Dating burial practices and architecture at Lepenski Vir

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Clive Bonsall, Ivana Radovanović, Mirjana Roksandic, Gordon Cook, Thomas Higham & Catriona Pickard

Abstract: Previous attempts to establish a chronology for Lepenski Vir using three different methods (stratigraphy, radiometric ^{14}C dating of bulk charcoal samples, and AMS ^{14}C dating of human bone collagen) produced inconsistent results. Discrepancies between the human bone and charcoal ages were found to result from a reservoir effect in the bones of people who ate significant quantities of Danube fish. When a reservoir 'correction' is applied, the human bone ^{14}C dates are consistent with the charcoal dates, and this raises questions about the excavator's relative and absolute chronology based on stratigraphy and inter-site comparisons. Single-entity dating of surviving archaeological materials offers the best hope of constructing a reliable chronological framework for Lepenski Vir. This paper presents the results of a further programme of AMS ^{14}C dating of human remains. Direct dating of 24 burials confirms that different burial practices characterized the Final Mesolithic and Early Neolithic. Previous attempts to assign burials to Mesolithic or Neolithic phases, based on stratigraphic observations, are shown to be broadly correct but not always accurate in detail. The evidence from radiocarbon dating and stratigraphy is used to calculate 'minimum' and/or 'maximum' ages for certain of the trapezoidal buildings, which suggest that this architectural form was in use during the Final Mesolithic and Early Neolithic. The implications of the human bone ^{14}C dates and associated stable isotope measurements for the timing of the Mesolithic–Neolithic transition in the Iron Gates are also discussed.

Key words: burials, architecture, Mesolithic, Neolithic, AMS ^{14}C dating, stable isotopes

Introduction

Lepenski Vir stands out among the Stone Age sites of the Iron Gates (Fig. 1) by virtue of its architecture characterized by distinctive trapezoidal structures with lime plaster floors containing numerous large stone sculptures and other symbolic artefacts (among other finds), together with a record of complex burial practices associated with the structures and the areas between them. Its unusual features have led many archaeologists, including the excavator Dragoslav Srejović to view Lepenski Vir as not just another settlement on the edge of the Danube, but as a site that came into being early in the Mesolithic and later assumed an important role in the lives of the local population as an aggregation, sacred and/or ceremonial site.

The conventional interpretation of the occupation sequence at Lepenski Vir was proposed by Srejović (1969, 1972a), who recognized a succession of Mesolithic settlements: Proto-Lepenski Vir, Lepenski Vir I, and Lepenski Vir II, followed by the Neolithic settlements of Lepenski Vir IIIa and IIIb. The main Mesolithic occupation phase of Lepenski Vir I was divided into 5 sub-phases (Ia–e) based on stratigraphic observations and material culture content, while the Early Neolithic Lepenski Vir IIIa phase was divided into two sub-phases (IIIa1–2). Srejović (1969, 1972a) argued for a significant time gap between Lepenski Vir II and III.

This periodization of Lepenski Vir became controversial even before the excavations were completed in 1970, due primarily (though not exclusively) to the discrepancies between Srejović's stratigraphic observations and the first published radiometric ^{14}C dates on charcoal samples collected from the Lepenski Vir I structures (Quitta 1969). The ^{14}C results suggested that some of the earliest Lepenski Vir I structures 'stratigraphically' were among the latest chronologically, according to their radiocarbon ages.

Radiometric ^{14}C dating of charcoals from the Lepenski Vir I–II structures gave ^{14}C ages between *c*. 7360 and 6560 BP (Quitta 1972, 1975). These ages were similar to those for Early Neolithic (Starčevo–Körös–Criş sites in the surrounding regions and were rejected by Srejović (1971, 1972a, 1972b) as being too young. He suggested an age range for Lepenski Vir I–II of *c*. 500 years earlier, based on radiometric ^{14}C ages of *c*. 7930–7440 BP for charcoal samples from Mesolithic contexts at the neighbouring site of Vlasac.

Other researchers have accepted the radiocarbon measurements for Lepenski Vir as valid and have interpreted phases I–II as either Early Neolithic (e.g. Jovanović 1969, 1972) or a Late Mesolithic survival in an area unsuitable for farming but rich in natural resources capable of supporting a hunter-gatherer population (e.g. Voytek and Tringham 1989).

Many of the burials at Lepenski Vir were also assigned to the five main phases (Zoffmann 1983), but the basis on which this was done was never adequately explained in the literature. It is assumed to be partly on the basis of stratigraphy, including the stratigraphic relationship with buildings, and partly on the basis of burial type. The human remains from Lepenski Vir were re-analyzed by Roksandic (1999, 2000; Roksandic *et al*. 2006, this volume), but a reconsideration of the phasing of the burials was beyond the scope of her study.

Subsequent AMS dating of human remains assigned to phases IIIa and IIIb, produced ages between *c*. 7770 and 6910 BP (Bonsall *et al*. 1997), which are earlier than expected on the basis of Srejović's stratigraphic interpretation and older than the charcoal ages for preceding phases I and II. Bonsall *et al*. (1997) suggested, and subsequent research (Cook *et al*. 2001) has demonstrated, that the radiocarbon ages on the

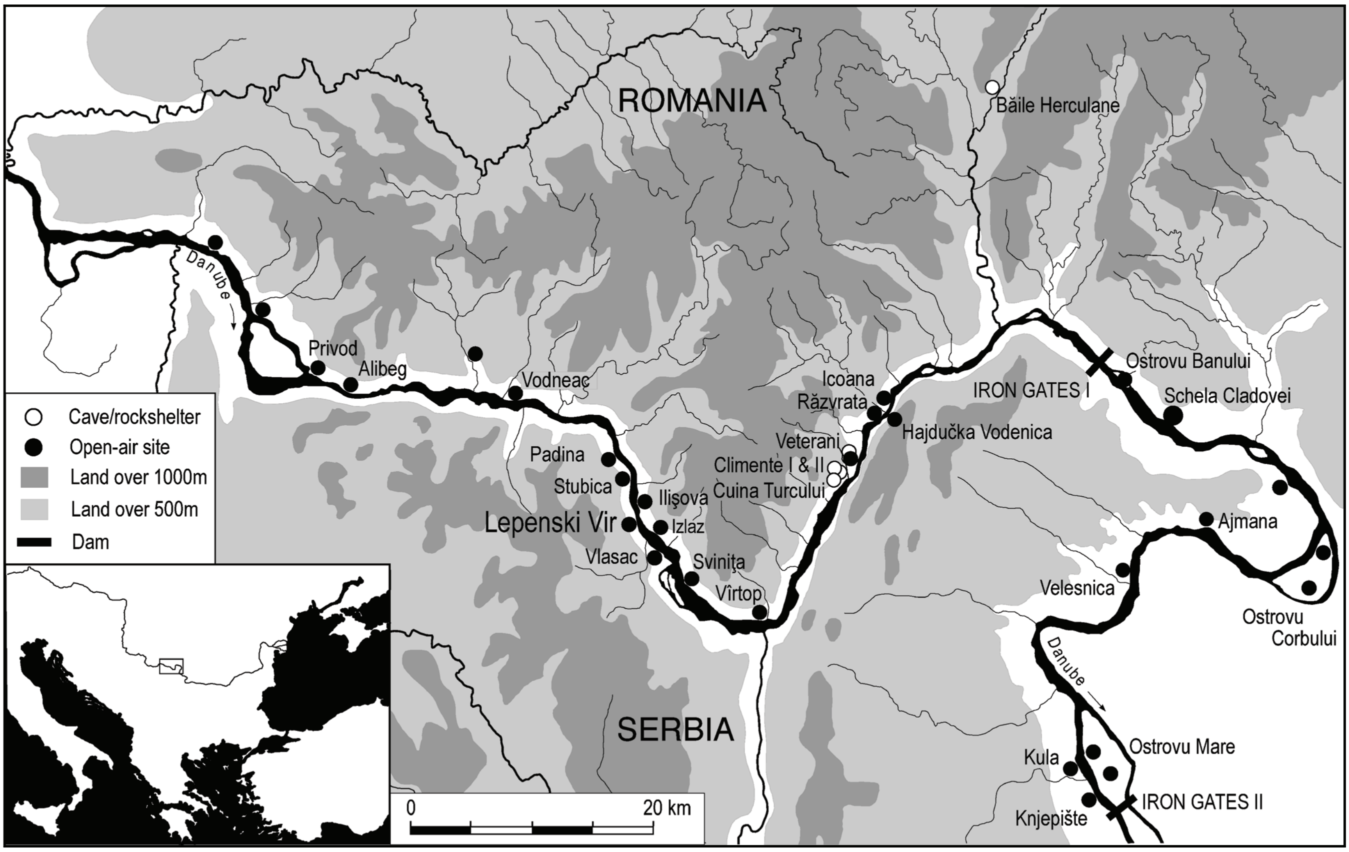

Figure 1. *Lepenski Vir and the Iron Gates.*

bones of humans whose diets included regular consumption of aquatic food sources (mainly freshwater fish) are subject to a reservoir effect of up to approximately 500 years. Cook *et al*. (2001, 2002) devised a method for correcting the ^{14}C ages made on human bone samples for this reservoir effect using: (1) the δ^{15}N values for human bone collagen samples to estimate the percentage freshwater aquatic diet, based on a knowledge of the approximate δ^{15}N end members for 100% freshwater aquatic and terrestrial diets, assuming a linear relationship between δ^{15}N and percentage freshwater diet and (2) the age offsets between human bone ages and closely associated ungulate bone ages for particular δ^{15}N values, based on excavated material from another Iron Gates site, Schela Cladovei, on the Romanian bank of the Danube. When this reservoir correction is applied to the human bone ages from Lepenski Vir obtained by Bonsall *et al*. (1997) the resulting age range (7310 to 6720 BP) is very similar to that of the bulk charcoals (7360 to 6560 BP). This age range and the fact that some of the Lepenski Vir III burials had 'Mesolithic' dietary signals raises questions about the phasing of the burials. It also raises doubts about the stratigraphic integrity of Lepenski Vir III, because the ages are no different from phases I and II.

In parallel with the AMS ^{14}C dating of human remains, Radovanović (1996a) attempted a revision of the Lepenski Vir stratigraphy. Using information in Srejović's published accounts together with previously unpublished field documentation, she proposed a revised sequence of occupation phases: Proto-Lepenski Vir, Lepenski Vir I (comprising sub-phases 1–3, with 11 building levels), Lepenski Vir II, and Lepenski Vir III. Subsequently, several authors have questioned the stratigraphic integrity or even the existence of some of Srejović's phases (e.g. Borić 1999, 2002b; Radovanović 2000; Garašanin & Radovanović 2001; Bonsall *et al*. 2002a; Perić & Nikolić 2004).

The greater part of the Lepenski Vir site was excavated in 1965–70 .With the impounding of the Danube by the Iron Gates I dam the site was flooded and is no longer accessible, apart from a number of structures from Lepenski Vir I that were rescued and preserved for display in 1970. Realistically, therefore, the disagreements over the relative and absolute chronology of Lepenski Vir can now only be addressed by a detailed programme of scientific analysis, including single-entity dating, of the surviving archaeological materials. To the authors' knowledge, no charcoal or other carbonized plant material is available for analysis. However, large collections of animal and human bones are still available for scientific study, as are low-fired, organic-tempered Starčevo pottery sherds that, potentially, are datable by AMS ^{14}C, archaeomagnetic intensity, and luminescence techniques (Bonsall *et al*. 2002b).

The dating programme

Aims and objectives

The main aims of the AMS ^{14}C dating programme reported here were to:

1. Investigate changes in diet and subsistence during the occupation of Lepenski Vir;
2. Establish the chronological contexts of particular forms of burial represented at the site;
3. Test the phasing of the Lepenski Vir burials proposed by Srejović (1969) and Zoffmann (1983) based on stratigraphy and burial custom;
4. Test previous hypotheses of the age and phasing of the trapezoidal buildings by dating human burials that were either cut through or sealed by their plaster floors; and
5. From the above, provide new information bearing on the timing of the Mesolithic–Neolithic transition in the Iron Gates gorge.

Why date the burials?

Two approaches have been used in an effort to establish a more reliable chronology for the trapezoidal structures at Lepenski Vir using single-entity AMS ^{14}C dating of bone remains. One approach has involved the dating of terrestrial animal bones (e.g. Borić & Miracle 2004; Borić & Dimitrijević 2005, 2007), the other the dating of human bones from articulated skeletons (Bonsall *et al*. 2004). Both approaches rely on the existence of a clear stratigraphic relationship between the dated bone and the building.

There are uncertainties associated with both approaches, but we suggest that the uncertainties are far greater with the first approach. The bases of the Lepenski Vir buildings were made by cutting more or less horizontally into the sloping bank of the Danube, effectively creating pit features, and these pits became infilled by one means or another after the buildings were abandoned.

A disarticulated bone found on the floor of a pit could have reached that position in any of a number of ways. It may be in a primary context, deposited when the building was in use, or shortly after its abandonment. On the other hand, the bone could be older than the pit (i.e. in a secondary context) deposited there after its abandonment as a result of slumping at the sides of the pit, movement of material from upslope due to gravity or hillwash (probably a common event on steep valley side slopes in the Iron Gates gorge), or deliberate infilling of the pit with soil material containing earlier archaeological objects. It is possible for younger bones to be introduced into ancient pit features as a result of bioturbation, including animal burrowing, earthworm activity and root penetration, or of post-depositional disturbance by humans. Moreover, unless animal bones bear manufacturing traces or butchery marks, there will always be an element of doubt about whether their presence in an archaeological site is the result of primary human activity or natural processes. These are just some of the initial steps in the taphonomic process that can affect bones prior to deposition; further loss of information (e.g. water transport or the destruction of datable collagen) may be expected in the deposit itself during fossil diagenesis. In addition, secondary human effects in the form of errors of excavation or curation (see below) may result in older or younger material being wrongly attributed to an archaeological feature. A possible example of this from the Iron Gates was discussed by Bonsall *et al*. (2002b).

It has been argued that the taphonomic biases associated with the dating of animal bones are lessened by dating bones that are still in articulation (skeletons or partial skeletons) on the assumption that they are in a primary context and were deposited soon after the death of the animal (e.g. Borić & Dimitrijević 2007: 55). However, these are rare occurrences on most archaeological sites, including Lepenski Vir.

