Abhandlung Band 45/2005 ISSN 0077-6149	Neue Forschungen zum Höhlenbären in Europa	Seite 143-154	Naturhistorische Gesellschaft Nürnberg e.V. Marientorgraben 8, 90402 Nürnberg

Gordana Jambrešić, Kazimir Miculinić & Preston Miracle

Pleistocene Fauna from the Cave Pećina na Brehu (Istria, Croatia)

Zusammenfassung:

Die pleistozäne Fauna aus der Höhle Pećina na Brehu in Istrien (Kroatien) wird vorgestellt. Die Hauptmenge der Funde sind Reste von *Ursus spelaeus*, wahrscheinlich von Individuen, die während ihrer Winterruhe in der Höhle starben. Gelegentlich nutzten auch andere Raubtiere sowie Murmeltiere die Höhle, während die Reste von Pflanzenfressern und Vögeln wahrscheinlich den Freßabfall von Raubtieren darstellen.

Summary:

Pleistocene fauna, recovered from the cave deposits in Pećina na Brehu in Istria (Croatia) is presented. Remains of *Ursus spelaeus* are the main component, probably from individuals, who died in the cave during hibernation. Other carnivores and marmots also used the cave occasionally, but herbivore and bird remains probably represent the refuse of carnivore consumption.

Résumé:

Présentation de la faune pléistocène provenant de la grotte Pećina na Brehu en Istrie (Croatie). La plupart des restes de faune sont des ossements d'*Ursus spelaeus*, probablement d'individus morts pendant la période d'hibernation. D'autres animaux de proie ainsi que des marmottes ont utilisé la grotte sporadiquement, les restes d'herbivores et d'oiseaux ont probablement été apportés dans la grotte par les animaux de proie.

Key words: Pleistocene fauna, cave bears, mortality, structure, Pécina na Brehu, Istria, Croatia

1. Introduction

Pećina na Brehu is a small, single-passage cave, formed in nummulitic limestone of Ćićarija in Istria, Croatia (Fig.1). The cave is located at an elevation of 592 m/sl., near the top of a ridge north of the village Slum. The entrance is southwest-facing, 5 m wide and 3 m high, followed by a 67 m long tunnel-shaped passage. For approximately half of the length of the cave the bedrock surface was uplifted 3 m due to its location on a fault,

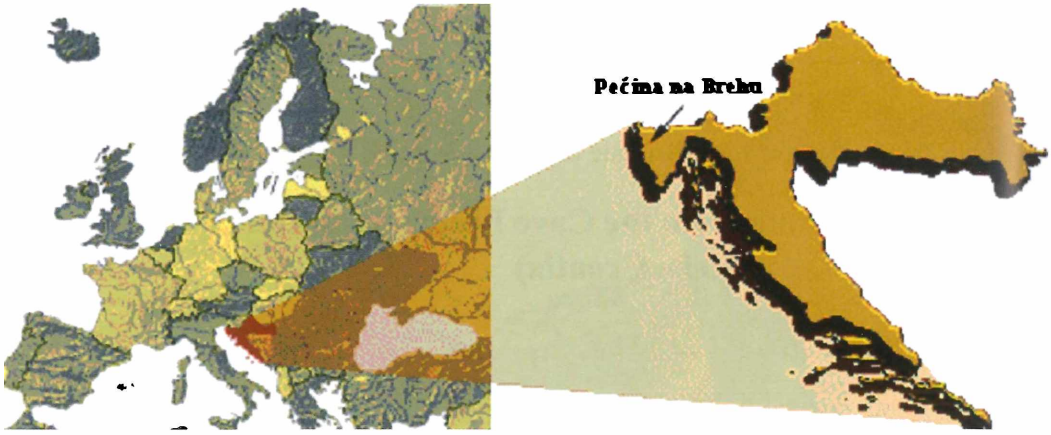

Fig. 1. Position map of Croatia with location of the cave.

