

LOWER PLEISTOCENE RUMINANTS FROM MONTE RICCIO (TARQUINIA, ITALY)

CROITOR Roman

Abstract. This paper refers to the remains of ruminants originating from the Lower Pleistocene site of Monte Riccio situated at northern part of Lazio (Italy). The assemblage of ruminants from Monte Riccio includes *Leptobos* sp. (possibly, similar to *L. etruscus*), *Eucladoceros ctenoides* (NESTI 1841), and *Praeelaphus lyra* (AZZAROLI 1992) and represents a geographically and chronologically specific combination of ruminant forms. The ruminants from Monte Riccio suggest a geological age similar to Olivola from Tuscany (Italy). The article also proposes the genus *Praeelaphus* PORTIS 1920 with type species *Cervus* (*s. l.*) *perrieri* as a taxonomical solution for archaic *Rusa*-like species with advanced antler morphology from the Pliocene and Early Pleistocene of Western Eurasia, including *Praeelaphus lyra*.

Keywords: Early Pleistocene, Monte Riccio, Italy, Cervidae, Bovidae, biochronology.

Rezumat. Rumegetoarele din Pleistocenul inferior de la Monte Riccio (Tarquinia, Italia). Articolul descrie resturi de rumegetoare din Pleistocenul timpuriu de la Monte Riccio, localitate din nordul regiunii Lazio (Italia). În componența faunei de la Monte Riccio sunt descrise *Leptobos* sp. (posibil *L. etruscus*), *Eucladoceros ctenoides* (NESTI 1841) și *Praeelaphus lyra* (AZZAROLI 1992). Această combinație de forme rumegetoare este specifică din punct de vedere geografic și biostratigrafic și sugerează poziția biostratigrafică a faunei de la Monte Riccio ca fiind similară cu cea a faunei de la Olivola. De asemenea articolul propune utilizarea genului *Praeelaphus* PORTIS 1920 cu specia tipică *Cervus* (*s. l.*) *perrieri* ca o soluție taxonomică pentru cerbii arhaici de tip *Rusa* cu coarnele morfologic avansate din Pliocenul și Pleistocenul timpuriu Eurasiei occidentale, inclusiv specia *Praeelaphus lyra*.

Cuvinte cheie: Pleistocenul timpuriu, Monte Riccio, Italia, Cervidae, Bovidae, biocronologie.

INTRODUCTION

The fauna from Monte Riccio is of special interest, since it provides new data on a crucial stage of faunal development during the Early Pleistocene in Western Eurasia: the faunal turnover known as “the wolf event” (term coined by AZZAROLI in 1982) or, more precisely, “*Pachycrocuta* event” (term proposed recently by MARTINEZ NAVARRO, 2010). This important stage of faunal evolution recorded in many regions of the Eurasian continent is based on the paleontological record from Central Italy. A certain difficulty is created by the fact that the description of fossil faunas and faunal turnovers are based on old historical Italian collections with uncertain or incompletely recorded provenance. Therefore, any new discovery of Lower Pleistocene faunas from Central Italy brings important biostratigraphical data improving our knowledge on the major stages of faunal evolution that affected the whole continent in the Early Pleistocene. The fauna from Monte Riccio was described in preliminary reports by MAZZINI *et al.* (2000) and PETRONIO *et al.* (2002). However, some taxonomical determinations of the material still need a refinement.

The published mammal faunal list includes *Prolagus* sp., *Mammuthus meridionalis*, *Sus strozzi*, *Hippopotamus antiquus*, *Leptobos* cf. *etruscus*, *Procapreolus* sp., *Eucladoceros ctenoides*, *Axis nestii*, *Stephanorhinus* cf. *etruscus*, *Equus* aff. *stenonis*, *Vulpes* cf. *alopeoides*, *Canis etruscus*, and *Megantereon cultridens* (MAZZINI *et al.*, 2000; PETRONIO *et al.*, 2002; SARDELLA, 2004). According to PETRONIO *et al.* (2002), the fauna from Monte Riccio corresponds to the Tasso Faunal Unit.

MATERIAL AND METHODS

The study represents a brief morphological and biometrical description of the most diagnostic specimens and a taxonomical study of the small-sized deer from Monte Riccio. The fossil material is stored in the Civic Museum of Allumiere (Lazio, Italy). The fossils are fragmented and in many cases are badly damaged, so not all measurements could be taken. The involved in present study comparative material from Olivola and Upper Valdarno is stored in the Museum of Geology and Paleontology of the University of Florence. The abbreviations used in the paper: L - length; H - height; D - breadth; DLM - medio-lateral diameter; DAP - antero-posterior diameter; nn - without number.

