, but all of them seem to be of recent creation.

The only preserved archaeological contexts in Trench 1 were two 17th–18th century AD graves. They confirm that the cemetery extended beyond the borders of the position known today as Staro Groblje ('Old Cemetery'), and probably continued further to the south. The individuals found in both graves must have been buried in wooden coffins, as suggested by the high number of discovered iron nails. However, the coffins completely disintegrated over time, leaving a barely visible trace in the soil. Grave 1 contained a burial of an adult male individual. He was put on his back with his head towards the northeast. His left arm was put on his stomach,

while his right arm was laid straight, next to the body. Grave 2 contained a burial of an adult female individual (**Pl. 3/1:1**). She was laid on her back, with her head oriented towards the southwest. Her arms were laid on her stomach. In her hands, she held a bronze cross and two beads, all of which must have belonged to the same religious object.

An additional preserved archaeological context was discovered in Trench 3, where a part of a large pit or a ditch was unearthed (**Pl. 3/1:2**). The pottery discovered in the fill of the feature dates mostly to the LIA–Roman period transition, although some Bronze Age sherds were also discovered. Therefore, the structure probably dates to the LIA–Roman period, while Bronze Age pottery represents residual material. It should be noted that the appearance of residual Bronze Age pottery is not surprising considering the fact that significant quantities of it were found in other trenches at Orlinac.

KOVAČI

The site of Kovači (13) ('Blacksmiths' in English) was discovered during the field survey in 2011. In 2017, the material collected at Kovači in 2011 was studied and the site was revisited. Both the density of surface finds and their wide spatial distribution suggested that Kovači was one of the largest archaeological sites in the Lovas Municipality. Consequently, we decided to open a test trench at the site. The test trench opened in 2017 was located on the highest point of the site, which also displayed the highest density of surface finds. Unfortunately, all cultural layers in this trench were found disturbed. The Copper and Bronze Age (Middle and Late) layers were destroyed by building activities in the LIA, which is common at settlement sites in Syrmia, both in Croatia and Serbia. The LIA layers were disturbed by ploughing. The only preserved archaeological structures were several waste pits of different sizes, dug into the bedrock. However, large pieces of wattle-and-daub, as well as destroyed pieces of house floors, attest to the existence of earlier, prehistoric houses at the site. Copper Age pottery fragments were connected with the Baden (3600–2800 BCE) and Kostolac (3250–3000 BCE) cultures (e.g. **Fig. 9:4** and **6–9, 10:1**). Other fragments indicated intense use of the site in the MBA (e.g. **Fig. 9:1, 10:3** and **10, 11:2**) and early LBA (e.g. **Fig. 11:10**), namely the Belegiš I (1700–1300 BCE) and Belegiš II (1300–1100 BCE) cultures.

In order to determine the degree of site destruction, in 2019, we conducted a geophysical survey and opened several test trenches at the site. The geophysical survey managed to detect a large number of prehistoric pits, as well as the remains of a possible prehistoric house. We also opened four test trenches in different parts of the site, two on the northern and eastern slopes of the site, and two in the central part of the plateau. In three out of four trenches opened in 2019, the cultural layers were destroyed by later activities. Nevertheless, in the majority of cases, the disturbance was too deep to be attributed to modern activity, especially because the examined fields have been almost completely abandoned for the last 30 years, and have, consequently, been untouched by modern heavy machinery. The absence of Medieval pottery in the disturbed layers, and the relatively low level of fragmentation of LIA vessels, as well as the appearance of Roman sherds in some disturbed layers and their complete absence in others, suggest that the heavy disturbances at the site most probably happened in the transition period between the LIA and the Roman period. However, it is highly unlikely that all of them resulted from a single large intervention at the site.

In all of the trenches with deep disturbed layers, we encountered prehistoric pits cut into the bedrock. Some of them were simple rubbish pits, while others were quite large. They did not contain much material, and might have served as working structures. The trench opened in the central part of the plateau in 2019 produced preserved MBA and Copper Age contexts. In the forthcoming years of the project, the settlement site at Kovači will become the focus of LAP.

