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Revealing the "hidden" Pannonian and Central Balkan Mesolithic: new radiocarbon evidence from Serbia

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Abstract

With the exception of the well known Mesolithic sites in the Danube Gorges (or the Iron Gates), the wider areas of the Central Balkans and southern fringes of the Great Pannonian Plain still represent a *terra incognita* when it comes to the presence of Mesolithic communities. The absence of Mesolithic sites in the region was associated with environmental changes in the Early Holocene, presumed low human population densities, limited possibilities of detection, or the lack of adequate research. However, valuable insights into the obscure regional Mesolithic can be gained not only by new archaeological excavations, but also by revisiting and reanalysing of existing archaeological collections. Particularly informative in this respect are the Early Neolithic sites, indicative of the extensive spread of farming communities from c. 6200 cal BC. Within the ERC Project BIRTH, a large sample of human and animal remains from these sites was dated, falling in the (expected) range between c. 6200–5300 cal BC. However, one human and several animal bone samples from the sites of Magareći mlin, Gospođinci-Nove zemlje and Grabovac-Đurića vinogradi were dated to the 8th millennium cal BC, providing the first radiocarbon evidence of Early Holocene sequences in the territory of Serbia other than the Danube Gorges. In this paper, we present the new radiocarbon dates, discuss the contextual provenance of dated bones, and explore the implications of these results for a better understanding of the problem of the "missing" and "invisible" Mesolithic in the region.

Keywords: new radiocarbon dates, Early Holocene, Mesolithic, Early Neolithic, Great Pannonian Plain, Central Balkans

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1. Introduction

From the mid-1960s onward, the discovery of more than 20 open-air sites and caves in the Danube Gorges (or the Iron Gates) (Fig. 1) yielded unprecedented evidence of Early Holocene adaptations and lifeways in a specific, riverine environment (Radovanović 1996; Bonsall 2008; Borić 2011). Flowing through the southern Carpathian Mountains in the North-Central Balkans (between present-day Serbia and Romania), the Danube carved a passage in the form of several narrow gorges interspersed by river valleys. Particular features of the landscape, including the abrupt changes in the riverbed, numerous cataracts and strong whirlpools, provided optimal conditions for catching fish such as large migratory sturgeon (Bartosiewicz *et al*. 2008; Živaljević 2017). Initially frequented during the Early/Middle Mesolithic (c. 9700–7400 cal BC) as good fishing and hunting spots (and occasionally for the burial of the dead), the riverine terraces witnessed extensive building activity (dugout features, rectangular stone-lined hearths), diverse mortuary practices (extended supine inhumations, secondary burials and cremations) and a proliferation of stone, bone and antler tools and personal ornaments during the Late Mesolithic (c. 7400–6200 cal BC). Eventually, during the period coinciding with the appearance of the first farming communities in the wider area (c. 6200–6000/5900 cal BC), some of these locations (e.g. Lepenski Vir and Padina) saw the emergence of complex fisher-hunter-gatherer settlements with reddish limestone trapezoidal-base buildings and distinctive sculpted boulders (Bonsall 2008; Borić 2011, 2016, 2019; Borić & Dimitrijević 2009; Bonsall *et al*. 2015; Borić & Griffiths 2015; Borić *et al*. 2014, 2018).

In striking contrast to the rich archaeological record from the Danube Gorges, other Mesolithic sites in the mainland Balkans remain virtually unknown. Thus far, a greater Mesolithic presence was documented in the peripheral areas of the peninsula – in karstic features along the coasts and hinterlands of the Adriatic (Radovanović 1986; Miracle 1997; Komšo 2006; Mihailović 2007; Runnels *et al*. 2009; Hauck *et al*. 2017; Pilaar Birch & Vander Linden 2018; Borić *et al*. 2019), Ionian, and Aegean seas (Galanidou & Perlès 2003; Galanidou 2011; Reingruber 2017). The occupancy of these caves and rockshelters was manifested by occasional burials, chipped stone, bone and antler artefacts, pendants and ornaments, and faunal remains indicative of a variety of exploited resources – terrestrial, freshwater and marine.

Similarly, north of the Danube and the Sava rivers, in the vast open landscape of the Great Pannonian Plain (also referred to as the Carpathian Basin), the evidence of Mesolithic presence has been patchily distributed. Open-air Mesolithic sites (most likely seasonal camps) have been identified on the basis of concentrations of lithic finds (geometric microliths and backed bladelets) and occasional hut-like dugout dwelling features and hearths – namely in the floodplains of the Tisza tributaries the Zagyva and the Tarna (the Jászág Basin), the Danube Bend area, and in Transdanubia in Hungary (Kertész 1994, 1996, 2002; Bánffy 2004; Eichmann 2004; Bánffy *et al*. 2007; Eichmann *et al*. 2010; Krauss 2016).

Several reasons have been proposed for the patchy Mesolithic record and large blank areas in Southeastern Europe, namely the environmental changes, presumed low human population densities, taphonomic issues, and the lack of targeted research. The Early Holocene expansion of closed canopy deciduous woodlands throughout the Balkans, relatively poor in edible plants, low in ungulate biomass, and hindering hunting and inter-group communication, could have imposed great obstacles for foraging communities and driven them to littoral areas (Gurova & Bonsall 2014; Pilaar Birch & Vander Linden 2018). In the Pannonian lowlands, the shifting of river channels and lake water levels, flood deposits and erosion events, as well as modern agriculture could have concealed or destroyed the traces of Mesolithic occupation (Bánffy 2004; Eichmann 2004; Bánffy *et al*. 2007; Eichmann *et al*. 2010). Also, given that the Early Holocene shore-lines mainly lie below present sea level as a result of marine transgression, many sites along the Black, Aegean and Adriatic coasts could have been submerged or eroded in the process (Gurova & Bonsall 2014). It should also be noted that remnants of Mesolithic activities can often go unrecognized, especially if represented solely by organic material and/or lithics which deviate from the expected norm (Eichmann 2004; Eichmann *et al*. 2010; Galanidou 2011). Finally, the lack of targeted research, more focused on cave sites than on expensive open-air survey, has also been an important contributing factor (Gurova & Bonsall 2014). Even the Danube Gorges sites, with their substantial architecture and monumental sculpture, had been discovered by chance – during the rescue excavations prior to the Iron Gates dams construction. More recent surveys and excavations in the Danube Gorges hinterlands, on the Serbian (Radovanović *et al*. 2014) and Romanian side of the river (Boroneanț 2011 *and references therein*), yielded promising, if modest evidence of Mesolithic presence. Other Mesolithic sites in the adjacent areas had not been systematically looked for, and ultimately not found (Tringham 2000).

By contrast, the Early Neolithic research in Southeastern Europe has been asymmetrical at best, providing an ever-growing, large body of data to explore the origins and spread of farming in the European continent. In the words of R. Tringham (2000: 21), ever since the writings of V. G. Childe, it has become “the darling of prehistorians world-wide”. The plethora of archaeological, radiocarbon and genomic evidence points to a major population growth and the extensive spread of farming communities from the Fertile Crescent and Anatolia, reaching the Aegean coast and its hinterlands by c. 6500 cal BC, and spreading throughout the Balkans and southern parts of the Pannonian Plain between c. 6500 and 6000 cal BC (Whittle *et al*. 2002, 2005; Pinhasi *et al*. 2005; Reingruber & Thissen 2009; Özdoğan 2011; Porčić *et al*. 2016, 2020, *in press*; Mathieson *et al*. 2018). In the latter areas, the ubiquity of Early Neolithic sites, with new kinds of settlement architecture, material culture (pottery, figurines, and other objects of fired clay), and remnants of domesticated animals and plants, is in stark contrast with the scarcity of pre-Neolithic sequences. Moreover, the genome-wide ancient DNA analysis of an extensive sample of individuals from Neolithic sites in Southeastern Europe has shown that their ancestry was largely northwestern-Anatolian-Neolithic-related (Mathieson *et al*. 2018; *see also* Szécsényi-Nagy *et al*. 2015; Hofmanová 2016). Thus, it was largely assumed that the first temperate farmers moved into a

territory which was sparsely populated, or, apart from notable exceptions (e.g. the Danube Gorges), not populated at all (e.g. van Andel & Runnels 1995).

Over the course of the ERC Project BIRTH (*Births, mothers and babies: prehistoric fertility in the Balkans between 10000 and 5000 cal BC*), centred on human health, fertility, diet, and population dynamic reconstruction, a large sample of human and animal remains from Early/Middle Neolithic sites from the territory of Serbia was selected for radiocarbon dating (Porčić *et al*., *in press*). The majority of the obtained dates corresponded to the expected range between c. 6200–5300 cal BC, consistent with the initial appearance of first farming communities and their subsequent development. However, one human and three animal bone samples from the sites of Magareći mlin, Gospođinci-Nove zemlje and Grabovac-Đurića vinogradi (Fig. 1) were dated to the 8th millennium cal BC (Table 1; Fig. 2). With the exception of a previously obtained late 8th–early 7th millennium cal BC date on a human bone from the Early Neolithic site of Topole-Bač (Whittle *et al*. 2002), considered highly dubious and discussed in more detail later, this study produced the first radiocarbon evidence of Early Holocene sequences in the territory of Serbia beyond the Danube Gorges. In this paper, we present the new radiocarbon dates, discuss the contextual provenance of the dated samples, and explore the implications of these results for a better understanding of the problem of the "missing" and "invisible" Mesolithic in the region.

2. The elusive Mesolithic: previous data

All previous knowledge concerning the existence of Early Holocene hunter-gatherer communities in the territory of Serbia – other than the Danube Gorges – was based on scant lithic finds, mainly from unknown contexts or secondary deposits. As early as 1950, the occurrence of six geometric microliths (trapezes and lunates) was recorded on the surface of a small sandy mound at the site of Hajdukovo-Pereš, a marshy meadow on the eastern shore of Ludaš Lake (Fig. 1, no. 5). According to published reports (Brukner 1966, 1974; Basler 1979; Gavela 1979), the microliths (attributed to the Tardenoisien type) were mixed with artefacts from later periods, and probably deposited on the surface as a result of wind erosion. More recently, the complete lithic assemblage from this site was examined by T. Marton and W. J. Eichmann, who noted that it included "two backed points which fit within Late Epigravettian tradition... and numerous trapezes (Castelnovian influences)" (Eichmann 2004: 188).

Another two geometric microliths were found in 1966 at the site of Bagrem, on a sandy outcrop of a brick factory in the periphery of the town of Bačka Palanka, in the vicinity of the Danube (Fig. 1, no. 6) (Brukner 1966, 1974; Basler 1979; Gavela 1979). Unfortunately, no other information regarding their contextual provenance is known. It is of interest, however, that both occurrences of geometric microliths were recorded in the northern part of the country (the

Autonomous Province of Vojvodina), which encompasses the southern part of the Great Pannonian Plain. More precisely, both Hajdukovo-Pereš and Bagrem are located in Bačka (the north-western part of Vojvodina), a micro-region bordered by the Danube and the Tisza rivers. B. Gavela (1979: 374) suggested that many more Mesolithic sites could potentially be found in the loess deposits of Bačka; however none were recorded until now.