and the step was later bridged with flowstone. The first excavation campaigns in 1953 and 1967 yielded a cave bear assemblage with few other taxa (MALEZ 1956, MALEZ 1960, MALEZ 1971). With improved methodological techniques new excavations were performed in 2003/04 by a team composed of palaeontologists and archaeologists. Three trenches and surface finds from the rear of the cave provide a rich Pleistocene faunal assemblage. Some bones were also collected from niches in the cave ceiling, indicating a dynamic history of deposition and erosion of sediments. The two trenches (2 and 3) located in the middle part of the cave contain an upper level that is Holocene aged in addition to the Pleistocene deposits, while the biggest trench, trench 1 near the entrance, is entirely Pleistocene in age. Concerning archaeological finds, prehistoric ceramics and other materials were found in Holocene deposits in trenches 2 and 3, while only 4 flint flakes were found throughout the Pleistocene sequence in trench 1.

2. Sedimentational history and stratigraphy

Several lines of evidence show that there have been dramatic fluctuations in the height of the cave floor from the Pleistocene to the present. Many occurrences of polished bed rock, „bear rubbings" were noticed on both cave walls from 90 to 220 cm above the current cave floor. In the ceiling niche of the flowstone «bridge» some sediment with Pleistocene fauna (cave bear) was found at a height of 100 to 250 cm. Together with some of the trench finds that suggest warmer periods of deposition (e.g. *Hystrix cristata*), it could be concluded that sediment accumulated in the cave from some of the interstadials in Oxygen Isotope Stage (OIS) 3 (maybe even in the earlier interglacial of OIS 5) until the end of last glacial maximum (OIS 2) when an erosional phase occurred. Approximately 2 m of sediment was removed at that time. New sedimentation during the Holocene, according to the archaeological finds in trench 2 and 3, started during the middle Neolithic (ca. mid-6th Millennium BC (FORENBAHER et al. 2004)).

Results presented here are limited to material and observations from trench 1. The trench was situated near the southeastern cave wall so its size is

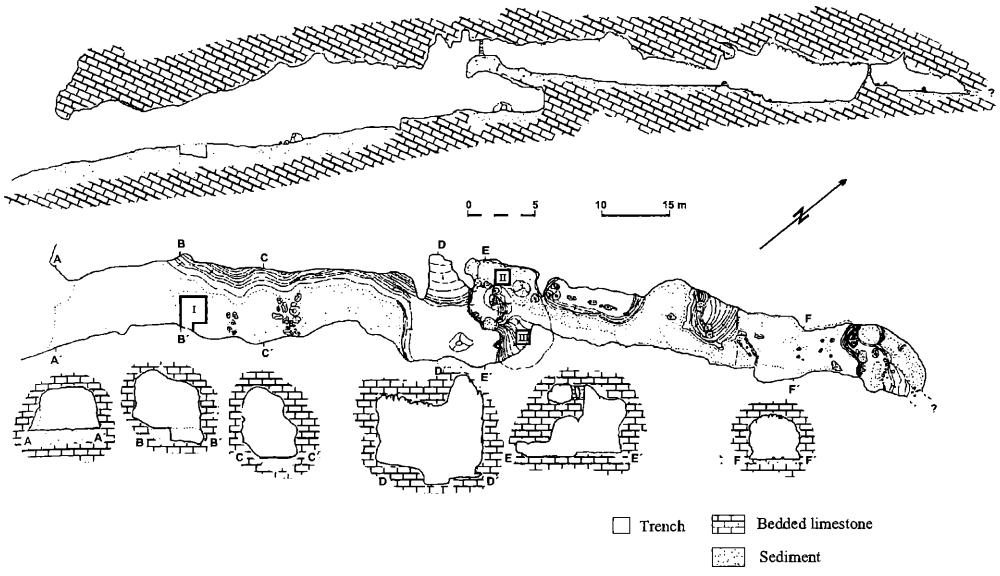

Fig. 2. Map of the Pećina na Brehu with position of the trenches.

only app. 5 m^2 (Fig. 2). It was dug to a depth of ca. 130 cm below the cave surface, where large rocks (bedrock?) were encountered. Sedimentological analyses are still in progress; our observations are based on macroscopic characteristics. The trench contains only Pleistocene sediments within natural layers were distinguished. Layers I, II and III are reddish brown sediments that showed some slight differences in color. The major difference is the degree of calcification. Layers I and III are equally lightly calcified while layer II is more heavily calcified and contains a larger amount of stones than layers I and III. Layer IV consists of pockets of sterile yellow clay. Orange lenses in layer I and calcification in layer II, which occurred during the period of sedimentation, are evidence that the sediment sequence is intact (apart from minor bioturbations).