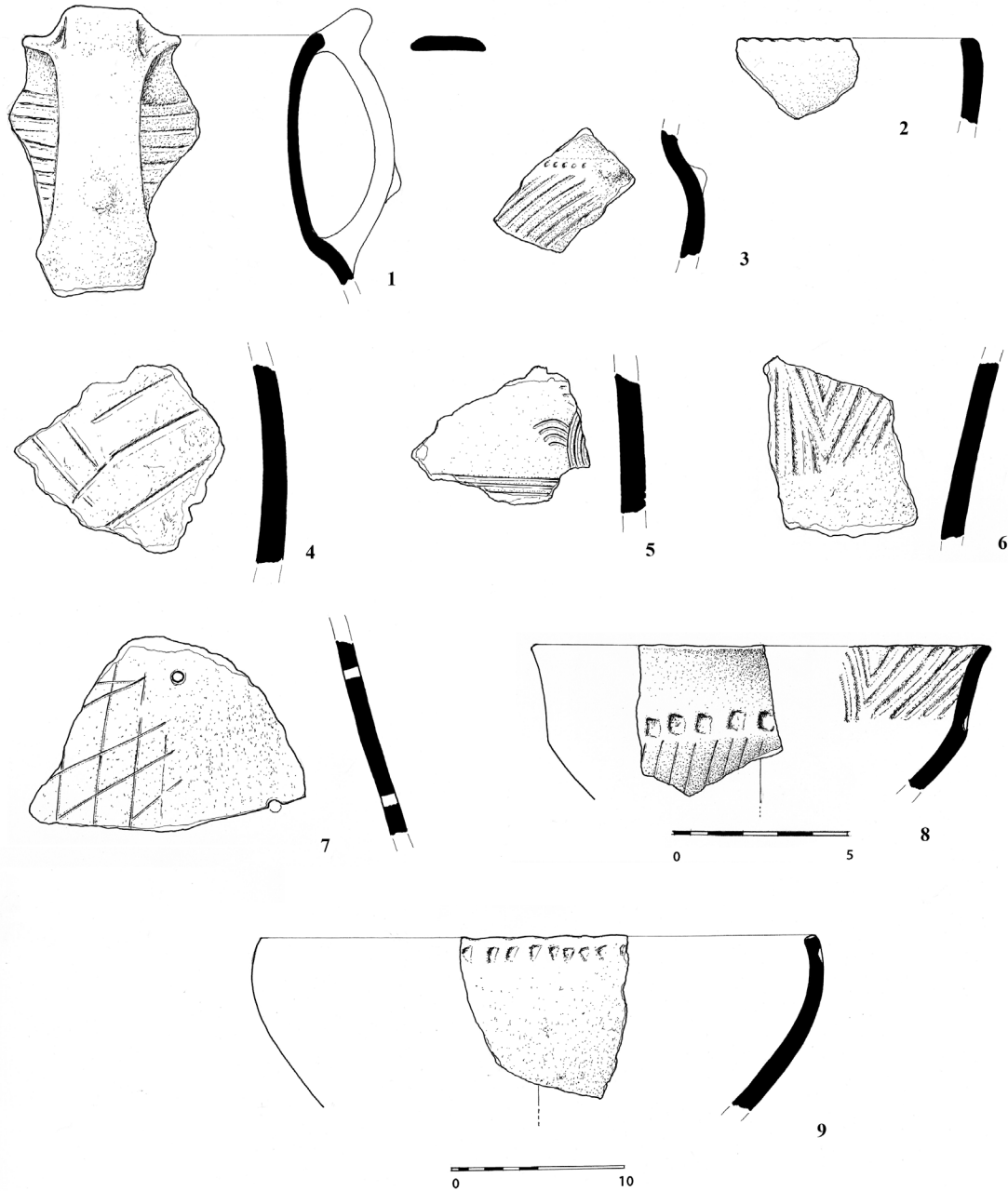


Fig. 9: Selection of pottery fragments uncovered during the 2017 excavation at Kovači.

A BRIEF NOTE ON PREHISTORIC HABITATION PATTERNS IN THE LOVAS AREA

As already noted earlier in the text, sites in the Lovas Municipality were mostly located on the edges of loess plateaus near the streams of Čopinac, Bečka, and Badnjara. Interestingly, most of the prehistoric sites exhibit similar habitation patterns. Many of the sites usually contain Copper Age, MBA, and LIA material, which suggests that patterns in the creation of settlements and landscape use were similar in all three mentioned periods. In some cases,