SYSTEMATIC PALEONTOLOGY

Family Bovidae GRAY 1821
Genus *Leptobos* RÜTIMEYER 1878
Leptobos sp.

The large-sized antelope-like bovine is documented by fragments of postcranial bones, isolated teeth and a poor fragment of horn core. None of the available fossil specimens are diagnostic at species level; therefore the species assignment is difficult to be done. MAZZINI *et al.* (2000) described this form of *Leptobos* as *L. cf. etruscus*. This determination possibly could be correct. However, I prefer a more conservative and cautious approach in this case.

Measurements of postcranial elements from Monte Riccio (Table 1, Fig. 1) are close to *Leptobos etruscus* from Senèze (France) and Leu (Romania) and fall in the size variation range of the *Leptobos* samples from Upper Valdarno and Olivola.

Table 1. Measurements of postcranial bones of *Leptobos* sp. from Monte Riccio.
Tabel 1. Măsurătorile oaselor postcraniene de *Leptobos* sp. din Monte Riccio.

Bone	number	L	DLM prox	DAP prox	DLM dist	DAP dist
radius	4309		91.0	46.3		
radius	4324		90.3	45.5		
tibia	4323				67.2	52.7
tibia	4375				65.6	52.0
tibia	4379				70.4	54.0
talus	4041	73.7			48.0	36.0
talus	4313				47.8	33.1

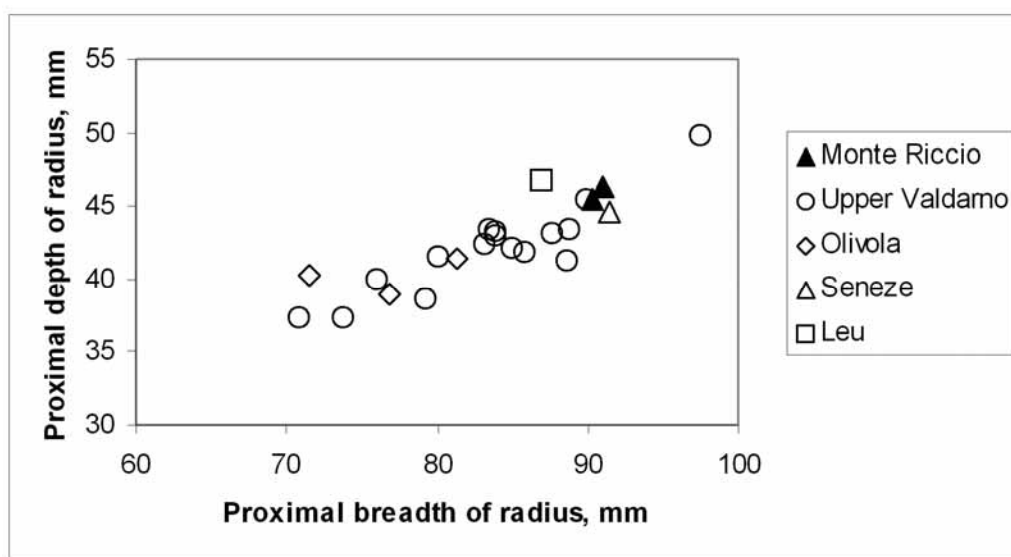


Figure 1. *Leptobos* sp. from Monte Riccio: measurements of proximal end of radius compared to samples from Upper Valdarno, Seneze, Leu and Olivola (comparative data adapted from CROITOR & POPESCU, 2011 and CROITOR, work in progress).

Figura 1. *Leptobos* sp. din Monte Riccio: măsurătorile epifizelor proximale ale radiusului din Monte Riccio comparate cu materialul din Valdarno Superiore, Senèze, Leu și Olivola (datele comparative au fost prelucrate după CROITOR & POPESCU, 2011 și CROITOR, date în proces de prelucrare).