This argument applies equally to human skeletons, which were much more frequent than animal skeletons/partial skeletons at Lepenski Vir. While ^{14}C age measurements on human bones from this site are less precise because of the reservoir age associated with them (see above), often the articulated bones (more-or-less complete skeletons, rather than typical food remains from animals) are from clearly-defined, archaeological contexts and are subject to better stratigraphic control. Moreover, in contrast to the limited information available for animal remains, the stratigraphic relations between burials and buildings at Lepenski Vir are reasonably well documented by photographs, plans and written records. Thus, given that we have already developed a reservoir correction for ^{14}C measurements on human bones from the Iron Gates (Cook *et al*. 2001, 2002, in press) this becomes our preferred material for a detailed dating programme.

Curatorial issues

Recovery methods and post-excavation practices can have as much taphonomic effect on bones as the diagenetic processes that led to their fossilization, and must be taken into account when assessing the ^{14}C dates and stable isotope results from Lepenski Vir. The following observations are based on the study undertaken by Mirjana Roksandic in 1996–8 for her PhD thesis (Roksandic 2000).

In many respects the Lepenski Vir excavation was a remarkable achievement. Between 1965 and 1969 in five campaigns lasting a total of 12 months, approximately 2500m^2 of the site, with deposits averaging 3.5 m deep, were excavated to reveal architecture, monumental sculpture and graves of the 'Lepenski Vir culture'. But all this was done at great speed, for the most part without the use of fine sieving,[1] and much detailed information on burial practices and relationships between burials and architecture undoubtedly was overlooked.

Judging from photographic evidence and testimonies of archaeologists who worked at Lepenski Vir as students, when burials were identified their excavation and recording was usually quite meticulous. But not all burials were recognized, or were only recognized after they had been disturbed by the excavators. In some cases (e.g. burials 29, 30, 49 and 60) only skulls and long bones were collected, even though the burials (according to the available photographs) were intact and the bones well preserved. In other cases, contextual data are imprecise. Some groups of bones were recorded only as coming from a particular 'cultural layer' and were not registered as 'burials'; yet these are sometimes represented by more skeletal elements than some of the identified burials. Furthermore, the material was washed on site by unskilled workers, and it is possible that some smaller bones and bone fragments were lost in the process. However, the frequency of small-sized human carpal bones and phalanges in the collection would seem to exclude this as a major factor affecting bone presence and preservation.

Since the excavations, the human bones from Lepenski Vir have been housed in the Faculty of Philosophy, University of Belgrade, where they have been studied by generations of researchers. Frequent handling took its toll on the collections, but most damage was a consequence of the economic and social problems that afflicted the former Yugoslavia in the 1980s and 1990s. During this period cardboard boxes and packaging materials were in short supply and storage space was at a premium. The collections could not be housed together in one area. There were not enough boxes to store the skeletons individually, and bones from two or more skeletons were occasionally placed together in the same box. Moreover, shelf space was limited with the result that boxes were piled on top of one another, which caused some to collapse. For a time a large part of the collection was housed in a damp basement, causing boxes and wrappings to disintegrate and mould to develop on some of the bones. Labels were also affected to some extent, but in the majority of cases were nevertheless still legible.

In 1997 with the support of the Wenner-Gren Foundation and logistical help from Prof. Ž. Mikić and students at the University of Belgrade, Roksandic was able to bring the collection together in one place, with proper shelving, and to embark on the task of restoring the collection to its original curatorial condition — work that took seven months. By 1998 she had reconstructed as much of the collection as she could, removed the mould from the bones, and recorded bone presence and preservation for each of the skeletons. A number of burials were found to be missing; some skeletons that appeared more or less intact in excavation photographs had few bones remaining in 1996–8; and discrepancies with the documentation and probable mixing of bones from different skeletons were consistently recorded.

This knowledge guided selection of samples for ^{14}C dating and stable isotope analysis in 2000. Even so, not all problems were resolved it seems, as illustrated by burials 4 and 7/I (see below).

Methods and results

Bone samples were prepared for AMS ^{14}C dating at the Oxford Radiocarbon Accelerator Unit (ORAU) using routine collagen extraction procedures (Law & Hedges 1989; Bronk Ramsey *et al*. 2000). An additional ultra-filtration pretreatment step was used to further purify the bone gelatin and retain only the >30-kD molecular weight fraction for ^{14}C assay (Brown *et al*. 1988; Bronk Ramsey *et al*. 2000). The <30-kD fraction may include degraded collagen fragments, salts, and contaminants that may be of a different ^{14}C age to the gelatin. We used the ratio of carbon to nitrogen (C:N ratio) to determine the chemical integrity of the extracted gelatin. All ratios were within the 2.9–3.6 range of acceptability for bone collagen used at ORAU. Yields of ultra-filtered gelatin that are below 10 mg g^{-1} are not dated routinely because they in-

Table 1. *AMS radiocarbon ages and stable isotope values for human burials from Lepenski Vir. Body position: Es – extended supine; Dd – dorsal decubitus; C – crouched; D - disarticulated; ? – uncertain*

Burial No.	Body position	Skeletal element	Lab ID	^{14}C age BP	δ^{13}C ‰	δ^{15}N ‰	Reservoir-corrected ^{14}C age BP	Calibrated age range (2σ) BC/AD	Median probability BC/AD
60	Es	R or L femur	OxA-11715	9470±55	-18.9	15.5	9020±80	8445–7953	8226
61	Es	R femur	OxA-11698	7860±50	-18.8	16.1	7374±80	6406–6071	6247
14	Es	R femur	OxA-11704	7830±45	-18.6	15.7	7368±75	6396–6072	6239
54c	Es	L femur	OxA-11696	7610±45	-19.6	12.4	7346±57	6365–6074	6205
26	Es	R tibia	OxA-11693	7380±45	-20.1	9.6	7284±47	6233–6056	6148
54e	Es	L femur	OxA-11697	7550±45	-19.1	13.0	7250±59	6227–6017	6126
7/I	Es	R femur[1]	OxA-12979	7697±38	-17.5	16.6	7183±77	6225–5907	6056
7/I	Es	R femur[2]	OxA-11692	7710±50	-18.1	16.2	7218±81	6243–5917	6094
62	Es	R femur or R tibia	OxA-11718	445±63	-18.5	9.3	—	*AD 1327–1635*	*AD 1465*
29	Es	L femur	OxA-11706	445±31	-18.4	9.4	—	*AD 1415–1606*	*AD 1445*
30	Es	R humerus	OxA-11717	477±34	-18.4	10.3	—	*AD 1404–1463*	*AD 1432*
69	Dd	L femur	OxA-11703	9180±50	-19.0	14.6	8784±72	8202–7609	7869
32a	C	L femur	OxA-5828	7270±90	-19.6	11.9	7036±95	6066–5728	5911
9	C	L femur	OxA-11695	7150±45	-19.4	10.8	6982±50	5983–5747	5866
88	C	Femur or L tibia	OxA-5831	7130±90	-20.2	10.5	6980±92	6023–5677	5862
8	C	L femur	OxA-11694	7050±45	-19.7	9.8	6942±47	5972–5729	5821
2	C	R femur	OxA-11719	5425±50	-19.5	10.6	5269±54	4236–3974	4108
4	C	L fibula	OxA-11699	485±31	-18.2	9.2	—	*AD 1405–1451*	*AD 1430*
54d	D	L femur	OxA-11700	7785±45	-17.7	15.2	7353±72	6385–6067	6219
45b	D	L femur	OxA-11701	7805±50	-18.5	15.8	7337±79	6388–6053	6198
79a	D	Scapula	OxA-11705	7780±50	-18.6	15.8	7312±79	6366–6029	6172
31a	D	L humerus	OxA-5827	7770±90	-18.7	15.7	7308±108	6401–5997	6177
44	D	R humerus	OxA-5830	7590±90	-18.9	15.3	7152±106	6233–5797	6027
89a	D	Tibia	OxA-11702	7595±45	-18.1	15.7	7133±75	6208–5845	6008
18	?	L ulna	OxA-11716	1874±40	-18.4	10.5	1724±44	*AD 219–420*	*AD 316*
35	?	Long bone	OxA-5829	6910±90	-19.7	11.2	6730±93	5792–5483	5643

[1] Sample collected in 2000
[2] Sample collected in 1989

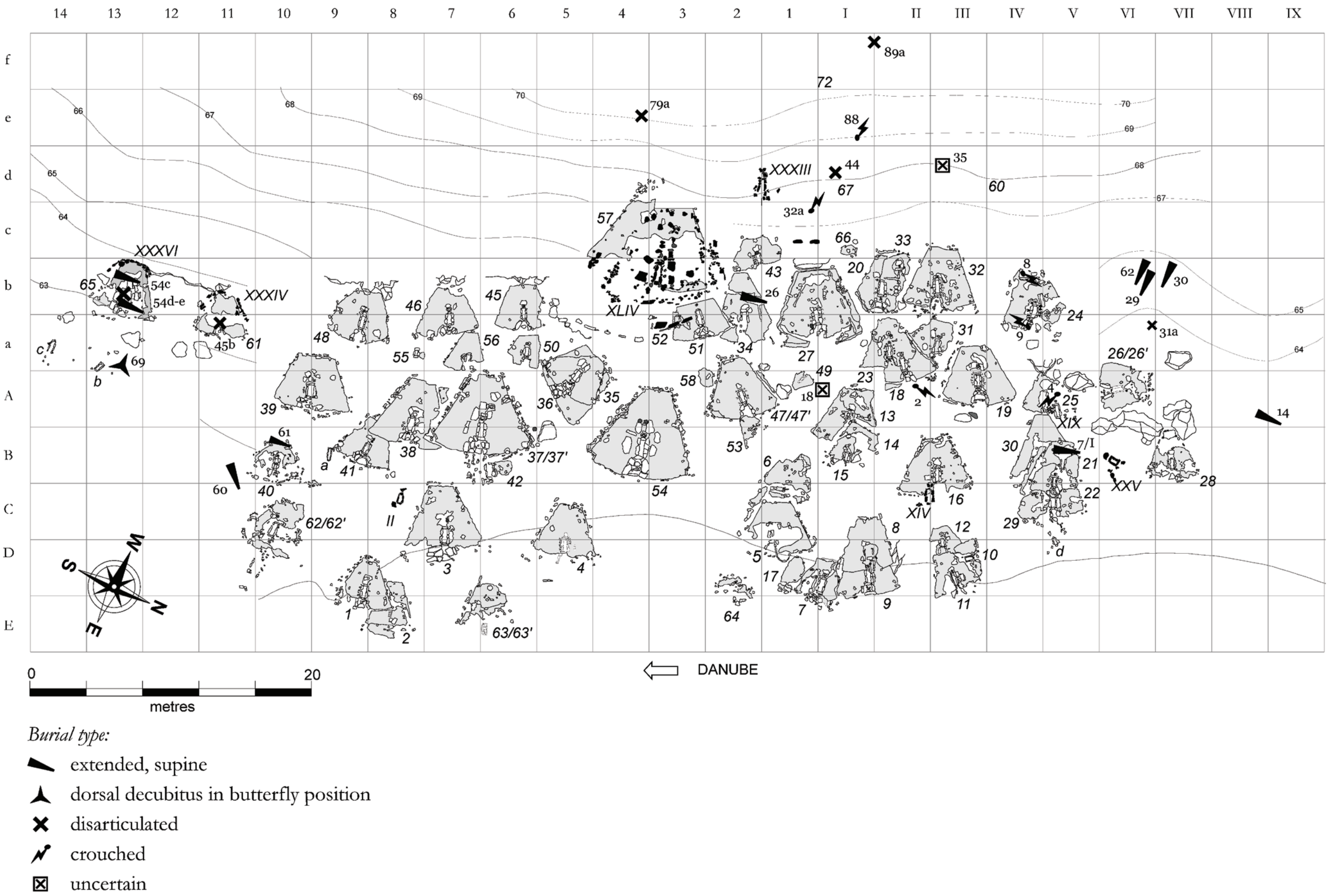

Figure 2 *Plan of Lepenski Vir showing the locations of the AMS ^{14}C dated burials (based on a drawing by Dušan Borić).*

dicate poor levels of collagen preservation. All of the ultrafiltered samples from Lepenski Vir were above this threshold.

The >30-kD fraction was lyophilized and analyzed using a Europa Scientific ANCA-MS system consisting of a 20–20 IR mass spectrometer interfaced to a Roboprep CHN sample converter unit operating in continuous flow mode. CO_2 from the combustion was trapped cryogenically and graphite was prepared by reduction of CO_2 over iron within an excess H_2 atmosphere. Graphite targets were then measured by AMS (Bronk Ramsey & Hedges 1997). Small samples of CO_2 (<1.6 mg C) were dated directly using the ORAU gas ion source (Bronk Ramsey & Hedges 1997). $\delta^{13}C$ values in this paper are reported in per mil (‰) with reference to VPDB and $\delta^{15}N$ results are reported with reference to AIR (Coplen 1994).

The radiocarbon results, both uncorrected and corrected for reservoir age, and the corresponding stable isotope values are presented in Table 2 together with results from five samples previously dated (Bonsall *et al.* 1997), and these 24 samples form the basis of the following discussion. The locations of the burials are shown in Figure 2.

The problem of burial 7

This burial included in the dating programme is currently the source of some debate. The burial, which according to Srejović (1972a: 120, 156) was inserted through the plaster floor in the rear of building 21, contained bones from at least two individuals. There was an almost complete, articulated skeleton (7/I) placed in the extended supine position. Originally published as female by Nemeskéri (1969), the skeleton was reassessed as that of an adult (middle-aged) male by Zoffmann (1983) and as 'male?' by Roksandic (1999). In addition, the isolated cranium (7/II) of an adult, classified as 'female' by both Zoffmann (1983) and Roksandic (1999), was found above the left shoulder of the skeleton. Animal bones were also recovered from the grave and assumed to have been deliberately placed there at the time of burial. These included the skull and horns of an aurochs, which lay on the right shoulder and upper rib cage of the skeleton (Fig. 6).

Samples of bone were collected in 1989, and again in 2000, from the right femur of the skeleton. Part of the sample collected in 1989 was analyzed for stable isotopes at the Scottish Universities Research Reactor Centre, East Kilbride (Bonsall *et al.* 2000), while the remainder of the sample collected in 1989 and the sample collected in 2000 were analyzed for AMS ^{14}C and stable isotopes at the Oxford Radiocarbon Accelerator Unit. The results of these analyses are presented in Table 2. The ^{14}C age (see Table 1) and the stable isotope data are consistent with the body position in indicating a Late Mesolithic context for the burial.

