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Scientific paper

## Revision of the Ungulate Fauna and Upper Pleistocene Stratigraphy of Veternica Cave (Zagreb, Croatia)

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**Ključne riječi:** paleontologija, ungulati, gornji pleistocen, paleolit, Hrvatska

Revision of the Veternica ungulates removes *Dama dama* (L.) (fallow deer) and *Megaceros giganteus* (BLUMENBACH) (giant deer) from the species list and adds *Bison priscus* (BOJANUS) (bison) to it. The rhino remains do not allow a specific determination. *Alces alces* (L.) (elk) and *Capreolus capreolus* (L.) (roe deer) are rarer than previously thought. *Rupicapra rupicapra* (L.) (chamois) remains are particularly common in levels *d* and *h*. *Capra ibex* (L.) (ibex) is limited to level *d*, while *Sus scrofa* (L.) (pig) needs to be added to the faunal list of level *e*. *Cervus elaphus* (L.) (red deer) is the most common ungulate in all of the levels, with the exception of level *d* and perhaps level *h*. This revision removes all of the so-called warm period ungulates from the fauna and casts doubt on an interglacial date for level *j*. Therefore, we suggest that level *j* at Veternica does not date to the last interglacial maximum (oxygen isotope sub-stage 5e, c. 128-118,000 BP), but to a later and cooler time period with a more open environment. The sediments, however, do indicate relatively warm and wet conditions of deposition, at least with regards to the rest of the profile. We favor a date during sub-stages 5c or 5a (c. 100,000 and 80,000 BP, respectively), but leave the question open for the time being.

Revizija fosilne građe skupine ungulata Veternice pokazala je odsutnost vrsta *Dama dama* (L.) i *Megaceros giganteus* (BLUMENBACH) i prisutnost vrste *Bison priscus* (BOJANUS). Ostaci nosoroga nisu se pokazali dostatnim za odredbu vrste. U ukupnom fosilnom materijalu skupine ungulata, vrste *Alces alces* (L.) i *Capreolus capreolus* (L.) manje su zastupljene nego što se do sada mislilo dok je *Rupicapra rupicapra* osobito prisutna u slojevima *d* i *h*. *Capra ibex* (L.) ograničena je samo na sloj *d*, a faunskoj zajednici sloja *e* priključena je i vrsta *Sus scrofa* (L.) U svim slojevima, osim *d* i možda *h*, najbrojniji su ostaci vrste *Cervus elaphus* L. Učinjena revizija fosilne građe skupine ungulata Veternice ne potvrđuje svoju pripadnost toplodobnoj faunskoj zajednici kako se to do sada smatralo. Mišljenja smo da se ni sloj *j* ne može datirati u posljednji interglacijalni maksimum (izotop kisika stadij 5e, cca 128-118.000 BP), već u kasniji i hladniji period s otvorenijim biotopom. I u pogledu ostalih dijelova profila, sedimenti ukazuju na relativno tople i vlažne uvjete taloženja. Prednost je dana datiranjima izotopom kisika, stadijima 5c ili 5a (cca 100 ili 80.000 BP), koji bi mogli odgovarati sloju *j*, no to pitanje ostaje otvoreno.

### 1. INTRODUCTION

Veternica cave is a well-known site of paleontological, archaeological, and speleological interest. It is particularly important for its abundant evidence of hominid and cave bear occupation during the Upper Pleistocene period. Hominid occupation is shown by Mousterian artifacts, probably manufactured by Neandertals, and hearths, while cave bear use of the cave is inferred from the abundance of their remains. The prehistoric significance of Veternica was recognized by the late Dr. Mirko MALEZ, who comprehensively presented the results of his research in an admirable monograph (MALEZ, 1963) and several articles (MALEZ, 1958/59, 1965).

A paleontological revision of the Veternica ungulates was undertaken as part of a larger study by the senior author of the taphonomy of cave sites in Croatia, and the evolution of hominid economies in this region during the Upper Pleistocene. In a recent publication, one of us (MIRACLE, 1991) suggested that many of the cave faunas from middle and early upper paleolithic sites may bear a very weak imprint of hominid activities. In particular, it was hypothesized, that assemblages

dominated by cave bear and large carnivore remains were accumulated primarily through non-hominid processes. While the presence of many carnivores in cave faunas may appear to be explained by the activities of carnivores, the taphonomic status of ungulates in assemblages is impossible to untangle in the absence of detailed studies of the remains themselves (MIRACLE, 1991). Remains from Veternica were originally examined as comparative material to aid the identification of remains from Šandalja II and other sites. When it became apparent that there were a number of problematic identifications in the monograph (MALEZ, 1963), it was decided to review and revise the ungulate remains in earnest.

### 2. SUMMARY OF THE VETERNICA SEQUENCE

Veternica is located about 9 km west of the center of Zagreb, Croatia, on the southwestern slope of Medvednica (45°50'36" North, 13°32'24" East, 306 m above sea level, MALEZ, 1965, 176). The entrance to the cave faces south southeast and is about 8 m wide and 4 m high. The entrance chamber is about 15 m

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long and 7 m wide (oriented east northeast-west southwest with the entrance on the southeast corner) and receives direct sunlight for most of the day. Beginning from the northwest corner of the entrance chamber, the "left hall" extends for 14 m and is 3-7 m wide. Leading off of the northeast corner of the entrance chamber is a narrow passageway that gives access to over 10 km of passageways and canals.

Quaternary sediments were excavated by MALEZ (1965, 178; 1972) in the entrance chamber and left hall from 1951-1955, and in 1970, over an area of approximately 207 square meters (43 m<sup>2</sup> in front of the entrance, 84 m<sup>2</sup> in the entrance chamber, and 80 m<sup>2</sup> in the left hall). In front of the cave, sediments were excavated to a depth of 8 m, while the entrance chamber and left hall were excavated to bedrock.

In the most complete profiles, 11 geological layers were identified. The first two layers, layers *a* and *b*, were black to brown in color, rich in organic material (particularly level *a*), and contained archaeological and faunal remains from the Neolithic to Middle Ages. These soils formed during the Holocene and were found in front of the cave and in most parts of the entrance chamber and left hall. Within the cave, but not in front of the entrance, these soils are underlain by dripstone, level *c*, which was barren of any remains except for a few floral remains of the following taxa: *Polypodium*, *Pteridium*, *Carex*, and *Corylus* (MALEZ, 1965, 202). Carbonate samples from the upper and middle parts of level *c* gave mid-Holocene C<sup>14</sup> dates (5800±80 BP, Z-218/II; 5960±90 BP, Z-194), while carbonate samples from the lower part of level *c* gave late Pleistocene C<sup>14</sup> dates (12,400±150 BP, Z-218/I; 13,650±75 BP, GrN-4989; 13,660±180 BP, Z-201) (MALEZ, 1979a, 218). Beneath this dripstone cap, there were a series of layers deposited during the Pleistocene. Layers *d*, *e*, and *f* contain almost exclusively cave bear (*Ursus spelaeus*) remains. Evidence of human occupation is very scant; there are a few lithics and a "hearth" from level *d* (MALEZ, 1965, 203), and there are several non-diagnostic lithics from level *f* (MALEZ, 1979b, 269). Level *g* was found primarily in front of the cave and in the entrance chamber, and was sterile of archaeological or paleontological remains excepting a few cave bear bones near the contact with level *h*. Level *g* consisted primarily of rock rubble and probably marks a major roof collapse that closed the entrance to Veternica (MALEZ, 1965, 207). Layers *h*, *i*, and *j* contain about 178 lithics that have been attributed to human handicraft, of which at least 18 are Mousterian "tools" (lithic totals calculated from MALEZ, 1958/59, 173, Figure 1; tool count from MALEZ, 1979b, Plates XXIX and XXX). A hominid calvarium from level *h*, considered by MALEZ (1979b, 268) to be a neanthropic representative of "*Homo sapiens fossilis*," has been described by others as completely modern in morphology and most likely redeposited from younger levels (SMITH, 1982, 682). Hearths were also found in all three levels, and charcoal from a hearth

in level *i* was radiocarbon dated at >43,200 BP (GrN-4984) (MALEZ, 1979a, 218). Artifacts and ungulate remains were found primarily in the entrance chamber. Cave bear remains are still very common, and were found in the entrance chamber and left hall. Hearths were found in both the entrance chamber and in front of the cave. On the basis of the sediments, associated faunas and artifacts, layers *h*, *i*, and *j* were dated as Würm I/II interstadial, Würm I stadial, and Riss/Würm interglacial respectively (MALEZ, 1963, 153; 1965, 220-222). The lowest level, *k*, was only found in front of the entrance and in the entrance, and did not contain any paleontological or archaeological remains.