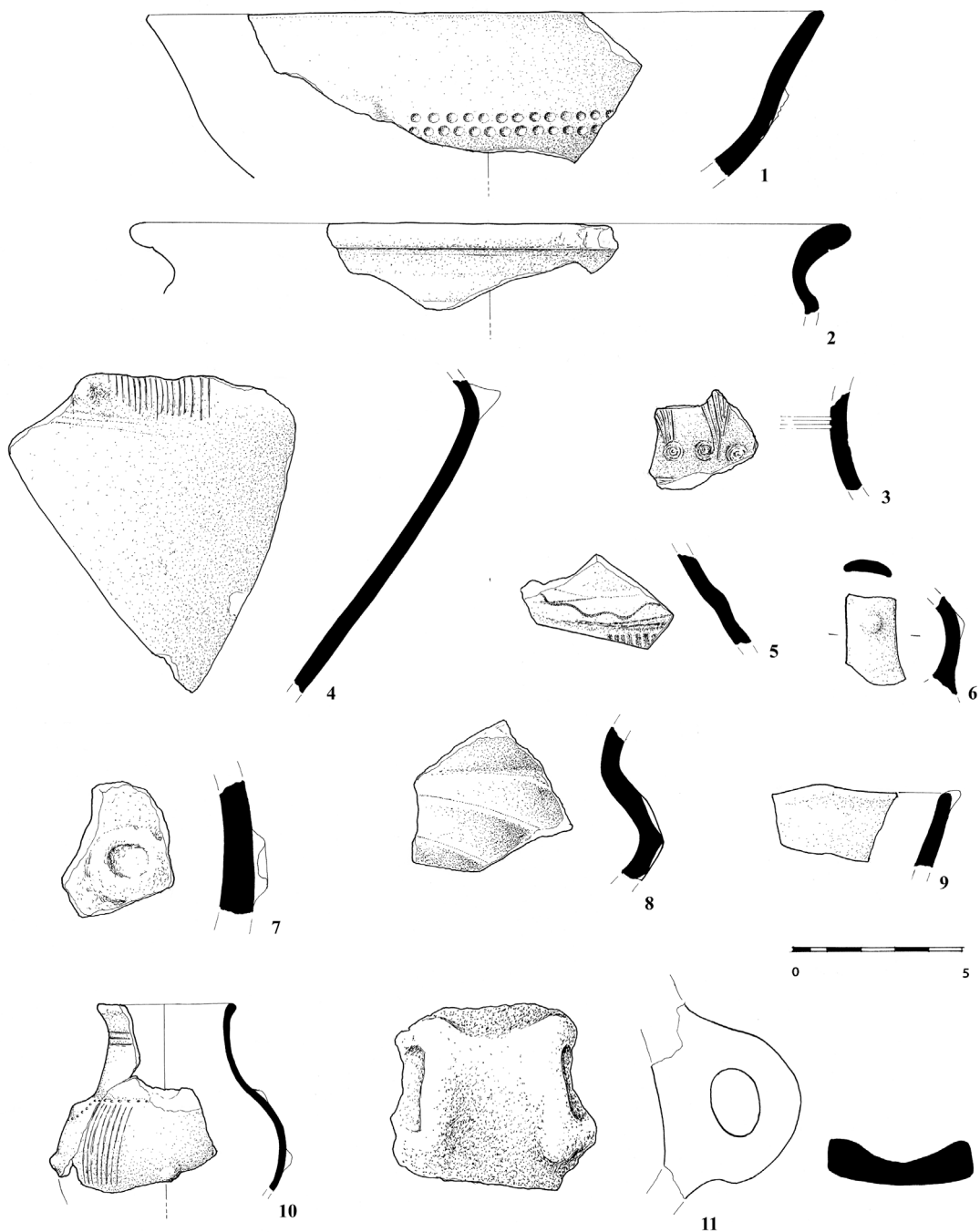


Fig. 10: Selection of pottery fragments uncovered during the 2017 excavation at Kovači.

early LBA pottery was also found on the surface, suggesting that some of the sites continued to be used in the transition between the MBA (later phase of Belegiš I; 1500–1300 BCE) and the early LBA (Belegiš II; 1300–1100 BCE). In this context, the sites of Kovači (13) and Čopinac (21) should receive special attention. According to the cultural and chronological analysis of the material collected during the systematic field surveys, the 2017 excavations conducted at