More recently, a much larger assemblage of chipped stone artefacts has been recorded at the agricultural holding "Ekonomija 13. maj", situated on a high loess hill (part of the Zemun loess plateau) (Šarić 2008). The hill dominates the right Danube bank, in the periphery of the Zemun municipality of the City of Belgrade (Fig. 1, no. 7). The assemblage included geometric microliths (trapezes, triangles, segments and rectangles, 51 pieces in total) and short blades with a retouched truncation (21 pieces) attributed to the Mesolithic (Tardenoisian), but also a significant quantity of Middle and Late Palaeolithic chipped artefacts, and several Neolithic ground stone axes and pottery fragments. Unfortunately, the artefacts were not found in situ, but collected over the course of many years from the collapsed loess section, over a 250x20 m area on the riverbank. According to J. Šarić (2008), who collected and published the finds, it was impossible to identify the cultural layers from which they originated in the hill section, due to its thick grass cover. Nevertheless, although their exact contextual provenance could not be determined, these finds also serve as a potential indicator of the presence of Mesolithic communities in the Pannonian Plain, in this case its southernmost edges – the micro-region of Srem, bordered by the Danube and the Sava rivers.

3. The Early Neolithic: "hidden" continuities or a clean slate?

As previously mentioned, the Early Neolithic sites in the region were far more numerous, greatly influencing the direction of the research. The spread of farming communities in the Central Balkans and the Pannonian Plain from c. 6200 cal BC (Whittle *et al*. 2002, 2005; Porčić *et al*. 2016, 2020, *in press*) has also been referred to as the First Temperate Neolithic (Nandris 2007), and, in terms of culture history, associated with the Starčevo-Körös-Criș culture. Thus far, 330 sites have been recorded in the territory of Serbia alone (Porčić *et al*., *in press*), characterized by new kinds of settlement organization and architecture (pit features, thermal structures), funerary rites (burials in a crouched position), material culture and symbolic expression (coarse and fine, occasionally painted ware, "altars", anthropomorphic and zoomorphic figurines, ground stone tools) and new economic practices (animal and plant husbandry) (Tringham 1971; Benac 1979; Srejović 1988; Leković 1995; Lazić 1988; Nandris 2007; Manning *et al*. 2013). At least to some degree, the large number of Neolithic sites can also be attributed to the greater visibility of architectural features and objects made from fired clay in the archaeological record.

Being the only area with Mesolithic-Neolithic "transitional" sequences recorded thus far, the Danube Gorges offers unique possibilities for exploring the nature of forager-farmer interactions and transformations in a specific cultural landscape. Here, the establishment of complex settlements at Lepenski Vir and Padina in the last century or so of the 7th millennium cal BC coincided with the emergence of the first farming communities in the wider area, and yet, these locations were of particular significance for the local hunter-gatherer-fishers in the long term. While some technological innovations – such as pottery vessels – were adopted during this time (Borić 1999; Garašanin & Radovanović 2001; Jovanović 2008), they were incorporated into the local habitus and mainly used for processing aquatic resources (Cramp *et al*. 2019). The period post c. 6000 cal BC saw the introduction of the first domestic animals (Borić & Dimitrijević 2007; Borić *et al*. 2018) and yet wild game and fish never lost their importance (Borić & Dimitrijević 2005; Živaljević 2017), the former remaining a major component of the diet of some individuals (Bonsall *et al*. 1997; Grupe *et al*. 2003; Borić *et al*. 2004; Nehlich *et al*. 2010; Jovanović *et al*. 2019). The evidence from Sr isotopes (Borić & Price 2013) and ancient DNA analysis of human bone samples (Hofmanová 2016; González-Fortes *et al*. 2018; Mathieson *et al*. 2018) further attest to increased mobility during the late 7th/early 6th millennium cal BC, resulting in genetic mixing of farmer and local forager ancestry. Some of the first incomers to the Lepenski Vir settlement (*cf*. Borić & Price 2013; Hofmanová 2016; Mathieson *et al*. 2018) were afforded a typical Late Mesolithic funerary rite (extended supine inhumations parallel to the Danube) (Radovanović 1996; Borić 2016) and a burial place within trapezoidal base buildings, along with other members of the community. The abandonment of these architectural features also signalled a change in the mortuary domain – the appearance of crouched burials of both local and non-local individuals, ocasionally in their backfills (Borić 2016). Thus, the final phases of the Lepenski Vir and Padina settlements might be best understood in terms of cultural hybridity, an amalgam of emerging new practices, beliefs and people organically incorporated into the long-term traditions and worldviews of local foragers. On the other hand, outside of the Danube Gorges, it would seem that the incoming farmers occupied a largely uninhabited landscape.

And yet, the nature of forager-farmer interactions, and the question of the Mesolithic-Neolithic transition in the wider Pannonian and mainland Balkan area is much more complex. As previously mentioned, the genomic evidence indicates that the process of Neolithization was largely a demographic one, involving the northward migration of populations from Anatolia and the Aegean with limited to no admixture with indigenous hunter-gatherers. However, some notable exceptions were also identified, in areas with no previously recorded Mesolithic presence. Such is the case with the Early/Middle Neolithic (c. 5800–5400 cal BC) site of Malak Preslavets on the shore of the homonymous lake in vicinity of the Danube in Bulgaria, where eight out of nine individuals (crouched inhumations and secondary skull burials) were shown to have significantly more hunter-gatherer-related ancestry in comparison to other Neolithic populations in the Balkans (Mathieson *et al*. 2018). Similarly, at the site of Tiszaszőlős-

Domaháza, the northernmost settlement of the Körös culture in the Middle Tisza valley in Hungary, one secondary interred skull dated to 5781–5646 cal BC (95% confidence intervals) originated from an exogenous individual with a hunter-gatherer genomic signature (Gamba *et al*. 2014). The growing body of genomic evidence from Hungary is also indicative of subsequent ancestry admixture (Lipson *et al*. 2017). The majority of Early/Middle Neolithic sites in Serbia beyond the Danube Gorges are yet to be studied in this respect; while the general pattern corresponding to the influx of new populations seems evident, the possibility of the presence of local foragers and/or their descendants should not be entirely disregarded.

Namely, whereas the character of post c. 6200 cal BC human settlement in the wider region is indicative of the adaptations of the incoming farmers and their negotiations with new, mosaic-like environments (Bartosiewicz 2005, 2007a; Whittle & Bartosiewicz 2007; Whittle 2012), it also raised the possibility of the greater involvement of indigenous foragers in the dispersal of "Neolithic" lifeways (Whittle 1998; Whittle *et al*. 2002; Bánffy 2004; Eichmann *et al*. 2010) and the existence of "hidden" continuities of previous traditions within them (Srejović 1974; Borić 1999; Bánffy 2004; Bogosavljević Petrović & Starović 2016; Krauss 2016). Unlike the Southern Balkan/Mediterranean archaeological record, with tell-like settlements, large quantities of painted ware, elaborate clay figurines and house models, and with domestic ruminants constituting an overwhelming majority in the faunal assemblages, the Early Neolithic settlement of the temperate northern parts of the peninsula was marked by thin occupation levels, crude architecture and less elaborate material culture, and a greater diversity of exploited resources (including wild game, fish, birds and shellfish, in addition to generally prevalent domestic animals) (Tringham 1971, 2000; Whittle 1996, 1998, 2001; Whittle *et al*. 2002; Greenfield & Jongsma 2006; Nandris 2007; Manning *et al*. 2013). These features were generally associated with higher residential mobility, although recent studies have shown that the patterns in site duration, residential practices, and subsistence strategies were far from uniform. Whereas some settlements appear to have been seasonally inhabited (Greenfield *et al*. 2014; Živaljević *et al*. 2017a), others are indicative of a more permanent system (Pike-Tay *et al*. 2004; Bogaard *et al*. 2007; Whittle & Bartosiewicz 2007; Whittle 2012).

Although foraging and farming lifestyles are by no means mutually exclusive, nor should they be understood as straightforward evolutionary steps and/or signifiers of particular societies, it is of interest to note that hunting seems to have played a significant role in some of the newly established settlements. Apart from the Danube Gorges, where the economic and social significance of hunting and fishing had been deeply embedded, a prevalence of wild game remains has also been noted in faunal assemblages from the sites of Nosa-Biserna obala (on the shore of Ludaš Lake, in the Bačka region of Vojvodina) (Bökönyi 1984), Golokut-Vizić (on the slopes of Fruška Gora mountain, in the Srem region of Vojvodina) (Blažić 1984–1985; Živaljević *et al*. 2017a) and Bukovačka česma (in the Great Morava River basin, in the hilly region of Šumadija in Central Serbia) (Greenfield 1994). The faunal sample from Donja

Branjevina (in the vicinity of the Danube, in Bačka), albeit dominated by domestic ruminants, indicates that fishing, fowling, and shellfish collection were also important (Blažić 2005). In this particular settlement, the presence of numerous catfish (*Silurus glanis*) bones (some of them originating from exceptionally large individuals) indicates that these activities required specialised skills and ethological knowledge (Živaljević, unpublished results). Further north, in the marshy valleys of the Tisza River and its tributaries in Hungary, fishing (including seasonal gathering of fish and shellfish in residual flood pools) seems to have been complementary to farming (Bartosiewicz 2007b, 2012, 2013; Domboróczki 2010), and particularly active (alongside fowling and hunting) in some contexts (Kovács *et al*. 2010). All of the aforementioned Early Neolithic settlements emerged within vastly diverse environments, and the foraging aspect of their subsistence could have been related to new adaptive strategies due to the particular features of the landscape, specific attitudes towards animals which dwell in it, or perhaps reflected certain localised traditions.