### 3. PALEONTOLOGICAL REVISION

#### Perissodactyla

##### *Dicerorhinus kirchbergensis* (JAEGER)

Four specimens were attributed to Merck's rhino; a left M<sub>2</sub> (VTR. 199), a first phalanx (VTR. 200), a third phalanx (VTR. 201) and a rib shaft fragment (VTR. 202), all from level *j* (MALEZ, 1963, 108-112; Plate XXII; Plate XXIV, Figure 1a-c). The relatively smooth enamel of the left second molar leaves little doubt that it is from the genus *Dicerorhinus*. The remaining elements are very likely from the same genus, if not the same individual as the molar. While metric comparisons (MALEZ, 1963, 109-110) suggest that the molar and the phalanxes are too large to be from *Dicerorhinus etruscus*, there is nothing to rule out the possibility that they are from *Dicerorhinus hemitoechus*. As observed by several authors (LOOSE, 1975, 6; GUERIN, 1980, 654) specific determination is extremely difficult on isolated teeth (particularly lower molars), let alone phalanxes and rib fragments. We suggest that a more prudent identification of these remains is *Dicerorhinus* sp.

#### Artiodactyla

##### *Megaceros giganteus* (BLUMENBACH)

MALEZ (1963, 114-115, Plate XXV, Figure 1a-d), assigned three specimens to giant deer (VTR. 1, 2, 3). These are a navicular-cuboid and two third phalanxes. The navicular-cuboid (VTR. 3, level *j*) is clearly bovid in morphology. In Plate I it is compared to a navicular-cuboid from a giant deer (see also MALEZ, 1963, Plate XXV, Figure 1a-d). In general shape, it is broader (medio-laterally) and shorter (superior-inferiorly) than that expected from a cervid. The superior juncture between the facets with the calcaneus and astragalus is flat, as in bovids. Similarly, the styloid on the plantar edge of the navicular is constricted medio-laterally, and in distal view, the posterior articular facet with the metatarsal is ovoid in shape; both morphologies are characteristic of bovids. This element is classified as *Bos/Bison*, since it does not show clear characteristics for specific determination.

The third phalanxes (VTR. 1 and 2, both level *i*) both lack a large nutrient foramen immediately inferior and



medial of the articular surface. A large foramen in this position is characteristic of giant deer and cervids in general. The phalanges are also marked by well-developed articular facets for distal sesamoids on the posterior edge of the articular surface. Such facets are typical of bovids, and rare or non-existent in cervids (Plate I, Figure 2A-B). Therefore, these phalanges are clearly from a large bovid, and are here only identified as *Bos/Bison*, since identification to species is very difficult (SALA, 1986, 162). Measurements made on these specimens did not differ significantly from those published by MALEZ (1963, 114).

#### *Dama cf. dama* (L.)

MALEZ (1963, 115, Plate XXVII, Figure 3) from level *j* identified an upper right M<sup>3</sup> as fallow deer (VTR. 41). Close examination of the tooth shows a slight wear facet on its distal surface. In this case, the tooth cannot be an M<sup>3</sup>, but rather must be either an M<sup>2</sup>, M<sup>1</sup> or dp<sup>4</sup>. Measured at the base of the crown, its dimensions are:

length (in mm) = 20.1  
width (in mm) = 21.7

these dimensions are not significantly different from those published by MALEZ (1963, 115). When compared to the dimensions of upper molariform red deer teeth from Upper Pleistocene levels in Šandalja II, the specimen from Veternica falls in the range of the M<sup>1</sup> (Fig. 1).

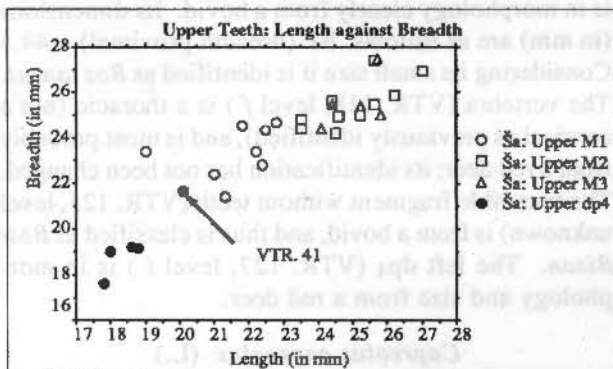


Fig. 1. Length against breadth at crown base of upper teeth in *Cervus elaphus* from Upper Pleistocene levels from Šandalja II (MIRACLE, unpublished) compared to the molar identified as *Dama dama* from Veternica (MALEZ, 1963, 115, Plate XXVII, Figure 3).

Slika 1. Usporedba dužina i širina mjerjenih na bazi kruna gornjih zuba kod vrste *Cervus elaphus* iz gomjopleistocenskih naslaga Šandalje II (MIRACLE, rukopis) i molara iz Veternice determiniranih kao vrsta *Dama dama* (MALEZ, 1963, 115, Tabla XXVII, slika 3).

Given the morphology and dimensions of this tooth, it is most likely a right M<sup>1</sup> from *Cervus elaphus*. One concludes that there are no identified remains of fallow deer from Veternica.

#### *Alces alces* (L.)

MALEZ (1963, 126-128; Plate XXV, Figure 2; Plate XXVIII, Figures 1, 7, 9; Plate XXX, Figure 1; Plate XXXV, Figures 1 and 2) identified the following specimens as elk: an upper M<sup>1</sup> (VTR. 47, level *h*), a lower M<sub>1</sub> (VTR. 46, level *h*), a cervical vertebra (VTR.

48, level *i*), an unfused distal epiphysis of a metacarpal (VTR. 45, level *h* or *i*), a calcaneus (VTR. 44, level *i*), a navicular-cuboid (VTR. 4, level *h*), a first phalanx (VTR. 24, level *i*), two second phalanges (both level *i*), and a third phalanx (VTR. 5, level *h*). Of these specimens, we are in agreement with the identifications of the teeth.

The cervical vertebra (VTR. 48) is complete with a fusing caudal centrum and a fused cranial centrum. Comparison with cervical vertebra of red deer, however, shows the specimen in question to be only slightly larger in size. The state of fusion of the centra makes it unlikely that the vertebra would have been much larger in an adult. If one considers that red deer during the Pleistocene were often larger than recent examples, then it appears quite likely that the specimen in question is from a red deer. In the absence of more complete comparative material, however, identification beyond the level of cervid is not warranted. The unfused distal epiphysis of a metacarpal (VTR. 45) is much closer in size to red deer than elk, and in fact, falls within the range of variation of other material identified as red deer from the site. The surface of the bone is compact and non-porous, suggesting that the epiphysis would not have grown much larger. Therefore, we also identify this specimen as from red deer.

The navicular-cuboid (VTR. 4) is extremely small for elk, and as shown in Figure 2, better fits into the range of red deer; although the specimen is certainly from a very large individual.