Family Cervidae GOLDFUSS 1820
Genus *Eucladoceros* FALCONER 1868
Eucladoceros ctenoides (NESTI 1841)

Very few remains belong to a larger deer of the genus *Eucladoceros*. The presence of this genus without any doubts is indicated by a proximal fragment of antler with a basal tine (mostly destroyed) and a very characteristic for *Eucladoceros* small accessory “outer tine” (according to terminology introduced by AZZAROLI & MAZZA, 1992) situated on the medial side of the antler beam near the basal tine. The species *ctenoides* is identified due to the presence of a fragment of simple cylinder shaped antler tine No. 4390 (maximal diameter – 28.2 mm; minimal diameter – 30.0 mm), distinguishing the *Eucladoceros* form from Monte Riccio from *E. dicranios* with flattened dichotomously branched tines. The talus No. 4360 (L=68.6 mm; DLM dist.=42.4 mm), and the fragment of maxilla (nn) with P⁴ (L=16.3 mm, D=19.0 mm) and M¹ (L=21.4 mm, D=25.5 mm) are among the best preserved bones.

Genus *Praeclaphus* PORTIS 1920

Genus definition: Deer of size of modern European red deer and sika deer. Pedicles of moderate length (median length of pedicle in adult males normally does not exceed its diameter), compressed antero-posteriorly. Fully grown antlers are large, four-pointed. The first tine normally is situated above the burr at a distance larger than the diameter of antler base. The antler segment between the first and the second tines is significantly longer than the segment between the second tine and the distal bifurcation. The antler beam forms flattened extensions in the areas of ramification. The transversal section of beam below the second tine is not regular, often pyriform. The beam above the second tine is significantly compressed antero-posteriorly and forms an extended flattening with frontal orientation. The

distal bifurcation normally is oriented in the frontal plane. The dentition is primitive: P_4 normally is simple, with low degree of molarization, lower premolar series is relatively long, longer than in *Cervus* and *Dama*.

Taxonomical remarks: PORTIS (1920: p. 133) proposed the subgenus *Cervus* (*Praeelaphus*) for Lower Villafranchian species *C. arvernensis* CROIZET et JOBERT 1828, *C. perrieri* CROIZET et JOBERT 1828, and *C. etueriarum* CROIZET et JOBERT 1828. HEINTZ (1970) pointed out that *C. etueriarum* is based on the juvenile specimen of *C. perrieri*. HEINTZ (1970) placed *C. perrieri* in the arbitrary group *Cervus sensu lato*, therefore the question of its systematic position remained open. *C. (s. l.) perrieri* apparently does not belong to the lineage of true modern *Cervus* and therefore a new taxonomical solution is needed in this case. The most reliable solution is to apply the genus name *Praeelaphus* PORTIS 1924 with type species *Cervus perrieri*. According to my vision, this genus includes archaic Pliocene and Pleistocene deer from Western Eurasia with rather advanced antler morphology and primitive *Rusa*-like cranial morphology (see for discussion CROITOR & STEFANIAK, 2009) and belongs to early evolutionary radiation of the Cervinae group. GRUBB (2000) supposed that *C. (Praeelaphus)* PORTIS may be synonymous with *C. (Metacervocerus)* DIETRICH, however, those subgenera are based on two different broadly recognized valid species: *C. perrieri* and *C. pardinensis* respectively. Therefore, PORTIS' *Praeelaphus* is available as genus name for *C. perrieri* and other closely related forms.

Type species: *Cervus perrieri* CROIZET et JOBERT, 1828 (= *C. etueriarum* CROIZET et JOBERT, 1828; = *Cervus issiodorensis* CROIZET et JOBERT, 1828); MN16b, France (see HEINTZ, 1970 for neotype designation, emended diagnosis, and description).

Other referred species: *Praeelaphus warthae* (CZYŻEWSKA, 1968) (MN15, Poland); *P. lyra* (AZZAROLI, 1992) (MN16, Italy).

Praeelaphus lyra (AZZAROLI, 1992)