A sample of bone from burial 7/I was also analyzed for stable isotopes at Gisela Grupe's laboratory in Munich (Grupe *et al.* 2003; Borić *et al.* 2004). The results ($\delta^{13}C$, -19.7‰; $\delta^{15}N$, +11.5‰) differ markedly from those obtained at East Kilbride and Oxford. The difference between the two

Table 2 *Stable isotope results for Burial 7/I (right femur) measured at the East Kilbride and Oxford Radiocarbon Laboratories.*

Date collected	*Laboratory*	*$\delta^{13}C$ ‰*	*$\delta^{15}N$ ‰*
1989	East Kilbride	-18.4	+15.8
1989	Oxford	-18.1	+16.2
2000	Oxford	-17.5	+16.6

sets of stable isotope measurements (East Kilbride/Oxford *vs* Munich) is substantial, and not easily explained in terms of inter-laboratory differences in analytical procedures. Grupe *et al*. (2003) did not report which skeletal element was sampled for their study. If the sample was also taken from the right femur, then the discrepancy in the stable isotope results must be due either to analytical error or to a curatorial error between the time of sample collection and processing. The consistency of the results from East Kilbride and Oxford implies that the samples collected in 1989 and 2000 would not have been the source of the error. On the other hand, if Grupe *et al.* (2003) sampled a different skeletal element, then a third possibility exists — that the right femur sampled in 1989/2000 and the (unidentified) bone analyzed by Grupe did not belong to the same individual, perhaps reflecting curatorial problems prior to sample collection (see above).

Borić *et al*. (2004) attempted to explain the discrepancy in the stable isotope results in terms of misreporting of the samples that were analyzed. The burials in grave 7 were referred to by Nemeskéri (1969, 1972) and Zoffmann (1983) as burial 7/I (skeleton) and burial 7/II (isolated cranium), respectively. Other authors have referred to them as burials 7a and 7b. Borić *et al*. (2004) equate burial 7a with 7/I. However, when the skeleton (7/I) was sampled in the Department of Archaeology in Belgrade in 1989 and 2000 it was clearly labelled 'burial 7b'; the equivalence of '7/I' and '7b' was also reported by Roksandic (1999). Regardless of whether burial 7/I equates to '7a' or '7b', it can be stated categorically that the bone samples taken in 1989 and 2000 did not come from the cranium (7/II) as suggested by Borić *et al*. (2004).

Discussion

Burial practices

A number of distinct forms of burial are represented at Lepenski Vir. They include: (i) extended (supine) inhumation; (ii) supine inhumation in the 'butterfly position'; (iii) crouched inhumation; and (iv) burial of disarticulated bones.

Extended supine inhumations

This burial mode is where the individual is laid on their back with the legs extended straight out (Figs 3–9). It appears to have been a characteristic burial form of the Mesolithic of the Iron Gates, directly dated examples from other sites in the region ranging in age between *c*. 9800 and 7500 BP (Bonsall *et al*. 1997; Boroneanț *et al*. 1999; Borić & Miracle 2004).

Ten examples of this burial type from Lepenski Vir (burials 7/I, 14, 26, 29, 30, 54c, 54e, 60, 61, and 62) were included in the current study. The results fall into three distinct periods:

1. By far the earliest in the series is burial 60 with a reservoir-corrected ^{14}C age of 9020±80 BP, which places it in the Early Mesolithic. The skeleton is probably that of an adult male, aged between 25 and 40 years at the time of death (Roksandic 1999). Located in the south-east part of the site, just beyond the zone with later trapezoidal buildings (which may explain why the grave remained more or less undisturbed prior to excavation) this burial is unusual at Lepenski Vir in being oriented more or less perpendicularly to the Danube (SW–NE) with the head away from the river. Radovanović (1996a: 186) reported only one other adult extended inhumation of presumed Mesolithic age from the site (burial 28) with the same orientation. Extended inhumations laid out perpendicular to the Danube are better represented at other sites in the Iron Gates gorge, such as Hajdučka Vodenica, Padina and Vlasac but, according to the ^{14}C evidence, were not confined to the Early Mesolithic. Burial 60 is the earliest dated burial from Lepenski Vir, and one of oldest known from the Iron Gates region — burials dating before 9000 BP were also found at Padina (Borić & Miracle 2004) and Vlasac (Bonsall *et al*. 1997). The ^{14}C date for burial 60, together with stable isotope values reflecting a diet heavily dependent on aquatic resources (cf. Bonsall *et al*. 1997), suggests that Lepenski Vir was already being used as a residential site or seasonal fishing camp in the very early Holocene.
2. Six burials (7/I, 14, 26, 54c, 54e, and 61) have reservoir-corrected ^{14}C ages ranging between 7374±80 and 7200±56[2] BP, and the 1-sigma calibrated age ranges overlap indicating that the results are statistically indistinguishable. The dates suggest that the burials coincided with the well-documented cold phase between *c*. 6400–6000 cal BC, known as the '8200 cal BP event' (Alley *et al*. 1997; Clark *et al*. 2001; Magny 2003) — a period that is not well represented by radiocarbon dates from other Iron Gates sites (Bonsall *et al*. 2002a). Archaeological opinion is divided on whether this phase in the use of Lepenski Vir should be interpreted as 'Final Mesolithic' (e.g. Bonsall *et al*. 2004), 'Neolithic' (e.g. Borić 2002b), or 'transitional' (e.g. Roksandic 2000; Borić *et al*. 2004). Of the six dated burials, five were adults (including both males and females) and one (burial 61) was a child aged 2–6 years (Roksandic 1999). With the exception of burial 14, they occurred within trapezoidal buildings of 'LVI–II'. In contrast to the much earlier burial 60, all were oriented roughly parallel to the river with the heads downstream, although there was some variation in body position, notably in the placement of the arms (Appendix 1). Burial 54c is distinctive in that the skull was missing; in contrast isolated crania were found in several contexts at Lepenski Vir, including grave 7 (see above). Since there are clear parallels in earlier contexts elsewhere in the region, including Schela Cladovei and Vlasac, burial 54c may represent the continuation of a Mesolithic tradition of skull removal and skull caching in the Iron Gates. Burials in the extended, supine position and oriented parallel to the Danube are very well-represented at Lepenski

Figure 3. *Burial 26 inserted through the plaster floor of building 34. Photo: Institute of Archaeology, Belgrade.*

Figure 4. *Building 34 and the outline of grave 26 prior to excavation. Photo: Institute of Archaeology, Belgrade.*

Figure 5. *Burial 7 (an extended supine inhumation) inserted through the plaster floor of building 21. The photograph shows the burial in process of excavation and what appears to be the outline of the 'grave pit'. Photo: Institute of Archaeology, Belgrade.*

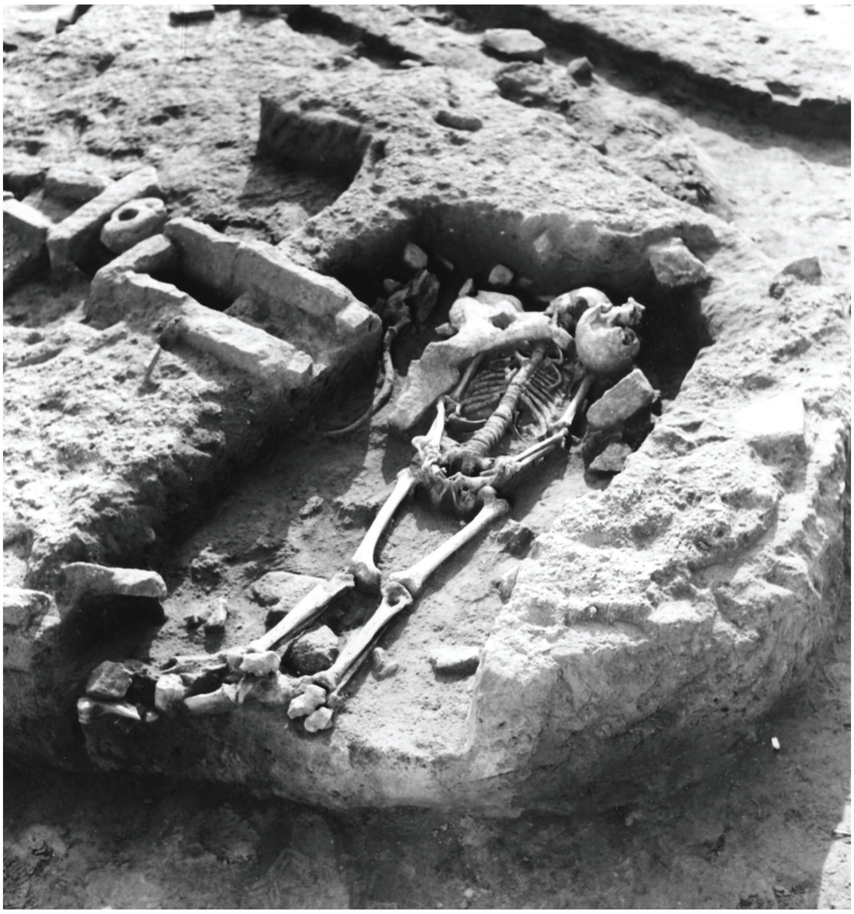

Figure 6. *Burial 7 after excavation. The 'grave pit' has been artificially enlarged, and the positions of various items interpreted as burial goods can be seen — a human cranium (7/II) above the left shoulder of the skeleton, an aurochs skull with horns above the right shoulder, and below the hearth a red deer skull with antlers attached. Photo: Institute of Archaeology, Belgrade.*

Figure 7. *Burial 54c (extended supine inhumation) in building 65, lacking the skull. Disarticulated bones from other individuals can be seen at a higher level, to the right of the articulated skeleton. Photo: Institute of Archaeology, Belgrade.*

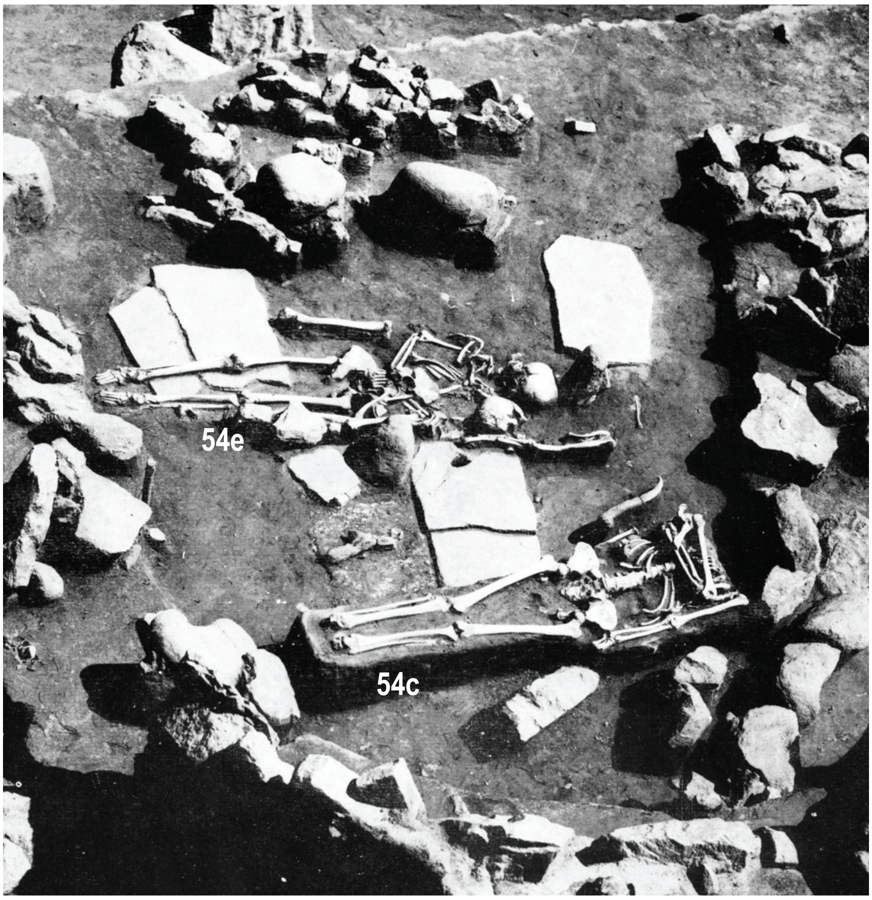

Figure 8. *Burials 54e and 54c (extended supine inhumations) in building 65. 54e lies directly on the floor of the building; a disarticulated skull and bones belonging to one or more other individuals occur around and resting on the upper body of the skeleton. Photo: Institute of Archaeology, Belgrade.*

Figure 9. *Burial 61 (extended supine inhumation of a juvenile) in building 40. Photo: Institute of Archaeology, Belgrade.*

Vir. Radovanović (1996a: 174–187) lists a number of other examples (both adults and children, including neonates), and some of these, though not all, were found within or under trapezoidal buildings. It remains to be established by direct ^{14}C dating how many of them also belong to the period between 6400 and 6000 cal BC.

3. The remaining three burials are much later in date. The ^{14}C ages for burials 29, 30 and 62 are very similar at 445±31, 477±34 and 445±63 BP, respectively. These and a fourth burial (49) were identified in the excavation records from Lepenski Vir as probably belonging to the 'Slavic' period, i.e. after the 7th century AD. All four burials are described by Roksandic *et al*. (2007). The three dated individuals were found close together in the north-west corner of the site (Fig. 2). The skeletons were oriented more-or-less E–W, with the heads to the west — similar to Early Mesolithic burial 60, and distinct from the 'period 2' burials. The excavation records suggest that they occurred at about the same depth with no associated grave goods. Although the burials were described as well-preserved, only a few bones appear to have been kept by the excavators. Osteological analysis suggests that all four individuals were young or middle-aged adult males. The skull of one individual shows signs of an injury caused by a sharp instrument, probably a heavy metal-bladed weapon, although signs of healing of the wound indicate that this was not the cause of death. Roksandic *et al*. (2007) have suggested that the four 'Slavic' period burials were those of soldiers involved in border warfare along the Danube, which was prevalent in the late 14th and early 15th centuries, except for a brief period of peace between 1403 and 1425. Soldiers would not necessarily have been born or lived locally and if no correction is applied for the River Danube reservoir effect, then the pooled mean of the ^{14}C ages of the three dated individuals, which is 458±22 BP (1415–1455 cal AD), is consistent with the interpretation proposed by Roksandic *et al*. (2007).

Dorsal decubitus inhumation in the 'butterfly' position

Burial 69 (Fig. 10) is the only example of a burial from Lepenski Vir in this position where the individual is lying on the back (dorsal decubitus) and the legs are flexed and splayed with the soles of the feet together, reminiscent of the butterfly pose in yoga. Like burial 60, burial 69 was found in the south-east corner of the site outside the zone with trapezoidal buildings, and was oriented perpendicularly to the river with the head upslope. The burial occurred in 'virgin' soil, beneath a pile of stones. According to Srejović (1972a: 117–118) the body was placed in a trapezoidal grave pit *c*. 1.10m long and the position of the head, bent forward on the chest, was taken to indicate that it had been supported by the rear wall of the grave.