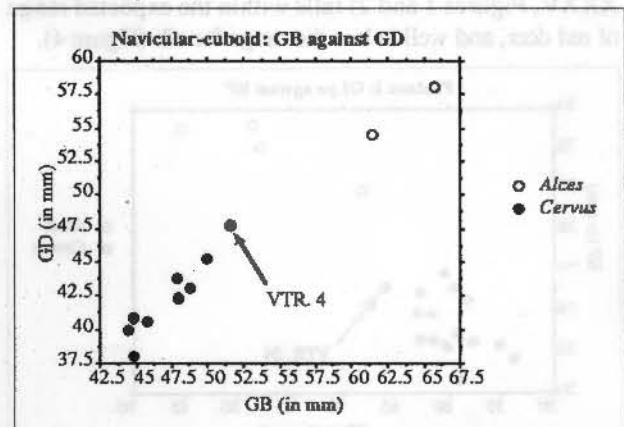


Fig. 2. Navicular-cuboid, greatest medio-lateral breadth (GB) against greatest dorsal-palmar depth (GD) in *Cervus* and *Alces*, compared to the navicular-cuboid identified as *Alces* from Veternica (MALEZ, 1963, 127, Plate XXV, Figure 2). Comparative data for red deer are from Šandalja II (MIRACLE, unpublished) and Veternica. Comparative data for elk are from Pleistocene (MALEZ, 1963, 127) and recent localities (MALEZ, 1963; MIRACLE, unpublished). Slika 2. Naviculare-cuboideum, odnos najveće širine (GB) i najveće udaljenosti (dorsalno-palmarne, GD) rodova *Cervus* i *Alces* u usporedbi s navikulamokuboidnom kosti roda *Alces* iz Veternice (MALEZ, 1963, 127, Tabla XXV, slika 2). Usporedni podaci za jelena su iz Šandalje II (MIRACLE, rukopis) i Veternice. Usporedni podaci za losa su iz pleistocenskih (MALEZ, 1963, 127) i recentnih lokaliteta (MALEZ, 1963; MIRACLE, rukopis).

The calcaneus (VTR. 44) is in morphology from a red deer, although from a very large individual (Figure 3). In red deer, the plantar edge of the articulation

with the navicular-cuboid is extended medially and forms a right angle with the body of the sustentaculum tali. In elk, this articulation is not extended medially and forms an obtuse angle with the body of the sustentaculum tali.

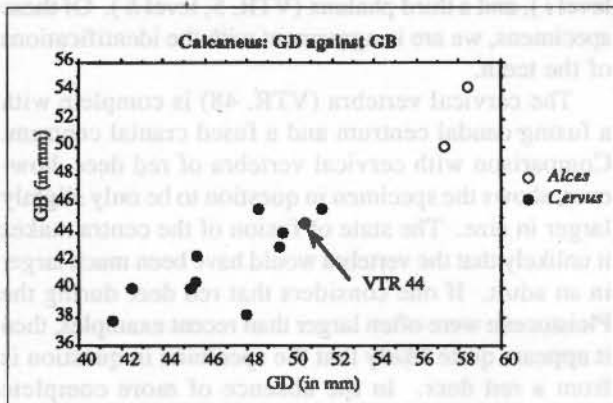


Fig. 3. Calcaneus, greatest depth (dorsal-palmar) of the sustentaculum tali (GD) against greatest breadth (GB) in *Cervus* and *Alces*, compared to the calcaneus identified as *Alces* from Veternica (MALEZ, 1963, 127, Plate XXX, Figure 1a-b). Comparative data for red deer are from Šandalja II (MIRACLE, unpublished) and Veternica. Comparative data for elk are from Pleistocene (MALEZ, 1963, 127) and recent localities (MALEZ, 1963; MIRACLE, unpublished).

Slika 3. Calcaneus, najveća udaljenost (dorsalno-palmaro) sustentacula talusa (GD) u odnosu na najveću širinu (GB) rodova *Cervus* i *Alces* uspoređeno s kalkaneusom roda *Alces* iz Veternice (MALEZ, 1963, 127, Tabla XXX, slika 1a-b). Usporedni podaci za jelena su iz Šandalje II (MIRACLE, rukopis) i Veternice. Usporedni podaci za losa su iz pleistocenskih (MALEZ, 1963, 127) i recentnih lokaliteta (MALEZ, 1963; MIRACLE, rukopis).

The first phalanx (VTR. 24, see MALEZ, 1963, Plate XXXV, Figures 1 and 2) falls within the expected range of red deer, and well below the range for elk (Figure 4).

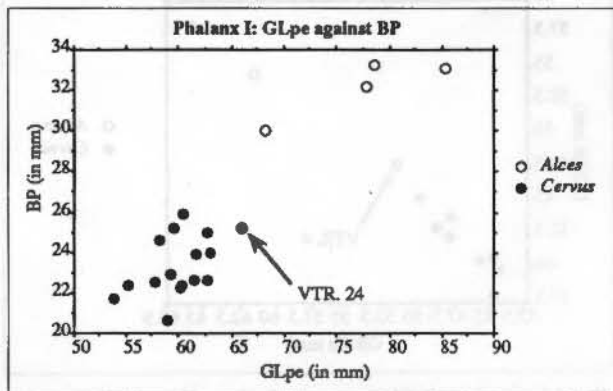


Fig. 4. Phalanx I: greatest length of the peripheral half (GLpe) against breadth of the proximal end (BP) in *Cervus* and *Alces*, compared to the first phalanx identified as *Alces* from Veternica (MALEZ, 1963, 127, Plate XXXV, Figures 1-2). Comparative data for red deer are from Šandalja II (MIRACLE, unpublished) and Veternica. Comparative data for elk are from Pleistocene (MALEZ, 1963, 127) and recent localities (MALEZ, 1963; MIRACLE, unpublished).

Slika 4. Phalanx I, najveća duljina periferne polovice (GLpe) u odnosu na širinu proksimalnog kraja (BP) rodova *Cervus* i *Alces* u odnosu na prvu falangu roda *Alces* iz Veternice (MALEZ, 1963, 127, Tabla XXXV, slike 1-2). Usporedni podaci za jelena su iz Šandalje II (MIRACLE, rukopis) i Veternice. Usporedni podaci za losa su iz pleistocenskih (MALEZ, 1963, 127) i recentnih lokaliteta (MALEZ, 1963; MIRACLE, rukopis).

Our measurements differ somewhat from those published by MALEZ (1963, 127). The measures are

as follows (in mm):

$$\begin{aligned} \text{GLpe (greatest length of peripheral)} &= 65.9 \\ \text{BP (breadth of proximal)} &= 25.3 \end{aligned}$$

Measures were not taken on the distal end due to a light abrasion of the distal condyles on their palmar surface. We also classify this specimen as red deer. All second phalanxes of cervids were located, but it was not possible to separate between those previously identified as red deer and elk (the material was mixed during curation, and none of the measurements correspond to those published by MALEZ [1963, 128] as elk). All of these specimens are well within the expected size range for red deer, and we have thus identified all of them as red deer. The third phalanx (VTR. 5) has been abraded on the anterior-medial surface. It lacks a large nutrient foramen immediately inferior and medial of the articular surface, has a well-developed articular facet for a distal sesamoid, and the articular surface with the second phalanx extends superior-posteriorly in a manner characteristic of bovids. As discussed above for the giant deer, these are characteristics of bovids, and we thus classify the specimen as *Bos/Bison*. Only two of the ten specimens originally identified as elk appear to be elk after further scrutiny.