Moreover, the practice of incorporating animal body parts in human burials, a recurrent feature in the Danube Gorges (Živaljević 2015; Borić 2016) and many other Mesolithic funerary contexts throughout Europe (Grünberg 2013), was also recorded at some Early/Middle Neolithic sites, namely in the Srem region of Vojvodina. At the aforementioned site of Golokut-Vizić, an aurochs (*Bos primigenius*) skull was placed upside down on the upper body of a female individual in a crouched position, and a scapula of the same species was placed next to her knees (Petrović 1987; Borić 1999; Živaljević *et al*. 2017a). At Zlatara-Ruma, three crouched inhumations (of a male individual, child, and a female individual) were discovered in two burial pits filled with more than 7000 land snail shells (*Helix pomatia* and *Cepaea nemoralis*), and bones of wild animals (red deer *Cervus elaphus*, roe deer *Capreolus capreolus*, wild boar *Sus scrofa*, brown hare *Lepus europaeus*, fox *Vulpes vulpes*, pine marten *Martes martes*) and domestic species (cattle *Bos taurus*, sheep *Ovis aries*, goat *Capra hircus*, pig *Sus domesticus*, dog *Canis familiaris*) (Blažić 1995; Leković 1995). Snail and bivalve shells and wild and domestic animal bones were also associated with an adult individual at the site of "Bara Alicija"-Pećinci (Leković & Padrov 1992) and a female individual at Kudoš-Šašinci (Blažić 1995). In the Banat (eastern) part of Vojvodina, at the site of Perlez-Batka, a large pit with numerous animal (dog and wild horse) bones was discovered between two inhumation burials (Borić 1999; Whittle *et al*. 2002). It is also worth noting that at the aforementioned site of Malak Preslavets in Bulgaria, characterized by a significant percentage of hunter-gatherer-related ancestry, one burial context contained a cattle skull placed between two disarticulated skulls of small children (Mathieson *et al*. 2018: Supplementary Information). The merging of new features in the mortuary domain (the practice of placing the deceased in the crouched position) and echoes of different ontologies (related to the partible nature of the human body and its potential to be reassembled with other, non-human beings, *cf*. Whittle 1998; Živaljević 2015), suggests that these communities were drawing from a number of symbolic repertoires, some of them possibly rooted in a much deeper past (Borić 1999).

Also, the way particular artefacts were produced, and the activities associated with them, could have had a much longer history. Certain continuity of older traditions in the raw material selection (quartz, quartzite) and manufacture of chipped stone tools (Bogosavljević Petrović & Starović 2016) and ground stone tools (Antonović 2002, 2005) were suggested in case of some of the Early Neolithic sites in Bačka, and the eastern, central and western parts of Serbia. At the aforementioned site of Donja Branjevina, the axes made from fine-grained rocks resemble massive tools made from pebbles from the earlier Danube Gorges sites of Padina, Lepenski Vir, Vlasac and Velesnica (Antonović 2002, 2005). Moreover, the chipped stone tool assemblage from Donja Branjevina was characterized by a particularly high microlithic component (microblades and geometric microliths), indicative of strong Tardenoisien traditions (Šarić 2005, 2014). The continuation of this lithic tradition has also been suggested at the site of Nosa-Biserna obala (Garašanin 1960). Albeit in modest numbers, geometric microliths were also found in Early Neolithic contexts downstream from the Danube Gorges (Velesnica, Knjepište, Ušće Kameničkog potoka), the site of Blagotin in the West Morava River basin, and Popovića brdo-Zablaće and Šalitrena pećina in Western Serbia (Šarić 2005, 2014).

Although there is no direct evidence of Mesolithic presence at any of these sites to this day, certain features in the mortuary domain, particular ways of relating to the environment, and the reflections of previous technological know-how suggest that there could have been long histories and possibly local roots to some of the Early Neolithic phenomena in the region. Moreover, these occurrences demonstrate that valuable insights into the obscure regional Mesolithic can be gained not only by new archaeological excavations, but also by revisiting and reanalysing the existing archaeological collections from the Early Neolithic sites.

4. New radiocarbon evidence: the sites and samples

Over the course of the BIRTH Project, 169 human and animal bone samples from 39 Early/Middle Neolithic sites in Serbia were dated thus far (Porčić *et al*., *in press*). As previously mentioned, the vast majority corresponded to the expected range c. 6200–5300 cal BC. However, three sites, with no previously recorded Mesolithic sequences, yielded four bone samples (three animal and one human) dated to the 8th millennium cal BC (Table 1; Fig. 2). One of them – Grabovac-Đurića vinogradi – is located on the right bank of the Sava River, in the Obrenovac municipality of the City of Belgrade. The remaining two sites – Gospođinci-Nove zemlje and Magareći mlin – are located in Bačka, the region where some of the aforementioned Mesolithic microlith finds have been reported (Fig. 1), as well as remnants of older practices suggested in Early Neolithic contexts. Here, we provide the archaeological background of the sites, discuss the contextual provenance of the dated samples, and the obtained radiocarbon dates. In addition, in the light of this evidence, we revisit and problematize a previously obtained Mesolithic date

from the Early Neolithic site of Topole-Bač (Whittle *et al*. 2002) (Table 1; Fig. 2), also in Bačka (Fig. 1, no. 2).

Site name	Context	Material	Lab No	δ13C (‰)	δ15N (‰)	C:N	Uncal BP	Standard error	Calibrated date BC (95.4% CI)	Source
Grabovac-Đurića vinogradi	H2V/pit 3	*Bos primigenius* astragalus	BRAMS-2257	NA	NA	NA	8743	29	7940–7616	This paper
Gospođinci-Nove zemlje	Feature 45	Large mammal long/ metapodial bone	BRAMS-2368	NA	NA	NA	8274	29	7454–7186	This paper
Magareći mlin	Lowermost level above the loess	*Homo sapiens* parietal bone	BRAMS-2395	-22.67	12.78	3.2	8532	29	7595–7538	This paper
Magareći mlin	Lowermost level above the loess	*Sus scrofa* maxilla	BRAMS-2814	NA	NA	NA	8212	28	7332–7084	This paper
Topole-Bač	Burial 2, Trench 1	*Homo sapiens* metacarpal bone	OxA-8504	-19.9	8.6	3.1	8085	55	7294–6824	Whittle *et al*. 2002

Table 1. Radiocarbon measurements of human and animal bone samples.

4.1 Grabovac-Đurića vinogradi

The site of Grabovac-Đurića vinogradi occupies an elevated position overlooking the Sava River, in the Obrenovac municipality of the City of Belgrade (Fig. 1, no. 4). At present, the area surrounding this U-shaped alluvial terrace is marshy, but was most likely a part of the main river channel in the past. The excavations of the site were undertaken in 1967–1969 (Fig. 3), led by J. Todorović from the Belgrade City Museum. During this time, more than 300 m^2 were investigated, revealing a c. 1.5 m thick culture layer with evidence of Early/Middle (Starčevo culture) and Late Neolithic (Vinča culture) occupancy. Four pit-dwellings, a large number of rubbish pits, and portable material including fine and coarse ware, clay weights, chipped and ground stone tools, and bone and antler tools were attributed to the former; and three above-ground buildings, 11 pits, several silos and ovens (as well as pottery fragments, figurines, stone,

antler and bone tools) to the latter phase of occupation. In addition, sporadic finds of Copper Age pottery were also noted (Todorović 1967, 1968, 1969). Over the course of the excavations, a small faunal assemblage from Early/Middle and Late Neolithic contexts was also retrieved, consisting mainly of large bones of large animals, due to selective, hand collection. The taxonomic composition of the faunal samples from the two phases of occupation was fairly similar, with the majority of remains originating from cattle. Other taxa represented in the samples included the aurochs, pig, wild boar, goat, sheep, dog, red deer, roe deer and brown bear (*Ursus arctos*), as well as several bird bones and gastropod and bivalve shells (Bulatović & Spasić 2019).

Five animal bone samples from Early/Middle Neolithic pit-dwellings and pits were dated within the BIRTH Project; four of them in the range c. 5786–5646 cal BC (95% CI) (*cf*. Porčić *et al*., *in press*). However, one sample – an aurochs astragalus from Pit 3 (sq. 2, block H) (Fig. 4) – was dated in the range 7940−7616 cal BC within the 95% CI (8743±29 BP, BRAMS-2257) (Table 1; Fig. 2). The pit in question was only partly excavated, but it could be determined that it was roughly circular in base, and cut about 70 cm into the natural. The remaining finds from this context included sporadic Early/Middle Neolithic and Late Neolithic pottery, a figurine fragment, and a few other animal bones. Apart from aurochs, they originated from cattle, sheep, and unidentified mammals (Table 2). All of them exhibited similar taphonomic characteristics; i.e. there were no observable differences in the colour and weathering which would distinguish the aurochs astragalus from the bones of domestic animals. Furthermore, the astragalus bore no traces of manipulation (butchery or working) (Fig. 4), which would provide unambiguous evidence of human presence at Grabovac-Đurića vinogradi during the Mesolithic. Nevertheless, given the complete lack of Early Holocene absolute dates in the North-Central Balkans thus far, it is worth examining this occurrence in more detail.

TAXON	**NISP**
Bos primigenius	1
Bos taurus	4
Bos sp.	1
Ovis aries	1
Mammalia indet.	2
TOTAL	**9**

Table 2. Taxonomic composition of the faunal sample from Pit 3, Grabovac-Đurića vinogradi.

The scarcity of finds and the occurence of both Starčevo and Vinča culture artefacts in Pit 3 suggest that this feature probably represented a Late Neolithic clay borrow pit, which disturbed the Early/Middle Neolithic, and possibly an even older layer. It is of interest to note that below the Starčevo deposits (previously assumed to represent the initial occupation of the site) and above the natural, there was a thin layer referred to as “prahumus” or “primary humus” by the

excavators. This is a coloquial term commonly used in Serbian archaeology to designate a vaguely defined paleosurface or paleosoil (*cf*. Borić 2019: 31), and it most likely represents a stratum influenced by pedogenic processes, broadly dated to the Early Holocene. Although it was never properly studied and pedologicaly defined, it appears to be an important stratigraphical marker in the region, and a focal point of further investigation of the earliest human habitation at Grabovac-Đurića vinogradi.

4.2 Gospođinci-Nove zemlje

The site of Gospođinci-Nove zemlje is located in the Bačka region (Fig. 1, no. 3), on the bank of the "Mala Bara" canal, a part of the Jegrička River (tributary of the Tisza) system. Prior to the channeling works, the Jegrička used to be a slow, intermittent water flow, connecting a series of marshes and bogs, and owerflowing its banks during the seasons of high water level. The site was excavated in 2017 (Fig. 5), as a rescue project due to the planned construction of a fruit processing plant. The excavations were undertaken by the Provincial Institute for the Protection of Cultural Monuments team, led by D. Anđelić, and the following information regarding the site is taken from field documentation.

In two excavation areas (43x26 m and 60x100 m), the remains of six Early Neolithic pit-features and numerous features from later periods (Middle Bronze Age, Late Iron Age, Early Medieval and Early Modern period) were recorded. The material culture associated with Early Neolithic contexts included pottery fragments, a fragmented figurine, clay weights, chipped and ground stone tools, antler and bone tools, a perforated marine shell, and numerous animal bones. The archaeozoological analysis is currently underway, but the preliminary results confirm the presence of domestic animals common in Early Neolithic faunal assemblages (cattle, sheep, goat, pig and dog), wild animals (roe deer), and terrestrial and freshwater molluscs (Živaljević *et al*., unpublished results).