The similarity in 'shape' and orientation between burial 69 and the majority of the trapezoidal plan buildings at Lepenski Vir led Srejović to suggest that the burial belonged to a phase immediately preceding the construction of the first plaster-floored buildings (Srejović 1972a: 117). However, the reservoir-corrected ^{14}C age for burial 69 (8784±72 BP) is substantially older than the ages of the charcoal samples from the buildings, implying that it derives from a much earlier period in the use of the site. Thus burial 69 can be regarded as Early Mesolithic, but on the radiocarbon evidence probably somewhat later than burial 60.

Borić & Miracle (2004) identified parallels for burial 69 at a number of other Iron Gates sites, specifically Padina (burials 15 and 16), Vlasac (burial 17), Kula (burial 5), Velesnica (burial 2G), and Ostrovul Corbului (burial 25). In most of these cases, however, the resemblance is not exact. For example, burials 15 and 16 at Padina are in a sitting position with the legs crossed (Radovanović 1996a: fig. 4.1; Borić & Miracle 2004: fig. 8), and burial 5 at Kula (Sladić 1986) also has the legs crossed. Only Velesnica burial 2G (Vasić 1986, this volume; Roksandic, this volume) is laid on the back (dorsal decubitus position) with the soles of the feet together. Currently, the only directly dated burial from this group is

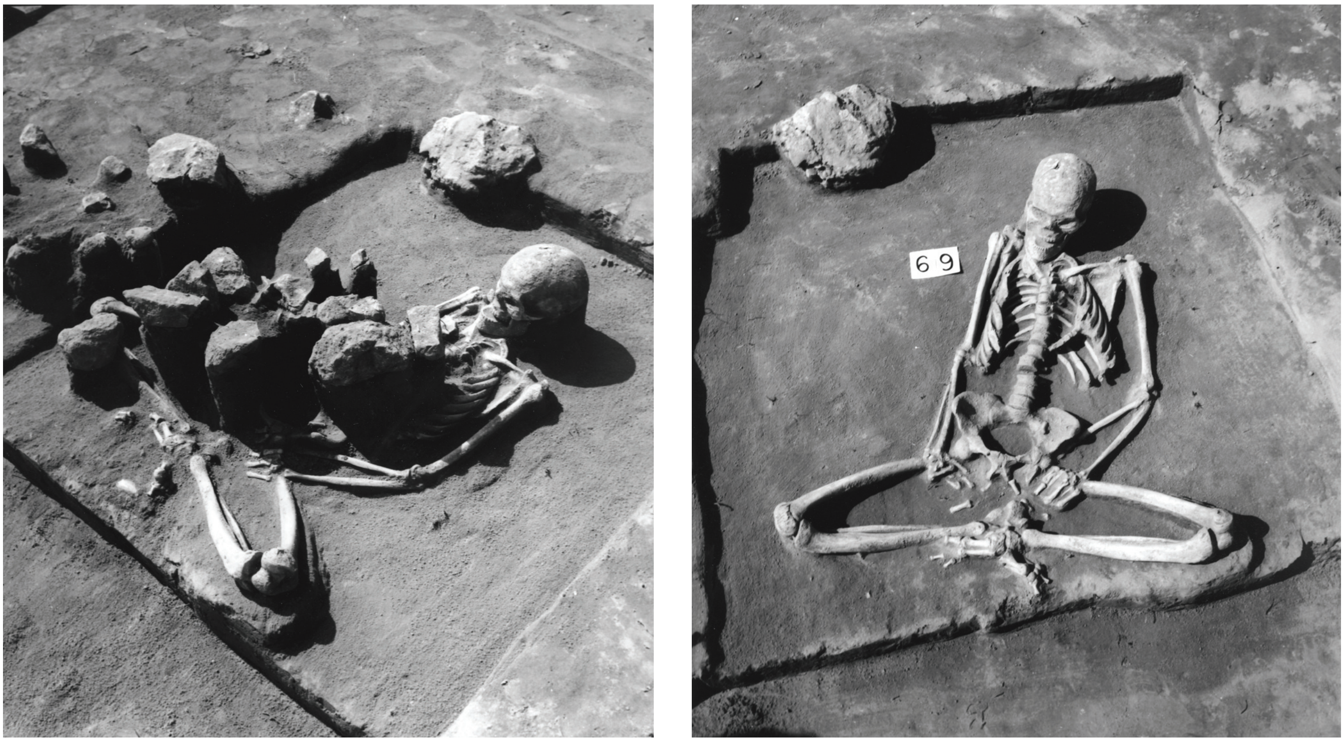

Figure 10. *Burial 69 (dorsal decubitus inhumation in the 'butterfly' position). Left: the burial with its original covering of stones. Right: after removal of the stones. Photos: Institute of Archaeology, Belgrade.*

burial 15 from Padina, with a reservoir-corrected ^{14}C age of 9138±71 BP; another 'seated' burial from Padina (burial 21) was dated at 9729±73 BP (Borić & Miracle 2004: table 3). On this evidence, the seated burials from Padina are Early Mesolithic, but somewhat older than burial 69 at Lepenski Vir.

Crouched inhumations

There are a number of examples of burials at Lepenski Vir where the body was laid out in a crouched or tightly flexed position (as defined by McKinley & Roberts 1995: 4). In the wider region of the central and northern Balkans crouched inhumation was characteristic of the Early Neolithic Starčevo culture (Tringham 1971), but was also common in the later Neolithic to Early Bronze Age (e.g. Ciugudean 1996; Whittle 1996).

We dated six crouched inhumations from Lepenski Vir (Table 1; Fig. 11). One of these, burial 2, was associated with pottery of the Salcuța culture. The reservoir-corrected ^{14}C age of 5269±54 BP confirms the Chalcolithic (Eneolithic) dating. Burials 8, 9, 32a and 88, which were assigned by Srejović (1969) to the Starčevo culture, gave reservoir corrected ages between 7036±95 and 6942±47 BP. These ages are statistically indistinguishable and confirm the Early Neolithic attribution. The stable isotope ($\delta^{13}C$ and $\delta^{15}N$) values for these four burials and burial 2 (Table 1) are indicative of diets based largely on terrestrial food sources, further supporting the post-Mesolithic dating.

Borić and Dimitrijević have also reported reservoir-corrected dates for crouched inhumations, though only in graphical form (Borić & Dimitrijević 2007: fig. 3). Burial 19 in building XLIV/57 has a calibrated age of *c*. 5950 BC (which equates to *c*. 7080 BP, uncalibrated) consistent with the Early Neolithic. Burial 5, found in grid square A/VI (Fig. 2), may also be of Early Neolithic date. A bone tool reported to have been found with this skeleton has a calibrated ^{14}C age of *c*. 6015 BC (which equates to *c*. 7135 BP, uncalibrated) (Borić & Dimitrijević 2007: fig. 3). However, there is some doubt about the association of the skeleton and the bone artefact; in the *Field Burial Record* for Lepenski Vir it is recorded that no grave goods were found with burial 5, while an entry in the *Field Journal* for 19 July 1967 includes a note that a " bone awl was found in the pelvic area".

Other, undated, crouched inhumations from Lepenski Vir were assigned by Srejović to his IIIa and IIIb (Starčevo culture) phases. However, in the absence of direct ^{14}C age measurements, it would be premature to conclude that they are all of Early Neolithic date. Although crouched burials are rare in Southeast Europe after the Early Bronze Age, they do occur occasionally even as late as the Medieval and post-Medieval periods where the rite seems to be associated with social outcasts such as 'witches' or 'mad' people, the bodies being bound up to prevent the individuals from 'causing trouble' (A. Choyke, pers. comm.; Taylor 2002).

It is interesting, therefore, that another crouched inhumation included in our dating programme, burial 4 (Fig. 11, right), produced the unexpectedly late ^{14}C date of 485±31 BP (OxA-11699). This is very similar to the dates obtained on bones from burials 29, 30 and 62 (see above), which were buried in the Late Medieval (Christian) tradition, lying on the back, fully extended, with the head to the east. The associated stable isotope values are also in agreement with a Late Medieval date; the relatively heavy $\delta^{13}C$ (combined with light $\delta^{15}N$) is characteristic of post-Bronze Age populations

Figure 11. *Crouched inhumations. Left: burial 8 (bottom) and burial 9 (top), above building 24. Right: burial 4, above building 25. Photos: Institute of Archaeology, Belgrade.*

in parts of Southeast and Central Europe, and probably reflects a farming economy where millet (a C_4 plant) was a staple crop grown for human consumption and/or animal fodder (Murray & Schoeninger 1988; Bonsall *et al*. 2000, 2004, 2007). The chances of the paired ^{14}C and stable isotope results being erroneous due to analytical error, or that one of the Late Medieval samples submitted for dating was inadvertently measured twice, are extremely small. A more likely explanation is that either burial 4 is Late Medieval in date, or the bone that was sampled came originally from another burial and was wrongly assigned to burial 4. In view of this uncertainty, OxA-11699 should be regarded as suspect and new ^{14}C measurements undertaken to confirm the date of burial 4.

Disarticulated bone burials

At Lepenski Vir there were many finds of disarticulated human bones, individually or in groups. It is likely that some (perhaps the majority) of these occurrences result from unintentional post-depositional disturbance of articulated burials and dispersal of the bones, either by later human actions (e.g. the digging of new graves or building foundations) or by natural processes. However, disarticulated bones were sometimes found in contexts suggesting deliberate burial of the bones or, in some cases, of body parts still held together by soft tissue. These were either buried separately or added to graves containing an intact body. They are generally interpreted as instances of 'delayed' or secondary burial linked to the practice of excarnation (Srejović 1972a: 117), which raises the possibility of storage and even 'use' of the (ancestral) bones for a time prior to burial. This treatment was afforded to the bones of adults (males and females) and children.

Samples from six disarticulated bone burials were included in our dating programme. These were from burial 54d in building 65 (Fig. 8), burial 45b in building 61 (Fig. 12), and burials 31a, 44, 79a, and 89a. With the exception of burial 79a where a scapula was sampled, all the samples for dating were taken from the shafts of long bones.

Burial 54d has been the source of some debate. It consists of a cranium and several long bones which were found in various positions around or resting on the upper body of a more or less complete, articulated skeleton, burial 54e (Fig. 8). According to the field notes made at the time of excavation (see also Srejović 1972a: 118), burial 54d was considered to be the earliest burial in building 65 and originally articulated, but subsequently disturbed by the insertion of burial 54e. However, the fact that the bones of burial 54d are so few in number and may belong to more than one individual (Roksandic 1999) casts doubt on this interpretation. It is also worth noting that the detached skull of 54d rests on the left shoulder of skeleton 54e, similar to the position of the detached skull (7/II) with respect to the articulated skeleton (7/I) in grave 7 (compare Figs 6 & 8). Thus, it seems much more likely that burial 54d represents an instance of deliberate secondary disposal of disarticulated bones or body parts, that were emplaced at the same time as burial 54e (see also Radovanović 2000: 336).

In cases of secondary disposal, the time interval between the death of the individual and final burial of the bones is unknown. Thus, radiocarbon dating will only provide an approximation of the time of death but not of final interment,

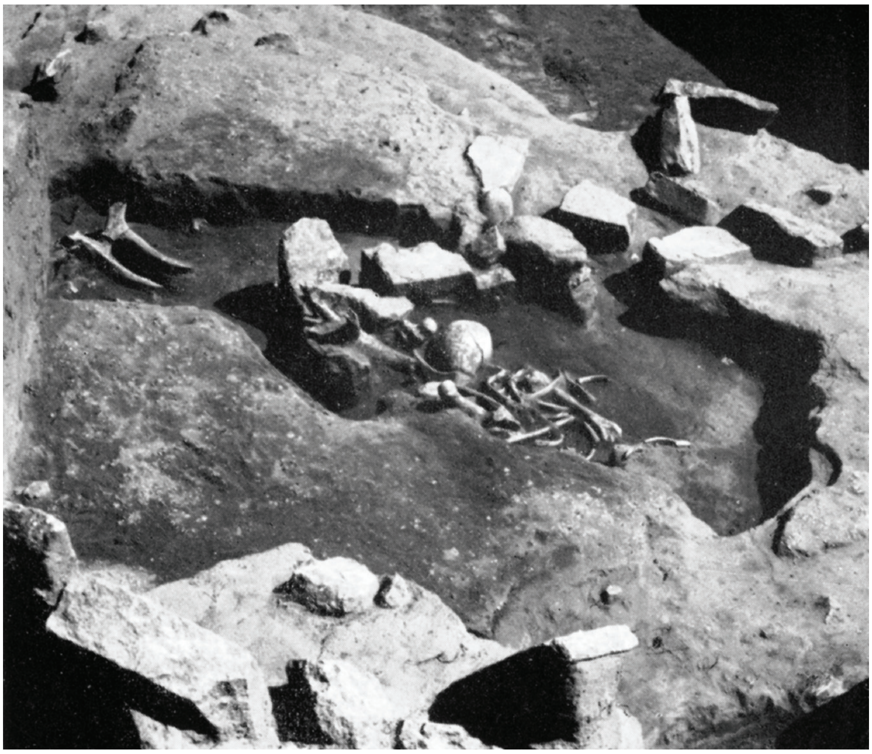

Figure 12. *Disarticulated bone burial (45b) inserted through the plaster floor of building 61. Photo: Institute of Archaeology, Belgrade.*

Figure 13. *Disarticulated human cranium (burial 122) above the hearth of building 47′. Photo: Institute of Archaeology, Belgrade.*

Table 3. *Srejović–Zoffmann phasing of the burials. Body position: Es – extended supine; Dd – dorsal decubitus; C – crouched; D – disarticulated; ? – uncertain.*

Burial	Reservoir-corrected ^{14}C age BP	Body position	Srejović–Zoffmann phasing
60	9020±80	Es	Ic
69	8784±72	Dd	Proto-LV
61	7374±80	Es	Ic
14	7368±75	Es	I–II
54d	7353±72	D	Ib
54c	7346±57	Es	Ib
45b	7337±79	D	I
79a	7312±79	D	—
31a	7308±108	D	IIIb
26	7284±47	Es	I
54e	7250±59	Es	Ib
7/I	7218±81	Es	I
44	7152±106	D	IIIb
89a	7133±75	D	II
32a	7036±95	C	IIIb
9	6982±50	C	IIIb
88	6980±92	C	IIIa
8	6942±47	C	IIIb
35	6718±93	?	IIIb
2	5269±54	C	Salcuța
18	1724±44	?	IIIb
62	445±63*	Es	Medieval
29	445±31*	Es	Medieval
30	477±34*	Es	Medieval

* No reservoir correction applied.

which may have occurred weeks to centuries later. The reservoir-corrected ages of the six disarticulated burials included in this study range from 7353±83 to 7133±75 BP, while the $\delta^{13}C$ and $\delta^{15}N$ ranges are -17.7 to -18.6‰ and +15.2 to +15.8‰ respectively, indicating diets that were heavily dependent on aquatic food sources. This evidence indicates that the practice of 'delayed'/secondary burial was certainly applied to the bones of Mesolithic people. Even if the bones are from 'Mesolithic' people, it is conceivable (though unlikely) that final burial of the remains took place after the Mesolithic. Similar evidence of secondary burial is well documented from older Mesolithic contexts elsewhere in the Iron Gates, notably at Schela Cladovei on the Romanian (left) bank of the Danube (Boroneanț *et al.* 1999; Bonsall 2003).