1992 – *Pseudodama lyra* sp. nov.: AZZAROLI, p. 6, fig. 2

2000 – *Axis nestii* (AZZAROLI): MAZZINI *et al.*, p. 247

2002 – *Axis lyra* (AZZAROLI): DI STEFANO & PETRONIO: p. 319, fig. 7

2009 – “*Cervus*” *lyra* (AZZAROLI): CROITOR & STEFANIAK: p. 27

Taxonomical remarks: The species under discussion was originally described inside of the AZZAROLI's genus *Pseudodama* (AZZAROLI, 1992). The revision of the type species of *Pseudodama*, *Dama nestii* AZZAROLI 1947, has revealed its close relationship with modern red deer; therefore *Pseudodama* is a junior synonym of the genus *Cervus sensu stricto* (CROITOR, 2006). *Pseudodama lyra* is based on fine complete antlers attached to the frontal part of the skull from the Early Villafranchian of Ponte a Elsa (Lower Valdarno, Tuscany); however, its validity was questioned because of superficial description and unclear diagnosis. According to AZZAROLI (1992), *P. lyra* differs from other species of the genus in a curvature of the antler beam and primordial bifurcation on the distal end of the antler. DE VOS *et al.* (1995) included AZZAROLI's species in the synonymy of *Cervus (s.l.) rhenanus*, since the definition of the Italian species was quite obscure and indicated just minor morphological differences from *C. rhenanus*. CROITOR (2006) recognized a juvenile character of the asymmetric primordial branching of the distal part of the antler in *Pseudodama lyra* and included it in synonymy of *Cervus nestii* (AZZAROLI, 1947), while *Pseudodama* is regarded as a junior synonym of *Cervus*. The further study of the specimen from Ponte a Elsa that I carried out some-what later, revealed its morphological similarity to *Cervus (s. l.) perrieri* (the position and the shape of the first tine, the irregular shape of transversal section of beam, the very long antler segment between the first and the second tine, the frontal orientation of the flattened beam segment between the second tine and distal bifurcation, the flattened extensions in the area of antler ramifications, antero-posterior compression of pedicles). The distal segment of the beam of the antlers from Ponte a Elsa is remarkably compressed from the anterior and posterior sides. This unusual morphological character is found also in some specimens from Olivola (CROITOR, work in progress), as well as in larger deer from the Early Pleistocene in Weze-1 (Poland). This observation suggests a taxonomical value of this character in combination with some other ones, like comparatively short braincase, smooth antler surface, a significant flattening of antlers in the area of second ramification. Despite of great similarity between *Pseudodama lyra* and *Cervus perrieri*, I prefer to keep this species name before a comprehensive comparative study will be made.

Description. The small deer from Monte Riccio is represented by quite poor fragments of postcranial bones, isolated teeth, and four antler pedicles (Tables 2, 3). The fossil material is quite uniform and indicates the presence of a single small-sized deer species. The lower fourth molar (P_4) is unmolarized: its metaconid and paraconid are not fused and the anterior valley remains open (Fig. 2, A). The metaconid is extended antero-posteriorly and gets in touch with the entoconid. The entoconid is fused with the entostylid closing the posterior valley between them. The lingual wall of P_4 is not cleft (Fig. 2, B). The protocone and hypocone of P_4 are separated each from another only by lingual vertical groove. No additional enamel folds are developed on the hypocone of P_4 . The additional enamel folds in upper molars are not developed as well (Fig. 2, C1-C2). The lingual wall of M^2 is rather oblique and forms with labial wall the angle of 50° (a primitive condition correlated to low-crowned molars), which distinguishes the deer from Monte Riccio from *Dama eurygonos* (the angle between labial and lingual walls of M^2 amounts to 37°) and *Cervus nestii* (the corresponding angle amounts to 30°).

The moderately long pedicles from Monte Riccio are peculiar in their antero-posterior compression found in old and young individuals (Table 3). The antero-posterior compression of pedicles also is a morphological peculiarity of the holotype IGF1933v of *Praelaphus lyra* from Ponte a Elsa (Lower Valdarno): the antero-posterior diameter of the left pedicle amounts to 24.7 mm, the latero-medial diameter of the left pedicle amounts to 30.0 mm, the corresponding measurements of the right pedicle are 25.7 and 29.7 mm. The shape of pedicles approaches the deer from Monte Riccio to *Praelaphus lyra* from the Early Villafranchian of Lower Valdarno and distinguishes it from the short incranial compressed from the sides pedicles of *Dama eurygonos* and the long compressed from the sides pedicles of *Cervus nestii* (CROITOR, 2006).