Within the BIRTH Project, one human and 12 animal bone samples from Early Neolithic contexts were selected for radiocarbon dating, with the majority (the human and all but one animal bone samples) giving a range c. 6066–5815 cal BC (95% CI) (*cf*. Porčić *et al*., *in press*). Similarly to the previously discussed occurrence from Grabovac-Đurića vinogradi, one specimen (a long/metapodial bone fragment of a large mammal) produced an Early Holocene date, in the range 7454−7186 cal BC within the 95% CI (8274±29 BP, BRAMS-2368) (Table 1; Fig. 2). The bone originated from the partly excavated Feature 45, a fairly large pit (3.6x4.8 m), ellipsoidal in base, and with an uneven bottom measuring c. 2 m in depth (Fig. 6). Its infill consisted of layers of dark grey and dark brown soil, which contained wattle and daub pieces, remains of floor, pottery fragments and clay artefacts, chipped and ground stone tools, a bone awl, animal bones and a significant quantity of snail and bivalve shells. The feature was dated by six other bone

samples (two cattle and four unidentified mammal bones) to the aforementioned, Early Neolithic span (Porčić *et al*., *in press*). The bone dated by BRAMS-2368 bore no traces of anthropogenic modification, but its taphonomy was noticeably different: whereas the majority of bones from this context were light brown, with sharp broken edges, and only slightly weathered, this bone was darker in colour, rounded, and covered in carbonate crust (Fig. 6).

As previously mentioned, no pre-Neolithic sequences have been recorded at the site, which would facilitate the interpretation of this find. It is of interest, however, that the Pit-feature 45 and many other pit features at the site were dug into the lowermost layer of light brown soil above the natural yellow loess. This layer, measuring c. 15 cm in thickness, was also identified as "prahumus" or "primary humus" by the excavators, and can probably be interpreted similarly to the aforementioned lowermost layer above the natural at Grabovac-Đurića Vinogradi. The finds from this layer included Early Neolithic pottery fragments, as well as sporadic Late Iron Age and Early Modern artefacts, and its mixed character was also noticeable in the faunal material. A significant number of bones originated from large wild bovids (aurochs i.e. *Bos*/*Bison*) which did not occur in the Early Neolithic assemblage, but the remains of cattle, pig, dog, an equid species (*Equus* sp.), fox, birds (possibly chicken *Gallus domesticus*) and freshwater mussel *Unio* shells were also present. Their taphonomic features were vastly diverse: some specimens were yellowish and appeared sub-recent, some were light brown, whereas a number of large bovid teeth and bones (mainly long and metapodial bone shaft fragments) were extremely pale (almost whitish), and bore traces of intensive weathering and root etching. Further archaeozoological analysis and radiocarbon dating of these specimens (currently underway) will provide a better insight into the time frame and pattern of their deposition, and possible association with pre-Neolithic activities at Gospođinci-Nove zemlje.

4.3 Magareći mlin

The site of Magareći mlin is located c. 5 km south-east of the town of Apatin in Bačka (Fig. 1, no. 1). It is situated on a tall, U-shaped alluvial terrace formed by the meandering of the Danube, sloping down towards a marshy area (Fig. 7) which was most likely connected to/or a part of the main river channel in the past. During the 1985–1989 excavation campaigns (Fig. 8), led by V. Leković from the The Provincial Institute for the Protection of Cultural Monuments, more than 260 m^2 were explored, yielding evidence of occupation during the Early Neolithic, Copper Age, Middle and Late Bronze Age, Iron Age, Late Antiquity and Medieval periods (Leković 1988; Lakatoš 2009). In 2018, some of the authors of this study (J. Pendić, I. Živaljević, A. Putica and V. Uzelac) and J. Lakatoš (who took part in the original excavations) revisited and surveyed the site (Fig. 9), in order to produce aerophotos and 3D isometric views of its surface (Fig. 7).

On the basis of seven radiocarbon dates on animal bones from Early Neolithic features, four previously obtained (Tasić 1993; Pinhasi *et al*. 2005) and three via the BIRTH Project (Porčić *et al*., *in press*), it was determined that the Early Neolithic sequence at Magareći mlin spanned approximately between 6200 and 5600 cal BC. Features from this phase included three semisubterranean dwellings and six associated rubbish pits, with monochrome and occasional white painted pottery fragments, chipped and ground stone tools, animal bones and mollusc shells (Leković 1988). The faunal remains were collected by hand only; consequently, mainly large bones of large mammals were represented in the sample. Similarly to a number of other faunal assemblages from Early Neolithic sites in the region, the sample from Magareći mlin was dominated by the remains of cattle, followed by sheep and goat, whereas the remains of domestic pig and wild animals (brown hare, fox, wild boar, red deer, roe deer, aurochs) were fewer in number (Stojanovski *et al*. 2020: Table 1).

In addition to the faunal assemblage from Early Neolithic features, three more small bags (nos. 2, 25 and 29) with animal bones were collected from a layer designated by the excavators as the "leveling down to the loess"; i.e. an arbitrary excavation layer presumably above the natural. No stratigraphic coherence and no features were documented in this layer, and its thickness and the exact location within the site could not be determined from the bag labels. Apart from the excavation layer, the only other information provided was the date (25.07.1988.), which solely enabled us to associate these bones with a 175 m^2 trench opened on the slope of the levee, the only portion of the site excavated in 1988 (Fig. 7). Moreover, the loose finds from the layer were mixed, reflecting the diachronic occupation of the locale. The majority included Early Neolithic pottery and grindstone fragments, but sporadic Bronze Age, Iron Age, Sarmatian and Medieval pottery fragments were also found. However, the taxonomic composition and the fragmentation pattern of the faunal sample from the lowermost level above the loess (in particular, from bag no. 2) were strikingly different in comparison to the aforementioned Early Neolithic sample. The bones from all three bags were heavily fragmented, to a much greater degree than those from Early Neolithic features. Moreover, whereas bags 25 and 29 contained both wild and domestic animal bone fragments, the bag no. 2 contained exclusively the remains of wild animals (brown hare, wild boar, red deer, roe deer), as well as tortoise (Testudines) shells, fish (vyrezub *Rutilus frisii* pharyngeal tooth and unidentified vertebrae) and mollusc (freshwater mussel *Unio* sp. and land snail *Helix* sp.) shells (Table 3; Fig. 10).

TAXON	**NISP**
Mammalia	
Lepus europaeus	1
Sus scrofa	2
Cervus elaphus	1
Capreolus capreolus	1
Ruminantia indet.	3
Mammalia indet.	38

Herpetofauna	
Testudines	2
Anura indet.	1
Pisces	
Rutilus frisii	1
Pisces indet.	2
Invertebrata	
Unio sp.	1
Helix sp.	1
Homo sapiens	2

Table 3. Taxonomic composition of the bone assemblage from the lowermost level above the loess (bag no. 2), Magareći mlin.

Given the conspicuous contrast between this small assemblage and the larger, Early Neolithic faunal sample, two specimens from bag no. 2 were dated, the wild boar maxilla fragment (MM 2/3) and the red deer tibia fragment (MM 2/4) (Fig. 10). The red deer tibia was dated in the range 4448–4333 cal BC within the 95% CI (5522±26 BP, BRAMS-2813), which would correspond to the initial phases of the Early Copper Age. However, the dating of the wild boar maxilla gave a range 7332−7084 cal BC within the 95% CI (8212±28 BP, BRAMS-2814) (Table 1; Fig. 2), which could suggest a previously unrecorded Mesolithic occupancy of the site. Although the uniformity of the sample evidently cannot be assumed, the absence of domestic species and the Early Holocene date obtained on the wild boar maxilla could suggest that some of the remaining bones were also deposited during this time.

The occurrence of vyrezub (*R. frisii*) pharyngeal tooth (Fig. 10, MM 2/12) is of particular interest, given that bones and teeth of this migratory cyprinid species were identified in Mesolithic and Mesolithic-Neolithic Transformation phase contexts from the Danube Gorges sites of Padina, Lepenski Vir, Vlasac, Ajmana and Kula (Živaljević 2017; Živaljević *et al*. 2017b, 2017c), as well as Răzvrata, Icoana, Ostrovul Banului and Schela Cladovei, where it was identified as *Rutilus* sp. (Bălăşescu *et al*. 2017; Mărgărit *et al*. 2017, 2018). Furthermore, there is currently no archaeozoological and historical evidence of its presence during the Neolithic and post-Neolithic periods in the territory of Serbia, which suggests that its disappearance from the Danube could have taken place already in the early stages of the Middle Holocene (Živaljević *et al*. 2017c). Although vyrezub remains occurred as early as mid-10th millenium cal BC contexts and throughout the Danube Gorges sequence, a particular ornamental tradition involving its pharyngeal teeth, modified and worn as garment appliqués, flourished during the 7th millennium cal BC. Such appliqués were found in a number of Late Mesolithic burials at Vlasac (Cristiani & Borić 2012; Cristiani *et al*. 2014; Borić *et al*. 2014; Živaljević 2017), Icoana, Schela Cladovei (Mărgărit *et al*. 2018) and Kula (Živaljević *et al*. 2017b), and in several Mesolithic-Neolithic

Transformation phase buildings at Lepenski Vir (Živaljević 2017: 177–178). Further upstream from Magareći mlin, similar ornaments were discovered in Late Mesolithic contexts (the end of the 8th and the 7th millennium cal BC) in several caves and rockshelters in the Upper Danube area in Germany (Rigaud 2011; Rigaud *et al*. 2014). The specimen from Magareći mlin bore no visible modifications, perhaps because (if contemporaneous with the wild boar maxilla) its deposition predated this particular body adornment practice by several centuries. Also, similarly to other animal bone samples which produced Early Holocene dates presented in this study, there were no anthropogenic marks on any of the bones from bag no. 2 which would straightforwardly associate their deposition with human agency.

However, in case of Magareći mlin, it is of particular importance to note that two fragments of a human skull – a parietal (Fig. 11) and an occipital bone fragment – were also identified during the analysis of the faunal sample from the lowermost level above the loess (Table 3). The parietal bone was dated by BRAMS-2395 in the range 7595−7538 cal BC within the 95% CI (8532±29 BP) (Table 1; Fig. 2), which makes it the first unambiguous Mesolithic human bone find beyond the Danube Gorges in the territory of Serbia, and one of the very few in the Great Pannonian Plain. Since only these two skull fragments were found, it was solely possible to determine that they originated from an adult individual. The somewhat later date of the wild boar maxilla (providing it was deposited as a result of human activity) could be indicative of sporadic presence of Mesolithic communities at Magareći mlin over the course of several centuries.

Further insights into their subsistence strategies, and consequently their environment, were obtained by stable isotope analysis of the parietal bone collagen. Isotope ratios of carbon ($\delta^{13}C$ -22.7‰) and nitrogen ($\delta^{15}N$ +12.8‰) (C % 41.3; N % 15.0; C/N ratio 3.2) (Table 1) indicate that the individual from Magareći mlin had a mixed terrestrial and aquatic diet. These values were fairly similar to those ($\delta^{13}C$ -22.4‰ and $\delta^{15}N$ +11.5‰) obtained by Whittle *et al*. (2002) on a disarticulated human skull from the site of Maroslele-Pana (south-east Hungary), dated in the range 6650−6410 cal BC (7680±70 BP, OxA-X-922-30, Whittle *et al*. 2005). The relatively negative $\delta^{13}C$ values and the elevated $\delta^{15}N$ values of both Magareći mlin and Maroslele-Pana individuals indicate that they probably derived most of their dietary protein from roughly equal amounts of terrestrial sources and freshwater fish. Their similar isotopic signatures could indicate a regional pattern in subsistence strategies in the Pannonian Mesolithic, however, at present, the paucity of isotopic and archaeozoological evidence hinders a better understanding of this issue.