It is an interesting question whether the practice of secondary burial continued into later periods at Lepenski Vir. Zoffmann (1983: 130) reported that disarticulated human bones were found in "Starčevo pits and Starčevo layers" at Lepenski Vir. The Early Neolithic crouched inhumation (burial 19) from building XLIV/57 dated by Borić and Dimitrijević (2007: fig. 3) lacked the skull. According to the *Field Burial Record*, a separate cranium occurred on a stone plaque above the skeleton, and a maxilla was found to the south at the same level as the skeleton. The skeleton, cranium and maxilla were assumed by the excavators to belong to the same individual, but there are no ^{14}C dates or stable isotope measurements for the cranium or maxilla to support this interpretation. Burial 35, dated to the Starčevo period (Table 1; Bonsall *et al.* 1997) has been interpreted as the secondary burial of a detached skull (Borić & Stefanović 2004: fig. 7), However, the field notes pertaining to this burial record that it was only partially excavated; it occurred at the very edge of a trench, several bones including a skull were removed, but other bones were left "in the section" unexcavated (Appendix 1). This description implies that burial 35 was not an instance of skull caching, but possibly an articulated (crouched?) burial. Another possible, post-Mesolithic example of a secondary burial that was included in our dating programme is burial 18. Dated to the Roman period (Table 1), it is described in the field notes as 'disarticulated'. However, judging from the field description, the bones could be from a disturbed context rather than a case of deliberate interment of disarticulated remains.

Phasing of the burials

The validity of the phasing of the Lepenski Vir burials proposed by Srejović and Zoffmann (Srejović 1969; Zoffmann 1983; Radovanović 1996a; Srejović, pers. comm. 1989) was first questioned by Bonsall *et al.* (1997) on the basis of bone collagen stable isotope analyses. They noted that several burials assigned to LVIIIa or IIIb yielded heavy $\delta^{15}N$ values, similar to those obtained from the majority of skeletons assigned to the 'Mesolithic' phases LVI and LVII (Bonsall *et al.* 1997: table 5). Moreover, two of the 'LVIII' burials produced ^{14}C ages that were more consistent with the Mesolithic, although at that time a reservoir correction was not being applied to the ^{14}C ages.

The extension of this dating programme, detailed here, provided a further opportunity to test the Srejović–Zoffmann phasing of the burials (Table 3). The results show that when the human remains had a clearly identifiable burial rite and/or diagnostic burial goods, the phasing proposed by Srejović/Zoffmann was broadly correct. For example, all the extended supine burials are assigned to phases I or II and all the crouched burials are assigned to phase III, except for burial 2, which was associated with typical Eneolithic (Salcuța) pottery and assigned to that period.

However, when the disarticulated burials are considered, there is a poor correlation between the Srejović–Zoffmann phasing and the radiocarbon ages. Similarly, within the group of extended supine burials, there is a poor correlation between the sub-phase assignments (LVIa–e) and the radiocarbon ages (to a lesser extent, the same is perhaps true of the crouched burials with respect to the LVIIIa–b sub-phasing). The most likely explanation for this is that phasing of these 'undiagnostic' burials relied on stratigraphic observations or the level at which a burial occurred — further evidence, perhaps, of the stratigraphic complexity of Lepenski Vir.

A special case is represented by burial 69, which was assigned by Srejović (1969, 1972a) to his 'Proto-Lepenski Vir' phase. Srejović's phasing of the Lepenski Vir site (as opposed to the burials) was based primarily on architectural evidence. The 'Proto-Lepenski Vir' phase was represented by remnants of stone-bordered hearths, which occurred in a narrow zone along the riverbank between the normal high water mark and the trapezoidal buildings of 'Lepenski Vir I–II'. There are no radiocarbon measurements on organic materials associated with the 'Proto-Lepenski Vir' hearths and no direct stratigraphic relationship was observed between these hearths and the buildings of Lepenski Vir I. Equally, there is no documented stratigraphic relationship between the hearths and burial 69. Srejović assigned burial 69 to 'Proto-Lepenski Vir' partly on the basis of the level at which it was found (said to be equivalent to the level of the 'Proto-Lepenski Vir' hearths) but primarily on the basis of the body position and the shape and orientation of the grave. As noted above, this led Srejović to suggest that the burial could be seen as the precursor of the architectural tradition represented by the trapezoidal plaster-floored buildings, and that it belonged to a phase immediately preceding the earliest phase of their construction (Srejović 1972a: 117–118). Radiocarbon dating has shown that, while burial 69 does indeed predate the earliest known trapezoidal buildings, it does not immediately precede them in time, nor is it necessarily the earliest burial on the site.

Architecture

The dating of the trapezoidal, plaster-floored buildings at Lepenski Vir rests on several lines of evidence: (i) the radiometric ^{14}C ages of charcoal samples from the buildings that could be interpreted as representing structural timbers or fuel; (ii) AMS ^{14}C ages of human burials with a direct stratigraphic relationship to a building; (iii) AMS ^{14}C ages of terrestrial animal bone material that was potentially related to a building; and (iv) the stratigraphic relationships of the buildings themselves, i.e. where one building was superimposed (partially or wholly) on another. In principle, the charcoal ages provide absolute dates for the construction or use of the buildings, while the other lines of evidence provide information on the relative ages of the buildings.

Charcoal ages

The first attempt to establish an absolute chronology for the major architectural features (the trapezoidal buildings) at Lepenski Vir was based on radiometric ^{14}C dating of charcoal recovered from a number of the buildings. Charcoal samples from 14 of the trapezoidal-plan, plaster-floored structures that are unique to this site gave ^{14}C ages ranging from 7430±160 to 6560±100 BP. This provides a possible time-range for the buildings of between 7750 and 6360 BP (*c*. 6590–5320 cal BC). According to Quitta (1972), the charcoal samples were recovered from:

> "... house floors or from the occupation layers immediately above them. Only in a few cases were they recognisable as elements of a house: parts of a burnt beam, for instance, from houses 36 and 37" (Quitta 1972: 205).

However, Borić (2002a: appendix 1) has provided information based on the original excavation records, which suggests that for at least 16 of the samples dated the charcoal came from contexts contemporaneous with the construction or use of the buildings. On the basis of the data presented by Borić (2002a: appendix 1), the buildings were built, or at least in use over a period from at least 7335±70 BP (weighted mean of two determinations for building 36) to 6620±100 BP (single date for building 51), equivalent to an overall time-range from 7475 to 6420 BP (6374–5380 cal BC).

This interpretation is complicated by two potential sources of error, (i) the charcoals from the 'houses' were from long-lived species — oak (*Quercus* sp.) and elm (*Ulmus* sp.) — which could produce an 'old wood effect', and (ii) some samples representing structural timbers could have been recycled from earlier buildings. Both of these would result in ^{14}C ages that are older than the true construction ages of the buildings. It should also be borne in mind that only a relatively small number of contexts were dated and, therefore, the range of ages may not be representative of the entire timespan over which construction of the trapezoidal buildings took place.

Dating buildings in relation to burials

A significant number of the burials at Lepenski Vir occurred in a direct stratigraphic relationship to trapezoidal structures and thus potentially provide additional information on the ages of the buildings. Nine such burials were included in our dating programme; they comprise seven examples of articulated burials, and two disarticulated bone burials. The following general principles are adopted here. A known-age burial that was sealed by a plaster floor establishes a *terminus post quem* (TPQ or maximum age) for the overlying building. A known-age articulated burial that cuts through a plaster floor can be presumed to be no older than the floor and therefore establishes a *terminus ante quem* (TAQ or minimum age) for the building.[3] However, a disarticulated bone burial that was inserted through a plaster floor does not establish a TAQ for the building, since the bones may have been stored for a significant number of years before burial. Similarly, a known-age articulated burial that overlies a plaster floor provides a TAQ for the building, but a disarticulated burial overlying a plaster floor does not.

a) Burials inserted through plaster floors

Two articulated burials fall into this category: burial 7/I in building 21 (Figs 5 & 6), and burial 26 in building 34 (Figs 3 & 4). The reservoir-corrected ^{14}C ages of these burials are very similar: 7218±81 BP and 7284±47 BP, respectively. In the case of burial 26 there is clear photographic and documentary evidence that the grave was dug through the plaster floor of building 34 (see Fig. 4). We are not aware of any photograph or field drawing of building 21 *prior to* the excavation of burial 7/I that shows a similar grave-sized disturbance in its plaster floor. However, if the excavator's interpretation (Srejović 1972: 120) is correct, then burials 7/I and 26 must be younger than the buildings to which they relate. Thus building 34 was probably built no later than 6056 cal BC and building 21 no later than 5917 cal BC (the respective younger limits of the 2-sigma calibrated age ranges). Since building 21 is superimposed upon buildings 22, 29 and 30 (Fig. 2), the ^{14}C age of burial 7/I also establishes a TAQ for these structures.[4]

b) Burials overlying building floors

Articulated burials overlying the plaster floors of two trapezoidal buildings at Lepenski Vir were included in our dating programme.

Burials 8 & 9 in building 24 have reservoir corrected ^{14}C ages of 6942±47 and 6982±50 BP, respectively, and exhibit the crouched body position characteristic of Early Neolithic (Starčevo culture) burials from the central and northern Balkans. Judging from photographic evidence (Fig. 11, left), the skeletons lay above the plaster floor but were not in contact with it, suggesting that both individuals were buried in the infilling of the 'house pit' — it is not known if the corpses were placed in grave pits, or laid directly on the ground and covered with soil material or stones. Thus, the interments must have occurred sometime after building 24 was abandoned, although their apparently deliberate placement with respect to the structure suggests the 'house pit' was still visible (i.e. not completely filled in) at the time of burial. On this evidence, building 24 is probably no younger than 5729 cal BC (the younger limit of the 2-sigma calibrated age range of burial 8), but it could be earlier than that date.

Other burials were found within or adjacent to building 24. They include the (articulated?) skeletons of four neonates (burials 94, 95, 101 and 102). These were not discovered until 1970, when the floor of building 24 was lifted as part of conservation work at the site — that is, several years after building 24 was first exposed and burials 8 and 9 excavated. Judging from the positions of burials 94 and 101 with respect to burial 8,[5] they may have been emplaced before burial 8. However, an AMS ^{14}C date for burial 94 reported by Borić & Dimitrijević (2007: fig. 3) is not significantly different from that for burial 8, i.e. any age difference is too small to be resolved given the precision on the AMS measurements. Borić & Stefanović (this volume; see also Stefanović & Borić 2004: fig. 10) have suggested that the neonates were buried in pits among stones at the rear of building 24. However, it is not clear from the original excavation records whether the stones represent a stone construction built to accommodate the burials, as suggested by Borić & Stefanović (this volume, page 144), or were part of the foundations of building 24, or elements of an earlier trapezoidal structure (building 24a — cf. Srejović 1969: 89) on which building 24 was superimposed. Whatever the explanation, the stratigraphic relationship of the neonate burials to building 24 is unclear, and so they provide no reliable additional information about the dating of building 24.

Building 65, in the south-west corner of the site, contained two articulated burials (54c and 54e) and several disarticulated burials (54a, 54b, 54d, and 47). The articulated burials are extended inhumations, with the same orientation, parallel to the Danube (see above). Judging from photographic evidence (Figs 7 & 8), skeleton 54e lay directly on the floor of building 65, while skeleton 54c occurred within the infill of the 'house pit'. As noted above, skeleton 54c lacked the skull — one of several examples of 'headless' skeletons from Lepenski Vir. Since there is no evidence in any of these cases of actual decapitation (in the form of cut marks), it is likely that the skulls were removed after decomposition of the soft tissue. This raises the question of how defleshing and skull removal were achieved without otherwise disturbing the skeleton. Deep burial followed by exhumation seems unlikely. Shallow burial or surface exposure to allow the flesh to rot away carries the risk of disturbance by scavengers; moreover, removal of the flesh by mammalian and some avian scavengers would be expected to leave marks on the bones, for which there is no evidence. Another method would have been to lay the body out on the ground and cover it with stones. Figure 7 shows building 65 at an early stage of excavation. Visible on the photograph is an elongated heap of stones in a position that appears to correspond with that of extended burial 54e at a lower level (cf. Fig. 8). This suggests that burial 54e was laid directly on the floor of building 65 and covered with stones. The same may have been done with burial 54c and the cairn subsequently dismantled or partially dismantled to allow the skull to be removed. Cairn burial was not uncommon in the Iron Gates Mesolithic; examples are known from several sites, including Lepenski Vir and Padina, dating back to the Early Mesolithic.

If articulated burials 54e and 54c were cairn burials, their respective positions in relation to the floor of building 65 would imply that 54e is the older burial. The ^{14}C ages of 7250±59 BP (54e) and 7346±57 BP (54c) are not significantly different and therefore neither support nor contradict this interpretation, but they do suggest that the two burials were not widely separated in time. Since the burials overlie the plaster floor, the ^{14}C data suggest that building 65 was constructed some time prior to 6017cal BC (the younger limit of the 2-sigma calibrated age range of burial 54e).

c) Burials sealed by plaster floors

A significant number of the burials from Lepenski Vir were reported as having been found below the plaster floors of trapezoidal buildings. Many of these were neonates (see Stefanović & Borić 2004; Borić & Stefanović, this volume), but they include the burials of older individuals. Often, however, it is not clear whether a burial was sealed by a plaster floor, or was inserted through the floor. Also, there is always the possibility of a plaster floor being repaired following interment, and the repair not recognized during excavation.