3. Faunal assemblage

The analyzed sample includes remains excavated from layers I, II and III in trench 1 in the 2003-4 seasons. Animal remains were excavated by hand and all sediment was dry-sieved using a 3-mm mesh. The faunal assemblage was sorted into «identifiable» and «unidentifiable» fragments. All fragments that could be identified to body part and/or taxonomic category were included in the category «identifiable», as were all other fragments greater than 5 cm in size. Many of the «identifiable» fragments were long bone shafts and parts of ribs that could at best be identified to a body size category. Our analyses are limited to larger mammals and bird species from trench 1. Surface finds and excavated remains from trenches 2 and 3 as well as all microfaunal remains from trench 1, are still under analysis and are not included here.

The identifiable assemblage is composed of 2773 NISP (NISP: number of identified specimens). Most of the remains from all three layers were yellow to reddish in color, although some had brown to black mineral staining. Weathering of the bone surface, fine-line fractures and spalling of bone surfaces, is present on over 95 % of the remains. Material from layer II was heavily brecciated with cemented rinds of calcium carbonate, sediment, and stones (57,8 % of NISP retained calcite rinds). Beneath these rinds many of the bear bones (especially long bones) were nearly complete. Material from layers I and III were only partially covered by calcium carbonate (34,8 % and 22,5 % of NISP retained calcite rinds) and these rinds were neither as extensive nor as thick as those in layer II. Carbonate rinds were removed using 10 % solution of Acetic acid ($C_2H_4O_2$). Broken edges on material were quite rounded, suggesting abrasion, perhaps from trampling. Between 6,5 % and 8,8 % of the bones show clear gnawing marks, probably made by bears and large and small carnivores. No clear cut marks were observed and only one bone was burned.

Of the 2773 bones and teeth from the identifiable assemblage, 73,4 % of NISP was identified to taxon. A total of 15 larger mammal species were identified (Table 1). Distribution of species did not show significant differences through the layers. Bear bones (*Ursus spelaeus* and *Ursus* sp.) make up 52,4 % of NISP. They are followed by marmot, badger, wild cat, roe deer, fox, red deer, hare, marten, chamois and horse. Ibex, fallow deer, porcupine and canid (not identifiable to species) are each represented by only one individual. Birds are represented by only 6 bones (0,22 % of NISP), and with exception of *Tetrao urogallus* all species are found in layer III.

Table 1. Species representation by layers at trench 1.