As there are currently no isotopic measurements of animal bones dated to the Mesolithic period in the region, we compared these values to isotopic ratios of wild fauna from Early Neolithic sites (*cf*. Whittle *et al*. 2002; Jovanović *et al*. 2019), which provided a local animal baseline. In comparison to the majority of Early Neolithic individuals from the sites in the Great Pannonian Plain (north Serbia, north-east Croatia and Hungary), characterized by a typical terrestrial dietary

signal (Whittle *et al*. 2002; Lightfoot *et al*. 2011; Jovanović *et al*. 2019), the individual from Magareći mlin had notably lower $\delta^{13}C$ values and higher $\delta^{15}N$ values. The only exception were two male individuals (a disturbed primary inhumation and the aforementioned disarticulated skull with a hunter-gatherer genomic signature, *cf*. Gamba et al. 2014) from the northernmost Körös settlement of Tiszaszőlős-Domaháza in the Middle Tisza valley in Hungary. Their depleted $\delta^{13}C$ values (-22.5‰ and -22.6‰) and elevated $\delta^{15}N$ values (+13.1‰ and +12.9‰) indicate a contribution of aquatic resources in the diet (Gamarra *et al*. 2018), supported also by the faunal evidence from the site, which included a considerable amount of fish and mussel shells in addition to domestic and wild animals (Domboróczki 2010). The genomic and isotopic data, along with the peripheral location of Tiszaszőlős-Domaháza, indicate a certain adherence to older lifeways on the edges of the Early Neolithic Körös world, an area which seems to have been populated both by the descendants of local foragers and the incoming farmers.

On the other hand, the Magareći mlin individual had significantly lower $\delta^{13}C$ values compared to its Mesolithic (as well as Transformation phase and Neolithic) counterparts from the Danube Gorges, and his/her $\delta^{15}N$ values were more depleted in comparison to the majority of Mesolithic individuals from this area (*cf*. Bonsall *et al*. 1997; Grupe *et al*. 2003; Borić *et al*. 2004; Nehlich *et al*. 2010; Jovanović *et al*. 2019). This indicates a greater reliance on terrestrial food sources and lower trophic level freshwater fish in the diet of the individual from Magareći mlin, whereas the Danube Gorges communities consumed a considerable amount of anadromous fish (Jovanović *et al*. 2019), also corroborated by a significant number of migratory sturgeon and vyrezub remains (Bökönyi 1992; Păunescu 2000; Bartosiewicz *et al*. 2008; Živaljević 2017; Živaljević *et al*. 2017b; Bălăşescu *et al*. 2017). Conversely, despite their proximity to the sea, Mesolithic populations in the coastal areas of the Adriatic (Istria and Dalmatia) derived most of their dietary protein from terrestrial herbivores, with limited (most likely, seasonal) input from marine resources (Paine *et al*. 2009; Lightfoot *et al*. 2011). Accordingly, these individuals were characterized by higher $\delta^{13}C$ values and lower $\delta^{15}N$ values in comparison to the Magareći mlin individual.

The presented isotopic evidence suggests that there were notable differences in subsistence strategies between the coeval Mesolithic communities inhabiting the riverine terraces in the steep and narrow Danube Gorges, the Adriatic coast and its hinterlands, and the open, forest steppe and marshy environments of the Great Pannonian Plain. The latter, currently represented solely by the Middle Mesolithic individual from Magareći mlin and the Late Mesolithic individual from Maroslele-Pana, seem to have mainly subsisted on wild game and freshwater food sources. At least in some areas, certain individuals adhered to these dietary patterns even with the advent of farming, as the evidence from Tiszaszőlős-Domaháza shows. Nevertheless, in order to confirm these hypotheses, more data is necessary – both well established Mesolithic faunal baselines and more Mesolithic human skeletal finds from the Pannonian Plain.

Ultimately, it remains unclear whether the preservation of the two skull fragments from Magareći mlin was an outcome of specific mortuary practices, later disturbances or site formation processes. Given that even minute faunal remains (such as the isolated roe deer and vyrezub tooth, hare astragalus, tortoise and mollusc shell fragments, and even a frog bone) were collected from the lowermost layer above the loess, it does not seem plausible that human bones, even fragmented, would have been omitted. It is tempting to attribute their deposition to post-mortem manipulation and fragmentation of the body, a recurrent practice in the European Mesolithic, including the Danube Gorges sites of Padina, Lepenski Vir, Vlasac, Hajdučka Vodenica, Icoana and Schela Cladovei (Srejović 1972; Srejović & Letica 1978; Radovanović 1996; Borić 2003, 2010, 2016; Borić *et al*. 2014; Jovanović 2008; Bonsall *et al*. 2013; Wallduck 2014; Wallduck & Bello 2016; Živaljević 2015). The funerary record from these sites included numerous occurrences of disturbed primary inhumations missing body parts and/or bearing cutmarks, and disarticulated elements (mainly skulls and mandibles) incorporated into later burials or structurally deposited on their own − on stone slabs, encircled with split stones, on/below building floors, or intermingled with animal bones. In this manner of "remembering [by] dismembering" (Borić 2010: 48), the dead were continuously engaged with the world of the living, their bodies disintegrated only to be reassembled with other persons, beings and locales. Although the evidence beyond the Danube Gorges is limited, the aforementioned Late Mesolithic and Early Neolithic secondary skull burials from Maroslele-Pana and Tiszaszőlős-Domaháza could suggest that similar durable body-related beliefs and practices existed in the Pannonian Plain.

4.4. Topole-Bač

Finally, in the light of this evidence, we return to the previously published Mesolithic date obtained on a human bone from the site of Topole-Bač (Whittle *et al*. 2002), considered highly dubious (Jovanović *et al*. 2017).

Like most of the previously discussed sites, Topole-Bač is located in Bačka, about 32 km away from Magareći mlin as the crow flies (Fig. 1). It is situated on a 85 m high, U-shaped loess ridge next to the meander of the Mostonga River (a tributary of the Danube), in the vicinity of the town of Bač. In 1977, the archaeological team led by Č. Trajković from the Town Museum of Sombor opened seven trenches (c. 150 m^2 in total) on the very top of the loess ridge, detecting occupational deposits 0.4-0.7 m thick. The excavations uncovered an Early Neolithic dwelling of irregular rectangular shape with a double burial underneath (Fig. 12), four rubbish pits with mollusc shells and animal bones, wattle and daub remains, coarse and fine ware, altars, figurines, chipped and ground stone and bone tools, as well as Late Neolithic and Copper Age pottery, and an Early Bronze Age burial (Trajković 1978, 1988; Stefanović *et al*. 2020). Animal bones, collected manually from the floor of the dwelling and from several pits, mainly originated from

674 cattle and to a lesser extent from sheep, goat, red deer and roe deer (Dimitrijević, unpublished
675 results).
676
677 The double burial, of a 20-25 year old female (Burial 1) and a 40-50 year old male individual
678 (Burial 2) (Jovanović *et al*. 2017) placed in a crouched position symmetrically back to back, and
679 with their heads pointing in opposite directions (Fig. 12), attracted the particular attention of
680 researchers. It was found below the hard burnt clay floor of the Early Neolithic dwelling in
681 Trench 1, with pottery fragments, a figurine, chipped stone tools, animal bones and *Unio* shells
682 scattered between and around the bodies (Trajković 1978, 1988; Jovanović *et al*. 2017). Upon
683 excavation, the skeletal remains were conserved in situ, lifted along with the surrounding
684 sediment and transferred to the Town Museum of Sombor, becoming a part of the permanent
685 exhibition.
686
687 The burials were originally dated by Whittle *et al*. (2002), showing a surprising discrepancy in
688 the obtained results. OxA-8693 dated the rib of the female individual from Burial 1 in the
689 expected, Early Neolithic range 6207–5923 cal BC within the 95% CI (7170±50 BP). However,
690 a metacarpal bone of the male individual from Burial 2 was dated in the range 7294–6824 cal BC
691 within the 95% CI (8085±55 BP, OxA-8504) (Table 1; Fig. 2), making it a thousand years older
692 than the female individual buried next to it. A tentative explanation of this inconsistency was
693 offered by D. Borić (2005a, 2005b), who proposed that older skeletal remains could have been
694 circulated as relics or heirlooms and deposited/buried at new locations, as manifested throughout
695 the Danube Gorges sequence. This author admitted that such scenario would have been more
696 plausible in the case of the aforementioned skull burial from Maroslele-Pana (another Early
697 Neolithic site with no recorded Mesolithic occupancy) than in the case of the fully articulated
698 Burial 2 from Topole-Bač, although he allowed the possibility of mummifying or wrapping
699 which would have kept the bones articulated for a long period of time. Nevertheless, the burial
700 context of the two individuals from Topole-Bač, their exact same, crouched position (a typical
701 funerary rite in the regional Early Neolithic), and their position in relation to each other, makes
702 this hypothesis highly unlikely (Jovanović *et al*. 2017). Furthermore, it is worth noting that their
703 isotopic signatures were fairly similar – $\delta^{13}C$ -19.7‰ and $\delta^{15}N$ +8.8‰ (Burial 1) and $\delta^{13}C$ -
704 19.9‰ and $\delta^{15}N$ +8.6‰ (Burial 2) (Whittle *et al*. 2002), which suggests a similar dietary pattern,
705 mainly involving terrestrial animals and plants.
706
707 In order to test this puzzling occurrence, Burials 1 and 2 were re-sampled and re-dated within the
708 BIRTH Project. BRAMS-2412 (fragment of the frontal bone of the female individual from
709 Burial 1) and BRAMS-2411 (proximal phalanx of the right hand of the male individual from
710 Burial 2) gave the respective ranges 6065–5985 cal BC (7144±28 BP) and 6066–5986 cal BC
711 (7147±28 BP) within the 95% CI (Stefanović *et al*. 2020; Porčić *et al*., *in press*), which confirms
712 that the deceased were indeed interred in a single event. A re-analysis of their isotopic ratios
713 produced fairly similar results to those obtained by Whittle *et al*. (2002), i.e. – $\delta^{13}C$ -19.9‰ and

