






Spearheading into the Neolithic: Last Foragers and First Farmers in the Dinaric Alps of Montenegro

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This article presents a summary of new evidence for the Mesolithic in the Dinaric Alps of Montenegro. The region is one of the best areas in south-eastern Europe to study Early Holocene foragers and the nature of the transition to Neolithic lifeways at the end of the seventh and the beginning of the sixth millennium cal BC thanks to the existence of biodiverse landscapes and numerous karstic features. We argue that harpoons found at two different sites in this regional context represent a curated technology that has its roots in a local Mesolithic cultural tradition. The continued use of this standardized hunting tool kit in the Neolithic provides an important indication about the character of the Mesolithic–Neolithic transition. We also use this regional case study to address wider questions concerning the visibility and modes of Mesolithic occupation in south-eastern Europe as a whole.

Keywords: harpoons, Mesolithic–Neolithic transition, forager–farmer contact, Dinaric Alps, Montenegro, eastern Adriatic

INTRODUCTION

The geographical affordances of the territory of present-day Montenegro have a high potential for the study of early prehistory. The eastern Adriatic littoral must have been

an important natural conduit for the dispersal of human groups along the coast while the hinterlands of the Dinaric Alps contain numerous karstic features, such as caves and rock shelters, which served as key repositories of regional occupational histories. Yet,

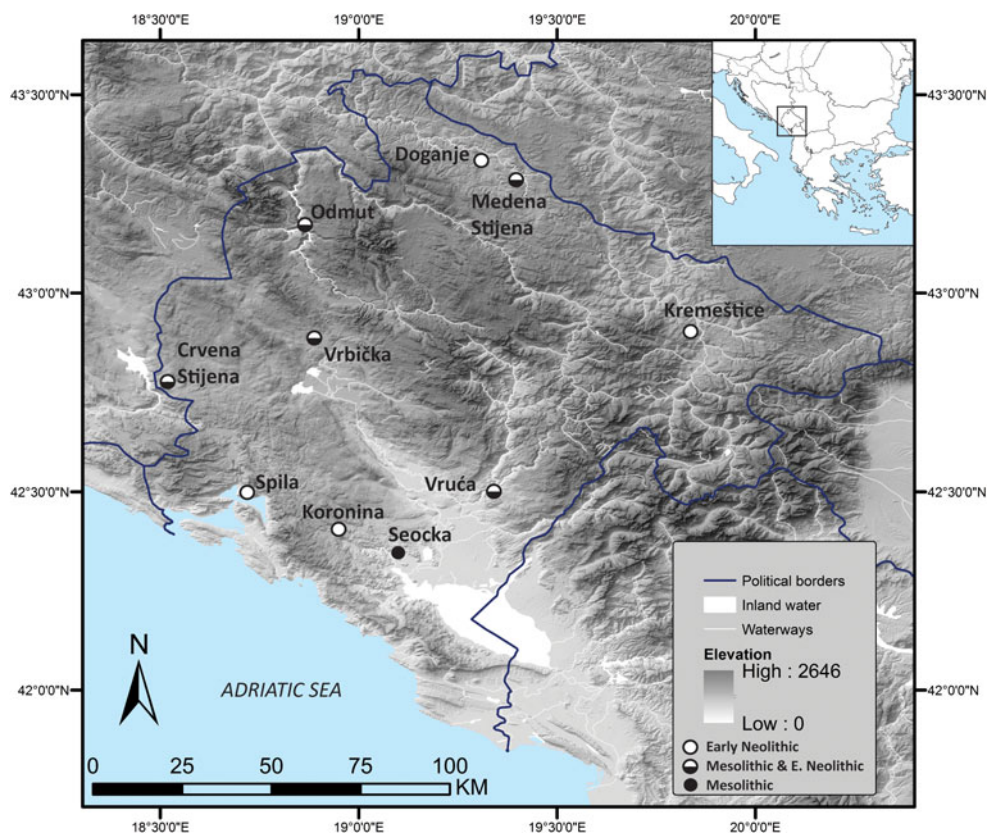


Figure 1. Map showing the position of known Mesolithic and Early Neolithic sites in Montenegro. Elevation data source: ASTER GDEM ('ASTER GDEM is a product of METI and NASA').

at present, there are only few known Mesolithic sites in Montenegro (Figure 1).

In this article, we examine the timing of the Mesolithic–Neolithic transition in the hinterland zone of the eastern Adriatic coast. Different strands of evidence from several sites are presented, the focus being on technological continuities in the manufacture and use of barbed points, i.e. harpoons, as a recognizable *fossile directeur* and part of a curated hunting toolkit with a high degree of standardization based on morphometric parameters. We also present some results of new fieldwork in this region, our techno-morphological and use-wear analysis of osseous and knapped stone artefacts, faunal datasets, and new direct AMS measurements on harpoons, other osseous artefacts, and environmental samples.

PROBLEMS IN MESOLITHIC ARCHAEOLOGIES OF SOUTH-EASTERN EUROPE

With the exception of the Mesolithic sequences in the context of the Danube Gorges area (e.g. Bonsall, 2008; Borić, 2011, 2016 and references therein; Borić et al., 2014), the Mesolithic period in most of south-eastern Europe still remains patchy, with large blank areas in Greece (Galanidou, 2011), the eastern and central Balkans (Gurova & Bonsall, 2014), and most of the Carpathian Basin (but for the latter region see Eichmann et al., 2010). The situation is somewhat better along the eastern Adriatic coast, where an abundance of karstic features such as caves and rock shelters contributed to Mesolithic

deposits being identified more readily (e.g. Miracle, 1997; Miracle et al., 2000; Komšo, 2006; Mlekuž et al., 2008; Harrold et al., 2017; Hauck et al., 2017; Pilaar Birch & Miracle, 2017). But sites with Mesolithic deposits, especially those dating to the seventh millennium cal BC (Forenbaier et al., 2013), are still few and far between, and a sustained focus on investigating this area as well as those blank spots on distribution maps elsewhere across the region is desperately needed.

It has been assumed that during the Last Glacial period, the Balkans acted as one of the southern European refugia for plant, animal, and human populations, with favourable environments especially during the Last Glacial Maximum (LGM) (e.g. Miracle, 2007; Magyari et al., 2013). Here, the transition from the Late Palaeolithic or Epipalaeolithic to the Mesolithic is not characterized by a radical break in the techno-morphological traditions of knapped stone industries. Across the Balkans there seems to be a pattern of continuing Epigravettian traditions with fewer diagnostic markers of temporal changes than in other parts of Europe (Kozłowski, 1999; see Galanidou, 2011: 232 for northern Greece). At the same time, the Holocene knapped stone industries from this region have also been characterized as markers of a 'decline' in comparison to the Late Upper Palaeolithic periods both in the type of raw materials used and in the range of manufactured tool types and techniques employed (Mihailović, 2001, 2007). While the concept of 'decline' might not be an optimal way to describe the change, it has been suggested that preferences in raw material choices with a shift towards locally available lithotypes (often with poorer knapping properties than those previously procured) may correspond to limited access to good-quality flint, and a

decrease in the distances involved in the transfer of raw material may have been due to the spread of temperate deciduous woodland with densely forested environments across the region at the onset of the Holocene warming (Kozłowski & Kozłowski, 1982; Willis, 1994).

