PIONEERS IN THE HILLS: EARLY MESOLITHIC FORAGERS AT ŠEBRN ABRI (ISTRIA, CROATIA)

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Abstract: In this paper, we examine the strategies used by early Mesolithic people as they moved into the karstic uplands of north-eastern Istria, Croatia. These strategies are inferred from detailed analyses of the lithic and faunal assemblages from Šebrn, a small upland rock-shelter occupied for a relatively short period of time in the early Holocene. We conclude that Šebrn's lithic assemblages are in technology and typology relatively homogeneous and can be treated as a single unit (related to the Sauveterrian and Epigravettian, *sensu lato*). The faunal remains, in contrast, reveal a dynamic situation of temporal changes in the scope and focus of activities on site. Drawing on several lines of evidence from the lithic and faunal assemblages, we suggest that the initial use of the site was intermittent and people who pursued a generalized subsistence strategy visited it. With the passage of time and as people learned about upland environments, they turned to a specialized procurement of red deer. Šebrn became part of a settlement system that related lowlands to uplands and the site gained significance in the cultural landscape as people brought to it expectations about what they would do and how long they would stay.

Keywords: Croatia, landscape, Mesolithic, rock-shelter, technology, uplands, zooarchaeology

INTRODUCTION

The European Mesolithic and our perceptions of it are strongly coloured by two major factors. First is the fact that the Mesolithic filling of the 'sandwich' (Gamble 1986) is often lost between the Palaeolithic and Neolithic bread. This point has been discussed in detail by many previous workers (J.G.D. Clark 1980; Gamble 1986; Rowley-Conwy 1986; Zvelebil 1986) and will not be explored further, although

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we note that most references to the Mesolithic are still in works on the Pleistocene–Holocene transition (e.g. Straus et al. 1996), the transition to farming (e.g. Harris 1996), or the Neolithic (e.g. Tilley 1996; Whittle 1996; Bradley 1998). In the northern Adriatic context we are using 'Mesolithic' in a chronological sense to refer to the remains and evidence of postglacial foragers prior to the appearance of food production in Europe. Our use of 'Mesolithic' as opposed to 'Epipalaeolithic' is not meant to imply discontinuity with the late upper Palaeolithic in the region, although this issue is certainly worthy of further investigation.

The second factor colouring our perceptions of the Mesolithic is the emphasis on coastal and lowland sites, particularly shell middens. This emphasis is understandable, given the exceptional preservation of organic remains at many coastal and waterlogged lowland sites, and the relative density of human settlement of coastal and interior zones is a question of considerable interest and importance (e.g. Mithen 1994). Researchers are aware, of course, that Mesolithic bands made use of hinterland areas and mountains, and there have been several attempts to relate lowland and upland sites in overall models of settlement and subsistence (e.g. J.G.D. Clark 1972; Mellars 1976; Jacobi 1978; G.A. Clark 1983). The Pupićina Cave Project, now in its fifth year (Miracle 1997), is exploring the use of hinterland areas of Istria during the Mesolithic (and other time periods) and has started compiling a database sufficiently rich and fine-grained in temporal and spatial resolution to address this and other issues.

North-eastern Istria is in many ways an ideal area to examine the use of upland and hinterland landscapes during the early Holocene. There is significant variability in landscapes within a fairly small area (Fig. 1). This variability is created in part by the underlying bedrock, in particular the contrast between karstic limestone with little or no running surface water and heavily eroded flysch and the well-developed, dendritic watersheds, as well as a variety of altitudes (from the coastline to 1400 msl), aspects, vegetation cover, rainfall, shelter from wind, and so on. We have to date tested seven archaeological sites (all appear to have early Holocene deposits) from different ecological zones in the hinterland (Fig. 1),[1] yet the greatest straight-line distance between any two sites is 15 km, well within a day's journey on foot, and five of these sites are within a few hours' walk of one another. This presents an excellent opportunity to explore past spatial and temporal variability at a number of different scales, many of which would have been salient to individual foragers and/or bands of Mesolithic hunter-gatherers.

One might expect people's perceptions and constructs of landscapes to vary considerably if a region is visited only intermittently as opposed to occupied on a regular basis. This perspective informs recent discussions of the late glacial recolonization of northern Europe (Gamble 1991; Housley et al. 1997), and earlier and ongoing debates over the 'neolithization' of Europe (Whittle 1996), as well as the Pleistocene colonization of the Americas and Australia (Kelly and Todd 1988; Beaton 1991). Housley and co-workers have suggested a two-phase model of (re)colonization with an initial 'pioneer phase' followed by a 'residential base' phase of settlement. Our analyses of Šebrn show that some of the same processes of colonization are visible at relatively fine spatial and temporal scales, in this case in a single drainage

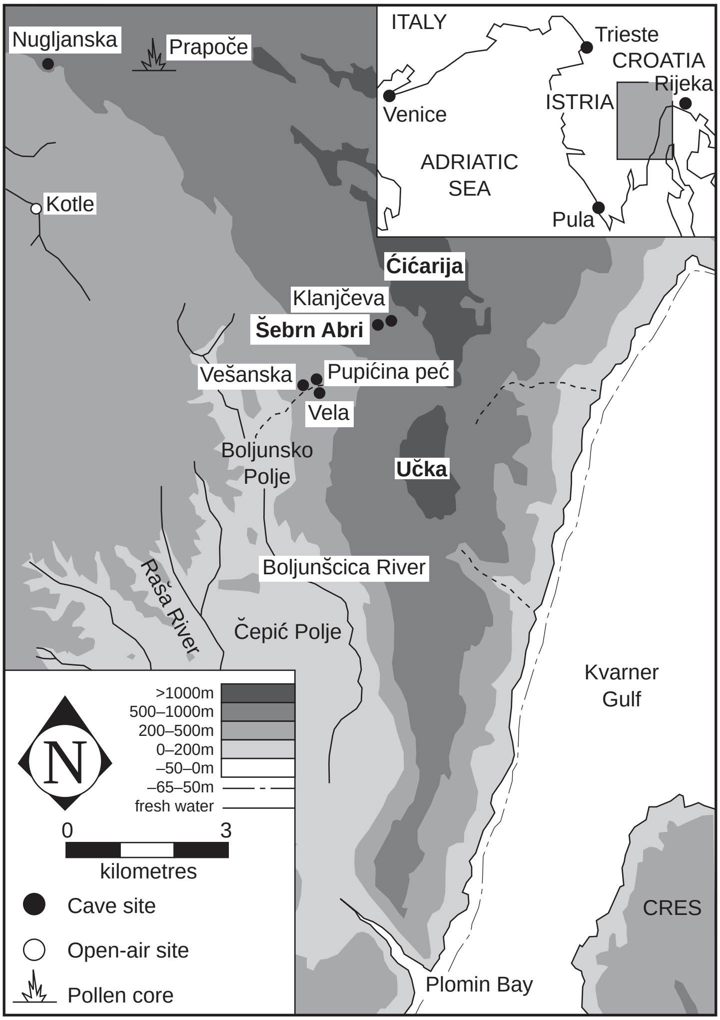

Figure 1. *Map of study area.*

basin over the course of only a few centuries. Our interest in Šebrn Abri thus stems from what it can tell us about when and how upland environments in north-eastern Istria were used during the early Holocene, and from this how these people were moving into and creating upland landscapes.

Šebrn and its setting

Šebrn Abri is located at an altitude of 750 msl, at the foot of a 30 m limestone cliff which forms the south-western border of the upper plateau of the Ćićarija mountain

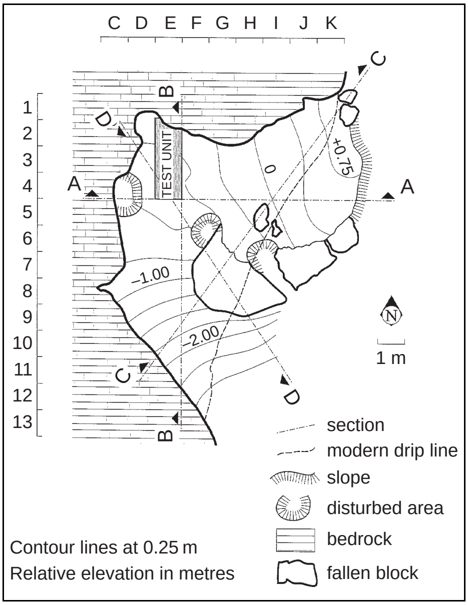

Figure 2. *Plan of Šebrn Abri.*

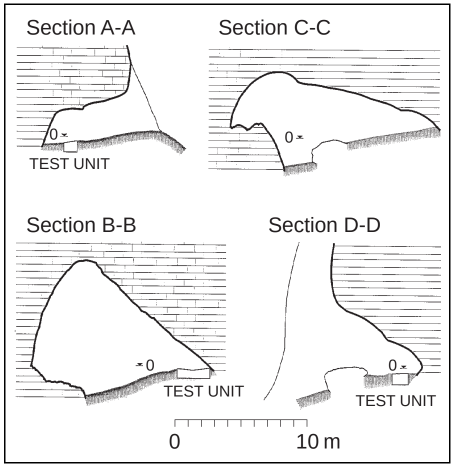

Figure 3. *Cave profiles of Šebrn Abri.*

(Fig. 1). The site lies only a few metres above the contact between Senonian limestone and Eocene flysch. Numerous intermittent streams fill the nearby flysch gullies after showers. A few of them continue flowing during the wet season, but they all run dry in summer. The rock shelter overlooks a steep, short valley that cuts into the south-western flank of the mountain, allowing communication between the lowlands and the plateau. Immediately in front of the opening of the rock-shelter, ground drops abruptly a couple of hundred metres to the valley bottom. Such a strategic location would have allowed its occupants to monitor the movement of animals or people up and down the mountain.

Šebrn is a relatively small and open rock-shelter (Fig. 2). It is only 6 m deep, with an area inside the drip line covering approximately 40 m^2, while its opening is 13 m wide and some 7 m high (Fig. 3). This does not make for an exceptionally well-protected shelter, particularly since it faces east-south-east, which makes it vulnerable to the *bura*, the dominant cold and dry wind in winter. On the other hand, the site is pleasantly breezy in summer and conveniently protected from the afternoon glare. Its entire area is well lit throughout the daylight hours. The ground inside the rock-shelter drops in the north-to-south direction, especially in its southern part where this slope is quite steep. This area contains no cultural sediments – they have been eroded away, if indeed they ever existed. A massive rock-fall, consisting of several very large limestone blocks, buttresses the relatively level northern part of the shelter, and this is where the archaeological strata have been preserved. Judging by the surface indications, the preserved area of the site, including the adjacent flat space beyond the drip line, covers about 35 m^2.