714 $\delta^{15}N$ +9.6‰ (Burial 1) and $\delta^{13}C$ -19.7‰ and $\delta^{15}N$ +8.5‰ (Burial 2), consistent with typical
715 Early Neolithic dietary patterns, where the bulk of protein was derived from a mixture of animal
716 and plant terrestrial foods.
717
718 However, while this solves the problem of the relationship of the two crouched burials, the
719 question of the Mesolithic date OxA-8504 obtained on human metacarpal bone remains open.
720 There is a possibility of contamination which could have ocurred during the chemical
721 conservation treatment of the burials (Jovanović *et al*. 2017; Stefanović *et al*. 2020), although the
722 sample dated by OxA-8693 does not seem to have been affected. For this reason, the new
723 samples dated by BRAMS-2411 and BRAMS-2412 were taken from the inner part of the bones.
724 The consistency of isotopic values of all four analyzed samples, obtained both by Whittle *at al*.
725 (2002) and our study, raises further doubts regarding the discrepancy in their dating. On the other
726 hand, given the new evidence of human presence at Magareći mlin during the Mesolithic, and
727 the aforementioned practices of circulating and redepositing human skeletal remains in the
728 Danube Gorges and Maroslele-Pana, the possibility of intentional or unintentional deposition of
729 an older bone in the Early Neolithic double burial must at least be considered. According to Č.
730 Trajković (1988: 99), the principal excavator of Topole-Bač, the occupational deposits were
731 formed on top of "loess virgin soil". At present, it is difficult to determine whether the lowermost
732 layers bore any traces of pre-Neolithic occupancy (as suggested in case of some of the other sites
733 discussed in this study), or the metacarpal bone dated by OxA-8504 (providing the date is valid)
734 could have been curated over significant periods of time and brought from another location.
735 Nevertheless, the new radiometric evidence (in addition to the existing archaeological evidence)
736 certainly provides a solid argument for human presence at the riverbanks and alluvial terraces in
737 Bačka during the Mesolithic.
738
739
740 **5. Discussion and conclusion**
741
742 The ongoing dating project of human and animal bone samples from numerous museum
743 collections in Serbia yielded the first Early Holocene dates in the region, other than those from
744 the well known sites in the Danube Gorges. Admittedly, all of the dated samples originated from
745 secondary deposits (i.e. from Neolithic pits in case of Grabovac-Đurića vinogradi and
746 Gospođinci-Nove zemlje) or arbitrary excavation layers (in case of Magareći mlin). The early
747 and late 8th millenium cal BC dates from Grabovac-Đurića vinogradi and Gospođinci-Nove
748 zemlje were obtained on unmodified animal bones, consequently their association with human
749 activity is yet to be supported by forthcoming radiocarbon dating. However, the archaeological
750 record at the latter site, with a substantial quantity of wild bovid bones with intensive traces of
751 weathering (taxonomically and taphonomically distinct from the Early Neolithic faunal
752 assemblage) in the lowermost layer above the natural, could reflect the pre-Neolithic use of the
753 locale. The archaeozoological analysis and dating of animal bone samples from this layer

(currently underway) will provide a better insight into the time frame and nature of their deposition. On the other hand, the site of Magareći mlin yielded unambiguous evidence of Mesolithic presence, possibly over several centuries during the mid/late 8th millennium cal BC. If the ambiguous date from Topole-Bač is accepted as valid, it would indicate the presence of human communities roughly in the same area during the late 8th/early 7th millennium cal BC.

In the Danube Gorges sequence, the 8th millennium cal BC corresponds to the period of increased building activity, a proliferation of burials, and overall a higher intensity of occupation of the riverbanks. More precisely, the clustering of dates between c. 8500–7400 cal BC, coinciding with a specific burial rite at Padina, Lepenski Vir and Vlasac (occasional burials in a seated lotus position) and the appearance of rectangular stone-lined hearths, justifies the association of these phenomena with a distinctive (Middle Mesolithic) phase (Borić 2011, 2016, 2019, Borić & Price 2013; Borić *et al*. 2018). The period post c. 7400 cal BC (the Late Mesolithic), at Vlasac in particular (but also at Hajdučka Vodenica, Schela Cladovei and some of the other sites), saw the emergence of first formal disposal areas for the burial of the dead, the construction of dugout dwellings and rectangular stone hearths, a proliferation of personal ornaments and stone and bone tools (Srejović & Letica 1978; Radovanović 1996; Bonsall 2008; Borić 2011; Borić *et al*. 2014), as well as the increased importance of fishing (Živaljević 2017) and resource exploitation patterns indicative of year-round occupation of at least some of these locations (Dimitrijević *et al*. 2016).

At this point, it remains difficult to discern the nature of coeval Mesolithic lifeways in the upstream Danube area and along its major tributaries in the southern fringes of the Pannonian Plain. In stark contrast to the Danube Gorges communities (which were plausibly more numerous and more consolidated overall) and their long term relations with particular places (riverine terraces in vicinity of large whirlpools), the current (bio)archaeological record from Pannonian sites is indicative of sporadic, episodic human presence and low-intensity activity at best, and generally a different way of moving through and relating to the landscape. However, albeit scarce, the data presented in this study provides unambiguous evidence of the presence of people beyond the Danube Gorges, places them in a chronological context, and offers a glimpse into their spatial distribution, sustenance, and possibly mortuary practices. The micro-region of Bačka (between the Danube and Tisza rivers) is particularly significant in this respect – both in terms of the previously reported lithic finds from Hajdukovo-Pereš and Bagrem, and the new absolute dates from Magareći mlin and (possibly) Gospođinci-Nove zemlje and Topole-Bač. They are indicative of human engagement with specific environments – the marshy shores of Ludaš Lake, and the former wetlands and elevated alluvial terraces formed by vigorous meandering of the Danube and its tributaries. Once vastly spread wetland ecosystems are presently restricted to patches along the Danube and other rivers flowing through Bačka (e.g. the Bačko Podunavlje Biosphere Reserve and the Jegrička Nature Park), comprising of marshes, forests, meadows, ponds, swamps and meanders, abundant with wildlife. The

794 osteoarchaeological and isotopic evidence from Magareći mlin, currently the only site which
795 yielded both human and animal remains dated to the Mesolithic, suggests that forager
796 communities could have thrived in such landscapes, exploiting both terrestrial and freshwater
797 resources. Similar environmental conditions and subsistence patterns seem to have existed
798 further north-east, along the Tisza and its tributaries in Hungary, as suggested by the evidence
799 from Maroslele-Pana and the sites in the Jászág Basin. In the latter, Mesolithic foragers
800 established their seasonal camps (indicated by occasional circular base hut-like structures and
801 concentrations of geometric microliths, backed bladelets and faunal remains) on small ridges
802 rising above the marshlands, abundant in fish, waterfowl and molluscs, and surrounded by
803 gallery woods and alluvial meadows rich in game and fur animals (Kertész 1996, 2002). In some
804 cases, such as Tiszaszőlős-Domaháza, certain individuals adhered to such dietary patterns even
805 at the onset of the Early Neolithic. The diversity of exploited resources, and certain continuities
806 in polished and chipped stone tool technology at the Early Neolithic sites of Donja Branjevina
807 and Nosa-Biserna obala suggest that some of the sites in Bačka could also conceal traces of
808 previous occupation.
809
810 As indicated by the differences in the environment, settlement patterns and subsistence strategies
811 of the Danube Gorges and Pannonian communities, there was no single and uniform "Mesolithic
812 way of being". To quote N. Galanidou (2011: 236), "what we are dealing with are patches of the
813 material record left behind by different people, having different economies, lifestyles and, after
814 all, different identities". On the other hand, certain features could have been shared across this
815 vast physical and social landscape. The deposition of human skull fragments at Magareći mlin
816 could have been driven by similar concepts of death, corporeality and partibility as evidenced by
817 secondary skull burials from Maroslele-Pana and Tiszaszőlős-Domaháza, and amply manifested
818 in the Danube Gorges archaeological record. Although the intensity and nature of their
819 connectivity remain obscure for the time being, it becomes evident that the Danube Gorges
820 Mesolithic can no longer be percieved as an isolated phenomenon.
821
822
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833

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Figure captions (*Colour should be used only in the online version)

Figure 1. The map of northern Serbia (encompassing the southern part of the Great Pannonian Plain and the North-Central Balkans), with relevant sites mentioned in the text. Red circles: the sites which yielded bone samples dated to the 8th millennium cal BC: 1) Magareći mlin, 2) Topole-Bač, 3) Gospođinci-Nove zemlje, 4) Grabovac-Đurića vinogradi. Black triangles: the sites with previously reported Mesolithic chipped stone tools: 5) Hajdukovo-Pereš, 6) Bagrem, 7) "Ekonomija 13. maj". Black circles: previously known Mesolithic sites in the Danube Gorges mentioned in the text: 8) Padina, 9) Lepenski Vir, 10) Vlasac, 11) Hajdučka Vodenica, 12) Velesnica, 13) Kula (on the Serbian bank of the Danube), 14) Răzvrata, 15), Icoana, 16) Ostrovul Banului, 17) Schela Cladovei (on the Romanian bank of the Danube). The top right map shows the location of northern Serbia and other known Mesolithic sites in Southeastern Erope (base map by: J. Pendić).

Figure 2. The distribution of radiocarbon dates obtained by this study (BRAMS-2257, BRAMS-2395, BRAMS-2368, BRAMS-2814) and Whittle *et al*. (2002) (OxA-8504), calibrated in OxCal.

Figure 3. Grabovac-Đurića vinogradi (photo from the archive of the Belgrade City Museum).

Figure 4. The cross section of Pit 3, Grabovac-Đurića vinogradi (field drawing by Lj. Grujić, from the archive of the Belgrade City Museum, digitalized by J. Pendić), and the aurochs (*Bos primigenius*) astragalus from this context.

Figure 5. Archaeological excavations at Gospođinci-Nove zemlje, 2017 (photo from the archive of The Provincial Institute for the Protection of Cultural Monuments).

Figure 6. The cross section of Pit-feature 45, Gospođinci-Nove zemlje (field drawing by V. Mogin, digitalized by Lj. Janković, from the archive of The Provincial Institute for the Protection of Cultural Monuments), and the large mammal long/metapodial bone from this context.

Figure 7. Magareći mlin, 3D isometric view of the site surface (image by: J. Pendić).

Figure 8. Archaeological excavations at Magareći mlin, 1987 (photo: Z. Ljubenović).

Figure 9. Field survey at Magareći mlin, 2018 (photo: I. Živaljević).

Figure 10. Selected faunal remains from the lowermost level above the loess (bag no. 2), Magareći mlin: MM 2/1 – wild boar (*Sus scrofa*) scapula; MM 2/3 – wild boar maxilla; MM 2/4 – red deer (*Cervus elaphus*) tibia; MM 2/6 – brown hare (*Lepus europaeus*) astragalus; MM 2/8 – roe deer (*Capreolus capreolus*) incisor; MM 2/10 – tortoise (Testudines) shells; MM 2/12 – vyrezub (*Rutilus frisii*) pharyngeal tooth; MM 2/11 – freshwater mussel *Unio* shell (photo: I. Živaljević).

Figure 11. Human parietal bone from the lowermost level above the loess (bag no. 2), Magareći mlin (photo: I. Živaljević).

Figure 12. Burials 2 and 1, Topole-Bač (photo: J. Pendić) (after Jovanović *et al*. 2017: fig. 3).