In her review of the Mesolithic record in Greece, Galanidou (2011) suggested that rather than expecting a unifying picture and narrative of what Mesolithic groups were like, with some essential core of 'Mesolithicism', we should embrace a potential diversity of regional adaptations, 'more like a patchwork of patterns, colours and textures than a uniform design' (Galanidou, 2011: 231; see Borić, 2005). Galanidou also stresses that the frequent invisibility of Mesolithic sites may stem from a combination of factors that include our inability to differentiate diagnostic Mesolithic artefacts in those instances where these deviate from the expected norm (e.g. microliths and armatures, or the presence of a microburin technique), problems of taphonomy and palimpsest effects of time-averaged thin deposits; these deposits may represent indistinguishable mixed episodes of ephemeral occupation where, in the absence of radiocarbon dates, the Mesolithic character of the occupation could easily go unnoticed. Our experience of working at Vrbicka cave in Montenegro (see below), where targeted radiocarbon dating was instrumental in the identification of Mesolithic occupation deposits, makes us sympathetic to this predicament. Similarly, Mesolithic-age materials have been AMS-dated at the cave site of Seocka in Montenegro (Figure 1, Table 1) in mixed deposits belonging to later prehistoric occupation and testify to similar taphonomic difficulties in identifying Mesolithic remains (Vander Linden et al., 2014).

Table 1. Mesolithic and Early Neolithic dates currently available from five Montenegrin sites. End points for calibrated dates and posterior density estimates are rounded up to ten years as the error terms are greater than twenty-five radiocarbon years.

Phase/ layer/ context	Sample context	Sample material	Lab ID	Radiocarbon measurement (BP)	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	C:N	Calibrated date (95 per cent confidence cal BC)	Posterior density estimate (95 per cent probability cal BC)	Source
Crvena Stijena above II in this column										
II	Test pit D, 0.8-0.9	Sus?, ulna	OxA-23344	7595 \pm 34	–	–	–	6500–6400	–	Mercier et al., 2017;
2 (IVa)	Quad. E-F97	charcoal	Beta-211504	7650 \pm 40	–	–	–	6510–6430	–	Baković et al., 2009: 22
2 (IVa)	Quad. E97	charcoal	Beta-211503	7630 \pm 40	–	–	–	6500–6420	–	
4 (IVb)		charcoal	Beta-211505	8830 \pm 40	–	–	–	8190–7700	–	
IVa	Test pit D, 1.3-1.6 beneath gravel	<i>C. elaphus</i> , metacarpus shaft	OxA-23345	8870 \pm 37	–	–	–	8230–7830	–	
VIII	?	<i>C. elaphus</i> , sesamoid	OxA-23314	9665 \pm 45	–	–	–	9260–8840	–	
VI	?	<i>C. elaphus</i> , prox. left radius	OxA-23311	9775 \pm 45	–	–	–	9310–9180	–	
VI	?	<i>C. elaphus</i> , prox. left radius	OxA-23312	9785 \pm 45	–	–	–	9320–9190	–	
Odmut Neolithic										
IIb		charcoal	SI-2223	6530 \pm 75	–	–	–	5630–5350	5650–5380	Cristiani & Borić, 2016 and references therein; OxA-dates: this article
IIb	Block V, spit 11	charcoal	Z-412	6730 \pm 160	–	–	–	5980–5370	5910–5470	
IIa		charcoal	SI-2222	6900 \pm 100	–	–	–	5990–5630	5960–5620	
IIa		charcoal	SI-2217	6985 \pm 100	–	–	–	6050–5670	5980–5670	
IIa		charcoal	SI-2219	6995 \pm 100	–	–	–	6060–5700	5980–5670	
XC	Block III/2, spit 13, inv. 132 (S.2)	<i>C. elaphus</i> antler harpoon fragment	OxA-35001	7035 \pm 36	–20.9	3.0	3.2	6000–5840	5990–5800	

Table 1. (Cont.)

Phase/ layer/ context	Sample context	Sample material	Lab ID	Radiocarbon measurement (BP)	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	C:N	Calibrated date (95 per cent confidence cal BC)	Posterior density estimate (95 per cent probability cal BC)	Source
<i>Mesolithic</i>										
Ib	Block I, spit 19	charcoal	Z-457	7030 ± 160	–	–	–	6230–5630	6340–5880	
Ib		charcoal	SI-2227	7080 ± 85	–	–	–	6100–5740	6210–5890	
Ib		charcoal	SI-2220	7150 ± 100	–	–	–	6240–5810	6230–5910	
Ia	Block V, spit 21	charcoal	Z-413	7350 ± 160	–	–	–	6510–5900	6500–5970	
Ib	Block V, spit 15	charcoal	Z-411	7440 ± 150	–	–	–	6590–5950	6590–6020	
XA	Block IV/2, spit 11	<i>C. elaphus</i> antler harpoon fragment	OxA-32283	7757 ± 38	–20.23	3.2	3.4	6650–6480	6650–6480	
Ib		charcoal	SI-2221	7720 ± 85	–	–	–	6770–6410	6760–6410	
Ia	Block V, spit 16, inv. 476 (S.4)	<i>C. elaphus</i> antler harpoon fragment	OxA-35003	7770 ± 40	–20.5	2.6	3.2	6680–6490	6680–6490	
Ib		charcoal	SI-2226	7790 ± 70	–	–	–	6910–6460	6910–6460	
Ib	Block II, spit 18, inv. 199 (S.1)	<i>C. elaphus</i> antler harpoon fragment	OxA-34966	7980 ± 50	–21.3	3.1	3.2	7060–6700	7060–6700	
?	Block IV/1, spit 13, inv. 394 (S.3)	<i>C. elaphus</i> antler harpoon fragment	OxA-35002	8207 ± 39	–20.3	2.7	3.2	7340–7080	7340–7080	
Ia/Ib	'Mixed dark and yellow sediment'	charcoal	SI-2224	8590 ± 100	–	–	–	7960–7460	7960–7460	
Ib		charcoal	SI-2228	9135 ± 80	–	–	–	8570–8230	8560–8000	
XD	Block III/1, spit 17	charcoal	SI-2225	10045 ± 85	–	–	–	10020–9310	9980–9290	
Vrbička cave										
(29)	Tr. 1/2013, spit 5, quad. 103/102/C	<i>Corylus avellana</i> charred nutshell	OxA-32862	7923 ± 39	–24.29	–	–	7030–6660	–	This article

(16)	Tr. 1/2012, spit 4, quad. 100/100/D (bag 564, 13/08/ 2012)	<i>S. scrofa</i> tusk tool	OxA-27790	8040 ± 34	−20.05	6.5	3.3	7080–6820	–	This article
Vruća cave										
10YR 4/2	Quad. A5/2, spit 8, bag 122 (29/11/ 1988)	<i>C. elaphus</i> antler harpoon	OxA-32282	6902 ± 35	−19.91	2.4	3.2	5880–5710	–	This article
10YR 2/2	Quad. B4/2, spit 9, bag 202 (01/12/ 1988)	<i>C. elaphus</i> antler harpoon	OxA-28274	6969 ± 33	−19.51	1.3	3.3	5980–5750	–	This article
10YR 4/4	Quad. B4/4, spit 21, inv. VR-40/97-1 (15/11/1997)	bone tool, medium-sized mammal	OxA-31133	8200 ± 45	−22.04	3.3	3.2	7340–7070	–	This article
Seocka cave										
1006	Tr. 1, Quad. L22, spit 5	<i>C. capreolus</i>	SUERC-50661	8778 ± 35	–	–	–	7970–7670	–	Vander Linden et al., 2014
1006	Tr. 1, Quad. L22, spit 5	<i>R. rupicapra</i>	SUERC-50662	8823 ± 34	–	–	–	8200–7750	–	
	Tr. 2, Quad. M29a, spit 7	<i>C. capreolus</i>	SUERC-50660	8903 ± 34	–	–	–	8230–7960	–	
	Tr. 2, Quad. M29a, spit 7	<i>C. capreolus</i>	SUERC-50656	9311 ± 55	–	–	–	8720–8340	–	