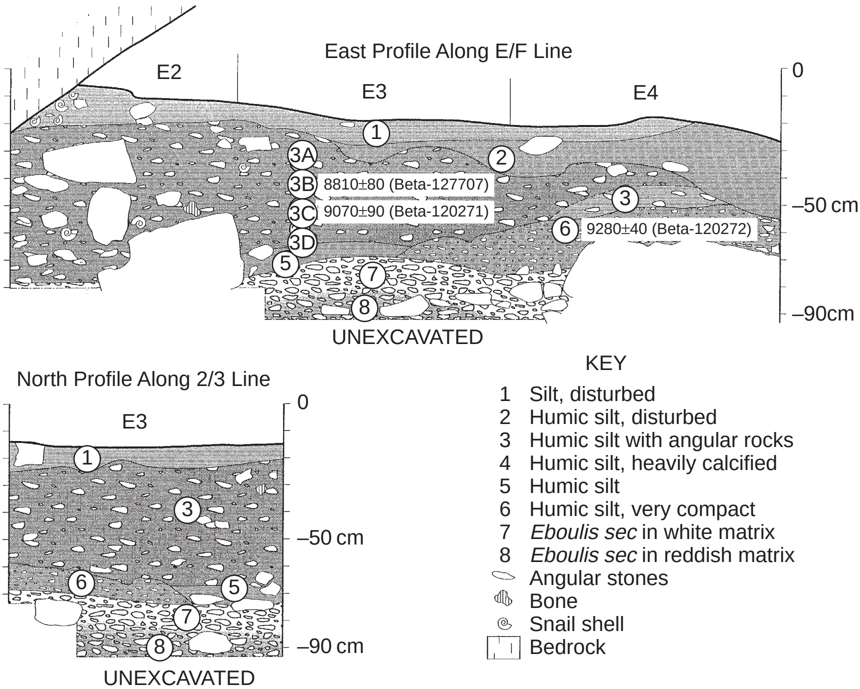

Figure 4. *East profile of test units E2–4 and north profile of test unit E3.*

The existence of a prehistoric site at Šebrn was confirmed in 1995 during field reconnaissance. Parts of the ground surface have been disturbed by animal burrows and a small robber trench. The site was test-excavated during the 1997 summer field season. A 1 × 3 m test unit was positioned in the deepest part of the rock-shelter, in an apparently undisturbed area, where numerous surface finds indicated the existence of archaeological levels. The lie of the strata, which is visible from east profile (Fig. 4), suggests that the accumulation continues and, possibly, thickens towards the east, while it peters out towards the south. Excavation proceeded by natural levels. Thick natural stratigraphic units were split into arbitrary sublevels, each one less than 10 cm thick. Finds were recovered by sieving all of the excavated soil through 3 mm meshes, and 8-litre environmental samples were taken from each square and level.

STRATIGRAPHY AND ABSOLUTE DATES

A fairly simple stratigraphic sequence was established in the test unit (Table 1 and Fig. 4). The disturbed superficial layer (level 1), some 5 to 10 cm thick, consists of loose silt with medium-sized angular rocks. Level 2, in the southern part of the test unit, contained many disturbances (rodent burrows filled with humus and silt) that penetrated somewhat deeper into the underlying stratum. Near the wall

Table 1. Level descriptions, excavated volumes and C-14 dates at Šebrn.

Level	Sediment description	Excavated vol. (m^3)	Date C-14 bp	Sample and method	Calib BC (2 σ)
1	disturbed, light grey powdery silt with large angular rocks and many recent roots and organics	0.181			
2	disturbed, light grey powdery silt with small angular rocks and many recent roots and organics	0.075			
3A	dark brown humic silt with some small sharp-edged stones and patches of light, grey-brown, partly-calcified silt	0.294			
3B	very dark brown humic silt with many small angular stones	0.176	8810 ± 80	Beta-127707, AMS C-14*	7610–8230
3C	very dark brown humic silt with some angular stones	0.225	9070 ± 90	Beta-120271, standard C-14	7965–8240
3D	very dark brown humic silt with some angular stones	0.125			
4	light brown calcified humic silt	0.063			
5	brown silt with humus	0.025			
6	dark brown compact clayey-silt	0.345	9280 ± 40	Beta-120272, AMS C-14	8160–8400
7	white *éboulis sec*	0.190			
8	red *éboulis* and crumbling bedrock				

*A second standard C-14 date (7840 ± 130 BP, Beta-120270) is rejected due to suspected rootlet contamination of the charcoal.

of the shelter, a concentration of snail shells partially cemented to the shelter wall contained a small, undiagnostic and very weathered potsherd. Below level 2 there is a fairly undifferentiated dark brown silty layer (level 3) with some small angular stones and a few larger limestone blocks. Level 3 was excavated by arbitrary sub-levels (levels 3A–3D), each approximately 10 cm thick. The density of finds in level 3 increases towards the back wall of the shelter. It is over 50 cm thick near the back wall of the rock-shelter, but thins out towards its opening. The sediment is lighter in colour and more heavily calcified moving away from the shelter wall towards the south of the trench (from square E2 to E4), and with increasing depth. A lens of sediment very heavily calcified by drip water and with very few archaeological remains was excavated separately (level 4). Beneath level 3 in the eastern part of squares E2 and E3 was a loose humic soil (level 5). Level 6 was another humic silt, but extremely compact in comparison to the overlying levels. Living floors, features or structures are absent from the area exposed by our test trench. Underlying the compact dark brown silts is an archaeologically sterile layer (level 7) which consists almost exclusively of small and medium-sized angular stones (*éboulis sec*). The lowest layer exposed at Šebrn (level 8) was also archaeologically sterile and contained an éboulis in a reddish silt matrix along with large limestone blocks. Bedrock was not reached anywhere in the excavation trench, although we suspect that the lowest layer consists of weathered bedrock.

Three radiocarbon dates in stratigraphic order securely place the cultural horizons (levels 3–6) in the early Holocene, with 95 per cent certainty between 8650–9360 C-14 bp or 7610–8400 Cal BC (Table 1). These dates bracket the main occupation at the site. The sterile éboulis (levels 7–8) most likely date to the late Pleistocene at a time when the shelter was not used by people. There is little evidence from surface finds or the disturbed upper horizons (levels 1–2) of a significant use of the site later during the Holocene. There is no evidence of more recent sediments having been removed from Šebrn, and the single, small piece of weathered pottery could have been incorporated into the sediments by colluvial or other processes not directly related to human use of the shelter. As discussed later, none of the lithic artefacts is typologically later than the Mesolithic, and no remains of domestic animals were identified in the faunal remains. The duration of human site use is thus at most *c*. 800 calendar years. As the three calibrated radiocarbon dates show limited overlap at two standard deviations, we cannot completely rule out the possibility that the human use of the site was restricted to a very short interval, perhaps only a few hundred years around 8200 Cal BC. The absolute dates suggest human use of the site during the late Preboreal and early Boreal pollen zones, although we note that we currently lack well-dated local evidence of vegetation change and early Holocene paleoecological conditions, and the relevance of north-west European pollen zones to the northern Adriatic remains to be established.

THE LITHIC ASSEMBLAGE

Šebrn's lithic assemblage shares a few features with Sauveterrian industries (*sensu lato*) (Bagolini et al. 1984; Kozlowski and Kozlowski 1984; Broglio 1996) and the allied group that exhibits Epigravettian characteristics and lacks trapezes (the so-called Epitardigravettian) (Mihailović 1999). Šebrn's industry, however, has certain features that are peculiar to it. Instead of attempting to fit it into any existing classification scheme, therefore, we shall be discussing its traits in relation to certain behavioural and technological parameters.

Šebrn has yielded 1061 lithic artefacts made of flint or chert. The condition of these artefacts is generally crisp and good, with fewer than 1 per cent exhibiting traces of patination. About a quarter of the artefacts show signs of having been

Table 2. Frequency and percentage of the main morphological categories in Šebrn's lithic assemblage.

	Frequency	%
Flake	484	45.6
Blade	32	3.0
Bladelet	217	20.5
Laminar flake	70	6.6
Debris > 1 × 1 cm	66	6.2
Core	34	3.2
Small flake > 1 × 1 cm	67	6.3
Debris > 1 × 1 cm	32	3.0
Unworked raw material	5	0.5
Indeterminate	54	5.1
Total	1061	100.0

burned. 83.5 per cent of the lithic assemblage consists of unretouched specimens, 11.2 per cent are retouched and 5.3 per cent have edge damage.[2] The morphological categories recovered in the greatest quantities are flakes and bladelets,[3] followed by laminar flakes, amorphous debris and some blades (Table 2). The specimens' butts are mainly flat, cortical or linear.

Every stage of the reduction sequence is present in the assemblage, which ranges from opening flakes to exhausted cores. The primary stages of reduction sequences are represented by opening and other cortical flakes and core preparation débitage, amongst which are some crested and semi-crested specimens (Table 3). Flakes whose entire dorsal faces are cortical comprise 5.7 per cent of the assemblage. Intermediate stages of reduction are represented by technical pieces, such as platform rejuvenation flakes and pieces for changing the direction of removal, and by waste flakes. Most of the pieces produced during knapping accidents relate to the intermediate and final stages of reduction sequences. The composition of the

Table 3. Frequency and percentage of the main technological groups and debris types.

	Frequency	%
Decortification	151	15.4
Core preparation debitage	350	35.8
Technical pieces related to core preparation (crested, semi-crested and core tablets)	25	2.6
Plain débitage	335	34.3
Accidents	15	1.5
Technical pieces related to tool production (burin spalls and microburins)	4	0.4
Knapping debris	44	4.5
Burnt debris	54	5.5
Total	978	100.0

Table 4. Sizes of cores (in mm) from the Šebrn rock-shelter: summary statistics.

	Minimum	Maximum	Mean	SD
Length	2.1	31.4	20.2	6.1
Breadth	8.2	32.4	18.5	6.3
Thickness	3.6	33.9	11.2	5.3

lithic assemblage clearly suggests that Šebrn was not merely an upland station where hunting weapons were re-tooled or re-hafted, but a place in which blanks were manufactured and further modified into tools.

The nodules from which the artefacts were manufactured were slabs, small and medium-sized pebbles and the occasional larger cobble. Some of them were preformed prior to their arrival at the site, whilst others were brought to the site as unprepared nodules for knapping on the spot. We have recovered five unmodified specimens – four slabs and one block of flint.