Burial 61, the extended supine inhumation of a child (Fig. 9), has sometimes been cited as an example of an articulated burial found below the plaster floor of a trapezoidal building, and for that reason was included in our dating programme. Srejović (1969, 1972a) described burial 61 as "...buried beneath the rear wall of building no. 40" He went on to observe that "the skeleton ... takes up the whole of the 'rear' wall, and a representational sculpture was placed on the floor above its head" Accordingly, he suggested that, "the burial took place immediately prior to the construction of the house" (Srejović 1972a: 119). If this were the case, then the reservoir corrected age of 7374±80 BP would indeed establish a TPQ for building 40. However, some aspects of this interpretation seem open to question. Building 40 was exposed during the 1967 excavation season. Burial 61 appears to have been found in 1968 when digging adjacent to the south-west 'corner' of the structure. This can be understood in terms of the method of excavation adopted at Lepenski Vir, which usually involved exposing the floor of a building and then continuing the excavation vertically beyond the perimeter of the structure, leaving the remains of the building on a soil pedestal — as can be seen on numerous photographs of the site (e.g. Srejović 1972a: plate III). Since the burial extended 'under the floor' of building 40 (*Field Burial Record*, August 1968) and no trace of a grave pit was observed when the floor was first exposed, it was assumed that the burial must be older than building 40 (Srejović 1972a: 119). However, judging from the available field drawings and photographs, building 40 was not well preserved. The precise limits of structure were unclear, and there were gaps in the plaster floor around the hearth and at the margins of the structure, including at the rear where burial 61 was later found. From this, it is not clear if the floor at the rear was damaged by the insertion of burial 61, or whether the floor was laid after the burial was emplaced and was damaged at a later date. Thus, it is not possible to say whether burial 61 is older or younger than building 40.

Borić and Dimitrijević (2007: fig. 3) report two AMS ^{14}C dates on a human cranium (burial 122) found in the south-west corner of the hearth of building 47′ (Fig. 13), underneath the floor of building 47. Provided that the burial was sealed by the plaster floor of building 47, and not inserted through the floor (no information is available to us that would confirm or refute this) then the ^{14}C dates for the cranium would establish a TPQ for building 47. In other words, building 47 would be no older than the older limit of the 2-sigma calibrated age range of the skull, *c*. 6200 cal BC (based on graphical information presented by Borić & Dimitrijević 2007: fig. 3). However, if the cranium had been curated for some considerable time prior to burial, the TPQ could substantially overestimate the age of building 47.

Dates on animal bones

Borić & Dimitrijević (2007) presented 32 AMS ^{14}C dates on mammalian bones from Lepenski Vir, of which two had been published previously (Whittle *et al*. 2002: 113). Details of the bones and their ^{14}C ages were provided for only seven samples. In the other 25 cases the radiocarbon dates were presented only in graphical form (Borić & Dimitrijević 2007: fig. 3), although from this it is possible to determine the approximate 2-sigma calibrated age ranges and median probability ages (to within 10–35 yr). Borić & Dimitrijević used the animal bone ages to establish: 1) the main periods of Mesolithic and Neolithic occupation at Lepenski Vir, 2) the main period of construction/use of the trapezoidal buildings, and 3) the timing of the introduction of agriculture (domestic livestock) at the site.

Table 4. *Summary of the ages of trapezoidal buildings at Lepenski Vir based on radiocarbon dating of associated or stratigraphically related finds. Numbers in italics and underlined signify buildings with pottery.*

Buildings *older* than →	Date (cal BC)	← Buildings *younger* than
	5500	
	5600	
	5700	
<u>24</u>, 24a	5800	51
	5900	*<u>32</u>*, *<u>37</u>*
21, 22, 29, 30, 30b	6000	*<u>1</u>*, 9, *<u>16</u>*, *<u>47</u>*
34, 65	6100	
	6200	
	6300	*<u>54</u>*
	6400	

Of the 32 dates on animal bones, 25 were on bone samples that were found above, below, or on the floors of buildings. Unfortunately, information relating to the species, state of articulation, or exact position of the bones was not provided, as this will be discussed in a forthcoming paper (Borić & Dimitrijević, in press). For present purposes, we assume that all their samples were from species with largely terrestrial diets (i.e. minimal aquatic input). In addition, we have to base our conclusions on the very limited contextual information that is provided for most of the samples.

We focus here on the utility of these samples for dating the trapezoidal buildings, and apply the following principles:

1. Disarticulated bones found on or above a building floor cannot be used to establish the age of the building, because their taphonomic histories are unknown. Such samples could be, a) closely contemporaneous with the building, if the bones were deposited on the floor during use or on abandonment of the structure, b) older than the building, in the case of re-deposited or curated objects, or c) younger than the building, in the case of bones introduced by later bioturbation.
2. A bone found underneath a building in a context that was clearly sealed by the plaster floor would provide a TPQ (maximum age) for the building.

As many as 16 of the animal bones dated by Borić & Dimitrijević (2007) potentially fall into the category of disarticulated bones found on or above a building floor. These are: OxA-8618, OxA-15999, OxA-16000, OxA-16007, OxA-16009, OxA-16071, OxA-16073, OxA-16075, OxA-16076, OxA-16077, OxA-16081, OxA-16082, OxA-16083, OxA-16084, OxA-X-2176-18, and OxA-X-2176-19.

Eight animal bone samples dated by Borić & Dimitrijević (2007) are listed as having been found "between [two] houses" or "underneath a house" — OxA-8610 (under building 23), OxA-15998 (between building 20 and building 33), OxA-16001, OxA-16002 (between building 26 and building 26′), OxA-16003 (between building 35 and building 36), OxA-16004, OxA-16005, OxA-16072 (underneath building 47′). If these samples were sealed by the plaster floors, then the ^{14}C ages would establish TPQs (maximum ages) for the overlying buildings. However, the plaster floors of the Lepenski Vir buildings were rarely intact; there were often gaps in the plaster which could have been caused by post-depositional disturbances, with the potential to introduce younger material into 'sub-floor' contexts. Unless the exact position of a bone in relation to an overlying plaster floor is known (e.g. from photographic evidence, detailed plans, or 3-D coordinates), then it may not be possible to say for certain when the bone was emplaced relative to the construction of the floor. Without access to this kind of information, we feel unable to comment further on the chronological significance of the animal bone samples found below building floors reported by Borić and Dimitrijević (2007).

Arguably, articulated bones (partial skeletons) are less susceptible to post-depositional movement in certain circumstances (but see Coard & Dennell 1995), and so may have greater potential for dating the trapezoidal buildings at Lepenski Vir. Even so, problems can still arise. For example, in the series reported by Borić and Dimitrijević (2007), OxA-16078 dates a red deer skull with antlers found on the floor of building 28. Dimitrijević (this volume) has interpreted this as the result of a symbolic act on abandonment of the building. Whilst this interpretation is reasonable, the absence of the mandible suggests that the deer skull was already de-fleshed at the time of deposition. If so, then it may represent a curated item (e.g. a trophy) from an animal that died long before its skull was deposited in the building, in which case the ^{14}C age reflects the death of the animal and not the act of deposition in building 28.

Reviewing the evidence

Appendix 2 summarizes the data bearing upon the dating of the trapezoidal buildings, including the ^{14}C ages of the charcoal samples, the stratigraphic information that relates the charcoal to the buildings, and the stratigraphic relationships between the buildings themselves and between buildings and ^{14}C dated burials. Using this information it is possible to establish a *terminus ante quem* (TAQ) or *terminus post quem* (TPQ) for certain of the buildings (summarized in Table 4). The TAQ and TPQ values are based on the extremities of the 2-sigma calibrated age ranges. For example, building 1 has a charcoal ^{14}C age of 6860±100 BP. This calibrates to 5982–5572 cal BC (95.4% probability range). The charcoal is assumed to be derived from timber used in the construction of the building or burnt in the hearth, but the ^{14}C age of the charcoal itself could have an 'old wood effect' associated with it (or derive from re-used timber), and thus may overestimate the age of the building. Therefore, the maximum age (TPQ) of building 1 would equate to the older limit of the 2-sigma calibrated age range of the charcoal (5982 cal BC), while the minimum age (TAQ) would be equal to or less than the younger end of the 2-sigma age range (≤5572 cal BC), given the possibility of an old wood effect.

A number of problems arise when attempting to interpret these data. Firstly, the dating of the trapezoidal structures still relies heavily on the original charcoal ^{14}C ages, and it could be argued that many of the taphonomic issues that surround the use of disarticulated bones as a source of chronological information apply equally to charcoal. For example, charcoal is just as susceptible to post-depositional movement, although if a sample came from a beam (i.e. thought to have been used in the construction of a building) or a hearth, we can perhaps have greater confidence that it was in a primary context. Secondly, there are a number of apparent conflicts among the data which need to be considered:

1. The ^{14}C age (6820±100 BP) of the charcoal sample from building 34 is significantly younger than the reservoir-corrected ^{14}C age (7284±47 BP) of burial 26 that was inserted through the plaster floor. In other words, the 2-sigma calibrated age ranges of the charcoal (5972–5554 BC) and the burial (6233–6056 BC) do not overlap. The charcoal sample was taken from a beam at the rear of building 34 (Borić 2002a: appendix 1). Judging from published plans (e.g. Srejović 1969: fig. 19; Borić 2002b: fig. 7) the rear 'wall' of building 34 was more or less contiguous with the front of building 43, which was interpreted as the later of the two structures (Srejović 1969, 1972a). If the charcoal sample (beam) was associated with building 43 rather than building 34, then this could explain the difference in the ^{14}C ages of the charcoal and burial 26.
2. Charcoal from the hearth of building 27 has a ^{14}C age of 7210±200 BP. Building 27 is reported as having been superimposed on building 34, which has a charcoal age of 6820±100 BP (timber beam from rear — cf. Borić 2002a: appendix 1). It is not clear from published plans/photos whether this was in fact the case. Regardless, the 2-sigma calibrated age ranges of buildings 27 and 34 (6445–5720 BC and 5972–5554 BC, respectively) overlap, and so are not inconsistent with the stratigraphic interpretation.
3. Building 21 is older than burial 7/I (7186±56 BP) that cuts through its plaster floor. Borić and Dimitrijević (2007) reported an AMS ^{14}C date on a red deer skull that they interpret as a grave offering with Burial 7/I. The 2-sigma calibrated age ranges of the burial (6212–5931 BC) and deer skull (*c*. 5890–5730 BC, estimated from Borić & Dimitrijević 2007: fig 3) do not overlap, which suggests the burial and the deer skull were not associated.[6]

If we accept the validity of the charcoal ^{14}C dates in relation to the plaster floored buildings (except in the case of building 34) and accept burial 7/I as establishing a TAQ for building 21, then the following observations may be made:

a. The data indicate that the trapezoidal buildings were constructed over a maximum time-range from *c*. 6400–5550 cal BC.
b. The implied time-ranges of individual buildings are quite broad because of the low precision on the charcoal ages and the reservoir-corrected human bone ages.
c. Of the directly or indirectly dated trapezoidal buildings, only two (34 and 65) can be shown to have been constructed before 6000 cal BC, while seven buildings (1, 9, 16, 32, 37, 47, and 51) were clearly constructed after 6000 cal BC, including three (32, 37 and 51) after 5900 cal BC.
d. Although the age ranges for the charcoal dates are typically post-6000 BC, this does not exclude the possibility that a substantial number of the trapezoidal buildings were constructed before 6000 BC, since those that can be dated in relation to charcoal samples or burials represent only about 10% of the total number of such structures that were identified at Lepenski Vir.

Are the trapezoidal buildings Mesolithic or Neolithic?

Pottery and domesticates

Srejović (1969, 1972a) regarded the trapezoidal structures of Lepenski Vir as a purely Mesolithic phenomenon. However, difficulties with this interpretation were apparent from the outset. Pottery, as well as ground-edge artefacts and imported Balkan flint, with clear parallels in the Early Neolithic Starčevo culture, occurred in some of the buildings. Different interpretations have been placed on this evidence:

1. Srejović argued that the pottery was derived from a later, Starčevo cultural layer, which he divided into two phases, LVIIIa ('Proto-Starčevo') and LVIIIb ('Classical Starčevo'). To accommodate this view, he rejected the charcoal ^{14}C dates that carry the implication that the trapezoidal buildings were at least partly contemporaneous with the earliest Neolithic settlements in the surrounding regions.

2. Other researchers have accepted the association between the trapezoidal buildings and Early Neolithic artefacts, although opinion is divided on whether the people involved were farmers (Jovanović 1969), or hunter-gatherers who had adopted some elements of Neolithic technology (Borić 1999, 2002b; Budja 1999, 2004) or simply acquired them through exchange with neighbours (Voytek & Tringham 1989; Radovanović 1996b).

Srejović (1969: 153, 1972a: 134) listed 15 trapezoidal buildings with pottery, although the (unpublished) excavation records suggest that pottery was also found in several more buildings. In some cases, it seems clear that the pottery was derived from later contexts. Irrespective of whether a Starčevo 'cultural layer' actually existed at Lepenski Vir, pottery formed the largest category of finds from the site; much of it was recovered from the many pit features that were recorded across the site, and which occasionally were observed to cut into earlier trapezoidal structures. Thus the potential for 'mixing' of material between contexts is clear. Perić and Nikolić (2004) have argued persuasively that the pottery found in building 5 was in fact intrusive, associated with a large Starčevo pit ('hut A') that was dug down to the floor of the trapezoidal structure and had a 'U-shaped stove' at its base.

Whole pots were found on the floor of building 4 and in the 'ashplace' of building 54, and these have been assumed to be *in situ* (Radovanović 2000; Garašanin & Radovanović 2001; Borić 2002). This interpretation is reasonable, although the possibility that they were later intrusions cannot be excluded entirely — complete pots also occurred at the bases of Starčevo pits that reached the floors of earlier trapezoidal buildings, as in building 5 (Perić & Nikolić 2004: 170–173).

While pottery and other Neolithic artefacts were reported from some of the trapezoidal structures, evidence of food production in the form of domesticated animal and plant remains was not. There was not even accidental 'mixing' of animal bones between archaeological contexts it seems, which is surprising in view of the evidence for disturbance of the trapezoidal structures by Starčevo pit features, and the very rapid and imprecise nature of the excavation of the site.