#### Cervidae inc. sed.

The right proximal metatarsal (VTR. 43, level *b*) is in morphology clearly from a bovid. Its dimensions (in mm) are as follows: BP (breadth proximal) = 44.5. Considering its small size it is identified as *Bos taurus*. The vertebra (VTR. 118, level *f*) is a thoracic (not a cervical as previously identified), and is most probably from a red deer; its identification has not been changed. The mandible fragment without teeth (VTR. 125, level unknown) is from a bovid, and thus is classified as *Bos/Bison*. The left dp<sub>4</sub> (VTR. 127, level *i*) is in morphology and size from a red deer.

#### *Capreolus capreolus* (L.)

MALEZ (1963, 129-130; Plate XXXVI, Figures 1, 4-6; Plate XL, Figure 4) identified the following specimens as roe deer: a cast right antler (VTR. 148, level *e*), a fragment of right maxilla with dp<sup>3</sup> and dp<sup>4</sup> (VTR. 149, level *d*), a fragment of left mandible with P<sub>4</sub>, M<sub>1</sub>, M<sub>2</sub> (VTR. 150, level *i*), a fragment of left mandible with dp<sub>4</sub> and M<sub>1</sub> (VTR. 151, level *d*), a right scapula (VTR. 152, level *h*), a left innominate (VTR. 153, level *h*), a left distal humerus (VTR. 154, level *h*), a right femur (VTR. 157, level *d*), a right distal tibia (VTR. 156, level *j*), a left calcaneus (VTR. 158, level *e*), a right astragalus (VTR. 159, level *e*), a right 2nd-3rd carpal (VTR. 160), and a second phalanx (VTR. 155, level *h*). The right maxilla (MALEZ, 1963, Plate XXXVI, Figure 5) contains permanent teeth, a P<sup>3</sup> and P<sup>4</sup>. The right scapula is caprid in morphology; the glenoid fossa is sub-rectangular in shape and the supra-glenoid tubercle projects inferiorly of the articular plane. Its dimensions



are as follows (in mm):

length (anterior-posterior) of proximal end	= 32.6
length (anterior-posterior) of glenoid cavity	= 25.2
breadth (medial-lateral) of glenoid cavity	= 20.7

In morphology and size this scapula corresponds to that from the chamois. On the femur both proximal and distal epiphyses are unfused, making identification difficult. Nonetheless, the distal shaft has a lip on the anterior edge that is characteristic of caprids, and thus we identify it as either chamois or ibex. The calcaneus (MALEZ, 1963, 130; Plate XL, Figure 4a-b) shows clear caprid morphology, especially in the extension of the astragalar facet inferiorly to the point that it contacts the articular facet for the navicular-cuboid. Again, we identify it as chamois. Finally, the second phalanx shows clear caprid morphology on both its proximal and distal articular surfaces. Due to its relatively small size and gracile morphology, we identify it as chamois. These changes neither remove nor add roe deer to the faunal lists from any of the levels. Its remains, however, are much less common than previously thought, particularly in level *h*.

#### *Bos primigenius* (BOJANUS)

MALEZ (1963, 130-133; Plate XXXVII, Plate XXXVIII; Plate XXXIX, Figures 2, 3) identified the following specimens as aurochs: a left  $M_1$  (VTR. 196, level *j*), a left  $M_2$  (VTR. 197, level *j*), a left  $dp_4$  (VTR. 181, level *j*), a fragment of left dentary without teeth (VTR. 187, level *j*), two thoracic vertebra (VTR. 182 and 198, both level *h*), a left distal humerus (VTR. 186, level *j*), a left diaphysis of a radius (VTR. 188, level *ij*), three left metacarpal fragments (VTR. 183 and 184, level *i*; VTR. 185, level *ij*), and one first phalanx (VTR. 187, level *j*). He specifically identified the humerus and metacarpal fragments as *Bos*; the remainder of the material was assigned to *Bos* on the basis of its association with these elements (MALEZ, 1963, 131).

Reconsideration of the humeral and metacarpal fragments suggests that they are either from *Bison* or do not allow specific determination. To identify the distal humerus, one orients the bone so that the shaft is perpendicular to a horizontal plane. In this orientation, the medial epicondyle (epitrochlea) of *Bos* is extended distally so that it forms the most distal part of the humerus, while in *Bison*, the trochlea and medial epicondyle are on the same horizontal plane, i.e. the medial epicondyle does not extend distally below the trochlea (SALA 1986, 138). The distal humerus (VTR. 186) is slightly damaged on the epitrochlea, making specific identification difficult. Nonetheless, the damage is very superficial; it is unlikely that the medial epicondyle would have extended distally below the trochlea (see MALEZ, 1963, Plate XXXVIII, Figure 1a-b, Plate XXXIX, Figure 3). This specimen is most likely from *Bison*, probably *Bison priscus*. Its dimensions are as follows (in mm, the latter two measurements after LEHMANN, 1949):

Breadth of distal end	= 108.7
Breadth of trochlea	= 105.7
Depth of capitulum	= 46.8
Depth of trochlea	= 64.9

In identifying distal metacarpal fragments, among other criteria, in *Bos*, the suture between the diaphysis and epiphysis is not evident in adults, while in *Bison*, the position of the suture is visible and at this point the bone is widened (SALA, 1986, 143-144). One distal metacarpal fragment, VTR. 183, a lateral portion of a left metacarpal, shows a very distinct swelling of the bone at the position of the suture (Plate II, Figure 1A). Also, comparison with *Bos* material from Šandalja II (Plate II, Figure 1B), and *Bison* material from Vindija shows similarities with *Bison*. Therefore, this specimen is classified as *Bison*. The other distal metacarpal fragment (VTR. 185) is a medial epicondyle of a left metacarpal. The bone is broken on or below the suture, and it is impossible to identify it to species. It is classified as *Bos/Bison*. The remaining left proximal fragment (VTR. 184) includes the medial articular surface, which has a rounded dorso-medial angle and a slightly quadrangular or trapezoidal shape. On the basis of its morphology alone, one cannot specifically identify it. However, if it is part of the same metacarpal as VTR. 183, which seems likely, then it is of *Bison*, and this is how we classify it.

Both molars, the deciduous premolar, and the dentary fragment are all part of the same left dentary. As MALEZ (1963, 131) notes, it is difficult to specifically identify isolated teeth. Nonetheless, both of the molars display features reminiscent of *Bison*. The left  $M_1$  (VTR. 196) has a narrowed neck and a pronounced swelling of the enamel at the base of the crown (Plate II, Figure 2A-B). Furthermore, it appears compressed mesio-distally (see MALEZ, 1963, Plate XXXVII, Figure 1). All of these features are typical of *Bison* (SALA, 1986, 120). The left  $M_2$  (VTR. 197, see MALEZ, 1963, Plate XXXVII, Figure 2) is broken at the base of the crown. Nevertheless, there is a pronounced swelling of the enamel at the crown base. On the basis of the morphologies outlined above, both teeth are identified as *Bison priscus*. The left  $dp_4$  (VTR. 181, see MALEZ, 1963, Plate XXVIII, Figure 2a-b) also shows an enamel swelling at the base of the crown. This left dentary with three teeth is from a relatively young individual, probably between one and two years of age since the  $M_2$  is just coming into wear (eruption time of the  $M_2$  in *Bison bison* is about 18 months, Frison and Reher 1970 cited in GIFFORD-GONZALEZ, 1990, 58, eruption time in *Bison bonasus* is between 12 and 24 months, WEGRZYN & SERWATKA, 1984, 118).

Specific identification based on the material itself is very difficult. We place it in *Bison priscus* because *Bison schoetensacki* is found only in localities from the Middle Pleistocene (older than levels *i* and *j* in Veternica), while *Bison bonasus* is restricted to locali-

ties from the Holocene (younger than levels *i* and *j* in Veternica). We further note that in *Bison bonasus*, the breadth of the trochlea in the distal humerus ranges from 74.5 mm - 98.6 mm (LEHMANN, 1949, Table 181), considerably smaller than the specimen from Veternica (105.7 mm). We are most likely dealing with the "steppe" bison, *Bison priscus*.