This recognition of the difficulties attached to discovering Mesolithic-age deposits stands in contrast to a recent suggestion by Gurova & Bonsall (2014), that the invisibility of Mesolithic occupation across south-eastern Europe should be taken at face value, as evidence that large tracts of land under a dense canopy cover remained uninhabited during the Mesolithic due to a concomitant reduction in ungulate biomass. They further suggest that concentrations of sites are to be expected only along riparian corridors, in wetland inland areas rich in aquatic resources and along coasts, with largely unoccupied hinterlands (see also Pilaar Birch & Vander Linden, 2018: 185). While tackling this model on empirical grounds for the whole of the region remains outside the remit of this article, our presentation of the Mesolithic evidence from Montenegro may contribute to a further contextualization of the problem of Mesolithic invisibility in south-eastern Europe, to which we will return in our discussion.

THE MESOLITHIC OF MONTENEGRO

There are currently only six sites (caves and rock shelters) with Mesolithic occupation deposits in Montenegro (Figure 1). Currently no open-air sites dated to the Mesolithic are known. Here, we present the results of our recent work on extant collections from the Odmut rock shelter and Vruća cave and our fieldwork at the newly discovered site of Vrbička cave in an attempt to further our understanding of these sites' Mesolithic occupation and to answer the question concerning the transition to the Neolithic in this regional context. The evidence from three other Mesolithic sites—Crvena Stijena, Medena Stijena (Mihailović, 1996), and Seocka cave—will contribute to our later discussion of wider regional patterns.

Odmut

In 1972–1974, rescue excavations at the Odmut rock shelter (N 43° 10' 43.5" E 18° 51' 13.3", c. 558 m asl; Figure 2) produced the first extensive and dated sequence of Mesolithic occupation in Montenegro (Marković, 1974; Srejšović, 1974), complementing at the time already known Mesolithic finds from the Crvena Stijena rock shelter (see Basler, 1975; Baković et al., 2009; Mihailović, 2009; papers in Whallon, 2017) (Figure 1). The site is located 85 km inland from the coast of the Adriatic Sea, above the river Vrbnica before its confluence with the river Piva. A stratified sequence 4 m deep was uncovered (Figure 3), ranging from the Early Mesolithic to the Bronze Age. More than half the stratigraphic sequence spans the Early to Late Mesolithic (phases/layers XD, XA, Ia, and Ib) and Early Neolithic (phases/layers IIa, IIb, XB, and XC). Two of us have published a more detailed account of various features from this site and its stratigraphy elsewhere (Cristiani & Borić, 2016).

Table 1 lists all available radiocarbon dates from Odmut, including four new AMS dates reported here for the first time. Five AMS measurements directly date diagnostic single-barbed points made on red deer antler found in different Mesolithic and Early Neolithic deposits. They help us understand the origin and duration of the curated and standardized technological tradition of completely shaped unilateral harpoons with straight barbs and single or double mesial, distal, and/or proximal perforation(s) (Figure 4). In the article that first described harpoons from Odmut, Srejšović (1974) mentions fifty-six specimens. It was possible to locate and study twenty-nine exemplars (Cristiani & Borić, 2016). These harpoons were found in both Mesolithic (n = 19) and Neolithic levels (n = 7). After Bayesian



Figure 2. View of the Odmuť rockshelter at the start of excavations in 1972. Photograph by kind permission of Alan McPherron.

modelling of all available dates from Odmuť (agreement index $A_{\text{overall}} = 98.3$; Figure 5; see also Supplementary Material 1), the oldest AMS-dated unilateral harpoon (OxA-35002) with two barbs and one mesial perforation gives the range of 7340–7080 *cal BC* (95 per cent probability). This measurement suggests that the beginnings of this tool tradition can probably be ascribed to at least the start of the regional Late Mesolithic. There are also three measurements (OxA-32283, OxA-34966, and OxA-35003) that date another three fragmented harpoons from Odmuť to the beginnings and the middle of the seventh millennium BC, thus partly overlapping with the charcoal dates available for Mesolithic layers Ia and Ib (Table 1, Figure 5). Finally, OxA-35001, which dates a harpoon fragment from the Early Neolithic layer XC (see Figure 3), is consistent with its Early Neolithic attribution and provides the youngest direct date yet

for a harpoon from this site, which calibrates to 5990–5800 *cal BC* (95 per cent probability).

At face value, these results suggest that the use of harpoons at Odmuť spanned a millennium or more, throughout the Late Mesolithic and into the Early Neolithic, during which time ceramics made their appearance at the site, chronologically overlapping with the appearance of Early Neolithic sites elsewhere in the Balkans. Further, existing faunal data (Cristiani & Borić, 2016: 174, table 2) from Odmuť show that the most hunted species in the Mesolithic occupation phase Ia (NISP = 1232, excluding bird and fish remains) is ibex (58 per cent), followed by red deer (20.5 per cent), marten (4.9 per cent), wild boar (3.8 per cent), chamois (3.2 per cent), and several other species found in smaller quantities. Similar frequencies of hunted species are reported for phase Ib (NISP = 668, excluding birds and fish