Cores make up 3.2 per cent of the lithic assemblage and are notably small (Tables 2 and 4). The intended products were either flakes or bladelets. The majority of the cores have prepared platforms. Fewer than 9 per cent of the cores were abandoned at an early stage of production, while around 17.6 per cent of the cores are very small and all but exhausted. These cores were made from flint whose quality was either excellent or very good, and were discarded only when it became impossible to produce any further blanks of the required size (Fig. 5a, b). A third of the cores had flakes as blanks, which clearly suggests that the flint knappers of Šebrn let little go to waste (Fig. 5c). We have observed that the site's catchment contains no sources of good quality flint. This dearth of easily accessible raw materials of suitable quality was probably partly responsible for the knappers' habit of exploiting their good quality cores to the utmost and reclaiming the waste products of early stages of production for use as cores.

The Šebrn toolkit comprises tools used as parts of hunting gear, namely backed bladelets, and tools used for transformation activities, namely backed flakes, pieces with lateral linear retouch, burins, scrapers, piercing implements and truncations. Notched pieces and denticulates are present, but there are only a few of them (Table 5). Also present are a composite tool (Fig. 5d), a hypermicrolithic backed bladelet of no particular geometric shape and a shouldered piece. We have also found evidence of use of the microburin technique (Fig. 5l).

The group of backed bladelets can be divided into four main categories (Table 6): unilaterally backed pieces (Fig. 5e), unilaterally backed pieces with oblique truncation (Fig. 5f, g, h), unilaterally backed pieces with lateral non-abrupt retouch on the other edge (Fig. 5i, k), and pieces with bilateral abrupt retouch (Fig. 5j). In the vast majority of the backed bladelets retouch is rectilinear. Bladelets with backing on one edge and non-abrupt retouch on the other were excavated in the uppermost levels (1–2, 3A) and in level 3C (Table 6). Level 3A also yielded a hypermicrolithic tool of no particular geometric shape that had been retouched abruptly on all three edges. Backed bladelets with oblique truncation are absent from levels 4

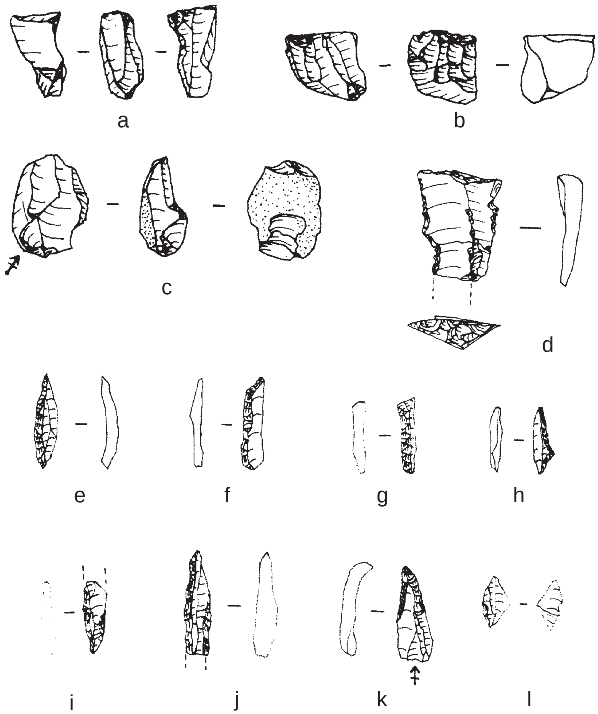

Figure 5. *Lithic specimens from Šebrn: (a) and (b) exhausted cores; (c) core on cortical flake; (d) composite tool; (e)–(k) backed bladelets; (l) microburin. Level 2: a; level 3A: b, d, h–l; level 3B: f–g; level 3C: e; level 5: c.*

Table 5. Frequency and percentage of the tool categories recovered from Šebrn.

	Frequency	%
Backed bladelets	29	24.4
Pieces with linear retouch	48	40.3
Burins	9	7.6
Piercing implements	7	5.9
Shouldered piece	1	0.8
Endscrapers	7	5.9
Sidescrapers	3	2.5
Backed flakes	5	4.2
Notched pieces	2	1.7
Denticulate	1	0.8
Composite tools	2	1.7
Truncations	3	2.5
Hypermicrolitic tool	1	0.8
Splintered piece	1	0.8
Total	119	100.0

Table 6. Percentages of types of backed bladelet, by level. Percentages relate to total number of backed bladelets found at each level.

Level	Unilaterally backed bladelets	Bilaterally backed bladelets	Unilaterally backed with oblique truncation	One edge backed & one edge non-abrupt retouch	Total
1–2	1 (25.0%)	1 (25.0%)	1 (25.0%)	1 (25.0%)	4 (100.0%)
3A	3 (42.9%)	1 (14.3%)	1 (14.3%)	2 (28.6%)	7 (100.0%)
3B	5 (55.6%)	0	4 (44.4%)	0	9 (100.0%)
3C	1 (20.0%)	0	2 (40%)	2 (40%)	5 (100.0%)
3D	0	0	0	0	0
4	0	1 (100.0%)	0	0	1 (100.0%)
5	0	0	1 (100.0%)	0	1 (100.0%)
6	2 (100.0%)	0	0	0	2 (100.0%)
Total	12 (41.4%)	3 (10.3%)	9 (31.0%)	5 (17.2%)	29 (100.0%)

and 6, but present in level 5. It appears unlikely that the absence of this category from levels 4 and 6 represents a temporal pattern. It is more probable that the fact that the sample of artefacts and tools recovered from these units was small has resulted in low diversity in the tool types recovered.

Pieces with lateral linear retouch outnumber other tool types (Fig. 6a, b, c). Most of these specimens have undergone secondary modification by means of partial

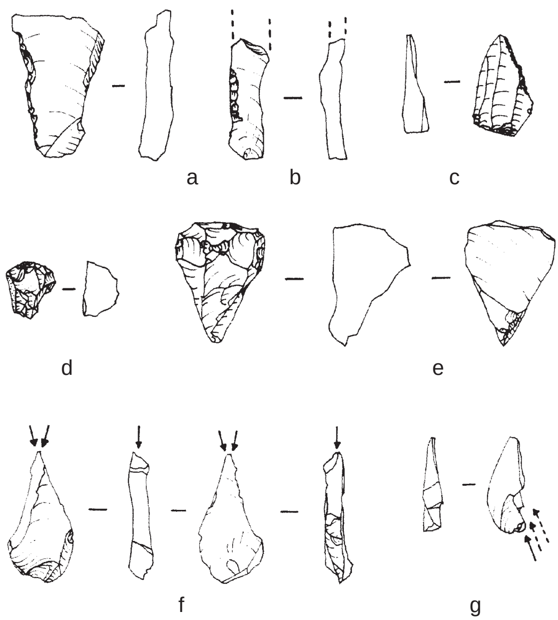

Figure 6. *Lithic specimens from Šebrn: (a)–(c) pieces with linear retouch; (d) and (e) end-scrapers; (f) and (g) burins. Level 3A: a, d; level 3B: f; level 3C: b, c, e, g.*

Table 7. Percentages of tool categories by stratigraphic unit. Percentages relate to total number of tools found at each level.

Tool categories	Levels 1–2	Level 3A	Level 3B	Level 3C	Level 3D	Level 4	Level 5	Level 6
Backed bladelets	4 (40.0%)	6 (17.1%)	9 (40.9%)	6 (17.6%)		1 (20.0%)	1 (100.0%)	2 (33.3%)
Pieces with linear retouch	4 (40.0%)	16 (45.7%)	8 (36.4%)	13 (38.2%)	2 (33.3%)	2 (40.0%)		3 (50.0%)
Burins		1 (2.9%)	3 (13.6%)	4 (11.8%)		1 (20.0%)		
Piercing implements	1 (10.0%)	3 (8.6%)		2 (5.9%)	1 (16.7%)			
Shouldered piece	1 (10.0%)							
Endscrapers		2 (5.7%)	1 (4.5%)	3 (8.8%)				1 (16.7%)
Sidescrapers			1 (4.5%)	2 (5.9%)				
Backed flakes		3 (8.6%)		1 (2.9%)		1 (20.0%)		
Notched pieces		1 (2.9%)		1 (2.9%)				
Denticulate					1 (16.7%)			
Composite tools		1 (2.9%)		1 (2.9%)				
Truncations				1 (2.9%)	2 (33.3%)			
Hypermicrolithic tool		1 (2.9%)						
Splintered piece		1 (2.9%)						
Total number of tools	10	35	22	34	6	5	1	6

semi-abrupt or low-angle retouch. The majority of the pieces in this category required only a limited technical investment, and are of an expedient character. In other words, they appear to have been manufactured and retouched on the spot for use in performing specific tasks about the site, and then discarded. This is a good archaeological example of 'situational gear' (Binford 1979).

Some variation can be observed in scraper size and type. We have, for example, recorded two small thumbnail endscrapers (Fig. 6d), a circular endscraper, an end-scraper on a bladelet, a conical endscraper (Fig. 6e), and an irregular scraper on a slab. Burins are either dihedral (Fig. 6f) or lateral (on breakage or on the butt) (Fig. 6g).

In general, the lithic assemblage appears to be undifferentiated from one stratigraphic unit to another as far as production technology and tool typology are concerned (Table 7). Although the material from recent excavations of roughly contemporaneous neighbouring sites in Istria is still being studied (Miracle 1997; Miracle et al. in press) and may yet prompt us to reconsider this point, the data to hand suggest that the lithic assemblage from Šebrn should be treated as belonging to a single phase. The main difference between the layers is in the proportion of retouched, unretouched and edge damaged pieces in the assemblage. Table 8 shows that in level 3D and in the lowermost levels 5 and 6 the percentages of retouched and edge-damaged specimens drop well below the average values. In other words, overall there are fewer tools and artefacts (which may have been used as tools) in the earliest stratigraphic units and in level 3D. This change should be considered alongside the change that we have observed in the composition of the faunal assemblage.

One of the interesting features of the Šebrn assemblage is the presence of refits. When the lithic material was studied, 41 specimens were found to refit. The percentage of refitted specimens increases in the levels that lie deeper in the sequence, the largest percentage being found in level 3D (Table 9). This suggests that this unit was of higher spatial integrity than certain others, in particular the very top and lowermost units. The absence of any refits from levels 4 and 5 may have to do with the fact that few artefacts were recovered from these units. The paucity of refits in level 6 may be related to the fact that this, the earliest unit, was eroded in parts of E3.

Table 8. Percentages of retouched pieces, by stratigraphic unit. Percentages relate to total number of artefacts found at each level.