The remaining elements lend themselves neither to generic nor specific identification. Therefore, the thoracic vertebra (VTR. 182 and 198), a left diaphysis of a radius (VTR. 188), and the first phalanx (VTR. 187) are classified as from *Bos/Bison*. We note that the first phalanx is from the anterior limb. To them we can add the right patella already classified as *Bos/Bison* (MALEZ, 1963, 133).

#### *Rupicapra rupicapra* (L.)

We suggest only one change to the remains identified as chamois (MALEZ, 1963, 133-134); the proximal tibia (VTR. 164) from level *e* is in morphology from a roe deer.

#### *Capra ibex* (L.)

We have only one change for the ibex material (MALEZ, 1963, 134-136); the right innominate (VTR. 165, level *e*) identified as ibex (MALEZ, 1963, 135) is in morphology clearly from a pig.

#### *Capra* sp.

All of the remains classified as from an undetermined caprid (MALEZ, 1963, 136-137) easily fall within the

range of variation of chamois. This adds to the chamois inventory from level *h* a radius (VTR. 169), metatarsal (VTR. 170), and 1st phalanx (VTR. 171).

#### *Ovis* sp.

The right humerus (VTR. 172, level *d*) identified as an undetermined sheep (MALEZ, 1963, 137) is in morphology and by dimensions most probably chamois. Its dimensions (in mm) are:

$$BD \text{ (breadth of distal end)} = 32.8$$

The results of this revision are summarized in Tables 1 and 2. Fallow and giant deer have been removed from the species list, while bison has been added. Elk and roe deer are rarer than previously thought, while 11 specimens are now identified as chamois. Chamois remains are particularly common in levels *d* and *h*. Ibex remains are found only in level *d*, while pig needs to be added to the faunal list of level *e*. On the other hand, red deer remains are slightly more common than previously thought, and include specimens from relatively large individuals. Red deer remains the most common ungulate in all of the levels, with the exception of level *d* and perhaps level *h* (if none of the *h/i/j* material is from level *h*).

#### 4. DISCUSSION

The implications of this revision for the paleoecological and stratigraphic interpretation of Veternica, particularly level *j*, are significant. Level *j*, the low-

Inventory Numbers	Identification	
	MALEZ 1963	Present study
VTR. 1-3	<i>Megaceros giganteus</i>	<i>Bos/Bison</i>
VTR. 5	<i>Alces alces</i>	<i>Bos/Bison</i>
VTR. 4, 24, 44, 45	<i>Alces alces</i>	<i>Cervus elaphus</i>
VTR. 41	<i>Dama dama</i>	<i>Cervus elaphus</i>
VTR. 43	<i>Cervus</i> sp.	<i>Bos taurus</i>
VTR. 48	<i>Alces alces</i>	<i>Cervidae</i>
VTR. 125	<i>Cervus</i> sp.	<i>Bos/Bison</i>
VTR. 127	<i>Cervus</i> sp.	<i>Cervus elaphus</i>
VTR. 152, 155, 158	<i>Capreolus capreolus</i>	<i>Rupicapra rupicapra</i>
VTR. 157	<i>Capreolus capreolus</i>	<i>Rupicapra/Capra</i>
VTR. 164	<i>Rupicapra rupicapra</i>	<i>Capreolus capreolus</i>
VTR. 165	<i>Capra ibex</i>	<i>Sus scrofa</i>
VTR. 169-171	<i>Capra</i> sp.	<i>Rupicapra rupicapra</i>
VTR. 172	<i>Ovis</i> sp.	<i>Rupicapra rupicapra</i>
VTR. 181, 183, 184, 186, 187, 196, 197	<i>Bos primigenius</i>	<i>Bison priscus</i>
VTR. 182, 185, 187 188, 189	<i>Bos primigenius</i>	<i>Bos/Bison</i>
VTR. 199-202	<i>Dicerorhinus kirchbergensis</i>	<i>Dicerorhinus</i> sp.
2 Phalanx II	<i>Alces alces</i>	<i>Cervus elaphus</i>

Table 1. Summary of paleontological revisions to the identified Veternica ungulate assemblage.  
Tablica 1. Rezultati paleontološke revizije skupine unglata iz spilje Veternice

Taxon	NISP by level						Total	
	d	e	f	h / i / j <sup>1</sup>	h	i		j
<i>Dicerorhinus</i> sp.							4	4
<i>Sus scrofa</i>	4	1					1	6
<i>Alces alces</i>							2	2
<i>Cervus elaphus</i>	4	5	2	109	3	8	12	145
Cervidae			1	1			1	3
<i>Capreolus capreolus</i>	2	3		1	2	1	1	10
<i>Bison priscus</i>						1	2	3
Bos/Bison	1			3	3	2	1	11
<i>Rupicapra rupicapra</i>	5	1					5	11
<i>Capra ibex</i>	3							3
<b>Total</b>	<b>19</b>	<b>10</b>	<b>3</b>	<b>114</b>	<b>15</b>	<b>13</b>	<b>22</b>	<b>196</b>

Table 2. Number of identified specimens (NISP) for ungulate taxa from the Pleistocene levels of Veternica.

Tablica 2. Broj određenih uzoraka (NISP) pojedinih vrsta skupine unglata iz pleistocenskih naslaga Veternice.

est level with paleontological or archaeological remains, has been dated as Riss/Würm interglacial on the basis of the characteristics of the sediments and the associated remains (MALEZ, 1963, 152; MALEZ, 1965, 220-221).<sup>2</sup> MALEZ (1965, 220) suggests that the near absence of a coarse fraction, the degraded state of the coarse fraction present, and the red color of the sediments all indicate sedimentation during relatively warm climatic conditions. Furthermore, he suggested (MALEZ, 1965, 218) that calcium carbonate (CaCO<sub>3</sub>) is deposited in sediments under cold-humid conditions. As such, the low percentage of CaCO<sub>3</sub> in level *j* (the lowest in the profile) is thought to indicate warm and dry conditions during the last (Riss/Würm) interglacial (MALEZ, 1965, 219). Paleontologically, a warm climate was considered to be well-marked by the following species: *Dicerorhinus kirchbergensis* (in particular), *Dama dama*, *Bos primigenius*, *Sus scrofa*, *Capreolus capreolus*, *Hystrix cristata*, and *Panthera pardus* (MALEZ, 1963, 152-154; MALEZ, 1965, 221). The Mousterian artifacts are purported to be "primitive" and indicative of a Riss/Würm date for level *j* (MALEZ, 1958/59, 182; MALEZ, 1963, 154). "Riss/Würm," as used in the works cited above, clearly refers to full interglacial conditions. In terms of the oxygen isotope record (see SHACKLETON, 1969; SHACKLETON & OPDYKE, 1973), this refers to sub-stage 5e (c. 128-118,000 BP).

The condition and composition of the sediments from level *j* suggest deposition during relatively warm and humid conditions. The low frequency of the coarse fraction, the well-rounded character of the coarse fraction, and the high percentage of clays all suggest vigorous chemical weathering. While this is not the place for a detailed review of the Pleistocene sediments of Veternica, we would like to point out that the low percentage of

CaCO<sub>3</sub> in level *j* is more likely to be indicative of humid instead of dry depositional conditions. A relatively low value suggests that it was leached out of the sediments due to weathering. As iron oxide (Fe<sub>2</sub>O<sub>3</sub>) is one of the residues of chemical weathering, one would expect higher percentages of it in levels that have witnessed relatively stronger chemical weathering. Conveniently, level *j* has the highest percentage of iron oxide in the Veternica profile (MALEZ, 1965, 218, Table II). Furthermore, although external sources of clay cannot be ruled out (i.e. sediment brought in naturally or by human agents), it is commonly formed in place by the chemical weathering of sediments. It should thus indicate chemical weathering and relatively higher moisture. Chemical weathering is dependent upon moisture to operate, and as a chemical process, will increase in rate with an increased temperature. Therefore, increased chemical weathering should also indicate higher temperatures. Relative to the rest of the profile, the climatic conditions during the deposition of level *j* were probably both warmer and wetter. This interpretation is also suggested by RUKAVINA (1983, 210), who further notes evidence of a major cooling in the upper part of the level.