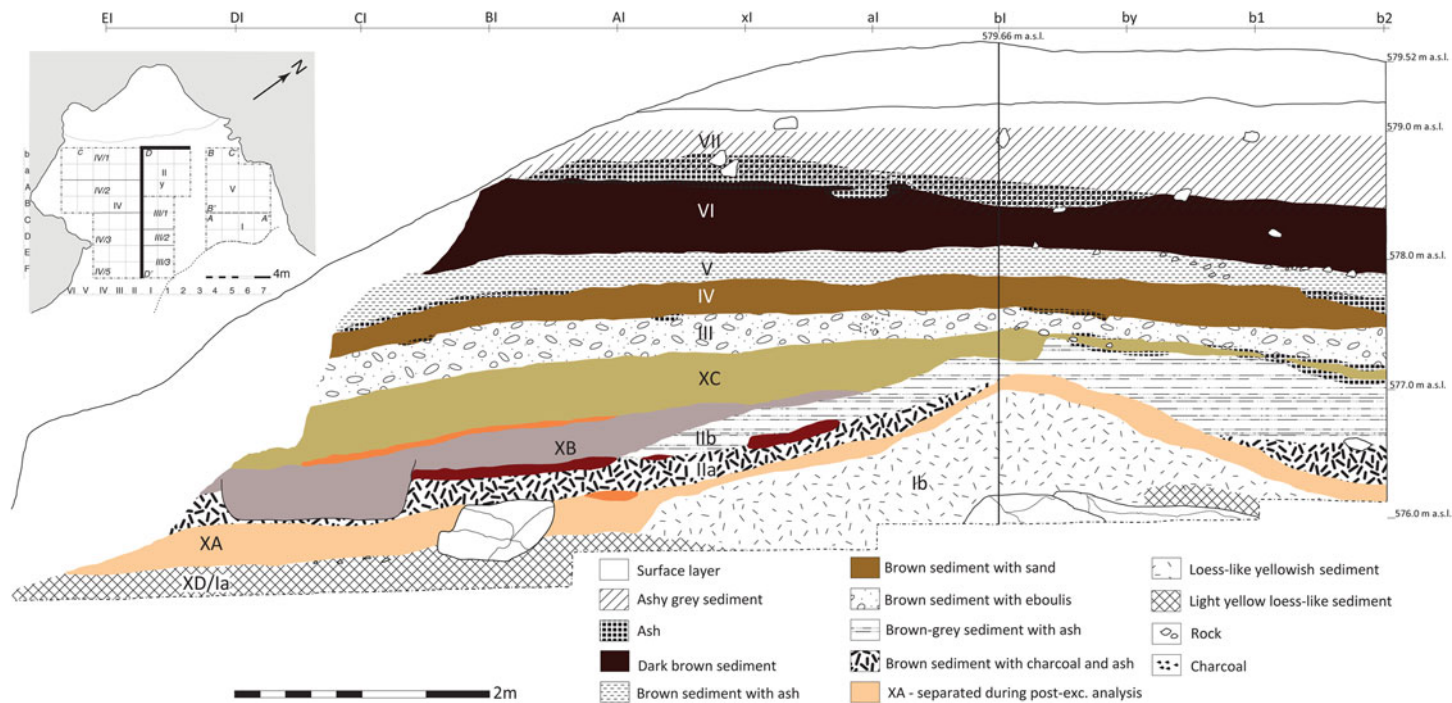


Figure 3. Stratigraphy of Odmuť as shown on section D–D'. Retraced and adapted after Kozłowski *et al.* (1994: [fig. 2](#)) by D. Borič.



Figure 4. A selection of complete and fragmentary barbed points found in different Mesolithic and Early Neolithic layers at Odmuť, including four AMS-dated specimens. 1: Layer IIa; 2: Layer Ia; 3: Layer Ib, OxA-34966; 4–8: Mesolithic levels; 9: Layer XC, OxA-35001; 10: Mesolithic levels, OxA-35002; 11: Layer Ia, OxA-35003 (see Table 1).

Photographs by D. Borić and E. Cristiani.

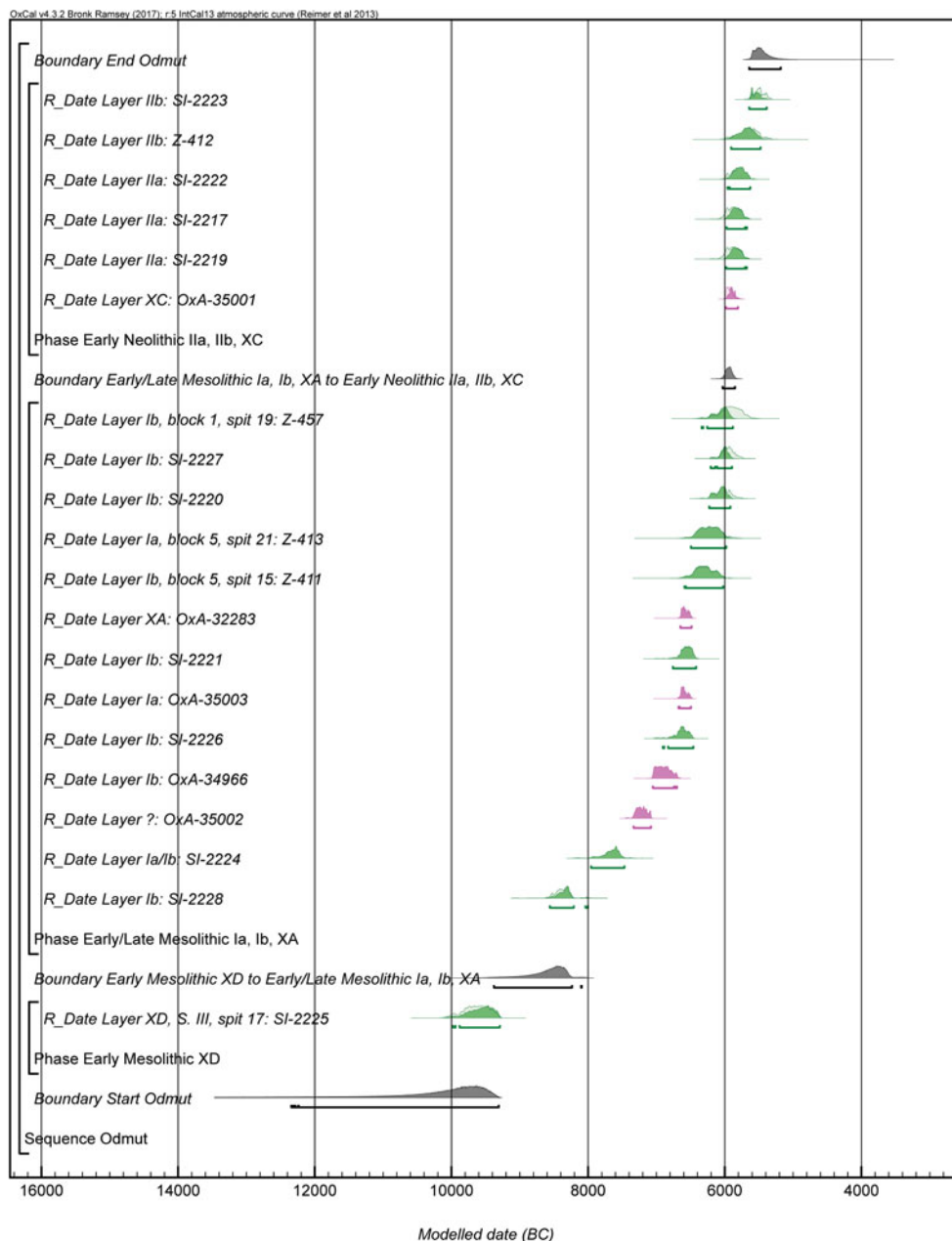


Figure 5. Probability distributions of radiocarbon measurements from Odmüt. Each distribution represents the relative probability that an event occurred at a particular time. For the radiocarbon measurements, distributions in outline are the results of simple radiocarbon calibrations, solid distributions are the output from the chronological model. Dates are calibrated using OxCal v4.3.2 (Bronk Ramsey & Lee, 2013). Green: charcoal dates; magenta: antler AMS dates. The CQL code can be found in Supplementary Material 1.

remains) where again ibex dominates (59.5 per cent), followed by red deer (14.1 per cent), chamois (10.2 per cent), marten (9.3 per cent), wild boar (2.5 per cent), and several other species found in smaller quantities. Seven specimens of domestic cattle are also reported for phase Ib and, like the ceramics found in this layer, these could be intrusive. While in Early Neolithic phases IIa–IIb (NISP = 324) small quantities of domestic animals, such as sheep/goat (9.6 per cent), cattle (4.3 per cent), and pig (0.6 per cent), have been found, the majority of animal protein still came from red deer (41.4 per cent), ibex (34 per cent), and chamois (3.1 per cent). This would suggest that not much changed in subsistence patterns from the Mesolithic to the Neolithic even though no fish remains are reported in Early Neolithic levels. Assuming that harpoons were primarily used for fishing, the absence of fish remains, if not caused by a recovery bias, contradicts the harpoons' continued presence at the site in the Neolithic, and may imply that they continued to be manufactured as part of the preceding Mesolithic cultural tradition. It is also possible that barbed points were used for (aquatic) mammal hunting as attested in various ethnographic examples (e.g. Pétillon, 2008).