Level	Total lithics	% Unretouched	% Retouched	% Edge damage
1–2	87	79.3	11.5	9.2
3A	267	81.3	13.1	5.6
3B	207	82.1	10.6	7.2
3C	257	80.9	13.2	5.8
3D	91	91.2	6.6	2.2
4	25	80.0	20.0	0.0
5	24	95.8	4.2	0.0
6	103	93.2	5.8	1.0
Total	1061	83.5	11.2	5.3

Table 9. Refits at Šebrn, by level. Percentages of refitted specimens relate to total number of artefacts found at each level.

Level	Number of refit groups	Number of refitted specimens	Percentage of refitted specimens
1–2	–	–	0.00
3A	1	2	0.75
3B	3	8	3.86
3C	5	19	7.39
3D	3	10	10.99
4	–	–	0.00
5	–	–	0.00
6	1	2	1.94
Total	13	41	3.86

Faunal remains and subsistence practices

The Šebrn animal bone assemblage contains 3781 remains that weigh 3805 g in total (Table 10). Of these, the number of identifiable species present (NISP) of 580 (15.3%) is identifiable to body part and/or species. The assemblage shows significant changes over time, both in terms of the nature of the unidentified fragments, as well as in the composition of the identified remains. The density of bones is relatively low in levels 4–7 (15.8–647.4 g/m^3) and increases in levels 1–3D (1430–4270 g/m^3). Within the upper levels, levels 1–2, the mixed surface levels stand out as anomalous with regards to the subunits of level 3, with a much lower density of animal bones (1430 kg/m^3 compared to values over 3500 kg/m^3). We suspect that this decrease in bone density may be due to greater chemical weathering and surface disturbance in the uppermost levels (see later). The density of bones in the sediment drops dramatically as one moves away from the shelter wall, from square E2 to E4, with the largest drop in most cases between squares E3 and E4 (Table 11).

Animal bones at Šebrn are highly fragmented. The average weight per bone for the assemblage as a whole is 1.0 g. Unidentified fragments are on average much lighter than identified specimens (0.65 g *v.* 3.28 g, respectively), as is to be expected, while average fragment weight is slightly greater for burned than unburned fragments (0.67 g *v.* 0.64 g, respectively), which is not expected (Lyman 1994; Stiner et al. 1995). The frequency of burned fragments, on the other hand, is much higher in the lower levels (35–83%)[4] relative to the upper levels (16.3–30.0%). Again, there are no clear trends within these grouped levels. There are interesting temporal patterns in bone fragmentation. Average unidentified fragment weight increases from levels 4–7 (unburned: 0.58 g, burned: 0.50 g) to levels 1–2 (unburned: 1.07 g, burned: 0.73 g). Unidentified fragment weight also drops from square E2 to E4 in most levels, suggesting greater fragmentation towards the edge of the site (away from the shelter wall). The source of this fragmentation is most likely greater exposure to chemical and physical weathering. The proportion of bones identifiable

Table 10. Composition of the Šebrn lithic and faunal assemblages. Percentages relate to total numbers of bones found at each level.

	Excavated volume	All lithics		All bones			Unidentifiable fragments					Identified bones			Microfauna		
			Density			Density	Unburned		Burned								
Level	m^3	N	N/ m^3	N	Wt (g)	g/m^3	N	Wt (g)	N	Wt (g)	%	NISP	Wt (g)	%	NISP	MNI	%
1–2	0.256	87	339.8	215	366	1430	136	146	48	35	22.3	30	185	14.0	1	1	0.5
3A	0.294	267	908.2	736	1157	3935	446	342	138	102	18.8	152	713	20.7	0	0	0.0
3B	0.176	207	1176.1	654	625	3551	403	219	87	50	13.3	131	356	20.0	33	4	5.0
3C	0.225	257	1142.2	1268	872	3876	775	384	151	108	11.9	146	379	11.5	196	13	15.5
3D	0.125	91	728.0	527	535	4280	278	235	121	91	23.0	92	209	17.5	36	7	6.8
4	0.063	25	396.8	20	8	127	6	2	14	6	70.0	0	0	0.0	0	0	0.0
5	0.025	24	960.0	18	16	640	11	13	6	3	33.3	0	0	0.0	1	1	5.6
6	0.345	103	298.6	337	223	646	190	105	115	58	34.1	29	60	8.6	3	1	0.9
7	0.190	0	0.0	6	3	16	1	1	5	2	83.3	0	0	0.0	0	0	0.0
Total	1.699	1061	624.5	3781	3805	2240	2246	1447	685	455	18.1	580	1902	15.3	270	27	7.1

Table 11. Density of bone and bone fragmentation by excavation square and level at Šebrn.

	Density (g/m^3) of all bone			Average wt (g) of all bone		
	Square			Square		
Level	E2	E3	E4	E2	E3	E4
1–2	4431.5	1039.1	460.9	2.35	1.12	1.30
3A	6322.6	4347.3	105.0	1.85	1.31	0.49
3B	4202.3	3307.1	463.2	1.25	0.80	0.39
3C	5662.6	2899.2	437.7	1.02	0.58	0.52
3D	5420.1	1636.7		1.12	0.89	
4			125.8			0.40
5	0.0	1696.0			0.94	
6	2115.6	278.1	273.4	0.70	0.53	0.70
7		0.0	27.7			0.50

ranges from 0 per cent (levels 4, 5, 7) to about 20 per cent (Levels 3A, 3B). Fewer bones were identifiable to body part and/or species in levels 4–7 (0–8.6%) than in levels 1–3D (11.5–20.7%), corroborating other evidence of an increase in bone fragmentation (lower percentage identifiable to species) with increasing depth. To control for the effects of changing species composition (see later), we calculated average fragment weight and length for small and medium-sized ungulates separately (Table 12). Red deer and medium ungulates show a similar temporal trend in average weight and length, with both parameters increasing with decreasing depth, and with the greatest change between level 6 and levels 3A–D. An increase in fragment weight and length with decreasing depth fits expectations of post-depositional fragmentation of bones due to profile compaction, weight of sediment overburden, and/or other site-formation processes. Roe deer and small ungulates, in contrast, show a slight decrease in both mean fragment weight and length between level 6 and levels 3A–D, and suggest that forces other than postdepositional fragmentation may be at work. That said, it is important to note that none of these differences are statistically significant, and the safest approach is to treat bone fragmentation as unchanged.

There are also significant changes in the frequency of microfauna (vertebrates smaller than a hare) in the deposits. They are extremely rare or missing from

Table 12. Average weight and length of bones identified to roe deer/small ungulate and red deer/ medium ungulate.

	Capreolus and small ungulate						*Cervus* and medium ungulate					
	wt (g)/NISP			length (mm)			wt (g)/NISP			length (mm)		
Level	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
L 1–2	3.90		1	73.00		1	5.53	6.56	15	44.80	22.96	15
L 3A–D	1.46	1.55	89	28.74	15.12	89	5.08	7.27	229	42.05	23.10	229
L 6	1.91	2.51	11	31.73	21.57	11	2.41	2.16	7	32.86	16.39	7

most levels; the exceptions are levels 3B–3D where they range from 5–15.5 per cent of the total bone NISP (Table 10). The changing frequency of microfauna (preliminary identifications suggest that remains are mostly from the dormouse *Glis glis*) suggests significant changes in their use of the site for hibernation (they commonly hibernate in caves in the area today) and/or the use of the site by roosting raptors, other predators, and/or human dietary choices. While we did not encounter any semi-articulated or articulated dormice remains during excavation, it is difficult to exclude the possibility of burrow deaths given other evidence of postdepositional disturbance and the homogenous nature of the deposits in level 3. We do not have any direct evidence of human consumption, although given the vernacular name of 'edible dormouse' for *Glis glis* (Nowak 1991), we should not arbitrarily strike it from the Mesolithic menu. On the other hand, remains of small carnivores (mostly wild cat and marten) are present in these levels, although their frequency is not particularly high compared to the rest of the site. The taphonomy and interpretation of these bones remain unresolved.

Of the identifiable remains, 370 were identifiable to genus and/or species, while 210 bones were identified to order and/or body size, and another 270 were from microfauna. Of the identifiable mammal bones from hare or larger-sized taxa, red deer (*Cervus elaphus*) dominates the assemblage (NISP 198, 34.1%), followed by roe deer (*Capreolus capreolus*, NISP 76, 13.1%), wild boar (*Sus scrofa*, NISP 66, 11.3%), medium-sized ungulates (NISP 134, 23.1%) and small-sized ungulates (NISP 59, 10.2%). These three species and associated body-size categories account for over 90 per cent of identifiable remains (Table 13); this faunal composition is quite typical of early Holocene sites in the region (Radmilli 1984; Barker 1987; Miracle 1997). The remaining species (all with NISP < 7) include a smattering of small to medium-sized carnivores, wild caprids, and a few bones of a large bovid (most likely the aurochs, *Bos primigenius*). The canid remains could come from wolf or domestic dog. The marten remains could come from either beech or pine marten, while the hare remains could conceivably come from either brown (*Lepus europaeus*) or varying hare (*Lepus timidus*). With the exception of the large bovid (and any ibex remains in the chamois/ibex category), all of these taxa are extant in the region today or in the recent past. The larger mammals are not in themselves very indicative of paleoenvironmental conditions.

There are, however, interesting trends in species representation within the occupation levels at Šebrn. Considering the entire mammal bone assemblage with species abundance quantified as the percentage of NISP (Fig. 7), red deer increases in frequency from the bottom (level 6, 27.6%) to the top (levels 1–2, 53.3%) of the stratigraphy. Likewise, chamois and ibex are missing from levels 3D and 6, and increase to 6.7 per cent of NISP in levels 1–2. Roe deer, in contrast, decreases in frequency over time, from 24.1 per cent of NISP in level 6 to only 7.9 per cent of NISP in level 3A. Wild boar is relatively rare in the oldest and youngest levels (levels 1–2, 3A, and 6, less than 6% of NISP) and much more frequent in the middle levels (3B–3D, over 13.5% of NISP). The relatively high frequencies of roe deer and wild boar in the earliest levels (levels 3D and 6) suggests that the relatively thick vegetative cover favoured by these species was already present in the region in the late

Table 13. Identified faunal remains from Šebrn.