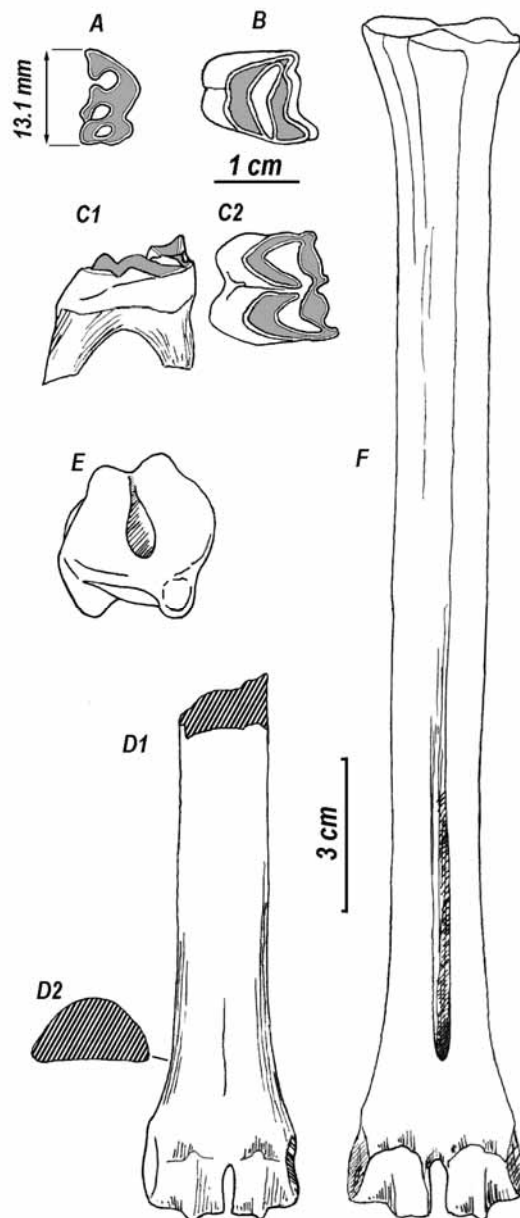


Figure 2. *Praelaphus lyra* (AZZAROLI, 1992): A, shape of occlusion surface of P₄ No. 4491; B, occlusion view of P⁴ No. 4492a; C, cranial (C1) and occlusion (C2) views of M² No. 4486; D, dorsal view (D1) and transversal section above articulation blocks (D2) of distal fragment of metacarpus No. 4310; E, proximal articular surface of fragmented metatarsal No. 4307; F, dorsal view of complete metatarsal No. 4305.

Figura 2. *Praelaphus lyra* (AZZAROLI, 1992): A – silueta suprafeței ocluzale a P₄ Nr. 4491; B – silueta suprafeței ocluzale a P⁴ Nr. 4492a; C – aspectul cranial (C1) și aspectul ocluziv (C2) al M² Nr. 4486; D – aspectul dorsal (D1) și silueta secțiunii transversale asupra blocurilor articulare (D2) fragmentului distal ale metacarpului Nr. 4310; E – suprafața articulară proximală a fragmentului de metatars nr. 4307; F – aspectul dorsal al metatarsului nr. 4305.

The metatarsal bone No. 4305 is comparatively short as in *Cervus nestii* (the length of metatarsus IGF 393 from Upper Valdarno amounts to 220.0 mm) and significantly shorter than in *Dama eurygonos* (the length of metatarsus IGF 299 from Upper Valdarno – 343.0 mm). Unlike *Cervus nestii*, the distal part of diaphysis of metacarpus No. 4310 (Fig. 2, D1-D2) is not compressed from the sides (CROITOR, 2006: p. 96, Fig. 10); it is rather compressed dorso-ventrally.

Table 2. *Praeelaphus lyra* (AZZAROLI, 1992): measurements of isolated cheek teeth.
 Tabel 2. *Praeelaphus lyra* (AZZAROLI, 1992): măsurători ale dinților izolați.

Tooth	Number	L (max)	D (base)
P ₄	4491	13.1	8.0
M ₁	nn	15.0	9.9
M ₃	nn	19.4	9.8
P ³	4492a	11.3	13.0
P ³	4492b	12.0	13.1
P ⁴	4490a	11.0	14.8
P ⁴	4490b	9.8	14.0
P ⁴	4491	10.2	13.2
M ²	4486	17.2	19.4

Table 3. *Praeelaphus lyra* (AZZAROLI, 1992): measurements of postcranial bones.
 Tabel 3. *Praeelaphus lyra* (AZZAROLI, 1992): măsurători ale oaselor postcraniene.

Bone	Number	L (H)	DLMprox	DAPprox	DLMdist	DAPdist
Pedicle	4008	22.0			37.4	31.0
Pedicle	4007	20.3	40.0	36.1	34.5	28.5
Pedicle	4006	22.0	26.6	25.0	25.5	21.2
Pedicle	nn	21.7	26.6	26.0	24.2	21.3
Metacarpus	4364		34.0	24.4		
Metacarpus	4310				28.6	19.4
Metatarsus	4365		28.3	28.2		
Metatarsus	4367		30.2	32.0		
Metatarsus	4307		29.0	32.2		
Metatarsus	4304		27.0	30.0		
Metatarsus	4500		26.7	29.1		
Metatarsus	4305	227.0	31.0		32,5	
Talus	nn	40.2			24.6	19.4
Phalanx I	4316	50.7	17.3	22.2	15.0	13.8
Phalanx I	nn	50.3	16.2	21.8	14.7	13.5