As for the chipped stone industry, while there are some oscillations over time in the presence of certain techno-morphological categories and in the choice of raw materials, there are continuities in the structure of the assemblage throughout the Mesolithic and into the Early Neolithic with a tendency over time for increasingly laminar knapped stone industries with armatures in the form of trapezes and micro-retouched bladelets (Kozłowski et al., 1994; cf. Cristiani & Borić, 2016: 171–72). This change is pronounced in layers Ib and particularly XA. The percentage of non-local lithotypes with good

knapping properties also increases during phase XA. The important novelty among retouched blades in layer XA are specimens with two opposite notches, which are characteristic of Castelnovian industries in Italy (Mihailović, 2009: 102–04; Franco, 2011). At Odmuť, these pieces were also found in the Neolithic layer IIa but they disappear in layers IIb and XC, with blades dominating in a very small lithic assemblage from layer XC. The important difference between Montenegrin and other Balkan Mesolithic sites on the one hand, and the 'classic' Castelnovian core area in northern Italy on the other, relates to the absence of the microburin technique in the production of trapezes as well as the lack of asymmetrical trapeze shapes and rhombs in the former regions (Kozłowski et al., 1994: 67).

In sum, at Odmuť, some Neolithic novelties, such as ceramics, a small number of domesticates, and also the acquisition of good-quality non-local lithotypes, were introduced at the time of the Mesolithic–Neolithic transition currently estimated to have occurred around 6040–5850 cal BC (95 per cent probability), probably in 5990–5890 cal BC (68 per cent probability) (*Early/Late Mesolithic Ia, Ib, XA to Early Neolithic IIa, IIb, XC boundary*). However, we have established continuities in the use of harpoons and in the character of the knapped stone assemblages throughout the Late Mesolithic (phases Ia, Ib, and XA) and into the earliest Neolithic (phases XC and IIa) occupation of the site along with evidence for a continuous dominance of hunted game in the Early Neolithic subsistence.

Vruća cave

Vruća cave (N 42° 30' 31.93", E 19° 19' 3.97", c. 124 m asl; Figure 1) is situated near the village of Bioče, 45 km inland from the nearest coast of the Adriatic Sea.

The cave is located high towards the top of the limestone massif on the left side of the Mala Rijeka tributary in the vicinity of its confluence with the larger river Morača, well-known for its dramatic, deeply carved canyon. The site was investigated in 1988–1989 and 1996–1997 (Đuričić, 1997). It is a small tunnel-shaped cave 11 m long and 3–4 m wide, with a 4.5 m wide and 3.5 m high entrance; it has a southern exposure with a 5×3 m terrace in front of the cave. The excavated area covered a surface of 7×2 m (Figure 6; see also Supplementary Material 1) and the stratigraphic sequence is up to 1.5 m thick. Medieval and later prehistoric ceramics were found in surface levels (10YR 3/1, 10YR 5/3, 10YR 3/2; all layers are marked with Munsell colour chart designations).

The Mesolithic layer (10YR 4/4) contains lenses of charcoal and ash (10YR 3/6, 10YR 7/2). In the part of quadrant A/3–4, at the top of the Mesolithic levels, there is a hearth with hardened sediment around it that spreads into the unexcavated section. Compared to later levels, there are fewer animal bones but numerous snail shells. Red deer, roe deer, and ibex are the dominant hunted species along with a number of fish remains and pond tortoise carapaces (see Supplementary Material 2). One burnt marine gastropod, *Columbella rustica*, was found at the top of the Mesolithic layer (spit 12) (Borić & Cristiani, 2016: fig. 11.5). An asymmetrical pointed tool found in spit 21 (Supplementary Figure 3.8) was dated (OxA-31133) to 7340–7070 cal BC (95 per cent confidence) (Table 1). In the Mesolithic assemblage of knapped stone tools, retouched tools were frequently made on narrow bladelets (<12 mm). Among retouched tools are scrapers, end scrapers and thumbnail scrapers, notched tools, truncations, burins, borers, as well as geometric microliths of trapezoid and

triangular types (Đuričić, 1997). Only one harpoon was found in the presumably Mesolithic levels in spit 16 (Figure 7.5).

The Neolithic layer (10YR 4/3) had several lenses of charcoal and ash (10YR 2/2, 10YR 5/2, 10YR 4/2). It contained ten fragments of Impressed Ware (Đuričić, 1997) and numerous animal bones dominated by cervids (red deer and roe deer), knapped stone tools, harpoons, and other bone artefacts (Supplementary Material 1). However, apart from osseous tools, we have not been able to study the faunal assemblage from the Neolithic levels. Among the chipped stone tools, blades and bladelets dominate with many narrow blades (width <12mm), followed by scrapers, tools with unilateral or opposite double notches, truncations, backed tools and composite tools, including backed tools with notches on narrow blades and a combination of burin and notching (Supplementary Figure 4). There were fifteen whole or fragmented unilateral barbed points in this layer (Figure 7; see also Supplementary Material) and on techno-morphological grounds these are part of the same tradition as those found at Odmuť (see below). The presence of a manufacturing phase on a harpoon roughout (Figure 7.11) points to local production. This roughout (spit 9) and another fragmented harpoon with a perforation (spit 8) have directly been AMS-dated and their calibrated ranges largely overlap: 5980–5750 and 5900–5710 cal BC (95 per cent confidence) respectively (Table 1), thus confirming their expected Early Neolithic date.

In sum, the regional Mesolithic tradition of using harpoons is attested primarily in the Early Neolithic and only minor changes were observed in the character of the flint assemblages at Vruća between the two periods. The question of chronological continuity between the Mesolithic and Neolithic levels must be resolved by further radiocarbon dating.

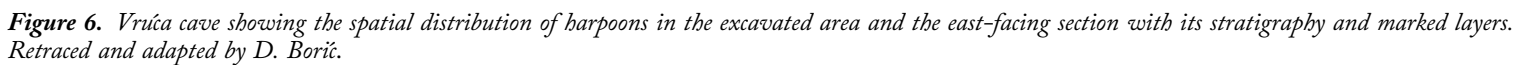




Figure 7. Barbed points found in Vruća cave. 11: OxA-28274; 14: OxA-32282. Photographs by E. Cristiani.

Vrbička cave

Vrbička cave (N 42° 53' 27.2", E 18° 52' 14.3", c. 948 m asl; [Figure 1](#)) overlooks the Duga ravine in the village of Presjeka, at a distance of c. 18 km north-west of the present-day town of Nikšić, 60 km inland from the nearest coast of the Adriatic Sea. The cave is located on a limestone escarpment with commanding views of the surrounding landscape ([Figure 8A](#)) and with good-quality, permanent freshwater springs nearby. Our excavations at the site took place in 2012–2013 and 2015–2017. The site contains finds dated to the Upper Palaeolithic, Mesolithic, Early Neolithic, Late Neolithic, Copper Age, and Bronze Age. The Mesolithic layer ([Figure 8B](#)) lies on top of an erosion surface, at the interface between Late Pleistocene and Holocene sediments. The fine fraction of this unit is characterized by a very loose, homogeneous, dark grey silt matrix, while the coarse fraction consists of a mix of very frequent angular to subangular limestone clasts (~1 cm being the most common) and charcoal (for a detailed micromorphological description, see Supplementary Material 1). It is only c. 10 cm thick and, in some areas of the excavated surface ([Figure 9](#)), the layer was removed by later prehistoric intrusions.