	Level 1–2		Level 3A		Level 3B		Level 3C		Level 3D		Level 6		Total			Burned	
	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	MNI	NISP	%
small animal					4		1	1	3	1	1		9	2		1	11.1
small ungulate	1		10	4	12	5	10	2	17	8	9	4	59	23		7	11.9
medium ungulate	10	1	51	5	23	2	38	12	10	2	2		134	22		18	13.4
large ungulate			3	1									3	1		0	0.0
ungulate			3	3	1								4	3		0	0.0
Rupicapra rupicapra	1	1	1	1	1	1							3	3	1	0	0.0
Rupicapra/Capra	1	1	1	1	1	1	2	2					5	5		0	0.0
Capreolus capreolus			12	5	16	6	23	6	18	8	7	2	76	27	3	16	21.1
Cervus elaphus	16	3	57	22	48	13	50	23	19	6	8	3	198	70	6	20	10.1
Sus scrofa	1		9	4	20	12	20	12	15	11	1		66	39	3	1	1.5
Bos/Bison			2	2									2	2	1	0	0.0
small carnivore			1	1									1	1		0	0.0
Canis sp.					2	2			1	1			3	3	1	0	0.0
Felis silvestris			1	1	1	1	1	1	4	4			7	7	2	0	0.0
Martes sp.					1	1			1	1			2	2	2	0	0.0
Meles meles			1	1	1	1	1	1			1	1	4	4	1	1	25.0
Lepus sp.									4	4			4	4	1	0	0.0
Total	30	6	152	51	131	45	146	60	92	46	29	10	580	218	21	64	11.0

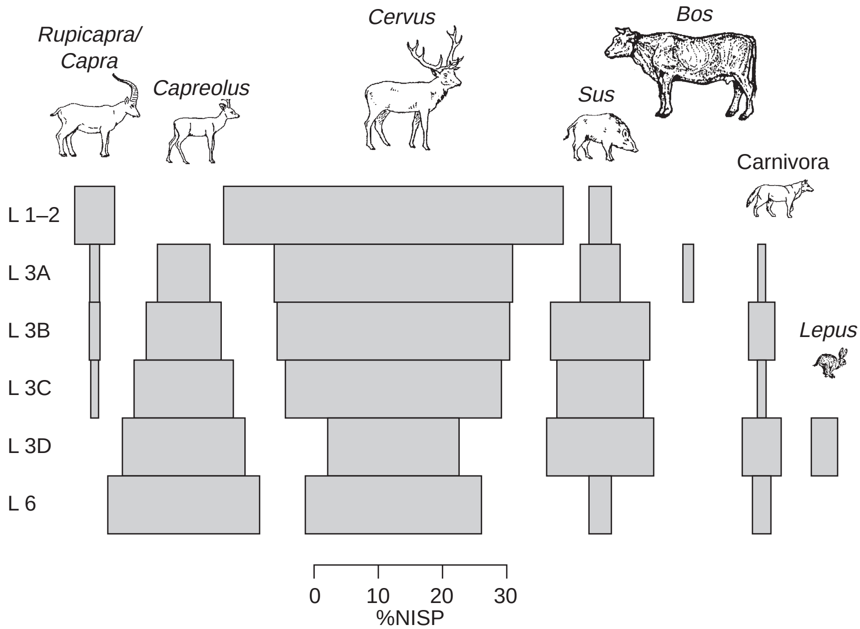

Figure 7. *Change in mammalian species frequency (%NISP) at Šebrn.*

Preboreal (*c.* 9200 C-14 bp, 8300 Cal BC). We interpret the temporal changes in taxonomic frequency, however, in terms of human practices rather than palaeo-environments. Before we make more of these taxonomic changes, we need to briefly consider the taphonomy of the faunal assemblages.

Many of the bone surfaces are weathered, and the frequency and intensity of this weathering increases as one moves up the stratigraphy, from around 37 per cent of NISP in levels 3C–6 to 100 per cent of NISP in level 1 at the surface (Table 14). Of 303 bones coded as 'weathered', 274 of them (90%) were etched by root tips

Table 14. Weathering of identified faunal remains from Šebrn.

Level	absent	NISP weathered slight	marked	Total NISP	% weathered
L 1–2	2	13	15	30	93.3
L 3A	40	82	30	152	73.7
L 3B	66	58	7	131	49.6
L 3C	93	52	1	146	36.3
L 3D	58	34	0	92	37.0
L 6	18	9	2	29	37.9
Total	277	248	55	580	52.2

or other chemical processes, which is not surprising as fine rootlets were very frequent in the sediments and increased in abundance toward the shelter surface. Calcium carbonate rinds on bone surfaces were rarely encountered (NISP 8, 1.4%), and these were found only near the limestone wall of the rock-shelter in square E2. With the exception of a single badger bone, burning is restricted to the three main ungulates and associated body sizes (Table 13). The frequency of burning is relatively high in the roe deer sample (21.1% of NISP) and low for wild boar bones (1.5% of NISP), which suggests spatial variation in the distribution of their bones and exposure to fire, contrasts in how they were cooked and consumed, and/or systematic differences among taxa in bone discard. The presence of calcined and partly calcined bones (NISP 9, 1.6%) indicates that some bones were exposed to prolonged and extreme heat (Shipman et al. 1984; Nicholson 1993) and some dispersion and/or cleaning of hearths at Šebrn must have occurred. Most of the calcined bones are from roe deer (NISP 4) and small-sized ungulates (NISP 2), which is one indication that differences among taxa in bone burning is probably related to discard patterns and chance contact with fires rather than contrasts in cooking practices. Level 4, the heavily calcified lens in square E4 (Fig. 4), has a very high frequency (70%) of burned bone fragments (Table 10) and 25 per cent of the lithics from this level are burned. During excavation, however, this feature did not appear very 'hearth-like', as it lacked rubified soil, concentrations of wood charcoal, fire-cracked rock or other evidence of burning.

Despite the poor preservation of bone surfaces due to weathering, we still observed 8 cut-marked bones (1.4% of NISP) among the following taxa: small ungulate (NISP 1), roe deer (NISP 1), red deer (NISP 4), and wild boar (NISP 2). No cut marks or other indications of human modification were observed on any of the other remains. Evidence of carnivore and rodent modification is even rarer (NISP 4, 0.7%). A single red deer 3rd phalanx appears to have been gnawed by rodents, while single fragments from a small-sized ungulate, red deer, and hare show acid-etching suggestive of having passed through a digestive tract. These digested bones were probably deposited at Šebrn in carnivore scats, potentially from a canid or wild cat. Along with the edible dormouse (see earlier), the hare and small carnivores may have been brought to the site by one of the larger carnivores (wild cat or wolf/dog) or even a raptor. Having raised this possibility, we would like to also note that there is very little taphonomic evidence of the agents of accumulation of the smaller mammals and carnivores. Given the small sample sizes and pending further evidence, we consider it prudent to drop these taxa from behavioural and dietary analyses for the time being.

Determinations of season of death are based on the presence of foetal/infant remains and the eruption/wear of deciduous teeth. Of 191 elements that could be aged, 26 (13.6%) are from foetal/infant animals (Table 15). The frequency of foetal/infant remains is quite similar among the major ungulates, ranging from 6.7 per cent in roe deer and small ungulates to 14.6 per cent in red deer and medium ungulates. If one includes the four foetal/infant remains identified only to 'ungulate' with the small ungulates, then the relative frequency of foetal/infant

Table 15. Age at death by taxon at Šebrn.

Taxon	Foetal/ Neonatal	Subadult	Adult	Old adult	Total	% Foetal/ Neonatal
Red deer + medium ungulates	14	41	40	1	96	14.6
Wild boar	5	12	19	0	36	13.9
Roe deer + small ungulates	3	15	27	0	45	6.7
Ungulates	4	0	0	0	4	
Other animals	0	2	8	0	10	
Total	26	70	94	1	191	13.6

remains is almost identical among the major ungulates. These data support an interpretation of a seasonally-restricted (spring) use of Šebrn, although they do not exclude activities at the site during other seasons. People were certainly visiting the site during the spring and procuring red and roe deer hinds (either pregnant females or nursery groups) as well as wild boar sows and/or suckling piglets. To the extent that at least some of the bones are from foetuses, these remains are also evidence that initial gutting and butchery of carcasses were carried out at Šebrn (Miracle and O'Brien 1998). There is also positive evidence, however, of use of the site during other seasons. A single red deer demi-mandible with dp2–dp4 and M1 in wear, and P3-P4 still in crypt (specimen #9.12) from level 3A was scored as 32–37 using Carter's (1998) system, which gives an age of 17 months. Assuming a birthing season in May–June, the animal must have died during its second autumn. Looking at the frequency of foetal/infant remains by level (Table 16), we observe that they are missing from levels 1–2, 3C, and 6, and account for 16–26 per cent of ageable NISP in levels 3A, 3B, and 3D. The absence of foetal/ infant remains from levels 1–2 and 6 may be due to a sampling error caused by small sample sizes, while variation within level 3 is difficult to interpret since the sublevels are arbitrary divisions of a more or less homogeneous deposit. If, however,

Table 16. Age at death by level at Šebrn.

Level	Foetal/ Neonatal	Subadult	Adult	Old adult	Totals	% Foetal/ Neonatal
L 1–2	0	1	7	0	8	0.0
L 3A	7	18	18	1	44	15.9
L 3B	13	15	21	0	49	26.5
L 3C	0	20	26	0	46	0.0
L 3D	6	14	17	0	37	16.2
L 6	0	2	5	0	7	0.0
Total	26	70	94	1	191	13.6

the drop in the frequency of foetal/infant remains is not simply a statistical artefact, it could be caused by many human practices, including hunting males, gutting carcasses at the kill site instead of Šebrn, as well as by a shift in the season of procurement. While the temporal variation is suggestive, the most likely interpretation is that the season of ungulate procurement did not change dramatically over time. Much of the hunting appears to have occurred during the spring, although a few animals were also hunted during other seasons.

The remainder of the ageing data (Tables 15 and 16) is based on epiphyseal fusion (unfused = juvenile, fused = adult) and dental eruption and wear. These data are very coarse and somewhat problematic since some of the early-fusing bones coded as 'adult' could also come from juveniles. Nonetheless, they bring out several interesting points. First is the rarity of teeth from old adults. Second is the general parity in the frequency of juvenile and adult remains.[5] The relative frequency of juvenile to adult remains varies somewhat among taxa and levels, although patterning is not very robust.