If one turns to the associated fauna, this revision suggests considerable attrition to the "warm climate" assemblage of level *j*. Fallow deer is not present, and the available rhinoceros material does not rule out the possibility that we are dealing with *Dicerorhinus hemitoechus* instead of *Dicerorhinus kirchbergensis*. *Dicerorhinus hemitoechus* appears to have been a more obligate grazer, and its appearance in the place of or in addition to *Dicerorhinus kirchbergensis* may indicate the change from a temperate woody savanna to a cooler steppe environment (LOOSE, 1975, 23). In any case, *Dicerorhinus kirchbergensis* is still present in Europe

<sup>1</sup> Most of the red deer remains were not labelled by level and one cannot be sure of their exact stratigraphic provenience. However, MALEZ (1963, 116) notes that the majority of red deer bones were from levels *h*, *i*, and *j*, and that only a few bones were found in the upper levels (*d*, *e*, and *f*). Following MALEZ's observation, these unprovenient bones are placed in the grouped level *h/ij*.

<sup>2</sup> In a later work (MALEZ, 1979b), he suggested that level *j* dates to the "upper part" of the Riss/Würm interglacial, although he neither gave a reason for modifying this date nor elaborated on its chronostratigraphic implications.



during the early Würm glaciation, including remains from Hortus cave in southern France (GUERIN, 1972, 207) and Črni kal in Slovenia (RAKOVEC, 1958, 395-396). Leopards have been found in a very wide range of Pleistocene contexts and are poor indicators of environmental conditions (KURTÉN, 1968, 88). The crested porcupine is also found in a variety of interglacial and glacial contexts (KURTÉN, 1968, 200) and does not necessarily indicate interglacial conditions. Pig and roe deer may be more or less dependent on the presence of deciduous forest. None of the taxa necessarily indicate an interglacial environment or date.

Previously, the presence of bison in assemblages has been considered indicative of cold and open environmental conditions. Research on fossil and recent members of this genus, however, shows that they were adapted to a wide range of biomes and climatic conditions (BAMFORTH, 1988; SALA, 1986; VERESHCHAGIN & BARYSHNIKOV, 1984). The paleoecological significance of bison in Veternica is difficult to evaluate due to the small number and poor condition of the remains.

In passing, we note that the "primitive" aspect of the artifact assemblage is very much dependent on the raw material, in this case, volcanic tuffs, basalts, quartzites, and jasper (MALEZ, 1958/59, 176). As MALEZ (1958/59, 176) notes, these materials are all available in gravel terraces from the nearby Sava River and other locales

in the immediate vicinity. Furthermore, although the frequent use of quartzites in level *j* contrasts with raw material use at Krapina (MALEZ, 1974, 16), close technological and typological similarities have been noted between the industry from level *j* at Veternica and the middle paleolithic assemblages from the lowest levels at Erd in Hungary (GABORI-CSANK, 1968, 258). The superposition of the Erd artifact levels on a well-marked paleosol indicates a date younger than the last interglacial (GABORI-CSANK, 1968, 105). The Veternica artifacts from level *j* need not indicate an interglacial date.

Given the data presented above, we suggest that level *j* at Veternica does not date to the last interglacial maximum (sub-stage 5e, c. 128-118,000 BP), but to a later and cooler time period with a more open environment. In Figure 5 we present our suggested revision of the stratigraphy and compare it to the existing stratigraphic interpretation by using the oxygen isotope stratigraphy as a common measure.<sup>3</sup>

The sediments, however, do indicate relatively warm and wet conditions of deposition, at least with regards to the rest of the profile. The pollen spectra for level *j* (MALEZ, 1965, 214) points to the presence of deciduous species in the area, although such trees may have been restricted to fairly limited stands. In the absence of absolute dates, this leaves open a relatively wide time

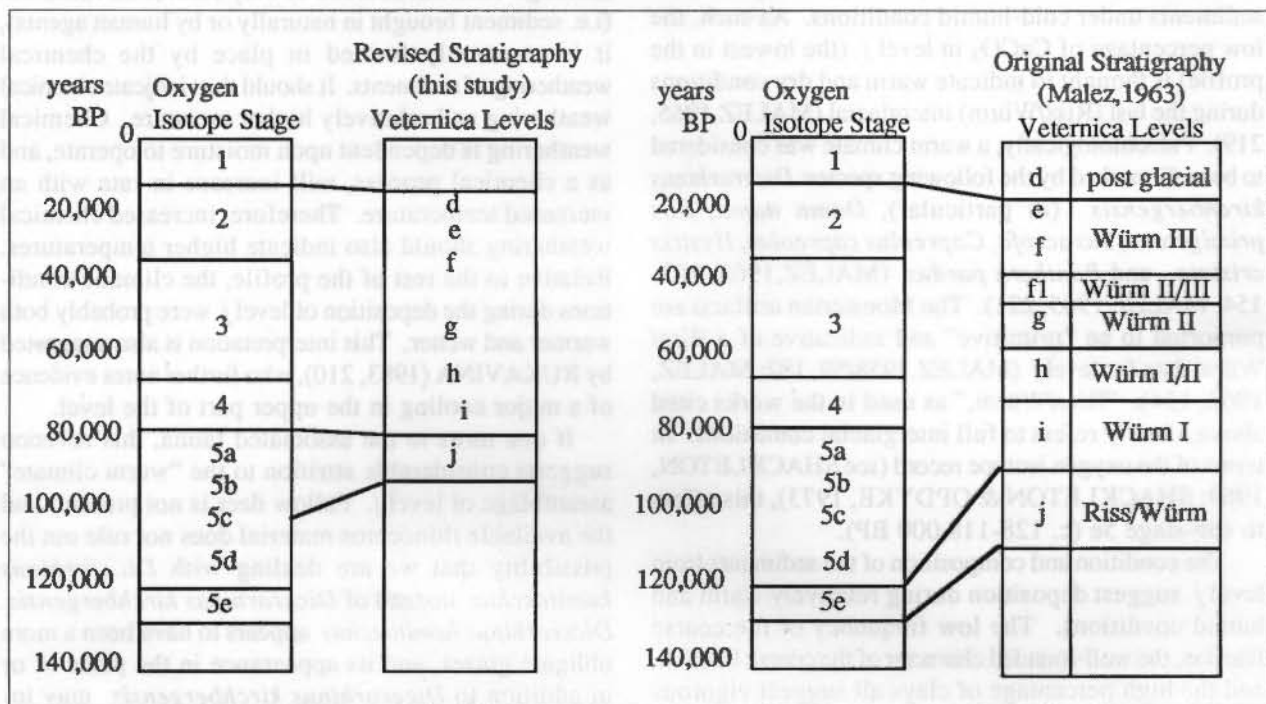


Fig. 5. Proposed revision of the Veternica chronstratigraphy and the original stratigraphic interpretation (MALEZ, 1963, 153, Figure 12), both compared to the oxygen isotope record (after GAMBLE, 1986, 76, Figure 3.3).