The Mesolithic knapped stone assemblage is characterized by local flints, some of poor knapping properties. Among formal tools, very small thumbnail end scrapers appear as the most characteristic artefact within this assemblage along with blades, bladelets, and prismatic cores for very narrow bladelets ([Figure 10](#)). The faunal remains are dominated by roe deer, red deer, ibex, wild boar, and chamois (see Supplementary Material 2). The absence of fish remains is not surprising considering the cave's environmental setting. Harpoons are absent. The Mesolithic occupation at Vrbička is dated to the very end of the eighth millennium or the first three

centuries of the seventh millennium cal BC by two broadly contemporaneous AMS dates ([Table 1](#)): OxA-27790 dates a wild boar tusk tool to 7080–6820 cal BC (at 95 per cent confidence) ([Figure 10.1](#)); OxA-32862 dates a hazelnut shell to 7030–6660 cal BC (at 95 per cent confidence). Currently in Montenegro, systematic flotation of excavated sediments has only been undertaken at Vrbička. Preliminary results from the Mesolithic context/layer (29) excavated in 2013 show the presence of burnt shells of hazelnut (*Corylus avellana*) as well as vitrified fragments of their kernels, that is the edible part of the nut. An unexpected discovery was a perforated bead made from a *Rutilus* sp. (carp family) pharyngeal tooth found in the Mesolithic context (29) ([Figure 10.2](#)). Similar beads have been found in large numbers in Late Mesolithic burials of the Danube Gorges area (Cristiani & Borić, 2012; Borić et al., 2014) and it is very likely that, if not the bead itself, the ornamental tradition of using such beads originated in the Danube Gorges area, more than 300 km away from Vrbička cave. *Columbella rustica* beads have also been found at Vrbička ([Figure 10.3–4](#)).

There were also a number of Early Neolithic decorated Impressed Ware sherds ([Figure 10.11–14](#)) found as part of the palimpsest in the levels above the Mesolithic sediments. At present, these Early Neolithic visitations of the cave remain undated. It is likely that there is a considerable hiatus in the occupation of the cave between the Late Mesolithic and the Early Neolithic.

DISCUSSION

Harpoons as a *fossile directeur* of a cultural tradition

Based on our techno-morphological examination of barbed points from Odmut and Vruća cave, we suggest that these



Figure 8. A: View of Vrbicka cave in August 2012. B: Stratigraphy as seen on the east-facing section in Trench 1/2013 with the Mesolithic layer context (29) directly above the reddish Late Pleistocene sediments.

Photographs by D. Borić.

specimens in the Montenegrin regional context share a common tradition of techno-functional gestures and know-how involved in their production and use. The

analysed specimens can be described as completely shaped unilateral harpoons with straight barb(s) and single or double mesial, distal, and/or proximal perforation(s)

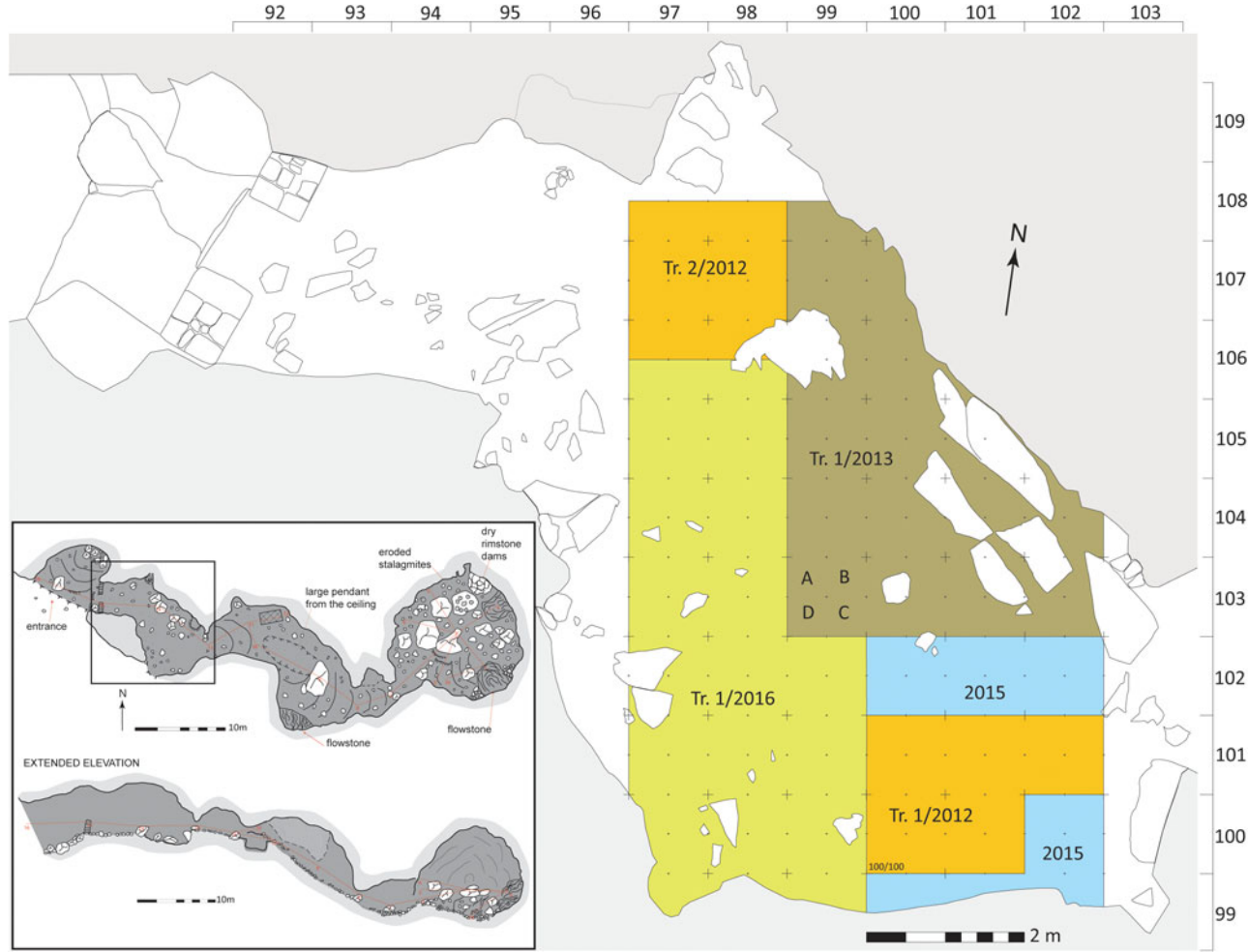


Figure 9. Vrbicka cave (surveyed by J. Čalić and P. Stošić, graphic design by Goran Dujković) and areas excavated in 2012–2017 in the first chamber of the cave.