Pećina na Brehu	layer I		layer II		layer III		Total			
Species	NISP	MNI	NISP	MNI	NISP	MNI	NISP	%	MNI	%
Lepus sp.			3	1	2	1	5	0,18	2	1,87
Rupicapra rupicapra	1	1			3	1	4	0,14	2	1,87
Capra ibex					3	1	3	0,10	1	0,93
Rupicapra/Ibex	3	-			1	-	4	0,14		
Capreolus capreolus	6	2	4	1	9	1	19	0,68	4	3,74
Dama dama	3	1					3	0,10	1	0,93
Cervus elaphus	1	1			6	2	7	0,25	3	2,80
Cervidae	7	-	4	-	4		15	0,54		
Equus sp.	1	1	1	1			2	0,07	2	1,87
Canis sp.	1	1					1	0,04	1	0,93
Vulpes vulpes			1	1	8	2	9	0,32	3	2,80
Ursus spelaeus	120	6	429	10	282	14	831	29,97	30	
28,04										
Ursus sp.	114	2	271	10	238	4	623	22,47	16	
14,95										
Felis silvestris	11	2	5	1	8	2	24	0,87	5	4,67
Martes martes					4	1	4	0,14	1	0,93
Martes sp.			2	1			2	0,07	1	0,93
Meles meles			5	1	33	4	38	1,37	5	4,67
Hystrix cristata					1	1	1	0,04	1	0,93
Marmota marmota	57	5	104	7	274	9	435	15,69	21	
19,63										
Tetrao urogallus	1	1					1	0,04	1	0,93
Tetrao tetrix					1	1	1	0,04	1	0,93
Turdus viscivorus					1	1	1	0,04	1	0,93
Phasianus colchicus					1	1	1	0,04	1	0,93
Anas sp.					1	1	1	0,04	1	0,93
Falco sp.					1	1	1	0,04	1	0,93
total ID taxon	326	23	829	34	881	48	2036	73,42	105	
98,13										
small-medium sized carnivore	1	1			1	1	2	0,07	2	1,87
small-sized animal	11		22		29		62	2,24		
small-sized ungulate or carnivore	18		67		42		127	4,58		
medium-sized ungulate or carnivore	75		294		177		546	19,69		
TOTAL	**431**	**24**	**1212**	**34**	**1130**	**49**	**2773**		**107**	

4. Skeletal representation of bear remains

Both, the cave bear *Ursus spelaeus* and the brown bear *Ursus arctos* occur sometimes together in Upper Pleistocene deposits in Europe. In most instances, it is possible to identify the bear remains to the species level. The majority of bear remains in Pećina na Brehu were identified as cave bear (*Ursus spelaeus*). Deciduous teeth and postcranial skeletal remains from juvenile bears, as well as bone fragments without clear speleoid characteristic are labeled as *Ursus* sp. (Table 2). This assemblage likely belongs to cave bears, as there is no clear evidence of the presence of the *Ursus arctos* in the cave. These remains have been grouped together in a column chart of skeletal representation (Fig. 3).

Table 2. Frequency distribution of the skeletal elements of *Ursus spelaeus* and *Ursus* sp. from layers I, II and III in Pećina na Brehu.

NISP (n)													
	Ursus spelaeus			*Ursus* sp.				*Ursus spelaeus*			*Ursus* sp.		
Skeletal element	I	II	III	I	II	III	Skeletal element	I	II	III	I	II	III
cranium	4	33	13	10	20	35	carpals						
maxilla	2	13	3	1	2		scapholunatum		1	1			
mandible	5	20	3	4	17	13	pisiform	1			2		2
isolated teeth							triquetrum		2				
dC				25	40	64	trapezium			1		1	
dI3 sup				1	5	6	trapezoideum			1			
dP4 sup				1	3	4	capitatum	1	2	2		2	
dP4 inf					1	4	hamatum		2				
C	4	18	8	5	3	3	Mc I	2	3	3			
I 1-2 sup	2	7	18				Mc II	2	2			1	
I3 sup	2	9	10				Mc III			1			
C sup	2	5	4				Mc IV	1	2	2			
P 1-3 sup					1		Mc V	2	4	1		2	
P4 sup	5	10	7				pelvis	1	12	4	3	11	3
M1 sup	4	5	15				penis bone	1		1			
M2 sup	4	13	4				femur	2	12	5	5	15	8
I1 inf	4	3	6				patella		3				
I2 inf	3	7	8				tibia	1	8	3	1	9	2
I3 inf	7	7	13				fibula	1	8	6	1		2
C inf		1	1		1		tarsals						
P4 inf	3	4	5				calcaneus	1	3	1		2	1
M1 inf	3	12	11				talus		3	2		2	1
M2 inf	2	10	6				navicular	2	1	4			
M3 inf	1	8	6				cuneiform I	1					
teeth indet.	1	5	8	8	8	10	cuneiform II		1				
hyoid		2	3				cuneiform III		2				
ribs		6	4	12	1	28	cuboid			1			
vertebras indet.	3	20	4	11	47		Mt I	1	1	1			
atlas	1	3	1	1	2		Mt II	1	1	2		1	
axis	2	6	1				Mt III		5	5			
cervical vertebras	2	10	2	1	1	2	Mt IV		3	4			
thoracic vertebras	3	11	3		1	1	Mt V	1	1				
lumbar vertebras	1	6	2				metapodial indet.	3	1	3	5	23	8
sacrum		4	1	1			sesamoids	3	2	2		2	4
caudal vertebras		3	8		1	1	phalanx I	8	9	18	5	10	9
sternum		1	2	1	1		phalanx II	8	13	14	5	2	6
scapula	1	3	2	1	13	8	phalanx III	5	22	9			2
humerus		19	2	1	11	3	phalanx indet.					1	1
radius		5		1	1	3	long bones indet.				2	4	4
ulna		11	1		3		**total NISP**	**120**	**429**	**282**	**114**	**271**	**238**