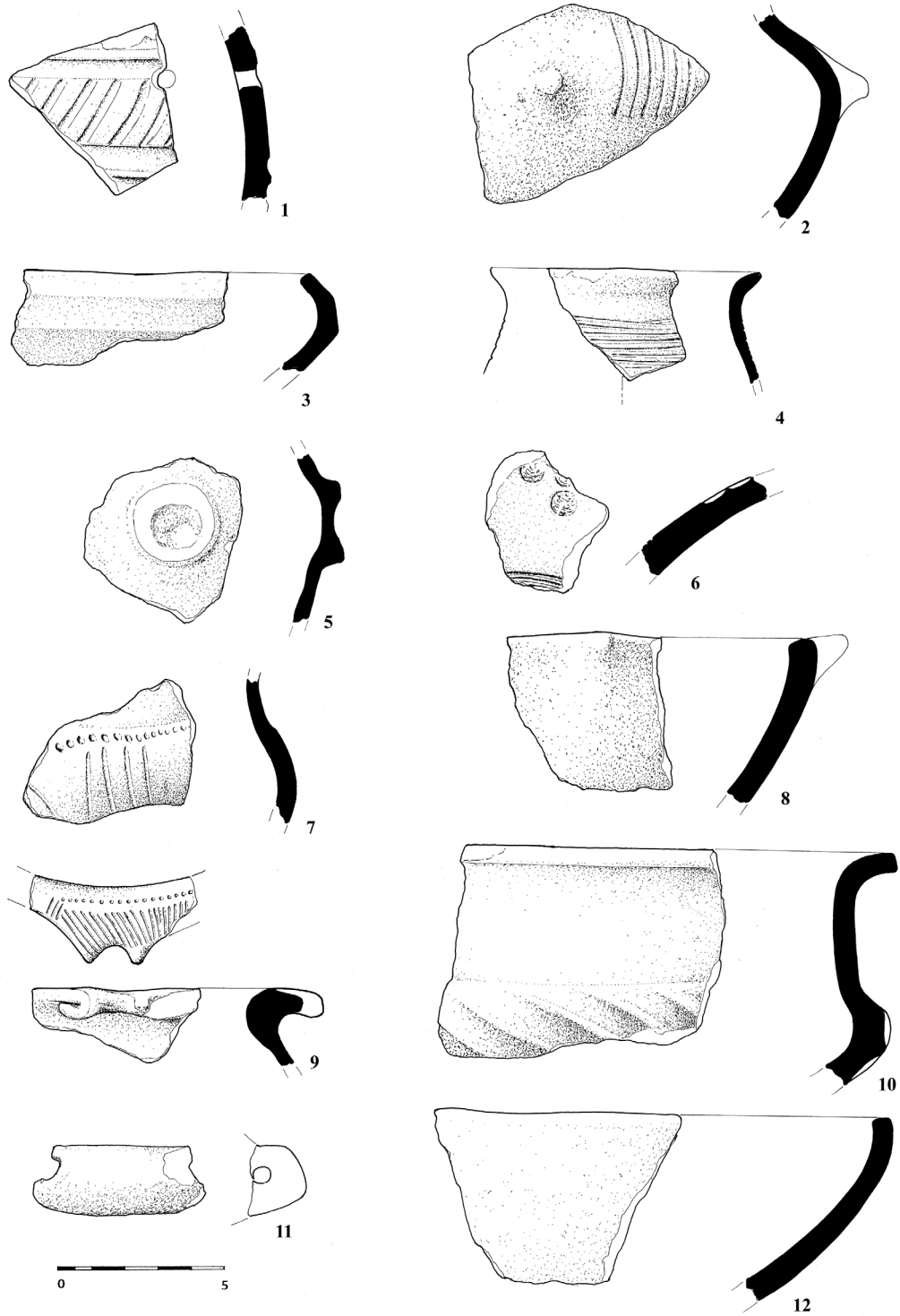


Fig. 11: Selection of pottery fragments uncovered during the 2017 excavation at Kovači.

Kovači (13), and earlier chance finds,⁴ it seems that there were probably two large MBA settlements (the period of Belegiš I cultural group) in the area of the Lovas Municipality: one at Kovači (13), and the other at Čopinac (21).

The wide spatial distribution of finds from the same periods poses questions on how the landscape was used in the wider area of the Lovas Municipality throughout history. The archaeological topography of the Lovas Municipality suggests several interpretations. One possibility is that the location of settlements from the same period (e.g. the Copper Age, MBA or LIA) changed several times, thereby causing such a wide distribution of finds. Another option is that there was no central settlement with a high frequency of structures, but rather that potential structures were widely distributed across the landscape in smaller or larger groups. A third option is that certain surface finds reflect traces of seasonal or sporadic activities, and not more permanent settlements. Future research in the Lovas Municipality will certainly broaden our knowledge on settlement patterns throughout different periods of the human past in the area. However, from the current state of research, it seems highly unlikely that a large central place existed in the Lovas Municipality in the Copper Age, MBA, or LIA.

An important problem regarding the formation of settlement patterns in the Lovas area during prehistory is certainly posed by the later LBA and EIA sites (dating after 1100 BCE). Sites of these two periods are the least represented, if represented at all. Although earlier reports mention EIA settlements and necropoleis in the area of the contemporary villages of Lovas and Opatovac (see overview in BUNČIĆ 2007, 46), material remains retrieved during the 2011 field survey and the 2020 test trenches in the area of the village of Lovas did not yield any evidence of significant habitation either in the later phase of the LBA or in the EIA. Considering the fact that archaeological remains ascribed to these two periods are almost completely absent at other sites, it seems likely that there was a certain shift in settlement patterns and other activities in the landscape at the transition from the LBA into the EIA.

There are two possible explanations for the change in the settlement patterns in the later stages of the LBA. The first option is the possible decrease in the size of the population, which lasted during the later phase of the LBA and the entire EIA. The second option is that a certain settlement nucleation occurred in the later phase of the LBA and in the EIA. More precisely, the use of several locations dispersed throughout the landscape might have been replaced by the creation of a (single?) central settlement. Unfortunately, in both cases, potential settlements dated to the later phase of the LBA and EIA might have been located below modern villages, which hinders further examination of this research question at the present moment.

ANALYSES AND SAMPLING OF ARTIFACTS FROM THE LOVAS AND VUKOVAR HOARDS

CONTEXTUAL DATA

The MBA Lovas hoard was discovered in October 1939. According to the original report, it was ploughed out from the soil by Mr. Zdravko Plašćević while working in his field. The exact location and circumstances of the discovery remained unknown for years. However, the City Museum in Vukovar keeps a record of Mr. A. Dorn, who mentions the 'plot of Zdravko Plašćević' at Gradac (9) as one of the known archaeological sites in Lovas. However, the use of the Gradac (9) toponym in Lovas is somewhat problematic, since it is used to describe different

4 A small ceramic amphora (VINSKI 1958, pl. IX: 6).

locations and is a common term for the locations of Kalvarija (11), Orlinac (8), and Staro Groblje ('Old Cemetery') (10), all confirmed archaeological sites (see discussions in BUNČIĆ 2007, 46; ĐUKIĆ – FRANKOVIĆ – MIHELIĆ 2020, 185–186). According to the information provided by the local inhabitants in 2011, 2019, and 2020, the team learned that the hoard was most probably discovered at a location called Čajer (5), located on yet another elevated position west of the village of Lovas. Čajer (5) is not adjacent to Gradac (9), which was originally thought to be the location of the discovery. It seems that the hoard was originally discovered on the land of the Rimar family. During the field survey in 2011, fragments of Bronze Age pottery were found at Čajer (5). Interestingly, the MBA settlement at Kovači (13) is located on the same plateau, but some 1.5 km to the north. Although bronze objects were rarely found in trenches opened at Kovači (13), their date and type somewhat resemble the objects discovered in the Lovas hoard.