Drawn by S. Stratton and prepared by D. Borić.



Figure 10. Mesolithic and Early Neolithic finds from Vrbicka cave. A: Mesolithic: 1: AMS-dated wild boar tusk tool (OxA-27790); 2: bead made from a pharyngeal tooth of *Rutilus* sp.; 3–4: *Columbella rustica* beads; 5–9: a selection of flint tools. B: Early Neolithic: 10–14: a selection of Early Neolithic decorated Impressed Ware.

Photographs by D. Boric and E. Cristiani.

(Cristiani & Borić, 2016; see also Supplementary Material 1 for methodology and harpoon technology). Here, rounding, compression marks, macro-scars, modification of the outline of the bases, and longitudinal fractures indicate that the proximal extremities of the harpoons were fixed to the shaft with a line, similarly to ethnographic detachable-head harpoons (Boas, 1888; Rudenko, 1961; Owen, 2005). Ethnographic artefacts show hafting traces that are comparable to those recognized archaeologically and which are related to repeated insertion of the proximal part of the harpoons into the shaft during use (see Pétilon, 2006: 73–75).

Perforations are a very peculiar techno-functional characteristic of the harpoons from Vruća and Odmuť. In most cases, these harpoons show a single perforation located on the meso-proximal part of the shaft in an asymmetric position in relation to the harpoon width, i.e. towards the side of the barb. There are clear similarities between the harpoon specimens with perforations found at Vruća and Odmuť. Only three specimens from Vruća exhibit different morphological traits (narrower blanks and absence of perforations). However, apart from one specimen (Figure 7.5), which might have come from the Late Mesolithic levels, the other two specimens come from the same Early Neolithic levels as the predominant type of harpoons. Similarly, at Odmuť, the variant of harpoons with narrower blanks and absence of perforation is found both in the Mesolithic and Early Neolithic (Figure 4.9) levels. Hence, we suggest that these specimens taken together exhibit an expected variability within the same technological tradition.

Our claim that the harpoons from Odmuť and Vruća are part of the same techno-morphological tradition throughout the Late Mesolithic and into the Early Neolithic is based on the co-existence of very peculiar single straight barbed

specimens within both assemblages and the presence, on almost all of the harpoons recovered at the two sites, of single or double mesial, distal, and/or proximal perforation(s). Such a homogeneity in the assemblages from Vruća and Odmuť is strengthened by a comparison to known contemporaneous Mesolithic examples of harpoon production in other parts of the Balkans (e.g. at Špehovka and Ljubljana riverbed in Slovenia: Turk, 2004; Brodar & Osol, 1979; and at Vlasac and Kula in the Danube Gorges area: Srežović & Letica, 1978; Vitezović, 2011) as well as detachable-head specimens documented in the eastern Alpine region of Italy (Cristiani, 2009), which all exhibit specific regional traits in harpoon manufacturing: the presence of bevelled bases and proximal gorges, the absence of single straight barbed specimens, and the absence of distal and/or proximal perforations. All the Mesolithic specimens from the Balkans and the eastern Alpine region of Italy can be characterized as detachable-head harpoons. However, we suggest that the presence of perforations on the harpoons from Vruća and Odmuť could indicate the existence of a specific technological tradition with different techno-functional solutions involving different gestures of production and use.

At the site of Badanj, located to the west of Odmuť (80 km) and Vruća (133 km) in the adjacent region of Herzegovina, two completely shaped unilateral antler barbed points with straight barbs and, in one case, a gorge towards the base (Supplementary Figure 5) have been found in Epipalaeolithic layers (Kujundžić, 1990), and this dating is now confirmed by direct AMS measurements (Borić *et al.* in press). These specimens are comparable in dimensions and techno-functional characteristics to the specimens found at Odmuť and Vruća, but it is hard to speculate here about the continuity of a

cultural tradition considering that these occurrences of barbed points are separated by several millennia.

We conclude that, from the perspective of practice theory, the existence of the same set of technological gestures and morphological traits in the process of production and use of the harpoons found at Odmuť and Vruća is indicative of a single cultural tradition, transmitted through learning processes. It is, therefore, very unlikely that two different populations during the Late Mesolithic at Odmuť had independently produced the same (even almost identical) types of harpoons in the course of the seventh millennium cal BC without a cultural transmission of knowledge and manufacturing know-how from generation to generation; it is just as unlikely that the same manufacturing tradition would independently emerge during the Early Neolithic at either Odmuť or Vruća in the first centuries of the sixth millennium cal BC. The identification of the same cultural tradition, formalized in the production of these emblematic harpoons and their continuity across Late Mesolithic and Early Neolithic contexts, is particularly relevant for our further discussion about the nature of the Mesolithic–Neolithic transition in the wider regional context.

The Eastern Adriatic and wider regional patterns

In light of the evidence presented here, let us return to Gurova & Bonsall's (2014) model mentioned earlier. They argue that the invisibility of Mesolithic sites in the Balkan interior should be taken as evidence of a genuine settlement pattern owed to the spread of a dense Holocene forest canopy that reduced the ungulate biomass and overall productivity of these zones for human exploitation, and stress

that the focus was on aquatic resources as the dominant form of Mesolithic lifeways. The model does not seem to take into account the evidence (highlighted here) from Mesolithic sites in the western Balkans distant from the coastal areas in the mountainous parts of the region. Here and elsewhere it may be unhelpful to reduce the dimensions of Mesolithic existence to a single narrative and character. As we have shown with the examples of sites discussed, various kinds of Mesolithic adaptations over relatively small distances appear to have existed, as exemplified by the occurrence of harpoons at some sites (Odmuť and Vruća) and their complete absence at others (Vrbička, Crvena Stijena, Medena Stijena, Seocka). Furthermore, while aquatic resources were exploited along with dominant forest game and smaller food 'packages', such as pond tortoise or land snails, there are sites with no evidence of aquatic exploitation in the faunal assemblage; this is the case of Vrbička, where hazelnut and perhaps also other plant resources along with land snails and forest game animals composed the bulk of the Mesolithic forager diet. Furthermore, contrary to suggestions that Mesolithic groups were isolated and despite changes in patterns of flint procurement when compared to the Late Upper Palaeolithic, we have uncovered at Vrbička unequivocal evidence of contact over long distances (*c.* 300 km) between different communities with a shared symbolic or ornamental vocabulary at the turn of the eighth to seventh millennia cal BC.