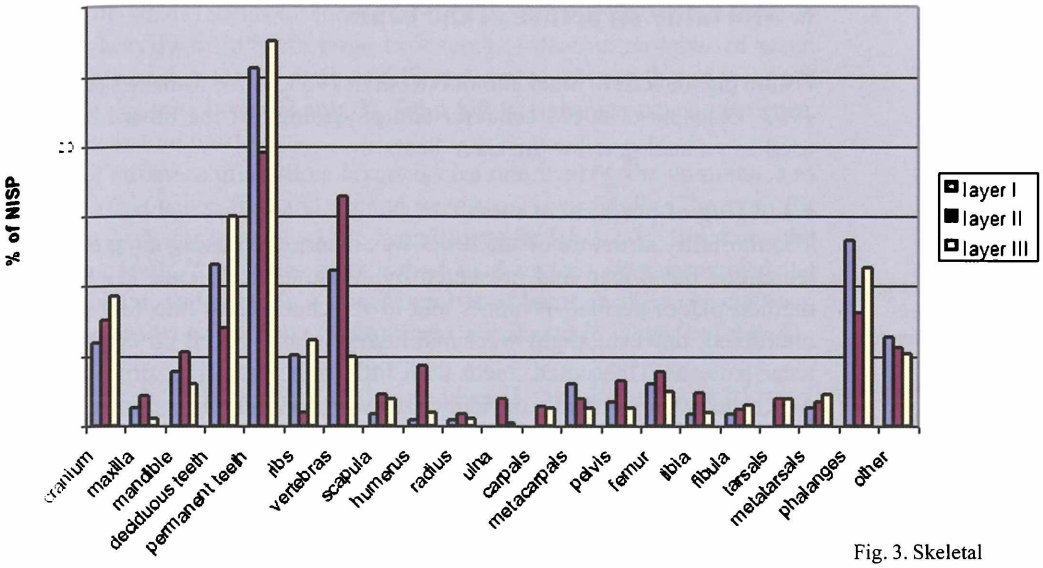

Fig. 3. Skeletal representation of bear bones (*Ursus spelaeus* and *Ursus* sp.) displayed as percent of NISP.

The bear remains from all three layers are characterized by the predominance of isolated teeth (in layer I - 37,18 %, in layer II - 26,57 % and in layer III - 42,50 % of NISP). Head elements (cranium, maxilla and mandibles), phalanges and axial elements are more frequent than either foot or limb bones (Fig. 3). Limb bones are somewhat more common in layer II than in the other two layers, and are well preserved (almost complete). In layers I and III long bones, together with other postcranial remains, are in a more fragmentary condition. Only some of the smaller, more compact bones, such as carpals, tarsals, phalanges, and metapodials, as well as teeth, were intact. This pattern in skeletal representation is known from many other cave bear assemblages in central and western Europe, e.g. Grosse Grotte (Weinstock 1999), Wildscheuer Cave (Turner 2002), and Westbury-Sub-Mendip (Andrews & Turner 1992).