A similar hoard dated to the MBA, but not as rich in deposited bronze objects, was discovered in the city of Vukovar. It was found in Mala ulica ('Little Street') in Vukovar at the end of the 19th century. In 1897, the hoard was acquired by Josip Brunšmid, the then director of the Archaeological Museum in Zagreb. The circumstances of its discovery remain unknown. Therefore, it is quite possible that it contained more objects than are known today.

The Lovas hoard (see VINSKI 1958) contained numerous artifacts made out of copper alloys (see **Fig. 12**), namely 409 tutuli, 6 round pendants, 2 horn-shaped pendants, 4 coiled hair rings, 8 double spiral rings, 2 double spiral armrings, 2 double spiral bracelets, 2 coiled wire bracelets, 2 coiled sheet armrings/greaves with a central rib, 2 tweezers, a decorated coiled sheet, a flanged axe, a dagger with four rivets (two of them preserved), 25 fragments of plano-convex pieces of raw copper. The hoard also contained 22 specimens of gold coiled wires and a ceramic vessel of the kantharos type. The less diverse Vukovar hoard (see VINSKI 1958) contained 155 tutuli and 1 round pendant made of copper alloy, as well as a ceramic vessel of the kantharos type. Both the Lovas and Vukovar hoards are currently displayed in the permanent exhibition of the Archaeological Museum in Zagreb.

ANALYTIC DATA

Both mentioned hoards were a subject of scientific examination in late February and early March of 2020, as a part of the LAP. At this point, we would like to present a brief report on the archaeometallurgical research conducted, as well as present some conclusions and plans for further research. However, it should be noted that research is still ongoing and the following discussion presents only the preliminary results of our research.

Unfortunately, some of the artifacts from the Lovas hoard published by Vinski (1958) could not be located anymore, and seem to have been lost since the 1950s. The missing objects are: 1 plano-convex piece of raw copper (inv. no. P-9994-26), 1 double spiral ring (inv. no. P-9969), and 12 tutuli (inv. nos. P-9990-1 to P-9990-12). All of the available objects were subjected to basic documentation (measuring of weight and dimensions), a visual survey and surface elemental composition analysis with pXRF (portable X-Ray fluorescence) spectrometer. Selected artifacts were sampled for a further advanced analysis (ED-XRF, ICP-MS, metallography; see more details below).

To capture the elemental composition of all metal artifacts, they were individually analysed by a handheld pXRF spectrometer Olympus DELTA Professional under the following conditions: Rh X-ray tube, mode Analytical Plus, measuring time 30–80s, collimator 8 mm, automatic evaluation of spectra. A total of 681 analyses by pXRF have been conducted so far. Some of the artifacts were measured on more than one spot to better characterise their different parts. The pXRF measurement was performed on the surface of artifacts without any