The frequency of different body parts is presented in Table 17 and Figure 8. Body part frequency is quantified by NISP, minimum number of elements (MNE), minimal animal unit (MAU), and percentage of MAU (Table 17). The MNE was

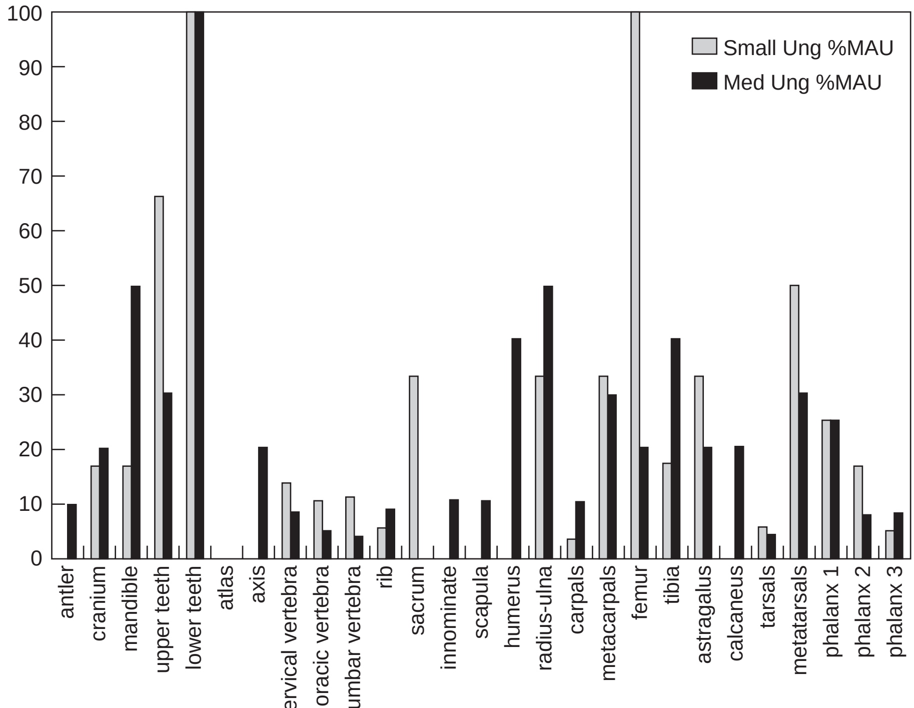

Figure 8. *Body part frequency in medium-sized (not including wild boar) and small-sized ungulates at Šebrn.*

Table 17. Body parts of medium and small-sized ungulates at Šebrn.

	Medium-sized ungulates				Small-sized ungulates			
Element	NISP	MNE	MAU	%MAU	NISP	MNE	MAU	%MAU
antler	16	1	0.50	10.00	0	0	0.00	0.00
cranium	18	2	1.00	20.00	5	1	0.50	16.67
mandible	20	5	2.50	50.00	4	1	0.50	16.67
upper teeth	9	3	1.50	30.00	10	4	2.00	66.67
lower teeth	58	10	5.00	100.00	12	6	3.00	100.00
atlas	0	0	0.00	0.00	0	0	0.00	0.00
axis	1	1	1.00	20.00	0	0	0.00	0.00
cervical vertebra	4	2	0.40	8.00	3	2	0.40	13.33
thoracic vertebra	4	3	0.23	4.62	4	4	0.31	10.26
lumbar vertebra	2	1	0.17	3.33	2	2	0.33	11.11
rib	24	11	0.42	8.46	11	4	0.15	5.13
sacrum	0	0	0.00	0.00	1	1	1.00	33.33
innominate	1	1	0.50	10.00	0	0	0.00	0.00
scapula	2	1	0.50	10.00	0	0	0.00	0.00
humerus	9	4	2.00	40.00	0	0	0.00	0.00
radius-ulna	10	5	2.50	50.00	4	2	1.00	33.33
carpals	5	5	0.50	10.00	1	1	0.10	3.33
metacarpals	12	3	1.50	30.00	10	2	1.00	33.33
femur	4	2	1.00	20.00	11	6	3.00	100.00
tibia	8	4	2.00	40.00	8	1	0.50	16.67
astragalus	2	2	1.00	20.00	2	2	1.00	33.33
calcaneus	3	2	1.00	20.00	0	0	0.00	0.00
tarsals	2	1	0.17	3.33	1	1	0.17	5.56
metatarsals	14	3	1.50	30.00	13	3	1.50	50.00
phalanx 1	21	10	1.25	25.00	8	6	0.75	25.00
phalanx 2	4	3	0.38	7.50	5	4	0.50	16.67
phalanx 3	3	3	0.38	7.50	1	1	0.13	4.17
sesamoids	4	4			1	1		
hyoid					1	1		
indet. metapodials	5	0			6	1		
indet. teeth	11	0			1	0		
long bone shafts	48	0			13	1		
spongy bone	5	0			1	0		
indet. vertebra					4	0		
indeterminate	3	0						
Total	332	92			143	58		

calculated on the basis of unique anatomical features for each element and with regards to the assemblage as a whole. As such, MNE values are independent among different stratigraphic units and can be added together. Among the axial elements, vertebral centra and zygophyses were coded, as were proximal parts of ribs (tubercle, neck, and/or head). In the limbs, all articular ends and shaft fragments that preserved landmarks diagnostic to element and side (such as nutrient foramen) were coded. An attempt was made to refit fragments and articulate elements, but it met with only limited success.[6] Due to the high fragmentation and weathering of the assemblage, we doubt that an intensive programme of refitting would be worth the effort. The minimal animal unit (MAU) was calculated by dividing the MNE for each element by its frequency in the skeleton. Finally, the percentage MAU was calculated by norming MAU relative to the most frequent element. Assemblages from individual levels are too small to be treated separately. Furthermore, bones from similarly-sized and built taxa are treated together to incorporate cases where bones were identified only to element and body size. Hence, in Table 17 and Figure 8 'small-sized ungulate' includes all remains identified to roe deer, chamois, chamois/ibex, and small-sized ungulate, while 'medium-sized ungulate' includes remains identified to red deer and medium-sized ungulate, but not wild boar. In both taxa lower teeth are the most common element, while antler/horn core, parts of the axial skeleton, and small-sized bones (carpals, tarsals, phalanx 3) are relatively rare. If one leaves teeth out of the picture, then it is clear that heads are fairly poorly represented relative to limbs and that this pattern is particularly strong in the small ungulates (Fig. 8). In considering element frequencies, it is critical that one considers the effects of density-mediated destruction, whether from bone processing, carnivore gnawing, postdepositional forces, or other factors, as in situ bone destruction can produce relative element frequencies identical to those expected from carcass transport and other economic decisions (Lyman 1985, 1994). A strong positive correlation between volume density and element frequency suggests that density-mediated destruction has had an important effect on element frequency, although a positive correlation in itself does not identify the specific taphonomic agent. At Šebrn there is not a statistically significant relationship between element frequency and volume density in small ungulates (Fig. 9a), while there is a strong and statistically significant relationship between these variables in medium ungulates (Fig. 9b). Turning to the latter case first, this result suggests that much of the

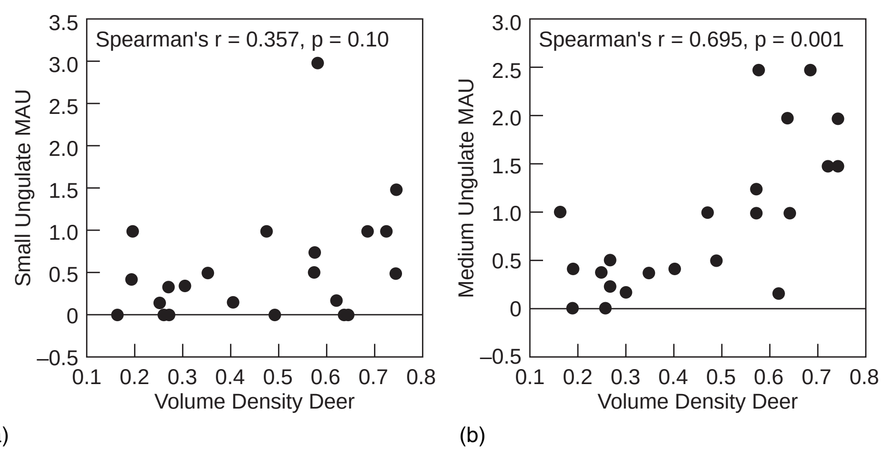

Figure 9. *Volume density deer versus MAU small ungulate (a) and MAU medium ungulate (b). Volume density from Lyman 1994 (Table 7.6). Bone mineral density scan sites used are: DN4, AT3, AX1, CE1, TH2, LU2, RI3, SC1, AC1, SP2, HU4, RA3, MC3, FE4, TI3, AS1, CA2, NC3, MR3, P13, P23, P31.*

variation in element frequency is due to on-site destruction. More or less complete carcasses of medium-sized ungulates (mostly red deer) were probably brought to the site for butchery and consumption, without an introduction or removal of separate joints of meat. There appears to have been some human selectivity for bones from within carcasses, as there is a strong and significant correlation (Spearman's $r = 0.681$, $p = 0.011$) between element frequency and marrow volume, using data on another similarly body-sized cervid, the caribou, as a proxy for red deer (Binford 1978; Jones and Metcalfe 1988). The weak and non-significant relationship between volume density and element frequency in small ungulates is a strong contrast with the medium ungulates and suggests that their carcasses were being treated somewhat differently. First, the rarity of heads (but not teeth) relative to limbs suggests that heads may have been discarded prior to carcass transport to Šebrn or that they may have been heavily processed (and destroyed) on site. Since only a portion of the archaeological deposits at Šebrn were excavated, it is possible that the missing heads are present elsewhere on site. This, however, would imply that teeth have been more commonly disassociated from skulls in the small ungulates than the medium ungulates, which would be expected if small ungulate heads were more heavily processed than those of medium ungulates. The very high frequency of the relatively meaty small ungulate femurs suggests that people were consuming the associated meat on site; upper hind limbs may have been brought to the site as food to be eaten while other animals were hunted in the site's vicinity. While the femur has a relatively large marrow cavity, at least in the sheep being used as a proxy for small ungulates (Jones and Metcalfe 1988), other relatively high-marrow yielding bones such as the humerus and tibia are absent or rare in the assemblage. Unlike the medium ungulates, there does not appear to have been a particular selection and discard of marrow bones in the small ungulates. This lends further support to our suggestion that small ungulate parts in addition to small ungulate carcasses were introduced to the site.

As mentioned earlier, the taxonomic composition of the faunal assemblage at Šebrn changes over time. Remembering that the taphonomic status of the small animals is open to debate and that people may not have consumed these taxa, there is, nonetheless, an interesting trend towards an increased focus on red deer over time. Assemblage diversity comprises two components – richness and evenness. Following standard definitions in ecology, richness is the total number of classes of objects and evenness is the relative equality of distribution of items among classes (Bobrowsky and Ball 1989; McCartney and Glass 1990). Measures of diversity that depend on both richness and evenness are referred to as heterogeneous.