5. Sex ratios

Sexual dimorphism among all members of the Ursidae family is strongly marked. Males are larger than females, although the difference in size varies from 10% to 50% depending on the species (Stirling 1993, Stubbe 1993). While it was clear from preliminary sorting of the bear remains (presence of os penis and bones of newborn cubs) that both male and female individuals were present in Pećina na Brehu, sexual dimorphism was impossible to quantify from either postcranial bones or teeth due to the fragmentary nature of the finds and the small number of measurable specimens.

6. Mortality structure of the bears

Following the lead of other authors (KURTEN 1955, 1976, ANDREWS & TURNER 1992, GERMONPRÉ 2002) behavior and physiology of the brown bear was used as an analogue for the Cave bears.

6.1. Aging of permanent teeth

The mortality structure of the bears was determined using an age-scoring technique developed and presented by ANDREWS & TURNER (1992). This method places permanent upper and lower cheek teeth into four stages – unerupted, unworn, slight wear and heavy wear – based on eruption and wear patterns. Unerupted: teeth with little root formation; unworn: teeth with roots wholly or partly developed but with no wear on the crown; slightly

Table 3. NISP counts of aged bear teeth from all three layers (age categories following ANDREWS & TURNER (1992)).

Layer I

Tooth	unerupted	unworn	slight	heavy	totals
P 4 sup.	0	2	1	2	5
P 4 inf.	0	1	1	1	3
M 1 sup.	2	1	1	0	4
M 1 inf.	1	0	0	3	4
M 2 sup.	2	1	0	1	4
M 2 inf.	0	1	1	1	3
M 3 inf.	1	0	0	0	1
totals	**6**	**6**	**4**	**8**	**24**

3 neonates; 12 yearlings; 1 second year; 8 adults

Layer II

Tooth	unerupted	unworn	slight	heavy	totals
P 4 sup.	0	2	2	6	10
P 4 inf.	0	4	0	1	5
M 1 sup.	0	1	0	4	5
M 1 inf.	0	2	8	3	13
M 2 sup.	6	4	1	3	14
M 2 inf.	0	6	0	6	12
M 3 inf.	3	4	0	4	11
totals	**9**	**23**	**11**	**27**	**70**

0 neonates; 38 yearlings; 5 second year; 27 adults

Layer III

Tooth	unerupted	unworn	slight	heavy	totals
P 4 sup.	0	4	1	1	6
P 4 inf.	1	4	1	0	6
M 1 sup.	2	7	1	7	17
M 1 inf.	0	1	5	4	10
M 2 sup.	0	1	1	4	6
M 2 inf.	0	5	0	1	6
M 3 inf.	2	3	1	0	6
totals	**5**	**25**	**10**	**17**	**57**

3 neonates; 32 yearlings; 5 second year; 17 adults

worn: with small facetes on the surfaces of the crowns but no exposure of dentine; heavily worn: with large exposures of dentine on areas of wear. The counts of age-scored teeth at different stages of growth and wear are shown in separate boxes (Table 3), from left to right: neonates, yearlings, second years, adults.

Mortality structure of all three layers is characterized by the dominance of juveniles (neonates, first and second year bear) over adults. The ratio for layer I is 2 : 1, for layer II - 1,5 : 1, and for layer III is 2,3 : 1. Among the juveniles, teeth from bears, which died in their first year, produced the highest count, followed by a lower number of bears in their second year. Neonates produced the lowest count, and are absent in layer II (Table 4).

	layer I			layer II			layer III		
Tooth	**N**	**J**	**A**	**N**	**J**	**A**	**N**	**J**	**A**
P 4 sup.	0	3	2	0	4	6	0	5	1
P 4 inf.	0	2	1	0	4	1	1	5	0
M 1 sup.	2	2	0	0	1	4	2	8	7
M 1 inf.	1	0	3	0	10	3	0	6	4
M 2 sup.	0	3	1	0	11	3	0	2	4
M 2 inf.	0	2	1	0	6	6	0	5	1
M 3 inf.	0	1	0	0	7	4	0	6	0
totals	**3**	**13**	**8**	**0**	**43**	**27**	**3**	**37**	**17**

Table 4.
NISP counts of bear teeth of different age categories;
N – neonatal,
J – juvenile,
A – adult
from all three layers.