Table captions

Table 1. Radiocarbon measurements of human and animal bone samples.

Table 2. Taxonomic composition of the faunal sample from Pit 3, Grabovac-Đurića vinogradi.

Table 3. Taxonomic composition of the bone assemblage from the lowermost level above the loess (bag no. 2), Magareći mlin.

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Ivana Živaljević: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing, Visualization, Supervision

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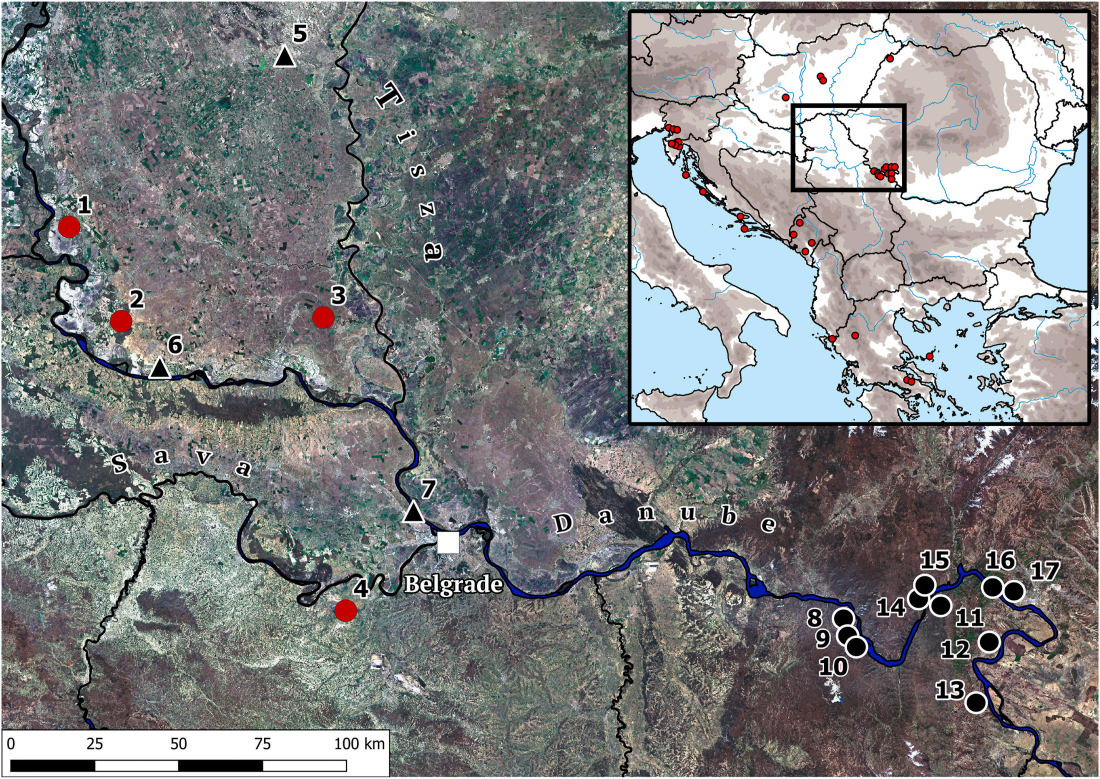
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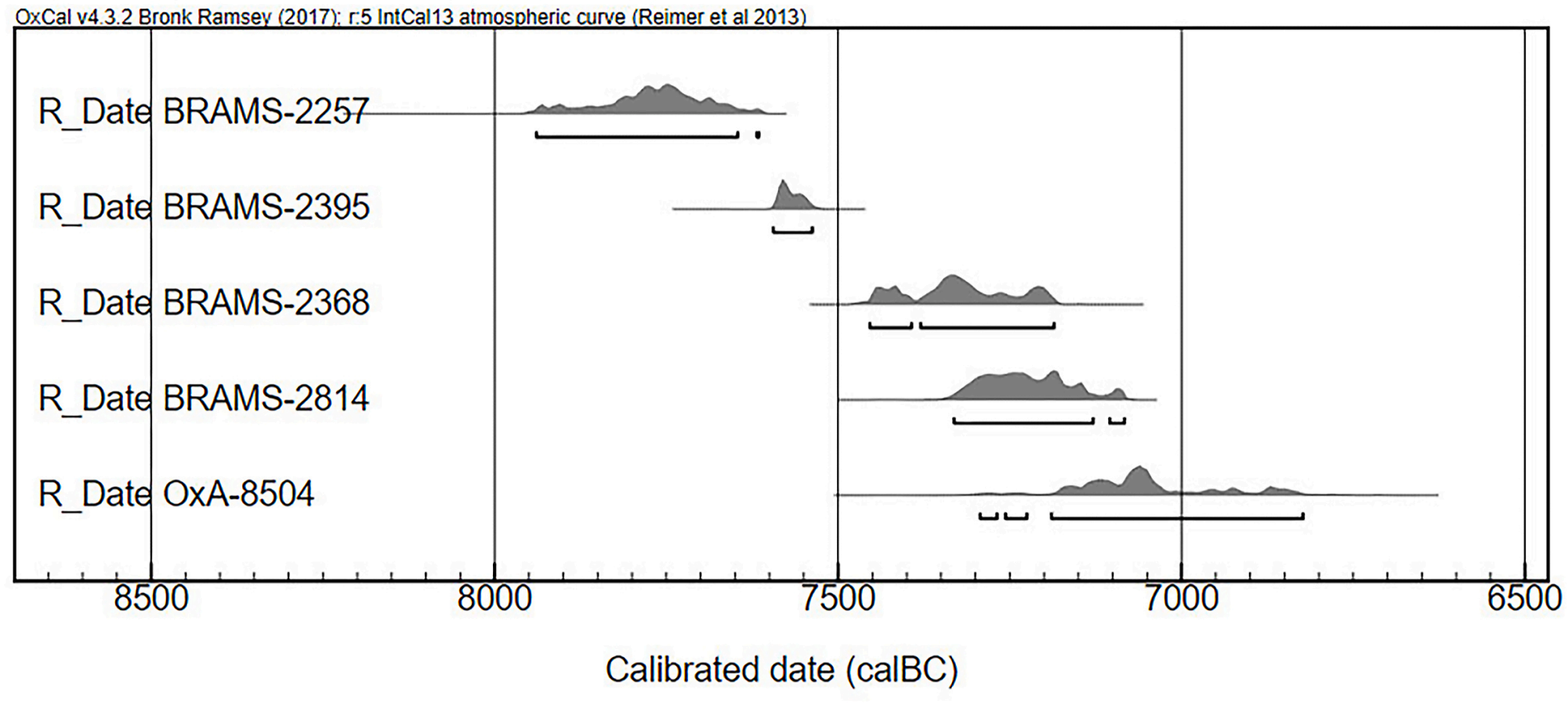
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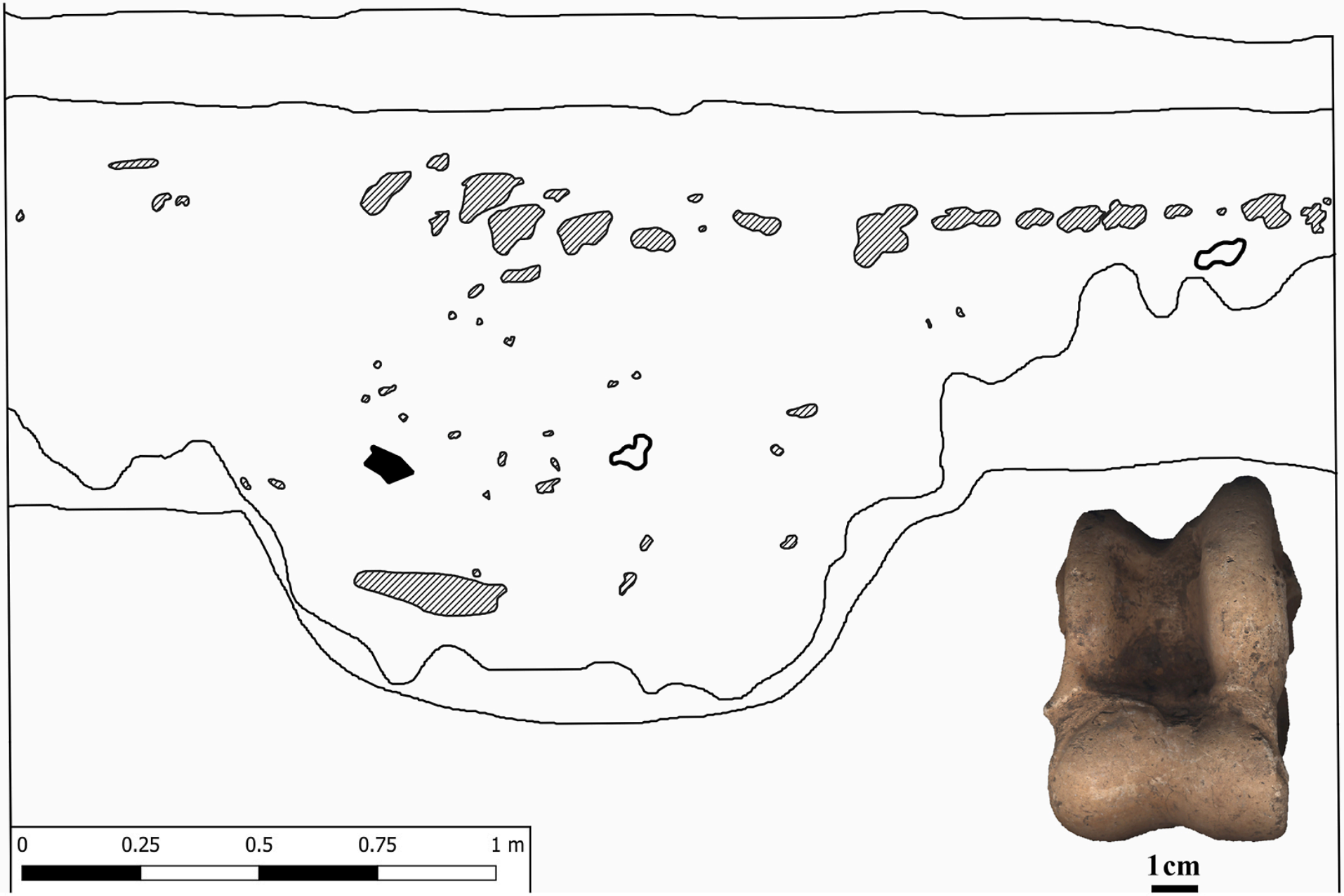
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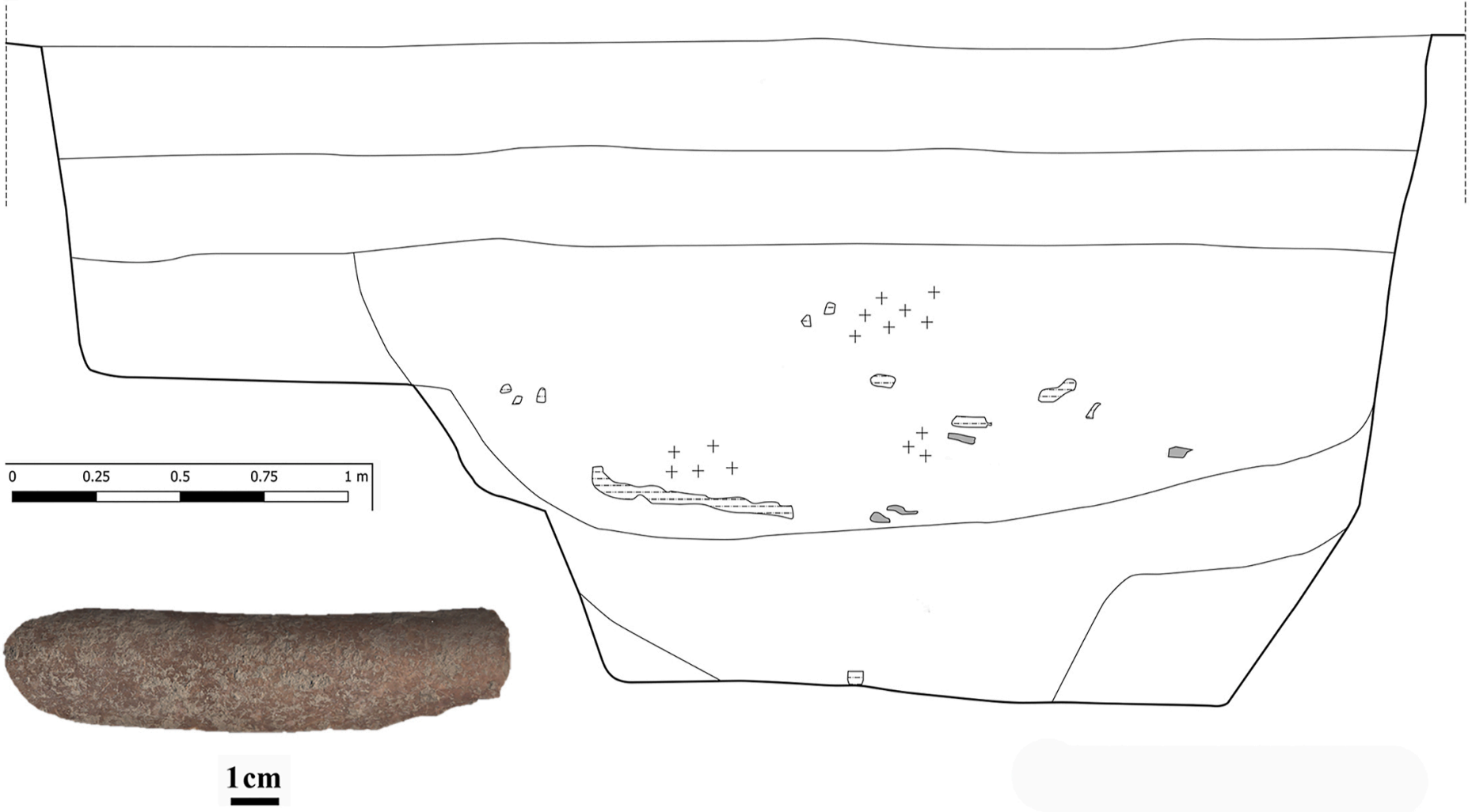
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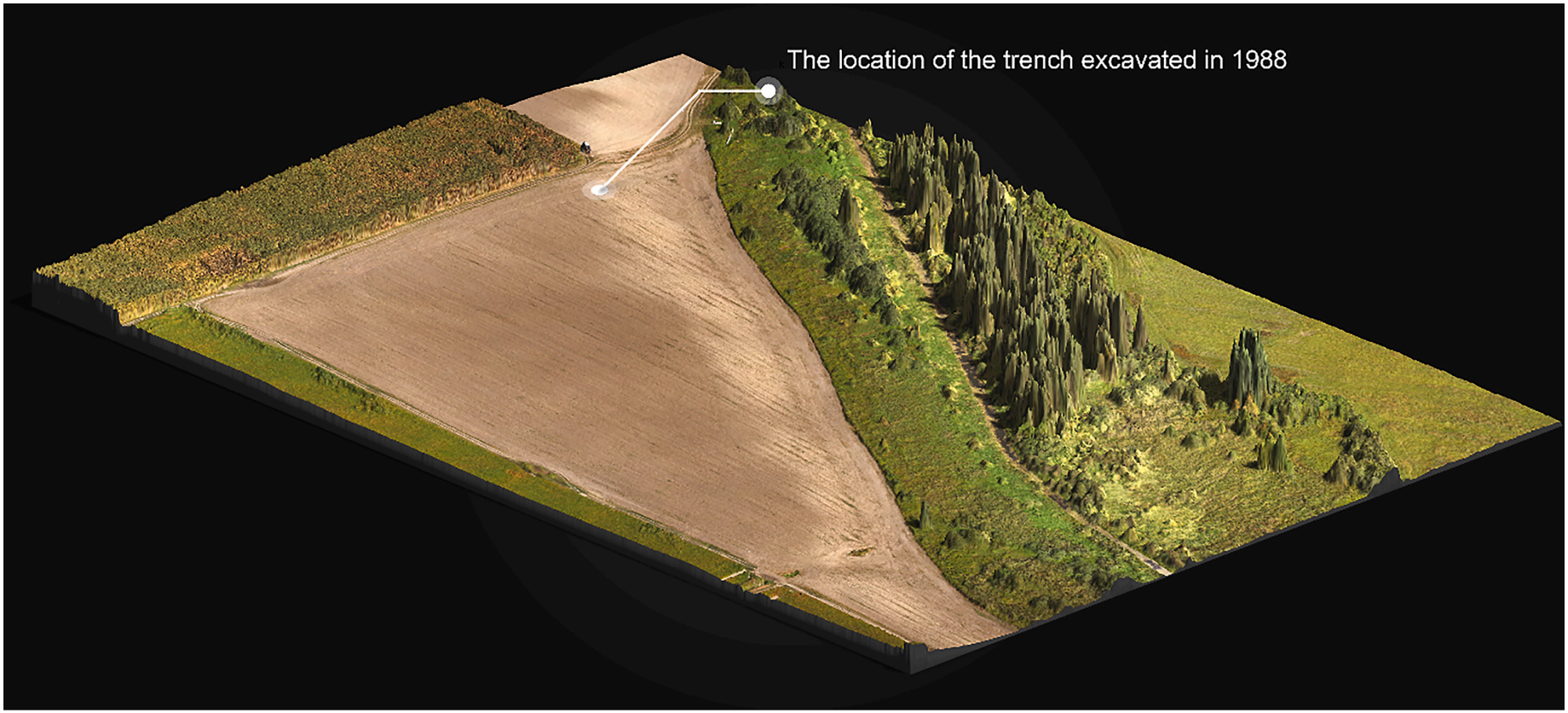
The location of the trench excavated in 1988