Slika 5. Prikazi revidiranog i izvornog (MALEZ, 1963, 153, slika 12) kronostratigrafskog profila Veternice uspoređeni s shemom izotopa kisika (usklađeno prema GAMBLE, 1986, 76, slika 3.3)

<sup>3</sup> While MALEZ never correlated the Veternica profile with oxygen isotope stages, we note again that his emphasis on the "warm" and "interglacial" character of the fauna and sediments from level *j* suggests placement of this level in the warmest part of the Riss/Würm interglacial, sub-stage 5e.



span in which to fit level *j*. We favor a date during sub-stages 5c or 5a (c. 100,000 and 80,000 BP, respectively), but will leave the question open for the time being.

Our revision of the chronology of the Veternica sequence is in close agreement with a little-known interpretation given by S. BRODAR (1966) in a book review of MALEZ's monographs. On primarily sedimentological and geomorphological grounds, BRODAR (1966, 519) suggested that level *j* dates to either a final phase of the Riss/Würm interglacial, or to an early Würm interstadial. In passing, he also noted that the "clacton" technique used in making the stone tools is found in many younger sites, and that the faunal remains, as published, do not indicate an interglacial date (BRODAR 1966, 519-520). It is satisfying to find that our data provide such clear support for an interpretation now over 25 years old.

Support for the stratigraphic revision proposed above is provided by PAUNOVIĆ (1991) in a study of changes in cave bear teeth from Veternica. She observed that primitive tooth morphotypes characteristic of Riss glacial and Riss/Würm interglacial deposits are not represented in the Veternica assemblages. The Veternica cave bear teeth, in both their size and frequency of morphotypes, are most similar to more evolved Würm populations of cave bears. Therefore, working from several independent lines of evidence, we can conclude that the Veternica sequence does not extend into the Riss/Würm interglacial.

## 5. CONCLUSION

The net result of the paleontological revision is to squeeze the Veternica profile into a slightly tighter time frame. The earliest level with archaeological and paleontological remains, level *j*, could have been deposited during a warmer phase towards the beginning of the Würm glacial. Level *j* is followed by two levels, *i* and *h*, that also contained archaeological and paleontological materials. In terms of the associated faunas and material culture, these levels are very similar to *j*. By level *h*, the crested porcupine has gone and the elk appears. Sedimentologically, these levels are very similar to each other, with the exception that the coarse fraction from *h* is more rounded and corroded (MALEZ, 1965, 209). These levels contain relatively less clay and iron oxide, and relatively more CaCO<sub>3</sub> and rubble than level *j*, suggesting cooler and drier depositional conditions, perhaps during an early Würm stadial. A single carbon<sup>14</sup> date from level *i*, of > 43,200 BP (charcoal, GrN-4984, MALEZ, 1979a) more or less confirms what we already know; levels *i* and *j* were deposited before c. 45,000 BP.

This revision also has implications for the reconstruction of paleoenvironments in the area during the deposition of levels *j* to *h*. The ungulate assemblages from layers *j* - *h* are very similar in composition. Although the indeterminate rhino and pig are restricted to level *j*, and elk and chamois are found only in level

*h*, it is difficult to attach any importance to these changes due to the extremely small sample sizes for these taxa. In general, the faunal assemblages from levels *j* to *h* suggest a relatively temperate forest-steppe, perhaps with patches of deciduous woodland.

Together with the sites of Krapina, Vindija, and Velika pećina, Veternica provides a unique chance to monitor the changing circumstances of hominid adaptation and evolution in southeastern Europe (e.g. SMITH, 1982). A first step to such a general study is an adequate identification, description and interpretation of the excavated data. We hope that the present study is successful on all three counts. Our revision facilitates chronostratigraphic comparisons with other sites and adds to reconstructions of paleoenvironmental changes in the region. Although we have not addressed the role of hominids in forming these assemblages, we have established a firmer contextual foundation from which to consider such questions in the future.

## 6. ACKNOWLEDGMENTS

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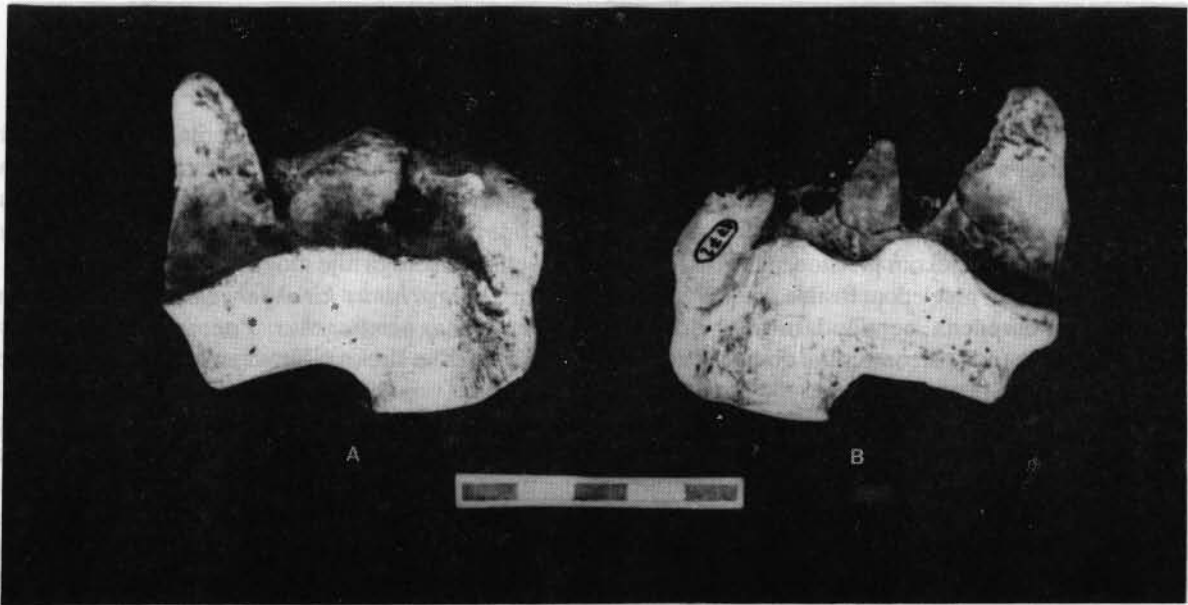
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#### PLATE - TABLA I

- 1A *Bos/Bison*, Upper Pleistocene, Veternica level *j* (VTR. 3), navicular-cuboid, right, scale in cm; gornji pleistocen, Veternica sloj *j* (VTR. 3), naviculare-cuboideum, desni, mjerilo u cm.
- 1B *Megaceros giganteus* (BLUMENBACH), Upper Pleistocene, Šandalja II level *H* (Ša. 1772), navicular-cuboid, left; gornji pleistocen, Šandalja II sloj *H* (Ša. 1772), naviculare-cuboideum, lijevi.
- 2A *Bos/Bison*, Upper Pleistocene, Veternica level *i* (VTR. 2), phalanx III, scale in cm; gornji pleistocen, Veternica sloj *i* (VTR. 2), phalanx III, mjerilo u cm.
- 2B *Megaceros giganteus* (BLUMENBACH), Upper Pleistocene, Šandalja II level *i* (Ša. 472), phalanx III; gornji pleistocen, Šandalja II sloj *i* (Ša. 472), phalanx III.



Revidirana fauna ungulata i stratičarske površine pleistocena sjeverne Vojvodine (Vojvodina Hrvatska)



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## Revizija faune ungulata i stratigrafije gornjeg pleistocena spilje Veternice (Zagreb, Hrvatska)

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Paleontološka revizija fosilne faune ungulata spilje Veternice dio je opširne studije koju je započeo Preston MIRACLE s ciljem proučavanja tafonomija spilja Hrvatske, uz razmatranja načina i uvjeta opstanka hominidnih zajednica tijekom pleistocena (MIRACLE, 1991). Preliminarnim pregledom fosilne građe Veternice primjećena je određena nepodudarnost s do sada objavljenim rezultatima paleontološke obrade Veternice (MALEZ, 1963), što je potaknulo potrebu za detaljnom revizijom.