Richness is measured as the number of mutually exclusive taxa or taxonomic groups; it has been calculated only on the ungulates for the taphonomic reasons outlined here. Diet breadth predictions for richness are relatively straightforward. Richness should increase through the inclusion of lower ranked resources. Evenness is measured following Kintigh (1984) as the Shannon-Wiener information statistic (H) divided by its maximum value for the observed richness ($Hmax$). Division by $Hmax$ removes the effects of richness from H and leaves us with evenness, which varies from 0 (all items in a single category) to 1 (items equally distributed among categories). Although McCartney and Glass (1990) suggest that Kintigh's evenness statistic is actually a measure of heterogeneity, since division by potential *Hmax* simply standardizes heterogeneity to a common maximum value, this point is only important if there are a priori reasons to expect potential richness to differ among assemblages, for example owing to an extinction or introduction of taxa during the time period covered by the assemblages. Change in assemblage evenness is not an expectation of diet breadth models and evenness can both increase and decrease with changes in diet breadth (Miracle 1996). On the other hand, the relative abundance of high- *versus* low-ranked resources gives a direct index of diet breadth, since diet breadth is predicted to change through the inclusion or exclusion of low-ranked resources (Miracle 1995, 1996). Mean prey weights were calculated for each assemblage as follows. For each species, the mean body weight, as determined from the literature or regressions on bone measurements, was multiplied by the species' MNE; these values were then added together and divided by the total MNE for the assemblage to give the mean weight of prey (Miracle 1995). This calculation is essentially assemblage composition weighted by body mass. It is not an estimate of meat weight since a reliable meat weight estimate must also consider the effects of foragers transporting body parts as well as whole carcasses. Measures of assemblage diversity and dietary composition for the Šebrn assemblages are presented in Table 18. We must consider the effects of sample size on these results prior to further interpretation.

Measures of richness and evenness have been shown to strongly depend on sample size, and both regression and simulation techniques have been proposed to control for the 'sample-size effect' (Jones et al. 1983; Grayson 1984; Kintigh 1984; Rhode 1988; Leonard and Jones 1989; McCartney and Glass 1990).[7] Throughout these analyses, I have used the minimum number of elements (MNE) to quantify the faunal assemblages. MNEs give a more reliable estimate of abundance than NISPs in contexts where fragmentation is variable between species and/or the identifiability of bones significantly varies between taxa (see Grayson 1991). The richness of the ungulate assemblage from Šebrn varies from three to five species (Table 18) and does not show any clear changes over time. There is clearly a positive relationship between assemblage size and taxonomic richness. While richness is a very

Table 18. Diversity indices and average carcass weight at Šebrn based on ungulate remains identifiable to genus or species. Evenness estimated following Kintigh (1984) as the Shannon-Wiener information statistic (H) *divided by its maximum value for the observed richness* (Hmax). *Average carcass weight calculated using species estimates in Miracle (1995, 1996).*

	Level					
Measure	L 1–2	L 3A	L 3B	L 3C	L 3D	L 6
NISP ID to genus/species	19	82	86	95	52	16
Richness (N taxa)	3	5	4	4	3	3
Evenness (H/Hmax)	0.33	0.60	0.66	0.68	0.68	0.55
Average carcass weight	238	227	178	168	134	154

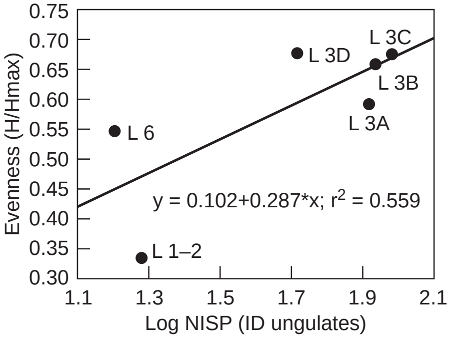

Figure 10. *Evenness plotted against assemblage size for ungulates identified at Šebrn.*

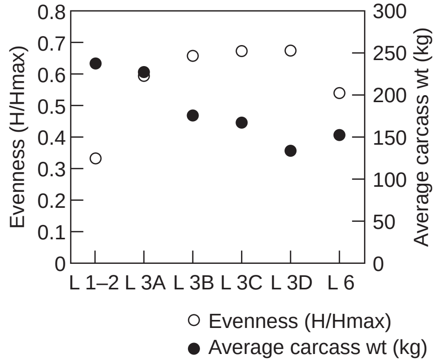

Figure 11. *Change in evenness and average carcass weight over time at Šebrn.*

powerful measure of changes in diet breadth, particularly when taphonomic considerations are taken into account (Broughton and Grayson 1993; Madsen 1993; Miracle 1996), it is too coarse a measure for our purposes here. Evenness also shows a strong positive relationship with assemblage size (Fig. 10), and regression analysis shows that much of the variance in evenness is accounted for by sample size. The residuals of the regression analysis, however, reveal some interesting information. Observed evenness values for levels 1–2 and 6 deviate more from the regression line than other assemblages, with lower values than predicted for the former and greater values than predicted for the latter.

Turning to the stratigraphic context of the diversity measures, there are some very interesting patterns (Fig. 11). Evenness steadily decreases from levels 3D to 1–2, confirming the impression of taxonomic changes formed by a visual inspection of Figure 8. This shift is shown even more clearly by an increase of over 100 kg in average carcass weight from level 3D to levels 1-2. Over the course of the few centuries that people were using the Šebrn rock-shelter, they changed their procurement strategies and consumption practices from taking roughly similar numbers of red deer, roe deer, and wild boar to focussing on red deer. It seems unlikely that the availability of game would have changed significantly in such a short time span, and there are no indications of a temporal shift in the seasonality of ungulate procurement and by inference site occupation that might also account for these changes in taxonomic composition. How can we account for these changes in Šebrn's faunal assemblages?

DISCUSSION

At present there are not any confirmed Pleistocene-age archaeological sites in the Ćićarija uplands, although there are numerous habitable caves in the region and some contain the remains of cave bears (Malez 1960, 1981, 1987). The sediments and absolute dates from Šebrn suggest first occupation during the early Holocene, which also seems to be the case at the nearby site of Klanjćeva Cave (Miracle and Forenbaher in press) as well as in neighbouring regions of the Slovenian karst (Leben 1976; Turk et al. 1992; Turk et al. 1993) and Trestino karst (Boschian and Montagnari Kokelj 1984; Boschian 1993, 1997). Current evidence indicates that people were moving into a new, previously unoccupied, landscape when they started making forays into the broken upland landscapes of Ćićarija during the early Holocene. The lack of human occupation of the upland karst prior to the early Holocene is intriguing, since there is clear evidence of a Pleistocene human presence at the nearby sites of Pupićina and Vešanska Caves, which are only 3 km distant (straight-line) and 500 m lower in absolute elevation than Šebrn (Miracle 1997; Miracle and Forenbaher in press).

The first visitors at Šebrn may have been hunters and scouts monitoring the movement of herds of red deer in search of new-growth forage during the spring. In this scenario, the early occupations at Šebrn would have been by subgroups of the larger foraging bands that were living in north-eastern Istria. These pioneers into the hills probably came from the nearby site of Pupićina Cave, for which we have abundant and broadly synchronous evidence of occupation during the early Holocene (Miracle 1997). The density and diversity of occupational refuse deposited at Pupićina Cave is much greater than at Šebrn. Differences in the composition of their artefact assemblages and food waste suggest that people occupied Pupićina for longer periods of time and in a more seasonally-structured manner than Šebrn. As analyses are ongoing, these interpretations are still preliminary. In site-functional terms, our current interpretation is that Šebrn is a logistical camp attached to a larger seasonal base camp at Pupićina Cave.

During their initial visits to the uplands, people probably brought some food with them, perhaps in the form of cuts of roe deer meat and other high-yield small ungulate parts. They may have also procured game more or less as it was available, taking the more conservative and reliable strategy of exploiting a wider range of resources. These are the kinds of practices that one may expect from people still familiarizing themselves with the opportunities provided by the uplands. Thus, during its first use, Šebrn may have been a 'logistic site' at which people were pursuing a fairly generalized subsistence strategy.

With the passage of time during this relatively brief period at the start of the Holocene, we see a clear shift to a more specialized use of Šebrn for the procurement of red deer. People were still probably coming to Šebrn to monitor herd movements and assess conditions in the uplands, but were doing so with a much clearer idea as to what they were likely to find. People were now hunting herds as they moved between the lowlands and uplands and then processing, consuming, and discarding the carcasses at Šebrn. While much of the meat and other products may have been prepared for transport and consumption elsewhere, there are not any clear indications from the faunal remains that this was the case.

This scenario based on the faunal remains is consistent with evidence from the lithic assemblage. As noted earlier, backed bladelets are fairly frequent (24.4%) among the retouched tools, and hunting gear is an important component of the

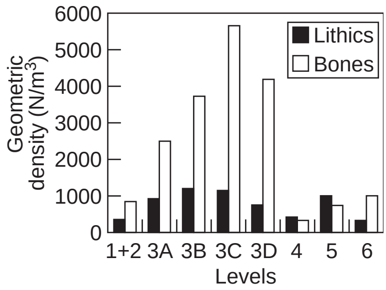

Figure 12. *Change in geometric density (N/m^3 of excavated sediment) of lithic artifacts and faunal remains at Šebrn.*

lithic assemblage. The presence of tools used for transformation activities as well as technological evidence of complete operational sequences, however, point to activities beyond simply 'gearing-up' – Šebrn was certainly more than just an upland hunting camp. While the general character of the lithic assemblage is fairly homogeneous, there are some subtle shifts that complement the changes noted in the fauna. For example, the frequency of backed bladelets varies considerably by level. Backed bladelets make up 33.3 per cent of the retouched tools in levels 4–6. Their frequency drops in levels 3C–3D to 15 per cent of the retouched tools, only to rise again to 28.4 per cent of retouched tools in levels 1–3B (calculated from Tables 7 and 8). One interpretation is that the relative importance of different activities also varied over time, with practices leading to the discard of backed bladelets and other hunting gear more important early and late in the sequence.