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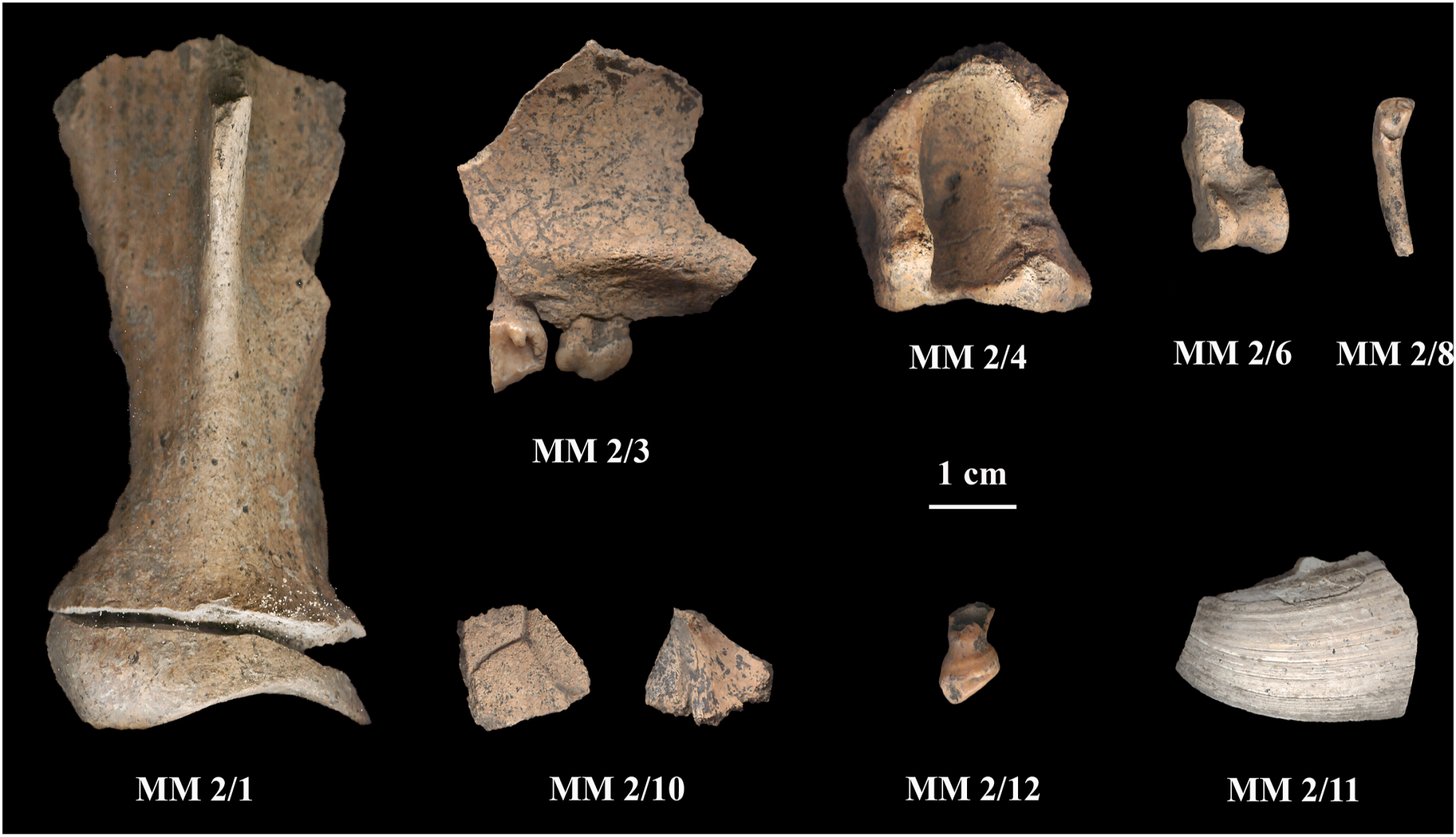
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MM 2/12
MM 2/11


1 cm

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: