

REVIEW AND NEW DATA OF THE FOSSIL REMAINS FROM MONTE PEGLIA (LATE EARLY PLEISTOCENE, CENTRAL ITALY)

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Abstract. After more than sixty years since its discovery, the fossils from Monte Peglia (late early Biharian, Umbria) are reconsidered in their entirety. The small mammals of Monte Peglia upper and lower levels had been studied in the past, whereas the remains of large mammals of Monte Peglia lower level, stored in several Institutions of central Italy, are described here for the first time. The following taxa have been described: *Hystrix refossa*, *Homotherium latidens*, *Panthera* cf. *P. gombaszoegensis*, *Felis* cf. *F. lunensis*, *Canis mosbachensis*, *Vulpes alopecoides*, *Meles meles*, *Pannonictis* cf. *P. nestii*, *Mustela palerminea*, *Ursus* cf. *U. etruscus*; *Macaca sylvanus florentinus*, *Equus altidens*, *Stephanorhinus* cf. *S. hundsheimensis*, *Sus* sp., *Capreolus* sp., *Axis eurygonos*, *Hemitragus* cf. *H. orientalis*, *Bison degiulii*. Moreover, the list of small mammals of the lower level has been updated with the addition of three new small vertebrate taxa: *Rana* sp., *Myotis* sp. (large size), cf. *Miniopterus* sp. The study of the remains of large mammals of the lower layer indicate the survival of a number of taxa of latest Villafranchian age. If we accept the biochronological correlation of Monte Peglia with the Colle Curti local fauna, its age should be ~1.072 Ma. In this case, it is possible to pinpoint the accumulation of the lower level to the MIS 35/33, as the small mammals confirm the presence of a mixed environment with forested and open spaces and warm temperate climate. The accumulation of the upper level, characterized by taxa typical of open spaces and steppes and a cooler climate, probably occurred during MIS 34/32.

INTRODUCTION

The Monte Peglia fossiliferous site is located close to San Venanzo (Terni, Umbria, central Italy; Fig. 1). It is one of the few Italian sites of the late Early Pleistocene which bears both small- and large vertebrates. The lithic artifacts found at Monte Pe-

glia are among the oldest of those retrieved in the Italian territory. The vertebrate fossils and the lithic artifacts were found in a karst fissure filled by red and brown clays and ossiferous breccia, located in an abandoned quarry at ~805 m a.s.l., next to the top of Monte Peglia (Blanc 1955, 1956; Piperno et al. 1984).

The small mammals were described by Van der Meulen (1973), whereas the large mammals

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are mentioned in some faunal lists (Blanc 1955, 1956; Piperno et al. 1984) without further description, with the exception of some fossils referred to *Macaca sylvanus* (see Basilici et al. 1991), several remains of *Homotherium latidens* (Owen, 1846) (Sardella & Iurino 2012), and some bird remains (Bedetti 2003).

Gliozzi et al. (1997) ascribed the Monte Peglia assemblage to the early Galerian (Colle Curti Faunal Unit) based on the small mammals which “indicate a more evolved assemblage than the one from Pirro Nord”, although “the large mammal assemblage, which has yet to be studied analytically, suggests the persistence of a large amount of Villafranchian taxa”.

The aim of this work is to (1) describe the unpublished fossil remains of the large mammals of Monte Peglia; (2) review and update the published data about the small mammals; and (3) discuss the palaeoenvironmental and biochronological frameworks shown by the analysis of small and large mammals of the two faunal assemblages recovered at Monte Peglia.

GEOLOGICAL SETTING

Monte Peglia is located in the western Umbrian-Marches Apennines, and is the highest peak (837 m) of the Monte Peglia-Monti Amerini carbonate ridge. The outcrops of the Monte Peglia area mainly consist of Cretaceous-Aquitainian carbonate units: reddish limestone and calcareous-marly sediments with red-brown chert referable to Scaglia Rossa Fm (Santonian-Paleogene) overlapping the whitish and havana limestones and marly-limestones with chert referable to the Scaglia Bianca Fm (Jacobacci et al. 1970; Álvarez & Montanari 1988). The carbonates of the Monte Peglia are affected by a karstic system limited by the course of the Fersinone torrent in the north, of the Chiani torrent in the west, the Tiber valley in the east, and by the Lake Corbara in the south.