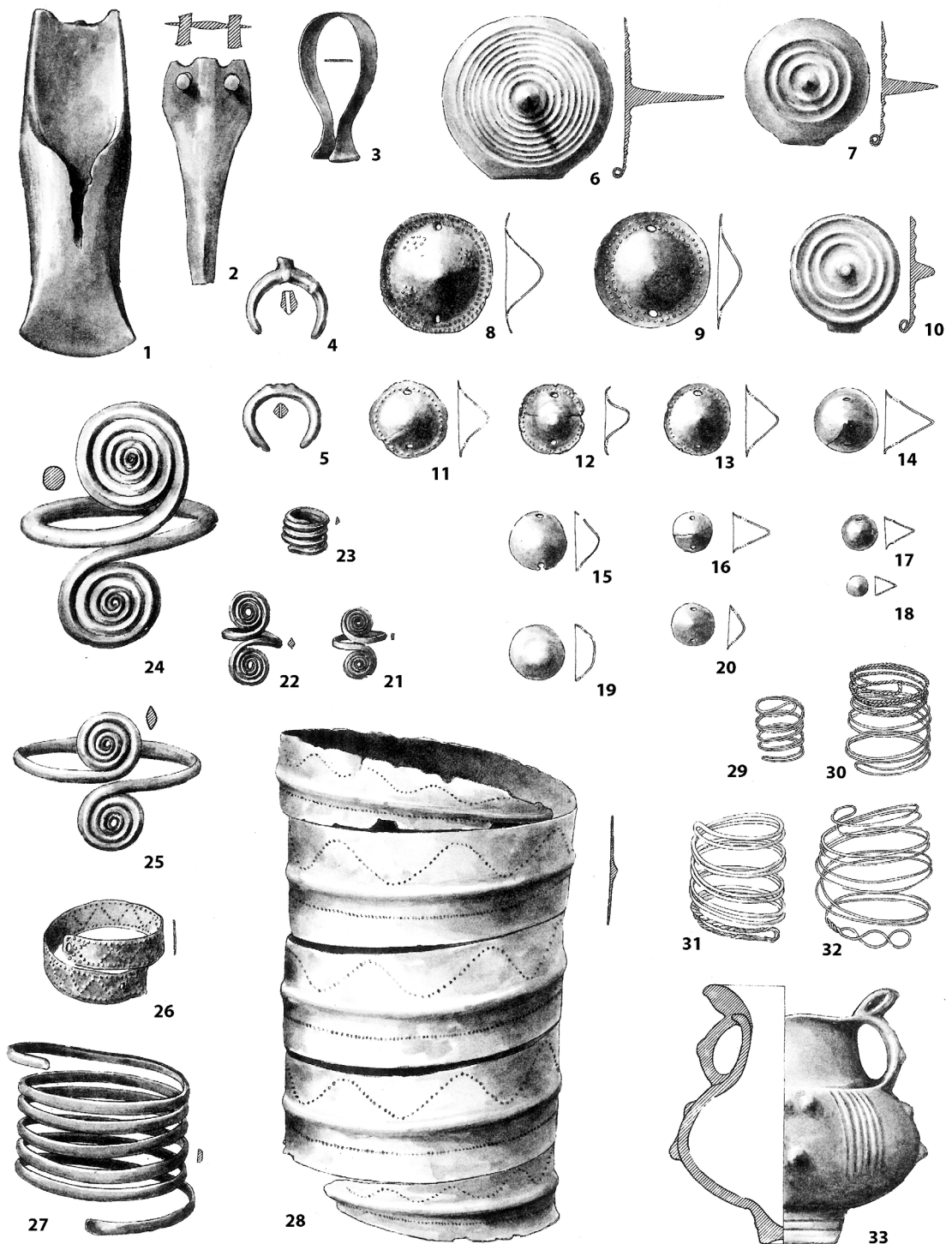


Fig. 12: Drawings of some of the finds discovered in the Lovas hoard (modified after BENAC 1983, pl. LXXV).

preparation (e.g. cleaning on the metal core level). It is therefore necessary to consider the influence of post-deposition processes (corrosion, impurities on surface) on the results and their interpretation (POLLARD – BRAY 2014). While the results from pXRF analyses will be later on correlated with the ED-XRF analyses of metal core samples and other methods applied, the use of surface elemental composition analyses is justified and serves to record at least the approximate composition of all artifacts, including those which were not core sampled. The aim is to obtain a picture of the basic material characteristics for both of the hoards – namely, to determine the used technology (e.g. alloying, admixture elements), and to separate the artifacts into basic material groups for properly substantiated sampling. The pXRF analysis of the artifacts still needs to be conducted on the two tweezers and golden wires, which were not available during our initial examination in February and March of 2020. However, some preliminary conclusions about the material composition of the Lovas and Vukovar hoards can already be made now (see below).

Beside the surface pXRF measurements, a thorough archaeometallurgical investigation of the hoards will incorporate targeted analyses of samples taken from selected artifacts. Samples were taken by drilling with a 1 mm diameter drill bit with abrasion resistant TiN coating and are supposed to be used for elemental composition bulk analyses (ED-XRF) and provenance studies (the provenance of the used material and the geological characteristics of related ore deposits; see e.g. PERNICKA 2014), including trace elements analyses (ICP-MS), as well as Pb and Cu isotopes (MC-ICP-MS). Moreover, samples taken by clipping or cutting of a compact piece of metal will be subjected to metallographic examination (see SCOTT 2011) in combination with observation by optical and scanning electron microscopy with EDS. This method focuses on examining the microstructure of the metal that can reveal manufacturing technology, as well as the mechanical and temperature treatment of artifacts.

PRELIMINARY RESULTS

The Lovas hoard offered a great variety of artifact types and samples were taken from 34 artifacts. Sampled were primarily fragments of 24 plano-convex pieces of raw copper (inv. nos. P-9994-1 to P-9994-25). Further samples were taken from the pair of double spiral armrings (inv. nos. P-9955 and P-9956; **Fig. 12:15**), the pair of double spiral bracelets (inv. nos. P-9957 and P-9958; **Fig. 12:25**), 2 double spiral rings (inv. nos. P-9965 and P-9966; **Fig. 12:20–21**), the dagger (inv. no. P-9979; **Fig. 12:2**), the axe (inv. no. P-9980; **Fig. 12:1**), and one pendant (inv. no. P-9985; **Fig. 12:5**). On the other hand, the Vukovar hoard consists of sheet tutuli only, with the sole exception of a cast pendant. For that reason, only one sample was taken by drilling from the said pendant (inv. no. P-1083).