The first direct AMS ^{14}C dates on bones of domesticates from Lepenski Vir have been provided by Borić and Dimitrijević (2007). They dated 5 bones belonging domestic cattle, pig and goat from Starčevo contexts; the dates range between 7043±37 and 7008±38 BP (6002–5798 cal BC). From this evidence, and the apparent absence of bones of livestock from any of the trapezoidal buildings, Borić and Dimitrijević concluded that this architectural form had ceased to be constructed at Lepenski Vir by 5900 BC. They further argued that the use of pottery must have preceded the introduction of livestock at Lepenski Vir. Thus, Borić and Dimitrijević identified a pre-agricultural, 'Early Neolithic' phase at Lepenski Vir between 6300–5900 cal BC, with trapezoidal buildings, pottery, ground-edge tools and 'Balkan' flint (corresponding to Srejović s LVI and LVII), which was succeeded by a 'Middle Neolithic' phase (equivalent to LVIII) distinguished by the appearance of animal domesticates, crouched burials, and new styles of pottery decoration (Borić & Dimitrijević 2007: table 2). There are several problems with this interpretation:

1. In the first place, the charcoal ^{14}C dates (discussed above) imply that the trapezoidal buildings continued to be constructed until after 5700 BC. To accept the hypothesis that the trapezoidal buildings all predate 5900 cal BC would therefore require us to reject the ^{14}C ages younger than 5900 BC as in error, or the charcoal as intrusive. This would be special pleading and, logically, there seems no more reason to dismiss a charcoal sample as intrusive, than the pottery or other small finds from the same context.
2. Secondly, there is no evidence that pottery was in use throughout the period represented by the trapezoidal buildings (as implied by Borić and Dimitrijević). In fact, the dated buildings with Starčevo pottery mainly have ^{14}C ages younger than *c*. 6000 cal BC. Building 54, where a complete pot was found in the 'ashplace' in front of the hearth (dated typologically to a very early phase of the Starčevo culture on the basis of the spiral decorative motif: Garašanin & Radovanović 2001; Whittle *et al*. 2002), has a ^{14}C age of 7132±64 BP (*c*. 6007 cal BC), but this should be regarded as a *maximum* age because of the possibility of an 'old wood' effect and/or reuse of the timber.[7]
3. Also at variance with the suggestion of an early appearance of pottery at Lepenski Vir is the general lack of evidence for Neolithic settlements near to the Danube before *c*. 6000 BC. ^{14}C dates for the earliest ceramic sites in Romania ('Pre-Criş' or 'Criş I') and south-east Hungary (early Körös) fall between 6000 and 5900 cal BC (Whittle *et al*. 2002; Biagi *et al*. 2005). South of the Danube, there have been claims for a very early Neolithic in eastern Croatia (Krajcar Bronić *et al*. 2004), central Serbia ('Proto-Starčevo' sites — e.g. Srejović 1988) and northern Bulgaria ('Early Monochrome' phase — e.g. Bojadžiev 1995; Vajsov 1998). However, the majority of the ^{14}C ages from sites belonging to the so-called 'Proto-Starčevo' or 'Early Monochrome' phases are later than 7150 BP/6000 cal BC; the few 'older' ^{14}C ages from these sites are mostly on charcoal and may show an 'old wood' effect. An exception is the site of Poljanica-platoto in north-east Bulgaria which has four radiometric ^{14}C dates on pottery sherds ranging between 7535±80 and 7140±80 BP (Quitta 1978; Todorova 1989; Görsdorf & Bojadžiev 1996). However, these dates were done in the 1970s before the development of stepped-combustion techniques for separating the different organic fractions in pottery; therefore, it is possible that the Poljanica dates have been affected by contamination from 'old' carbon present in the clays that were used to make the pots (cf. Bonsall *et al*. 2002b). There are other potentially early sites in northern Bulgaria, notably Dzhuljunitsa and Koprivets (Gurova 2008), but so far no ^{14}C dates have been published. Currently, the nearest Neolithic site geographically to Lepenski Vir that appears securely dated to before 6000 cal BC is Blagotin in central Serbia, some 120km from the Danube (Whittle *et al*. 2002).

Returning to the question of the dating of the introduction of domesticates vis-à-vis the trapezoidal buildings, another potential problem for Borić and Dimitrijević's (2007) hypothesis is sample size. The bones of domestic livestock were generally scarce at Lepenski Vir, being far outnumbered by those of wild mammals, dogs and fish, as well as by the quantity of Starčevo pottery sherds. In Bökönyi's (1969, 1972) analysis of the faunal material collected during the first few seasons of excavation (up to 1968?), the bones are not listed according to individual archaeological features and it is not made clear on what basis material was assigned to the 'Mesolithic' (LVI–II) or 'Neolithic' (LVIII), respectively. A smaller faunal sample that was recovered mainly in later field seasons was analyzed by Dimitrijević (Borić & Dimitrijević 2005). Of the 120 ungulate bones among the material studied from trapezoidal structures (Borić & Dimitrijević 2005: table 4), only 15 came from contexts that according to Srejović (1969, 1972a) also contained pottery. Thus, sampling bias cannot be ruled out as a possible explanation for the absence of domesticates from those contexts.

Stable isotope data

The bone collagen stable isotope values of the burials discussed in this paper (Table 1) have some bearing on the question of the timing of the Mesolithic–Neolithic transition at Lepenski Vir. On the basis of these data, it may be suggested that two distinct dietary patterns are represented among the individuals buried at Lepenski Vir between 6300 and 6000 cal BC (Bonsall *et al*. 2004). The majority of individuals show very heavy $\delta^{15}N$ (+15.2 to +16.2‰) and relatively heavy $\delta^{13}C$ (-17.7 to -18.8‰) values suggesting diets that were dependent on riverine food sources, especially fish — similar to the dietary pattern found throughout the Mesolithic in the Iron Gates (Bonsall *et al*. 1997, 2000). Three directly dated skeletons (26, 54c, and 54e) have much lighter $\delta^{13}C$ and $\delta^{15}N$ values, similar to values recorded for crouched burials belonging to the period after 5900 cal BC at Lepenski Vir (Table 1). Such lighter values are consistent with the inclusion of much higher proportions of terrestrial foods in the diets compared to the traditional Mesolithic pattern, although the diets of at least two of the three individuals probably included significant amounts of protein of aquatic origin.

Higher-level interpretation of these data is complicated by several factors. One is the possibility that between 6300 and 6000 cal BC Lepenski Vir had the status of 'sacred site', that is, one with special religious significance for the people who lived within its 'catchment' or zone of influence (Srejović 1969, 1972a; see also Gimbutas 1991; Bonsall *et al*. 2002a; Radovanović 2006); thus some or all of the people buried at Lepenski Vir may not have lived there, but at outlying settlements along the river or in the hinterland. Another issue is the dating of burials 26, 54c and 54e relative to the group with strongly 'aquatic' diets — were they contemporaneous, or did the three individuals with 'more terrestrial' diets belong to a later phase within the 6300–6000 cal BC age range? The relative ages of the two dietary groups cannot be determined precisely, because of the ^{14}C date uncertainties of the individual skeletons and the shape of the calibration curve around that time (Bonsall 2007). However, there is some limited evidence to support the idea that the 'terrestrial' group is later, although the evidence is not conclusive. Remains of individuals belonging to both groups occurred in building 65, and were included in the dating programme (Table 1: skeletons 54c, 54d, and 54e). The chronological sequence of the burials has already been discussed (see above). More important in the present context, however, is the sequence in which the individuals died. Disarticulated skeleton 54d (with $\delta^{15}N$ = 15.2‰, $\delta^{13}C$ = -17.7‰) is a 'secondary' burial, and the individual almost certainly died before individuals 54e ($\delta^{15}N$ = 13.0‰, $\delta^{13}C$ = -19.1‰) and 54c ($\delta^{15}N$ = 12.4‰, $\delta^{13}C$ = -19.6‰). Thus, in one context at Lepenski Vir (building 65) an individual with a typical 'Mesolithic' dietary signature can be shown to be very probably older than two skeletons that have C- and N-isotope values closer to the 'Neolithic' pattern (i.e. intermediate between 'aquatic' and 'terrestrial' diets).

There are a number of possible explanations for the presence of individuals with 'intermediate' and 'terrestrial' diets at Lepenski Vir between 6300–6000 cal BC (cf. Bonsall *et al*. 2004; Radovanović 2006; Bonsall 2007). They could (be):

1. Members of a local population, or even a single co-resident group, with highly variable dietary preferences;
2. Belong to a phase when farming started to make a significant contribution to the local economy — presumably in the latter part of the 6300–6000 BC time-range;
3. Belong to a time(s) when there was a shift in the Mesolithic subsistence base, toward greater reliance on wild terrestrial resources;
4. Local Mesolithic foragers who moved away to live with hunter-gatherers (with more terrestrial-based diets) or farmers, but were returned to Lepenski Vir for burial;
5. Incomers who originated among either, a) hunter-gatherers or b) farmers in the hinterland, and subsequently moved into the Lepenski Vir locality (e.g. on marriage, or as slaves/war captives);
6. Members of outlying a) hunter-gathering or b) farming communities who had some connection with Lepenski Vir and were brought there for burial.

Further research, including higher-resolution dating of the skeletons, comparison of $\delta^{13}C$ and $\delta^{15}N$ values for teeth and bone to help identify dietary change between childhood and adulthood, as well as Sr- and O-isotope analysis of teeth to try to assess geographic origin, may help to narrow the range of possibilities. In the meantime, we offer the following general observations: Hypotheses 1 and 3 seem unlikely, since there is no evidence of equivalent dietary variability among earlier or later populations in the Iron Gates, and we are unaware of appropriate ethnographic or archaeological parallels elsewhere. Hypothesis 2 would be consistent with the evidence from building 65 of a time trend, with later individuals showing lower C- and N-isotope values suggestive of an increase in the consumption of terrestrial protein. It would also imply that farming had begun in the Lepenski Vir locality before 6000 BC and, significantly, before the change from traditional Mesolithic extended supine inhumation burial to the characteristic Starčevo burial rite of crouched inhumation. Hypotheses 5b and 6b would carry the implication that, as the agricultural frontier advanced towards the Danube, there came a point before 6000 BC when the Lepenski Vir 'catchment' included both Mesolithic (hunting-gathering) and Neolithic (farming) settlements. In this scenario, the Neolithic settlements would probably not have been very far from Lepenski Vir — the distance over which a corpse could be transported intact presumably was limited by a number of factors, including the rate of decomposition and ease/mode of transport (overland or by water).

Conclusions

This paper has presented new AMS radiocarbon and stable isotope results for human remains from Lepenski Vir, and discussed the implications of these data for our understanding of temporal changes in burial practices, the chronology of the distinctive trapezoidal buildings, and the timing of the Mesolithic–Neolithic transition at the site.

Attention has been drawn to a number of factors that complicate interpretations of the data. These include: a) the lack of precision in the human bone ^{14}C dates because of the need to apply a reservoir correction; b) doubts about the reliability of certain archaeological observations made at the time of the excavations; c) the possibility of curatorial errors leading to mixing of bones from different burials; and d) the effects of post-depositional taphonomic processes. The principal findings of the study are as follows:

1. A number of changes in burial customs are documented during the period of site use. Extended inhumation, skull removal/caching, and disarticulated bone burial ('partial burial') were all characteristic of the Mesolithic. Two articulated burials dated to before 7500 cal BC ('Early Mesolithic') were both oriented perpendicularly to the Danube with the head away from the river, while articulated burials dated to the period 6400–6000 cal BC ('Final Mesolithic') were all laid out more or less parallel to the river with the head downstream. Crouched burial replaced extended inhumation after *c*. 6000 cal BC, and was still in evidence during the Chalcolithic, *c*. 4100 cal BC. The burial customs of the later prehistoric period are unknown, but extended inhumation is attested again in the Middle Ages.
2. The ^{14}C results show that previous interpretations of the phasing of the burials from Lepenski Vir were flawed. This is most obvious in the case of the *disarticulated* burials where the original dating relied mainly on 'stratigraphy'.
3. At least six burials included in the dating programme were found within trapezoidal buildings, either inserted through the plaster floor or deposited on or above the floor. The ^{14}C ages of these burials establish minimum ages for four of the buildings, indicating that at least three of these four buildings are older than 6000 cal BC. This reinforces the impression gained from other lines of evidence that many of the plaster-floored stuctures recorded at Lepenski Vir are older than that date. However, if a previous series of radiometric ^{14}C dates on wood charcoal samples are valid, then trapezoidal buildings with lime plaster floors continued to be erected at Lepenski Vir until 5700 cal BC or later.
4. The paired ^{14}C and stable isotope measurements on human bone indicate that a significant change in diet occurred at some point between 6300 and 6000 cal BC, and that it took place at a time when the Mesolithic tradition of extended inhumation was still practised at Lepenski Vir. If this dietary shift reflects the beginning of farming in the Lepenski Vir catchment area, then other Neolithic markers might be expected to occur around the same time. On present evidence it is difficult to argue for the appearance of pottery, ground-edge artifacts, domestic livestock, and crouched inhumation before 6000/5900 cal BC. However, if the dietary shift occurred close to 6000 cal BC, then the archaeological and isotopic indicators of change are not necessarily irreconcilable. Resolving the issues surrounding the Meso–Neolithic transition at Lepenski Vir is an important goal for future research, but one that may require the application of higher resolution dating, including direct dating of pottery, as well as advances in radiocarbon and stable isotope analyses of human bone, if not new field research to locate and investigate evidence of Mesolithic–Neolithic settlement in the hinterland.