The Monte Peglia carbonate ridge is a rootless NE verging anticline surrounded by the siliclastic units of the Tuscan domain (in this area consisting only of Eocene-Oligocene sediments). The Tuscanian unit was thrust over the Cretaceous-Paleogene carbonates. The folding of the complex in an anticline (anticline of M. Piatto-Civitella del

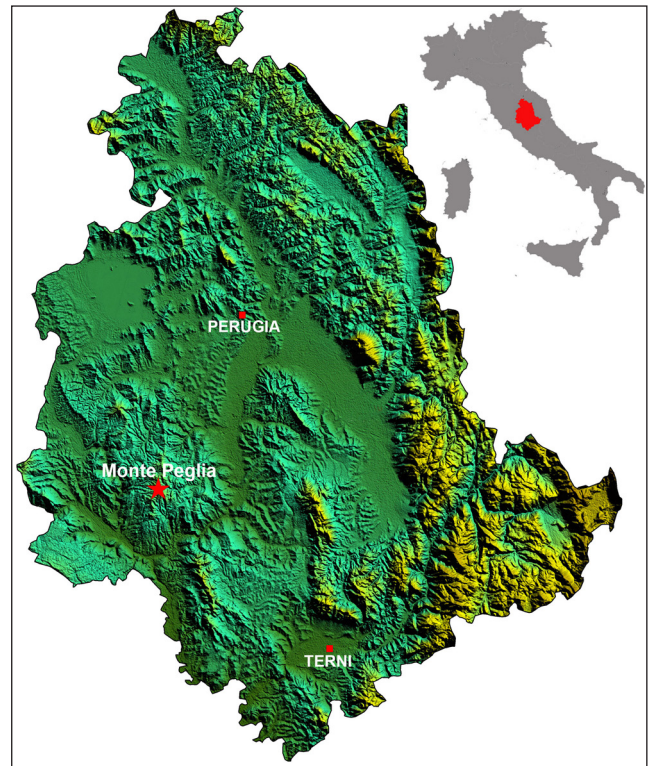


Fig. 1 - Geographical localization of the Monte Peglia (Umbria, central Italy) fossiliferous site.

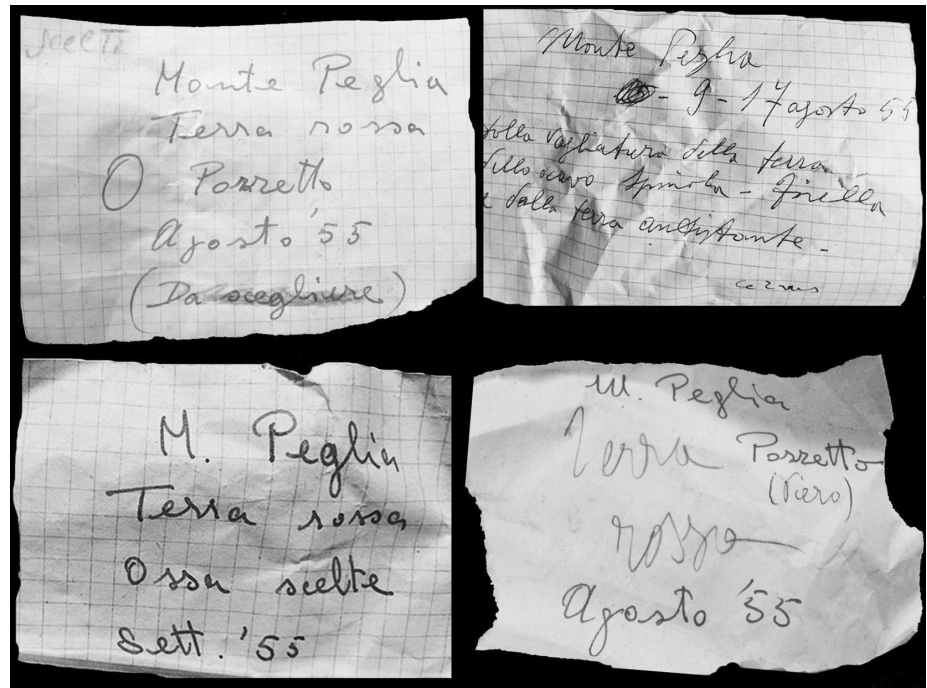
Lago) determined the erosion at the culmination of the structure and the appearance, in a tectonic window, of the Monte Peglia limestones. The anticline of M. Piatto-Civitella del Lago is cut by several N-S right-lateral strike-slip faults related to thrust emplacement. The Neogene compression structures are cross-cut by a set of Plio-Pleistocene NW-SE normal faults with an offset that can reach several hundreds of meters (Damiani 1991).