Temporal trends in the geometric density of lithics and bones add to the scenario outlined earlier in this article. The majority of the lithic artefacts were excavated in levels 3A–C (Table 10). The average geometric density of the stratigraphic units, calculated as the number of specimens per unit volume of deposit (N/m^3), was 703.1. The geometric density of lithics and bones is relatively low in levels 4–6 compared to levels 3A–3D (Fig. 12). There was then a very dramatic change between levels 4 and 3D, particularly in the density of faunal remains. The earliest occupations at Šebrn appear to have been very short visits, with people probably camping only overnight en route to other sites in the uplands. Levels 4 and 5 also stand out as the only levels in which the geometric density of lithics is greater than that of the faunal remains. People's activities were generating more lithic than faunal waste, suggesting tool maintenance and/or production with little animal procurement and processing. People were gearing up for activities elsewhere and Šebrn and its surroundings were incidental to practices rather than a focus for them. Interestingly, the continued shift towards a more focussed use of red deer from level 3C to levels 1–2 occurs at a time of declining densities of faunal remains. While people were procuring more red deer at the site during later occupations, they were probably doing so during relatively shorter visits and/or transporting red deer products to other sites. Visits to Šebrn during levels 4–6 appear to have been very ephemeral, followed by longer occupations of the site during levels 3C–3D, and ending with somewhat shorter occupations in levels 1–3B. It is impossible to determine the precise duration of occupations during different periods of shelter use, but we suggest that visits may have been for hours to days in levels 4–6, for days to weeks in levels 3C–3D, and for days in levels 1–3B.

Šebrn, as a culturally-constructed place, changed significantly over the several centuries it was visited and used by people. Initially it was an overhang, a bit of shelter from the wind and rain, a place to stop and retool weapons, that probably did not stand out from other places of shelter on the edge of the Ćićarija uplands. Use of the site was intermittent and, in one sense, fortuitous in that as the need arose for shelter while people were passing through the area, they would stop at the site. With the passage of time and as they learned about upland environments, people started coming to the site more regularly and for longer periods of time. One's perception of the place today differs dramatically depending on whether one is climbing to or descending from the Ćićarija uplands. In the former case, the 30 m-high limestone cliff above the shelter dominates the view, while in the latter one's attention is dispersed widely among the Učka summit, Vela Canyon, Boljunsko Polje, and the undulating flysch topography below (Fig. 1). The site's location on what must have been an important path between the uplands and lowlands probably imbued it with symbolic significance (Tilley 1994). While we consider it important to recognize and explore past landscapes as cultural constructs, we are not yet comfortable with ascribing meanings to Šebrn and/or some of the prominent landforms in its vicinity.

CONCLUSIONS

We have presented in this paper a close and detailed analysis of an early Mesolithic site in the karstic hinterland of north-eastern Istria, Croatia. Although the site was sampled by a relatively small trench and yielded a fairly shallow stratigraphic sequence of occupational debris, its archaeological assemblages are of considerable interest for the information they provide about the organization of activities at the site and how these activities changed over a relatively short period of time. The big surprise at Šebrn is that, while the lithic assemblages are relatively homogeneous and there is some justification for treating them as a single unit, the faunal remains reveal a much more dynamic situation of temporal changes in the scope and focus of activities on site. Keeping in mind that there are very real limitations on the temporal and spatial resolution of archaeological data, particularly from the Palaeolithic and Mesolithic, and hence the scale at which we can interpret past activities and strategies, there nevertheless remains much mileage in close analyses of sites and assemblages and we have many tools at our disposal to extract patterns in the data despite the ubiquitous problems of palimpsests. We have partitioned variability in several different ways to suggest the relevance of (1) duration of occupation, (2) on-site activities, (3) anticipated moves and practices at other places in the region and (4) environmental knowledge of the people who used the shelter to the composition and structure of Šebrn's faunal and lithic assemblages. While these suggestions are somewhat speculative and the robustness of patterning in the data is limited by sample size, our interpretations are clearly linked to the stones and bones that constitute the 'hard' data.

Within the larger framework of the Pleistocene–Holocene transition in the northern Adriatic Basin, analyses of Šebrn's assemblages show ways in which one might study the occupation of previously unused landscapes. People's interactions with landscapes are very different if they are there only intermittent as opposed to using them on a regular basis. These points have been very cogently made by Housley et al. (1997) in a discussion of the earlier, late glacial recolonization of northern Europe. These authors suggest a two-phase model of recolonization with an initial ‘pioneer phase’ followed by a ‘residential base’ phase of settlement, and with each phase characterized by strikingly different archaeological records. Despite significant environmental differences between late glacial northern Europe and early postglacial southern Europe, it is of considerable interest that some of the same processes of colonization are visible at a much smaller geographic scale (a single drainage basin) in small-scale yet significant contrasts in lithic and faunal composition and formation rate of deposits.

Our analyses of subsistence change at Šebrn make use of diversity indices and other measures of taxonomic composition that commonly have been used to address large-scale issues surrounding the broadening of the resource base at the end of the Pleistocene (e.g. Christenson 1980; G.A. Clark 1987; Edwards 1989; Neeley and Clark 1993). Several authors have noted, however, that it is very difficult to differentiate between alternative explanations of subsistence change due to the presence of confounding variables interacting simultaneously on multiple different scales (Miracle 1995, 1996, 1997; Morales et al. 1998). These authors have stressed the importance of starting from local and small scales when addressing these issues.

The uncomfortable fit of the Šebrn lithics in generic typological labels like ‘Epigravettian’ and ‘Sauveterrian’ probably relates to a combination of (a) a technological tradition carried on from the late upper Palaeolithic, which some authors call ‘Epitardigravettian’, (b) the highly specialized nature of on-site activities, and (c) the small sample retrieved and available for analysis. Therefore, we have stressed morpho-technological features of the assemblages, acknowledging the potential inter-site variability generated by the different activities, cultural traditions, and expectations that constituted foraging peoples’ places and landscapes.

Without getting a better handle on the effects of local factors in small-scale patterning in the archaeological record, it will be impossible satisfactorily to sort out larger issues like recolonization, dietary diversification, task differentiation, and the extent of continuity of traditions from the late glacial to postglacial in Europe. We hope that our analyses and interpretations of Šebrn have shed light on the Mesolithic from a poorly known part of Europe, as well as providing a framework for relating small-scale changes to larger issues.

Karstic uplands around Šebrn, however conceived, were only a part of the landscapes created by early Holocene foragers in north-eastern Istria. Returning to the canyon ‘lowlands’, there is a clear temporal trend towards a more intensive use of resources through diversification during the early Holocene at Pupićina Cave (Miracle 1997). The synchronic trend towards a more regular use of Šebrn for red deer procurement thus may be part of a larger pattern. People were diversifying strategies by regularly incorporating novel ecological zones in the larger region as well as by procuring previously ignored resources from already exploited habitats. Landscapes were thus fluid at the macro- and micro-scales. Rather than viewing landscapes in purely essentialist terms, we find it useful to think of them as embedded in cultural strategies used by people in negotiations with one another and their surroundings. Šebrn thus became part of a settlement system that related lowlands to uplands, and the site gained significance in the cultural landscape as people brought to it expectations about what they would do, how long they would stay, and who they would see.

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NOTES

1. Coastal Mesolithic sites in Istria have yet to be identified.
2. It is not clear as yet whether damage to the edges of artefacts is the result of their use as tools or of depositional or post-depositional rolling etc. It is expected that microscopic analysis of the edges will help us to determine this.
3. In this assemblage we have defined as bladelets those blades whose breadth is equal to or less than 10 mm.
4. The very high values of 70 per cent and 83 per cent from levels 4 and 7 may be due to the effects of very small sample sizes.
5. These patterns still hold up if only teeth are considered.
6. Six pairs of conjoined/articulated elements were identified, one between levels 1–3A, one in level 3A, two in level 3C, and two in level 3D.
7. As Plog and Hegmon (1993) point out, assemblage size itself may be an important indicator of behavioural variation.

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ABSTRACTS

Les pionniers des collines: les cueilleurs du Mésolithique ancien de l'Abri Šebrn (Istrie, Croatie)

Preston Miracle, Nena Galanidou et Stašo Forenbaher

Les stratégies utilisées par les populations du Mésolithique ancien lors de leurs explorations des régions karstiques de l'Istrie du nord-est (Croatie), sont examinées dans cet article. Ces stratégies sont déduites de l'analyse détaillée des assemblages lithiques et de la faune de Šebrn, un petit abri sous roche des hautes terres, occupé pour une période relativement courte de l'Holocène ancien. Les assemblages lithiques de Šebrn apparaissent relativement homogènes du point de vue de leur technologie et de leur typologie et peuvent être traités comme une unité, apparantée au Sauveterrien et à l' Epigravettien sensu lato. Au contraire, la faune met en évidence l'évolution dynamique au cours du temps, de l'étendue et du type d'activités entreprises sur ce site. Les résultats fournis par l'étude des assemblages lithiques et de la faune nous permettent de suggérer que l'utilisation de ce site fut au début intermittente - des visites par des groupes avec une stratégie généraliste de survie. Mais, petit à petit, ces groupes apprirent l'environnement des hautes terres et se spécialisèrent dans la chasse au cerf. Šebrn faisait partie d'un système de peuplement qui reliait les basses terres aux hautes terres, et la signification du site dans le paysage culturel s'accrut avec les groupes apportant leurs espèrances de ce qu'ils pourraient y faire et le temps qu'ils pourraient y passer.

Pioniere in den Hügeln: frühmesolitische Sammler am Šebrn Abri (Istrien, Kroatien)

Preston Miracle, Nena Galanidou und Stašo Forenbaher

In diesem Artikel untersuchen wir die Strategien, die frühmesolithische Menschen anwandten, als sie ins karstige Hochland Nordostistriens, Kroatien, einwanderten. Diese Strategien werden aus detaillierten Analysen der lithischen und pflanzlichen Inventare von Šebrn erschlossen, eines kleinen Hochland-Abris, das während einer relativ kurzen Zeit im Frühholozän benutzt wurde. Wir könnten feststellen, dass die lithischen Inventare aus Šebrn in Technologie und Typologie relativ homogen sind und als geschlossene Einheit betrachtet werden können (in Beziehung zum Sauvettien und Epigravettien, *sensu lato*). Die pflanzlichen Reste dagegen zeigen eine dynamische Situation von zeitweiligen Wechseln in Umfang und Fokus der Aktivitäten am Ort. Auf der Grundlage verschiedener Beobachtungen am lithischen und pflanzlichen Material erschließen wir, dass der Ort anfänglich periodisch genutzt und von Menschen aufgesucht wurde, die eine generalisierte Subsistenzstrategie verfolgten. Im Laufe der Zeit und durch das Kennenlernen der Umwelt des Hochlandes wandten sich die Menschen speziell der Rotwildjagd zu. Šebrn wurde Teil eines Siedlungssystems, das Tiefland und Hochland miteinander verband, und der Ort gewann an Bedeutung für die Kulturlandschaft, da die Menschen Erwartungen mit ihm verbanden über das, was sie dort tun würden und wie lange sie bleiben würden.