As already noted, the other way of sampling was done with pliers by clipping small samples of sheet (dimension 2–4 mm) for metallography. This was conducted on 13 artifacts from sheet metal, namely 5 tutuli from the Vukovar hoard (inv. nos. P-1084-1, P-1084-5, P-1085-1, P-1085-3, P-1085-4), 7 tutuli from the Lovas hoard (inv. no. P-9988, P-9991-125, P-9991-160, P-9992-79, P-9992-134, P-9993-11, P-9993-17; **Fig. 12:7–8, 11–14, 17–19, 22–24**) and one coiled sheet armring/greave (inv. no. P-9954; **Fig. 12:28**) also from the Lovas hoard.

Visual survey of the artifacts revealed traces of previous sampling that can most probably be correlated with the analysis conducted for the SAM project (see JUNGHANS – SANGMEISTER – SCHRÖDER 1968). A total of seven artifacts from the Lovas hoard have a hole made by previous drilling (\varnothing 3 mm), filled now with green waxy material. Only three relevant results (connected with the above-mentioned dagger and a pair of double spiral armrings) were found among published data (JUNGHANS – SANGMEISTER – SCHRÖDER 1968, An. Nr. 8534–8536), but were

recorded under incorrect inventory numbers. There is also a possibility that other artifacts were sampled as well, but relevant published data were not found. For example, one tutulus (inv. no. P-1084-5) bears traces of recent cutting/clipping of material along the edge. The connection between previous sampling and the missing artifacts mentioned above is unknown.⁵

All relevant data from the archaeological and archaeometallurgical investigation of the Lovas and Vukovar hoards are to be published in a planned comprehensive monograph. For the time being, the analyses indicate that the artifacts from the Vukovar and Lovas hoards were made from copper alloy, namely tin bronze with an admixture of arsenic, antimony, nickel, lead, zinc, iron, and traces of cobalt and titanium (the presence of iron and titanium could partly be caused by soil impurities on the surface). It is certainly worth noting that the plano-convex pieces of raw copper display a completely different composition. Their tin content is very low (in most cases even under the detection limits of the instrument – ca. 0.03%), but other elements are present in higher concentrations in comparison to other artifacts. This suggests that these ingot fragments were not refined, and present unalloyed raw copper material with high amounts of impurities of dissimilar content (especially in the case of arsenic, iron, antimony and lead).

Through a comparison of the elemental composition acquired by surface pXRF measurements, we can compare the material of the Lovas and Vukovar hoards to each other (the plano-convex pieces of raw copper of specific composition aside). In general, tutuli and other artifacts from the Lovas hoard show quite a close correlation in composition (**Pl. 3/2:1**). However, there is a substantial difference between artifacts from the Lovas and those from the Vukovar hoard. The tutuli from Vukovar exhibit (except for a few examples) significantly lower amounts of antimony and arsenic. On the other hand, they have a higher amount of nickel in their composition (**Pl. 3/2:2**). The analysed hoards, although more-or-less contemporaneous, were apparently composed of material of different origin. However, more detailed conclusions and interpretations should not be based solely on the pXRF analysis of their surface. The given hypothesis will be tested by the further analyses mentioned above that will focus on metal supply in the MBA of Southeast Europe, the identification of the provenance of the used material, the applied manufacturing technology and other relevant implications.

CONCLUDING REMARKS

The aim of the LAP is to explore the habitation patterns in different periods of prehistory in the Lovas Municipality. While our general methodological approach focuses in equal measure on all prehistoric periods, as well as later periods of human history, the main periods of interest are the local MBA and early LBA. This is mirrored also in the major focus on the examination of sites which have produced evidence of intensive activity in the two named periods. Through the conducted field survey, planned geophysical survey and test trenches, we want to explore the formation of settlement patterns, landscape use, and the development of funerary landscapes. In the forthcoming seasons, we plan to continue the excavations of the settlement at Kovači (13), as well as to open test trenches at other large sites in the Lovas Municipality. Test trenches will be opened on the sites which will be covered by geophysical prospection in 2021, namely the sites of Bečka-Jug/South (19) and Bečka-Istok/East (20).

Furthermore, through the examination of individual sites we plan to provide a more detailed insight into the chronology of the MBA and early LBA in east Croatia, as well as to refine

5 It should be noted that, in contrast to all other artifacts, tutuli have no corrosion products on their surface, which is probably a result of chemical cleaning before sampling.

the pottery typology of both periods and anchor them better between Central Europe and the Balkans. Simultaneous examination of metal finds from both the Lovas and Vukovar hoards and of the metal finds obtained through excavations at some of the sites, might provide us with a better insight into the development of the MBA and early LBA metallurgy in the area. The project focuses also on the examination of other sets of data, such as zooarchaeological and archaeobotanical. We hope that such a holistic approach might shed new light on the rather unexplored MBA and early LBA periods in east Croatia. In our opinion, only through the detailed picture created through a bottom-up approach in individual micro-regions, can we hope to understand the formation of larger cultural phenomena.