Notes

1. Some sieving was undertaken at Lepenski Vir but only, it seems, of the infills of certain 'house pits' excavated after 1967; the mesh size used is not reported in the field documentation.
2. Weighted mean of OxA-12979 and OxA-11692 after reservoir correction (see Table 1).
3. Strictly speaking, it is the act of burial that postdates the plaster floor. Death may have preceded burial by several days and it is conceivable, though unlikely, that the plaster floor was laid in the interim. Moreover, the 14C age of the skeleton is that of the bone collagen — in adults the turnover rate for collagen is in the order of 1.5–4% per year, for adolescents the rate is typically higher (up to 15% per year) (Hedges *et al*. 2007). Therefore, the 14C age may overestimate the time of death by years to decades, depending on the age-at-death of the individual.
4. If burial 7 was *not* inserted through the floor of building 21, then an entirely different set of chronological interpretations would follow.
5. Comparison of excavation plans and photographs suggests that burial 8 occurred more or less directly above infant burials 94 and 101.
6. While there is the possibility of curatorial error in the dating of burial 7/I (see discussion on pp. 177–178), there is also uncertainty over which deer remains were actually dated by Borić and Dimitrijević and the relationship of those remains to burial 7/I. Srejović (1972: 120) states that a deer skull was found "by [the] right hand" of skeleton 7/I; however, this is not visible in any photograph or field drawing we have seen. According to the *Field Journal* a single antler was found next to the legs of skeleton 7/I, but there is no mention of a deer skull at that location. A red deer skull with antlers attached was found below the floor of building 21 to the east of skeleton 7/I (Fig. 6). Some distance separates this find from the skeleton, and it seems it was only discovered when the 'grave pit' of burial 7/I was artificially enlarged during excavation (cf. Figs 5 & 6). This raises doubts that the red deer skull/antlers was really deposited with the burial. Furthermore, careful scrutiny of field drawings and photographs suggests the plaster floor above the deer skull/antlers was originally intact; in fact one of the antlers attached to the deer skull appears to have extended below the hearth of building 21 (see also Stefanović & Borić this volume: fig. 15). Therefore, it seems unlikely that the red deer skull/antlers was inserted through the floor of building 21, and more likely perhaps that it relates to underlying building 22. It is worth noting that another red deer skull with antlers attached was found on or above the floor of building 22 — this can be seen in the photograph published by Srejović & Babović (1983: 136), and the plan produced by Stefanović & Borić (this volume: fig. 15). We are unsure if the red deer skull/antlers near the hearth of building 21 is that dated by Borić and Dimitrijević (2007). If it is, then the ^{14}C measurement would have important implications for the dating of building 21 and could conflict with our dating based on the ^{14}C result for burial 7/I (see also Note 4).
7. Charcoal from building 54 was dated at three different radiocarbon laboratories, Berlin, Köln, and Zagreb. Two dates, KN-407

and Z-143, have very large errors (>100yr) and should, perhaps, be disregarded. The weighted mean of the three dates with errors of 100 yr or less is 7079±57 BP (*c*. 5950 cal BC).

Acknowledgements
We would like to thank the Director of the Institute of Archaeology in Belgrade for permission to reproduce photographs from the Lepenski Vir archive. The senior author would also like to thank Dušan Borić for permission to use his plan of Lepenski Vir for Figure 2.

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Appendix 1. *Descriptions of the burials included in the AMS ^{14}C dating programme.*

Body position	Burial	Location	Relationship to trapezoidal structure	Summary descriptions taken from the *Field Burial Record* (BR) and *Field Journal* (FJ)
Extended	7/I	Building 21	Burial cuts through floor, to rear of hearth	**BR:** Burial no. 7, extended, S–N orientation, arms along the body, hands on pelvis; to the west of the skull of the skeleton was another human skull; to the east of the skull of the skeleton was a bovid skull and antlers. **FJ:** Oct 24 1967: skull belonging to skeleton no. 7 is labeled 'Skull I' ; the separate skull next to it (to the west) is labeled 'Skull II' (described as having prominent supra-orbital ridges).
	14	Grid square A/VIII–IX	Upstream of the zone with trapezoidal buildings	**BR:** Burial 14 occurred in an oval pit with bones of other individuals (it was originally labeled burial no. II from the 'ossuary'); it is described as extended S–N, upper arms along the body, lower arms on the body.
	26	Building 34	Cuts through floor of building 34, to rear of hearth	**BR:** Body extended S–N, hands on pelvis.
	29	Grid square b/VI, VII	n/a (medieval)	**BR:** Body extended W–E, left arm along the body, right arm bent across the torso, hand touching the chin.
	30	Grid square b/VI, VII	n/a (medieval)	**BR:** Body extended W–E, lower right arm across the torso, left arm bent, hand on the pelvis.
	54c	Building 65/XXXV	Above floor of building 65 (field interpretation: cut through burials 54a–b)	**BR:** Body extended S–N, right arm bent with hand on left shoulder, left arm along the body, no skull.
	54e	Building 65	On the floor	**BR:** Body extended S–N, lower arms across the pelvis (field interpretation: burial 54e disturbed skeleton 54d).
	60	Near building 40 and Proto-LV hearth. Grid square B-C/11	Next to corner A of building 40, 'in virgin soil'	**BR:** Extended SW–NE, right arm bent touches the chin, lower left arm across the pelvis.
	61	Building 40	Burial cuts through floor, to rear of hearth	**BR:** Body extended S–N, right arm along the body, hand on pelvis, lower left arm missing.
	62	Grid square b/VI, VII	n/a (medieval)	**BR:** Extended W–E, lower right arm on pelvis, left arm bent with hand on the right shoulder.
Dorsal decubitus	69	Grid square a/13	In 'virgin soil', downstream of the zone with trapezoidal buildings	**BR:** Covered with stones, W–E orientation, back almost vertically placed, legs bent, left foot over the right foot, arms along the body over the upper legs, left arm slightly bent.
Crouched	2	Grid square A/II–III, 2nd excavation level.		**BR:** S–N orientation, crouched on left side; damaged – only mandible, maxilla and femur recovered.
	4	Grid square A/V, 8th & 9th excavation levels, relative depth 1.57–2.06m		**BR:** In rectangular stone construction, covered by stones. Orientation W–E, head to W, crouched on the right side, well preserved. Around the head – lithics, river shells and animal bones; bone awl in area of legs.
	8	Building 24	Above the floor, in rear part of building	**BR:** S–N orientation, crouched on right side, knees at level of upper body, arms bent, hands in front of face.
	9	Building 24	0.30 m above floor in front part of building	**BR:** N–S orientation, crouched on the right side.
	32a	Grid sq. c–d/1–I	On flat rock behind (upslope of) buildings in the central part of the site	**BR:** Found with burials 32b–c. Body in crouched position, in burial pit bordered with several stones. [orientation and 'side' not recorded]

Appendix 1 (cont.). *Descriptions of the burials included in the AMS ^{14}C dating programme.*

Body position	Burial	Location	Relationship to trapezoidal structure	Summary descriptions taken from the *Field Burial Record* (BR) and *Field Journal* (FJ)
Crouched	88	Grid sqare e/I, in a pit bordered with stones	To the rear of the central part of the settlement, upslope of the zone with trapezoidal buildings	**BR:** Burial pit bordered with stones. Skeleton crouched with E–W orientation, left arm bent below the backbone, right arm extended along the body touching a fragmentary bowl. ['side' not recorded]
Disarticulated [1]	31a	Grid square a/VI		**BR:** Above pit 2. Burial 31 consisted of left mandible with 5 teeth, 3 separate teeth, and head of a femur.
	44	Grid square d/I		**BR:** In pit. Comprises ulna, radius, part of pelvis, a few vertebrae, femur head
	45b	Building 61		**BR:** In destroyed hearth construction with burials 45a and 45c (45a is recorded as a skull, 45b is recorded as a skull found within the hearth but below the level of the floor, and 45c is recorded as consisting of a pelvis, femur, and vertebrae).
	54d	Building 65	On the floor; comprising disarticulated bones adjacent to articulated skeleton 54e (burials 54a–c occurred at higher levels in infilling of 'house' pit)	**BR:** Field interpretation: extended inhumation with S–N orientation dislocated by the interment of individual 54e; lower extremities preserved.
	79a	Grid square e/4	At rear of central part of the site, upslope from trapezoidal structures	**BR:** In burial pit bordered with stones, with burials 79b–c. Burial 79a described as comprising fragments of a skull and the left side of the mandible; 79c also described as parts of a skull and the left side of a mandible.
	89a	Grid square f/I–II, next to profile f	Behind (upslope) buildings in the central part of the site	**BR:** Burial 89 consists of bones from 2 individuals, an adult (89a) and an infant 3–4 years old (89b); adult comprises fragments of skeleton and skull. [field interpretation: extended burial, S–N orientation, arms along the body, damaged, legs missing, *Bos primigenius* horns around the head]
Uncertain	18	Grid square A/I		**BR:** Comprised fragments of a skull and a tibia.
	35	Grid square d/III, section d/II		**BR:** a fragment of a skull, shoulder bone, and ribs from the right side of the body collected from section d/II in sq. d/III on 18th July 1967. The rest of the body remained within the section – not excavated.

1 The bones sampled for dating from burials in the 'disarticulated' and 'uncertain' categories (cf. Table 1) do not always correspond with the descriptions of the burials in the *Field Burial Record* or *Field Journal*. It is not clear if this reflects post-excavation curatorial errors, or errors in the field documentation.

Appendix 2. *Chronological and stratigraphic relationships of the trapezoidal buildings at Lepenski Vir, and presence/absence of pottery and ground-edge tools.*

Building	Sample type	Context	^{14}C age BP	Calibrated age range BC (2σ)	TAQ (minimum age) cal BC	TPQ (maximum age) cal BC	Younger than	Older than	Pottery	Ground edge tools	Comments
1	Charcoal	From floor	6860±100	5982–5572	≤5572	5982	Building 2		x	x	
2					≤5572	>5982		Building 1			
4									x		
5							Buildings 5a, 6 and 17		?	?	
5a							Building 6	Building 5			The existence of building 5a was disputed by Perić & Nikolić (2007)
6								Buildings 5 and 5a			
7					≤5565	>5978	Buildings 8 and 17	Building 9		x	
8					≤5565	>5978		Buildings 9 and 7			
9	Charcoal	From structural beam and floor	6845±100	5978–5565	≤5565	5978	Buildings 7, 8 and 17			x	
13								Buildings 14 and 15			
14							Building 13	Building 15			
15							Buildings 14 and 13		x		
16	Charcoal	From floor	6820±100	5972–5554	≤5554	5972			x		
17					≤5565	>5978		Buildings 9, 7 and 5			
18							Buildings 31 and 19?	Building 23			
19								Building 31?	x		
20					≤5571	>5867	Building 66	Buildings 32 and 33	x		
21	Bone	From burial inserted through plaster floor			5931	>6212	Buildings 22, 29, and 30	Burial 7/I		?	Borić & Dimitrijević (2007) reported an AMS date of *c.* 5800 cal BC on a red deer skull interpreted as a grave offering with burial 7/I
22					>5931	>6212	Buildings 29 and 30	Building 21, and burial 7/I			

Appendix 2 (cont.). *Chronological and stratigraphic relationships of the trapezoidal buildings at Lepenski Vir, and presence/absence of pottery and ground-edge tools.*

Building	Sample type	Context	^{14}C age BP	Calibrated age range BC (2σ)	TAQ (minimum age) cal BC	TPQ (maximum age) cal BC	Younger than	Older than	Pottery	Ground edge tools	Comments
23							Buildings 18, 31 and 19?				
24	Bone	From crouched burials in the infill of 'house' pit			5729	>5983	Building 24a	Burials 8 and 9	x	x	TAQ/TPQ based on 2-sigma calibrated age range of burial 8
24a					>5729	>5983		Building 24			
26							Building 26′		x	x	
26′								Building 26			
27	Charcoal	From the hearth?	7210±200	6445–5720	≤5720	6445	Building 27b, 34 and 52			x	TAQ/TPQ based on charcoal age (but context of charcoal uncertain).
27					<5554	<5972				x	TAQ/TPQ based on charcoal age of stratigraphically older building 34.
27b						>6445?	Buildings 34 and 52?	Building 27			TPQ based on charcoal age of building 27 (but context of charcoal uncertain).
28									x		
29							Building 30	Buildings 21 and 22, and burial 7/I			
30					>5931	>6212	Building 30b	Buildings 21, 22 and29, and burial 7/I		x	
30b					>5931	>6212		Building 30			
31							Building 19?	Buildings 18 and 23		x	
32	Charcoal	From the hearth	6814±69	5867–5571	≤5571	5867	Buildings 33, 20 and 66		x		
33					≤5571	>5867	Buildings 20 and 66	Building 32			
34	Charcoal	From a beam	6820±100	5972–5554	≤5554	5972?	Buildings 27, 27b and 43?		x		Conflict between charcoal age and age relative to burial 26. Association between charcoal sample and building is suspect.
34	Bone	From burial inserted through plaster floor			>6056	>6233		Burial 26	?		TAQ/TPQ are based on stratigraphic relationship to burial 26.

Appendix 2 (cont.). *Chronological and stratigraphic relationships of the trapezoidal buildings at Lepenski Vir, and presence/absence of pottery and ground-edge tools.*

Building	Sample type	Context	^{14}C age BP	Calibrated age range BC (2σ)	TAQ (minimum age) cal BC	TPQ (maximum age) cal BC	Younger than	Older than	Pottery	Ground edge tools	Comments
35					≤6061	<6374	Building 36		x	x	
36	Charcoal	From a beam	7335±70	6374–6061	≤6061	6374		Building 35			
37	Charcoal	From a beam and floor	6870±65	5890–5640	≤5640	5890	Buildings 38 and 41	Building 42	x		
38					≤5640	>5890	Building 41	Buildings 37 and 42			
40									?		Burial 61 claimed to be sealed by building 40, but no corroborating evidence.
41					≤5640	>5890		Buildings 42, 37 and 38			
42					≤5640	>5890	Buildings 37, 38 and 41				
43	?				?	?	Building 34?				Not clear if any overlap existed between building 43 and building 34.
46							Building 55	Building 56	x		
47	Charcoal	From a beam	6970±60	5983–5735	≤5735	5983	Buildings 47′, 58 & 53, and burial 122		x		Burial 122 has 2-sigma cal BC age ranges of 6208–5982 and 6020–5838. These are not in conflict with the charcoal age.
47′					≤5735	>5983	Buildings 58 and 53	Building 47			
48									?		
51	Charcoal	From a beam and floor	6620±100	5718–5376	≤5376	5718	Building 52			x	
52					≤5376	>5718		Buildings 51, 27, 27b and 43?			
53					≤5735	>5983		Buildings 47 and 47′			
54	Charcoal	From a beam and hearh	7132±64*	6205–5849	≤5849	6205			x	x	* Weighted mean of 5 ^{14}C determinations (one sample with uncertain context excluded)
55								Buildings 46 and 56			

Appendix 2 (cont.). *Chronological and stratigraphic relationships of the trapezoidal buildings at Lepenski Vir, and presence/absence of pottery and ground-edge tools.*

Building	Sample type	Context	^{14}C age BP	Calibrated age range BC (2σ)	TAQ (minimum age) cal BC	TPQ (maximum age) cal BC	Younger than	Older than	Pottery	Ground edge tools	Comments
56							Buildings 46 and 55				
57											Borić & Dimitrijević (2007: fig. 3) reported a calibrated ^{14}C age of *c.* 5950 cal BC for burial 19 (crouched, headless) "found at the floor level" of building XLIV/57. The number of buildings at this location, and the stratigraphic relationship(s) between the building(s) and the burial, are unclear.
58					≤5735	>5983		Buildings 47 and 47′			
62	Charcoal	From a beam	7430±160	6592–6006							Context of charcoal sample (7430±160 BP) is uncertain.
63							Building 63′				
63′								Building 63			
65					>6017	>6365		Burials 54e and 54c			
66					≤5571	>5867		Buildings 32, 33 and 20			