6.2. Aging of deciduous teeth

In addition to permanent teeth, 154 deciduous teeth were also recovered. The majority of them (129) are canines. These are an important source of information about the mortality of bears during their first months of life. Each canine was assigned to one of the six categories defined by KURTEN (1958) in his investigation of the cave bear from Odessa (Table 5).

Teeth in the first three categories (a-c) represent individuals up to 5-6 months old. They are teeth of unweaned cubs that died in their first winter and spring prior to leaving the cave. Following Kurten's method, the mortality of these bears does not vary greatly through the layers (layer I = 29,2 %, layer II = 22,5 %, and layer III = 37,7 %). Categories (d-f) represent yearlings. A large number of the deciduous canines have broken roots with advanced resorption. In brown bears, and presumably in cave bears as well, the permanent canines erupt at about 1 year of age. Their eruption stimulates the resorption of the roots of the deciduous canines, which often break.

Table 5.
Root development of deciduous canines.

Wear-stage after KURTEN 1958	layer I	layer II	layer III
a) root walls only beginning to form	2	2	3
b) root almost fully formed	3	5	19
c) root closed, no resorption	2	2	1
d) root with resorption traces	1	2	3
e) root partially resorbed	1	1	2
f) root completely resorbed	15	28	33

Expulsion of the deciduous canines occurs during the cub's second winter, 3-5 months after eruption of the permanent canines (KURTEN 1976). Thus, the milk canines with resorbed broken root can be either shed teeth or teeth that were about to be shed. The distinction is important: if they are expulsed teeth, then they do not represent individuals that died in the cave, although, they would confirm the presence of yearlings during the winter. If they were about to be shed, but still in the jaw at the moment of death, then they would represent yearlings who actually died at the site. A third possibility is that the bears whose canines were shed at the cave died somewhat later during the same winter while still hibernating inside the cave; they are thus also represented by permanent teeth (WEINSTOCK 1999). Given the large proportion of permanent teeth of yearlings in Pecina na Brehu, it seems probable that deciduous canines also represent animals that died in the cave.

6.3. Aging of postcranial bones

It was possible to assign an age category for 76,1 % of postcranial bones. These elements also contribute some information about the age structure of the bear sample in the site. Bear bones of different ages were present in all three layers and there is no significant difference among layers (Table 6). Between 1,3 and 3,2 % of NISP of age determinable bones belong to neonates, 9,0 - 16,5 % belong to juveniles, and 80,2 - 97,8 % to subadults and adults.

In summary, according to the eruption and wear of teeth among the bear remains from Pecina na Brehu, it is apparent that a significant proportion

Table 6. Postcranial skeletal elements (NISP) of different age categories where age is determinable; N – neonatal, J – juvenile, S-A – subadult-adult.

	layer I			layer II			layer III		
Element	N	J	S-A	N	J	S-A	N	J	S-A
ribs			6			3			4
vertebras		1	15		2	72			30
scapula			2			7		2	2
humerus		1		2	9	19	2	2	2
radius		1			1	5	1	2	
ulna					1	12			1
carpals			4		1	10		1	6
metacarpals			7		4	10			6
pelvis			3		5	13			5
femur	2	1	3	1	9	15	2	6	5
tibia	1		1	1	5	11	1	1	2
fibula			1			7		1	7
tarsals			4			7		2	6
metatarsals			3			11			12
phalanges		3	28			42		10	46
other		2	10			9		4	16
total	3	9	87	4	37	253	6	31	150

of newborns died. The most significant peak in the mortality is at about 1 year, i.e. during the bears' second winter.
While the proportion of newborns as reflected by teeth on the one hand, and postcranial elements on the other, is nearly the same, the relative abundance of juveniles (yearlings) as calculated by both methods differs considerably. The age structure as reflected by the postcranial elements cannot be uncritically accepted since it is clear that the taphonomic history of the young and older bears is significantly different (WEINSTOCK 1999).