Remarks. The available paleontological record and recently published results of genetic analysis (PITRA *et al.*, 2004) suggest that the genus *Praeelaphus* represents together with Plio-Pleistocene genus *Arvernoceros*, and modern genera *Rucervus* and *Axis* the earliest evolutionary radiation of the subfamily Cervinae. The earliest occurrence of *Praeelaphus lyra* in Western Eurasia is recorded in the Lower Pliocene sites Cociulia and Lucești (MN15) from Moldova (CROITOR & STEFANIAK, 2009). *Praeelaphus lyra* is closely related to the slightly larger form *P. warthae* from the Early Pliocene of Poland, which, on its turn, is a forerunner of the largest species of the genus *P. perrieri* from the Early Villafranchian of France. The genera that resulted from early Cervinae radiation became extinct in Western Eurasia before the end of the Early Pleistocene, while the Asian forms *Rucervus divaucelii* and *Axis axis* are still present in modern fauna. Unlike *P. perrieri* from France, *P. lyra* survived on the Italian peninsula for a longer time. It coexisted with similar-sized *Cervus nestii* in Olivola F. U. (CROITOR, work in progress) and was substituted by *Dama eurygonos* in Tasso F. U.

DISCUSSIONS

The assemblage of ruminants from Monte Riccio geographically and biochronologically is rather specific. The distribution of *Eucladoceros ctenoides* is restricted to Western and Mediterranean Europe and chronologically from Middle to Late Villafranchian. Apparently, *Leptobos* of *etruscus* type arrived to Western Europe from Caucasian area shortly before the *Pachycrocuta* event and was substituted by *Leptobos vallisarni* in Farneta F. U. (CROITOR & POPESCU, 2011). The third ruminant species, the small-sized cervid *Praeelaphus lyra*, is an archaic Lower Pliocene faunal representative, which survived in Italy until the *Pachycrocuta* faunal turnover. This is the most interesting species of ruminants, which gives reason to reconsider the age of the fauna from Monte Riccio proposed by MAZZINI *et al.* (2000) and PETRONIO *et al.* (2002). The Villafranchian small-sized deer from Italy represents a taxonomically very confused problem partly due to the fact that researchers are dealing in this case with several ecologically opportunistic species representing a similar ecotype, therefore those little specialized and equal-sized species may coexist, and partly due to the specific problem of old historical paleontological collections where original type specimens come from, often lacking exact data on geographical and stratigraphical provenance. The revision of old collections and implication of modern osteological material in the comparative analysis has revealed the presence of two small-sized species of cervids in the Early Pleistocene of Italy, which, however, belong to different genera: a primitive small-sized *Cervus nestii*, which is closely related to the modern red deer *C. elaphus*, and a peculiar fallow deer with simple four-pointed antlers *Dama eurygonos* (CROITOR, 2006). *Praeelaphus lyra* coexisted with *Cervus nestii* in Olivola F. U. and was substituted by *Dama eurygonos* in Tasso F.U. (CROITOR, work in progress). I could not find in the available material from Monte Riccio any remains belonging to *Procapreolus*, which is mentioned in the faunal list by PETRONIO *et al.* (2002). The only difference between Monte Riccio and Olivola is the presence of *Cervus nestii* in Olivola, which has not been recorded in Monte Riccio yet. It seems that the age of the fauna from Monte Riccio is similar to that of the fauna from Olivola or even could be slightly older.

CONCLUSIONS

The study of fossil remains from the Lower Pleistocene site of Monte Riccio (Northern Lazio, Italy) revealed the presence of a large antelope-like bovine *Leptobos* sp., the red deer sized *Eucladoceros ctenoides*, and a small sized archaic deer *Praeclaphus lyra*. The last species is the most interesting for understanding the biostratigraphical position of the fauna from Monte Riccio. *P. lyra* is very close to the Lower Villafranchian *P. perrieri* from France and is a Lower Pliocene holdover in the Upper Villafranchian fauna from Italy. The association of ruminants from Monte Riccio seems to be geographically specific for the limited region of Italy and biochronologically corresponds to the Olivola F. U.

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Croitor Roman

Centre for Archaeology, Institute of Cultural Patrimony
Bd. Ștefan Cel Mare, 1 – MD2001 – Chișinău, Republic of Moldova
E-mail: romancroitor@europe.com

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