Rezultati revizije (tablice 1 i 2) značajni su za paleoekološku i stratigrafsku interpretaciju Veternice. Taksonomskom obradom utvrđena je odsutnost vrsta *Dama dama* i *Megaceros giganteus*, ali i prisustvo vrste *Bison priscus*. Također je izmjenjeno kvalitativno i kvantitativno sudjelovanje vrsta *Alces alces* i *Capreolus capreolus*. *Rupicapra rupicapra* je osobito zastupljena u slojevima *d* i *h*. *Capra ibex* utvrđena je jedino u sloju *d*, dok je paleofauni sloja *e* pridodana i vrsta *Sus scrofa*. Ostaci vrste *Cervus elaphus* ukazuju na pripadnost krupnim jedinkama, i ta je vrsta u cjelokupnoj fosilnoj građi najviše zastupljena. Od skupine ungulata jelen dominira u gotovo svim slojevima.

Do sada je sloj *j*, najstariji sloj koji sadrži paleontološke i arheološke ostatke, po svojim sedimentološkim i faunističkim karakteristikama bio datiran u interglacijal Riss/Würm (MALEZ, 1963, 152; MALEZ, 1965, 220-221). MALEZ (1965, 220-221) je tvrdio: "toplodobni karakter sloja *j* vrlo dobro markiraju neki predstavnici faune, i to u prvom redu nosorog vrste *Dicerorhinus kirchbergensis*, zatim jelen lopatar (*Dama cf. dama*), dikobraz (*Hystrix cristata minor*), leopard (*Panthera pardus*), divlja svinja (*Sus scrofa*), srna (*Capreolus capreolus*), divlje govedo (*Bos primigenius*) i drugi". Isti autor smatra da sakupljeni musterijski artefakti iz sloja *j* pokazuju "primitivne" karakteristike te indiciraju datiranje sloja u Riss/Würm (MALEZ, 1958/59, 182; MALEZ, 1965, 221).

Sastav sedimenata sloja *j* sugerira taloženje u relativno toplim i vlažnim uvjetima, a revizija faunske asocijacije upućuje na određeno "osipanje" toplodobnih elemenata. Tako je primjerice utvrđeno odsustvo vrste *Dama dama*, a ostatke nosoroga nije moguće točno determinirati kao vrstu *Dicerorhinus kirchbergensis* ili možda vrstu *Dicerorhinus hemitoechus*. *Panthera pardus* i *Hystrix cristata* bili su široko rasprostranjeni tijekom pleistocena čime gube vrijednost kao indikatori klimatski prilika (KURTÉN, 1968, 88, 200). *Sus scrofa*, i *Capreolus capreolus* nisu karakteristične vrste za određenu ekološku nišu. *Bison priscus* nekad se smatrao predstavnikom isključivo hladnodobne faunske zajednice ali danas je to mišljenje izmjenjeno (BAMFORTH, 1988; SALA, 1986; VERESHCHAGIN & BARYSHNIKOV, 1984). Uslijed malobrojnih ostataka bizona u naslagama Veternice teško je govoriti o paleoekološkom značaju ove vrste.

Prije ustvrđena određena "primitivnost" izrade musterijskih artefakata, zapravo veoma ovisi o vrsti materijala koji je bio upotrebljen. Artefakti iz Veternice izrađeni su od vulkanskih tufova, bazalta, kvarcita i jaspisa koji su se mogli prikupiti u šljunčanim nanosima Save i u neposrednoj blizini spilje. No neophodno je napomenuti da navedeni paleolitski materijal ne mora indicirati starost sedimenta.

Po rezultatima dobivenim u ovom radu smatramo da se sloj *j* u Veternici ne može datirati u posljednji interglacijalni maksimum (izotop kisika, stadij 5e, cca 128-118.000 BP, SHACKLETON, 1969; SHACKLETON & OPDYKE, 1973), već u kasniji i hladniji period s otvorenijim biotopom. Sastav faune ungulata sličan je u slojevima *j* - *h*. Općenito sastav faunske zajednice u ovim slojevima upućuje na razmjerno umjerene klimatske uvjete i na šumsko-stepski okoliš s rijetkim bjelogoričnim šumarcima. I u pogledu ostalog dijela profila, sedimenti ukazuju na relativno tople i vlažne uvjete taloženja. Metodom <sup>14</sup>C datiran je sloj *i* na starost

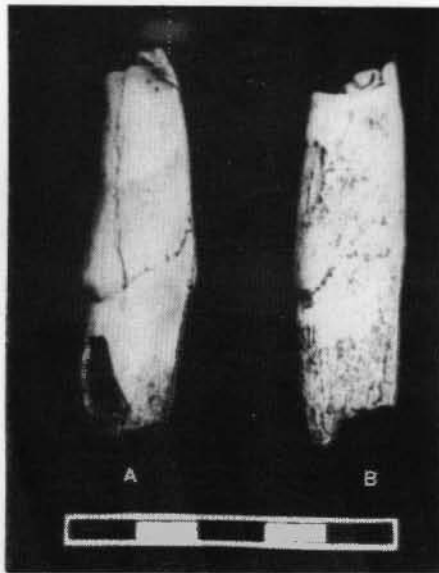
### PLATE - TABLA II

- 1A *Bison priscus* (BOJANUS) Upper Pleistocene, Veternica level *j* (VTR. 183), metacarpal, right, scale in cm; gornji pleistocen, Veternica sloj *j* (VTR. 183), metacarpus, desni, mjerilo u cm.
- 1B *Bos primigenius* (BOJANUS) Upper Pleistocene, Šandalja II level *GH* (Ša. 1269, 1266), metacarpal, left; gornji pleistocen, Šandalja II sloj *GH* (Ša. 1269, 1266) metacarpus, lijevi.
- 2A *Bison priscus* (BOJANUS) Upper Pleistocene, Veternica level *j* (VTR. 196), M<sub>1</sub>, left, scale in cm; gornji pleistocen, Veternica sloj *j* (VTR. 196), M<sub>1</sub>, lijevi, mjerilo u cm.
- 2B *Bos primigenius* (BOJANUS) Upper Pleistocene, Šandalja II *B/C* (Ša. 7398), level *B/d*, M<sub>1</sub>, left; gornji pleistocen, Šandalja II sloj *B/C* (Ša. 7398), M<sub>1</sub>, lijevi.





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veću od 43.200 BP (ugljen, GrN-4984, MALEZ, 1979a). Period taloženja naslaga teško je odrediti bez apsolutnih datiranja. Prednost dajemo datiranjima s izotopom kisika, stadijima 5c ili 5a (cca 100 ili 80.000 BP), koji bi mogli odgovarati sloju *j*, no to pitanje ostaje otvoreno.

Veternica, uz ostale lokalitete, Krapinu, Vindiju i Veliku pećinu, pruža jedinstvenu mogućnost promatranja svih okolnosti evolucije i adaptacije čovjeka u prostorima jugoistočne Evrope. Prvi korak prema širim znanstvenim

proučavanjima je odgovarajuća odredba, opis i tumačenje sakupljenog materijala. Nadamo se da je ova rasprava ispunila sva tri uvjeta. Cilj učinjene revizije je da olakša kronostratigrafske usporedbe s drugim nalazištima te da doprinese rekonstrukcijama paleoekoloških i paleozooloških uvjeta tijekom gornjeg pleistocena u ovim prostorima. Premda u oblikovanju faunskih zajednica uloga čovjeka nije određena, vjerujemo da ova rasprava pruža pouzdane osnove za otvaranje nekih novih pitanja.

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