7. Conclusion

During the Pleistocene the cave was used as a winter den by pregnant bear females where they gave birth to their cubs and lived with them for the first months after birth. The cave also served on other occasions as a den for females with their yearling cubs. Two-year-old bears also used the cave either together with their mothers, or for the first period of winter dormancy after separation. Adult males and possibly adult females without cubs, also utilized cave for hibernation and perhaps as a den at other times of the year.
A juvenile-dominated mortality structure is in accordance with winter hibernation deaths arising primarily from starvation, disease, and predation that would have affected predominantly juvenile individuals.
The absence of traces of human modifications (cut marks) coupled with traces of carnivore gnawing support the theory that the remains originated from bears that died naturally in the cave during winter hibernation and perhaps at other seasons too. The presence of four small flint flakes in trench 1 attest to the presence of humans close to the site, but do not indicate that humans accumulated any of the faunal remains. The carnivores and marmots present at the site can be regarded as autochthonous to the cave, while the herbivore and bird remains probably represent the refuse of carnivore consumption.
The new excavation in Pecina na Brehu provides important information about paleontology and paleobiology of the cave bears in Croatia. Well-documented cave bear sites in northeastern Italy and southwestern part of Slovenia can now be correlated with cave bears from the Croatian part of the Istrian peninsula.

8. References

ANDREWS, P., TURNER, A. (1992): Life and death of the Westbury bears.- Annales Zoologici Fennici, 28, 139-149.

FORENBAHER, S., KAISER, T., MIRACLE, P. (2004): Pupicina Cave pottery and the Neolithic sequence in northeastern Adriatic.- Atti della Società per la Preistoria e Protostoria della Regione Friuli-Venezia Giulia, XIV, 2003 (2004), 61-102.

GERMONPRÉ, M. (2004): Two cave bear assemblages from Goyet (Chamber A, horizon 1 and 3), Belgium.- Revue de Paléobiologie, 23 (2), 855-875.

KURTEN, B. (1955): Sex Dimorphism and Size Trends in the Cave Bear. Ursus spelaeus Rosenmüller & Heinroth.- Acta Zoologica Fennica, 90, 1-48.

KURTEN, B. (1958): Life and death of the Pleistocene cave bear.- Acta Zoologica Fennica, 95, 1-59.

KURTEN, B. (1976): The cave bear story.- 1-163, New York (Columbia University Press).

MALEZ, M. (1956): Novija istrazivanja pecina u N. R. Hrvatskoj.- Acta geologica, I, 179-201, Zagreb.

MALEZ, M. (1960): Pécine Ćićarije i Ucke u Istri.- Acta geologica, II, 163-260, Zagreb.

MALEZ, M. (1971): Paleontološka, paleolitska i speleološka istrazivanja u 1967. godini.- Ljetopis JAZU, 75, 419-428, Zagreb.

STIRLING, I. (1993): The Living Bears.- In: STIRLING, I. (ed): Bears.- 240 pp. (Harper Collins).

STUBBE, M. (1993): Familie Ursidae GRAY, 1825.- In: STUBBE, M., KRAPP, F. (ed): Handbuch der Säugetiere Europas. (Teil 1) Raubsäuger.- 526 pp.

TURNER, E. (2002): The Cave Bears from the Wildscheuer Cave in Hessen, Germany.- Cave-Bear-Researches. Abhandlung zur Karst-und Höhlenkunde, 34, 17-21.

WEINSTOCK, J. (1999): The Upper Pleistocene mammalian fauna from the Grosse Grotte near Blaubeuren (southwestern Germany).- Stuttgarter Beiträge zur Naturkunde, Serie B, 277, 49 pp.

Addresses of authors:

Gordana Jambrešic, Kazimir Miculinic Institute of Quaternary Paleontology and Geology, Croatian Academy of Sciences and Arts, Zagreb, Croatia

Preston Miracle, Department of Archaeology, University of Cambridge, Cambridge CB2 3DZ, UK