At Vrbička and possibly also Vruća, the current evidence suggests a chronological gap between the Late Mesolithic (around the end of the eighth and beginning of the seventh millennia cal BC) and the Early Neolithic (early sixth millennium cal BC) occupation, leaving the greatest part of the seventh millennium unaccounted for. This apparent temporal gap between the latest

Mesolithic and Early Neolithic occupation of various cave sites (which remain the main repositories of Mesolithic material but also the greatest part of Neolithic sequences) is not new in the region. Several authors have argued that a hiatus in the coverage of the Late Mesolithic in the Mediterranean hinterland zones point to a region-wide population decline in the course of the seventh millennium cal BC, which facilitated a replacement of the local foragers by farmers from elsewhere at the end of the millennium (e.g. Biagi & Spataro, 2001; but see Mlekuž *et al.*, 2008). The dating evidence from the entire eastern Adriatic region has indeed suggested a pattern of occupation more visible in the tenth and ninth millennia cal BC (Forenbaher & Miracle, 2005, 2006; Forenbaher *et al.*, 2013), which is further strengthened by recent Early Mesolithic dates from Crvena Stijena and Seocka in Montenegro (Table 1). However, the AMS dates from Vrbička and Vruća presented here put the occupation of these two sites either at the end of the eighth or the beginning of the seventh millennium cal BC. Furthermore, the largest number of radiocarbon dates in the long-lived Mesolithic–Neolithic sequence at Odmuť, but also at Crvena Stijena, cover exactly the seventh millennium cal BC (Table 1). There is now also strong evidence that the tradition of harpoon manufacturing and use established at Odmuť by the early seventh millennium cal BC continued to be relevant in the Early Neolithic at the beginning of the sixth millennium cal BC. This is confirmed by the presence of the same curated barbed point tradition in the Early Neolithic levels at Vruća (Supplementary Figure 6). Other strands of evidence (knapped stone, fauna) from both sites also indicate that these transitional assemblages were mixed in nature, with cultural traits and subsistence patterns exhibiting both continuities with the

preceding Mesolithic occupation and introduction of some novel elements from Neolithic cultural repertoires.

Earlier, we have suggested some of the possible reasons for the frustrating absence of Mesolithic sites in Montenegro, that is a combination of the ephemeral nature of occupation and taphonomic problems related to cave deposits. There are at least two other reasons for the absence of open-air sites in the context of the eastern Adriatic region as well as in other environmentally similar contexts across south-eastern Europe. The first relates to the role erosional events and sedimentation plays in masking the visibility of many Mesolithic but also some Early Neolithic sites in lowland areas along valley floors. An example of this process is the Middle Neolithic site of Kula Atlagić in the Zadar plain of Dalmatia, Croatia, found 1.5 m below alluvial sediments (Chapman *et al.*, 1996: 258–59). The almost complete absence of open-air Mesolithic or Early/Middle Neolithic sites in Montenegro, except in the north where only two open-air Early/Middle Neolithic sites (Kremešćice near Berane, and Doganje near Pljevlja; Borovinić *et al.*, 2017: 234) are known (Figure 1), could stem from the same natural formation processes.

We contend that the second major reason for the observed bias is linked to the lack of training or research focus among many south-eastern European archaeologists who conducted regional surveys in the past to recognize lithics rather than ceramics. In Montenegro, in particular in the higher altitude zones of the Dinaric Alps, such as the Durmitor Mountain where several glacial lakes are known (Hughes *et al.*, 2011), we may perhaps in the future expect a pattern of possibly seasonally occupied Mesolithic sites comparable to instances of similar post-Pleistocene adaptations and recolonization of high altitude zones, for example

in the Italian (e.g. Biagi, 1993; Fontana et al., 2016) and Austrian Alps (e.g. Schäfer, 2011). Hence it seems reasonable to expect a pattern of more widespread (Late) Mesolithic settlement than is currently known.

CONCLUSIONS

Direct AMS-dating of harpoons, which form part of a curated and standardized Mesolithic hunting toolkit and a key *fossile directeur* in the Dinaric Alps of Montenegro, enabled us to establish that this local forager technological tradition survived into the Early Neolithic period. The introduction of Neolithic novelties in the hinterland of the southern parts of the eastern Adriatic should be dated at least a century or two earlier than previously proposed by Forenbaher and Miracle (2005, 2006) in their two-staged model for the spread of farming and herding in this regional context. While Impressed Ware and some domesticates were introduced into the hinterland of the Adriatic catchment zone from around 6000 cal BC, cultural changes and adoption of novelties were piecemeal, probably pointing to population continuities from the Mesolithic to the Neolithic. Future discoveries of Mesolithic and Neolithic human remains, which are currently non-existent in Montenegro, along with their aDNA analysis (now available for other areas of south-eastern Europe: Mathieson et al., 2018), would be crucial for resolving this issue.

We suggest that the evidence presented here best fits the ‘individual frontier mobility’ model (Zvelebil & Lillie, 2000). There may have been newly-founded, pioneer settlements, both in caves and on open-air locations, of Neolithic immigrants closer to the Adriatic coast, assuming their maritime spread, or in other ecological niches across the region. A case in point is the existence

of the probably newly-established Early Neolithic cave sites of Spila near Perast in the Bay of Kotor and Koronina near Cetinje (Figure 1) (Marković, 1985; Borovinić et al., 2017), which are currently undated. Finding and investigating similar sites must remain a priority for future research in order to elucidate further the nature of the Mesolithic–Neolithic transition in this regional context.

SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit <https://doi.org/10.1017/ea.2019.14>.

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A l'orée du Néolithique: les derniers chasseurs-cueilleurs et les premiers paysans des Alpes dinariques au Monténégro

Dans cet article, nous présentons une synthèse des nouvelles données concernant le Mésolithique dans les Alpes dinariques du Monténégro. Cette région est extrêmement bien placée en Europe du sud-est pour étudier les chasseurs-cueilleurs du début de l'Holocène et la nature de la transition envers les modes de vie du Néolithique à la fin du septième et au début du sixième millénaire cal BC grâce à ses paysages biodiversifiés et ses reliefs karstiques. Nous soutenons que des harpons découverts sur deux sites différents dans cette région sont symptomatiques d'une technologie conservatrice qui a ses racines dans une tradition mésolithique locale. Le maintien de cette panoplie de chasse standard au Néolithique est un indice important qui nous renseigne sur le caractère de la transition du Mésolithique au Néolithique. Notre étude de cas sert également de tremplin pour traiter des questions d'ampleur plus large concernant la visibilité archéologique et les modes d'occupation au Mésolithique dans l'ensemble de l'Europe du sud-est.
Translation by Madeleine Hummler

Mots-clés: harpons, transition Mésolithique-Néolithique, contacts entre chasseurs-cueilleurs et agriculteurs, Alpes dinariques, Monténégro, Adriatique orientale

Abschluss ins Neolithikum: die letzten Sammler und Jäger und die ersten Bauern in den dinarischen Alpen im Montenegro

In diesem Artikel werden neue Erkenntnisse über das Mesolithikum in den dinarischen Alpen von Montenegro zusammenfassend behandelt. Dieses Gebiet bietet mit seinen biologisch vielfältigen Landschaften und Karstrelief sehr günstige Bedingungen für die Untersuchung der Sammler und Wildbeuter des frühen Holozäns in Südosteuropa und über die Natur des Übergangs zu neolithischen Lebensweisen am Ende des siebten und am Anfang des sechsten Jahrtausend cal BC. Wir sind der Meinung, dass Harpunen, die auf zwei verschiedenen Fundstellen in der Gegend gefunden worden sind, eine betreute Technologie, die in einer lokalen mesolithischen Tradition verwurzelt war, darstellt. Die Weiterbenutzung dieses standardisierten Werkzeugsatzes im Neolithikum ist ein wichtiger Hinweis über den Charakter des Übergangs vom Mesolithikum zum Neolithikum. Unsere Fallstudie ist auch Anlass für eine Betrachtung von weiter reichenden Fragen der Sichtbarkeit und Arten der mesolithischen Besiedlung in Südosteuropa. Translation by Madeleine Hummler

Stichworte: Harpunen, Übergang vom Mesolithikum zum Neolithikum, Kontakt zwischen Sammler/Jäger und Bauern, dinarische Alpen, Montenegro, ostadriatisches Gebiet