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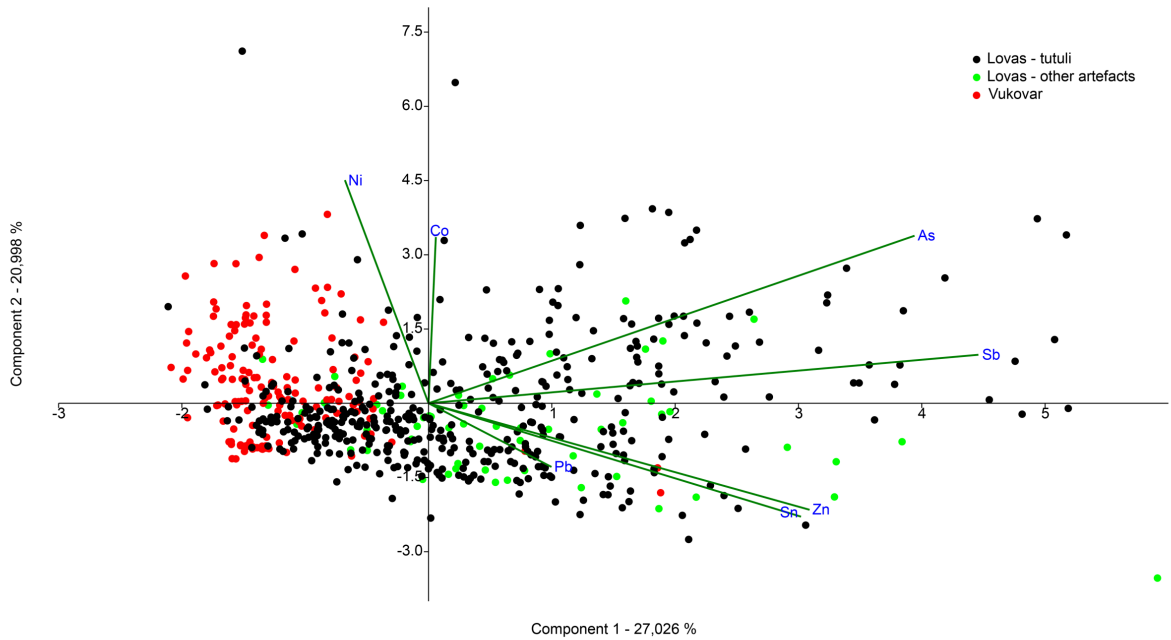


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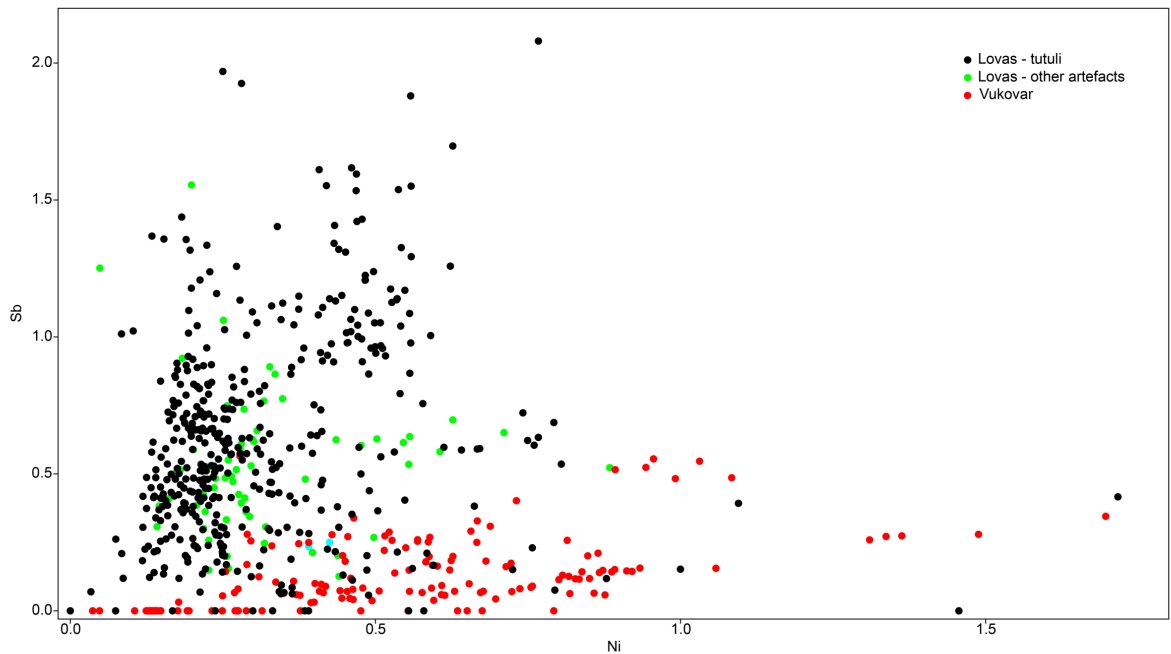


2

Pl. 3/1: Preserved archaeological contexts discovered during the 2017 excavation season at Orlinac. 1 - Modern Age burial of a woman; 2 - large pit/ditch dated to the Late Iron Age-Roman Period.



1



2

Pl. 3/2: 1 - A scatter plot of the PCA analysis of pXRF results (except for copper ingots); 2 - the XY graph of Sb Ni ratio of pXRF results (except for copper ingots).