The outcrop in which the “Breccia Ossifera” of Monte Peglia was found is located in the central part of the Monte Peglia ridge, next to the top of Monte Peglia. It consists in a karst fissure carved in the Paleogene part of the Scaglia Rossa Fm and filled by ~3 m of residual deposits (red and brown clays with carbonate elements), and bone breccia. The infilling consists of two main parts separated by a carbonate concretion (see Blanc 1955, 1956; Van der Meulen 1973; Piperno et al. 1984).

HISTORY OF THE RESEARCHES AT MONTE PEGLIA

Two collectors, P.C. Fajella and the Marquise R. Spinola, reported the Monte Peglia deposit for

Fig. 2 - Accompanying notes of the fossil remains from Monte Peglia stored at IsIPU reporting the name of the fossiliferous site and type of encasing sediment.



the first time in July 1955 and eventually in August-September of the same year, the IsIPU initiated a field campaign carried out with several scientists, among others A.C. Blanc, L. Cardini, V. Chiappella, and G.H.R. von Koenigswald (Blanc 1955, 1956). In the following years, several field campaigns were carried out: in 1957, 1964-66 and 1968 by IsIPU (Piperno et al. 1984), and in 1963 by A.P.H. van Meurs and A.J. Van der Meulen of Utrecht University (Van der Meulen 1973).

Van der Meulen (1973) and Piperno et al. (1984) distinguished two faunal assemblages separated by a massive carbonate concretion. The lower one (corresponding to level 1 in Van der Meulen 1973, fig. 2, p. 4; and to levels 1-3 in Piperno et al. 1984, fig. 5, p. 117), contains small and large vertebrates. The upper one (corresponding to level 4 in Van der Meulen 1973, fig. 2, p. 4; and to levels 7-8 in Piperno et al. 1984, fig. 5, p. 117), contains only small vertebrates accumulated during cooler climate. Fejfar & Heinrich (1983) refer the two assemblages as Monte Peglia 1 and Monte Peglia 2.

The oldest mammal assemblage of Monte Peglia, collected in the lower red and brown clays, is called “*Mimomys blanci* assemblage” and is characterized by the abundance of *Mimomys blanci* and *Microtus (Allophaiomys) nutiensis* (= *Allophaiomys* sp. A in Van der Meulen 1973). It includes thirteen species of small mammals (Van der Meulen 1973; see Tab. 1). Blanc (1956) listed the medium- and large-sized vertebrates of the lower assemblage as follows: *Ma-*

chairodonus, *Cervus perrieri*, *Canis etruscus*, *Hystrix etrusca*, *Macaca*, *Bos* vel *Bison*, *Sus* sp., *Ursus* sp., *Vulpes* sp., *Talpa* sp., *Lepus* sp., Aves, and an “Antilope”. Piperno et al. (1984) recorded: *Macaca florentinus*, *Felis* cf. *F. lunensis*, *Panthera* cf. *P. toscana*, *Homotherium crenatidens*, *Canis* cf. *C. etruscus*, *Canis* cf. *C. arnensis*, *Ursus* cf. *U. etruscus*, *Lepus terraerubrae*, *Leptobos* sp., *Cervus* cf. *C. perrieri*, *Hemitragus* sp. among mammals, and *Falco antiquus*, *Corvus pliocaenus*, and *Perdix palaeoperdix* among the birds.

The youngest assemblage, called “*Allophaiomys* sp. B assemblage”, was collected in the clays and in the ossiferous breccia overlaying the stalagmite layer. It is characterized by the abundance of *Microtus (Allophaiomys) burgondiae* (= *Allophaiomys* sp. B in Van der Meulen 1973). According to Van der Meulen (1973), it includes nine species of small mammals (see Tab. 1).

As mentioned above, the large mammals described so far are *Macaca sylvanus* and *Homotherium latidens* (see Basilici et al. 1991; Sardella & Iurino 2012). The avifauna records *Hieraaetus* n. sp., *Aquila* sp., indeterminate Accipitridae, *Falco antiquus*, *Coturnix coturnix*, *Perdix* sp., *Columba livia minuta*, and *Corvus pliocaenus* (see Bedetti 2003).

Four lithic artifacts were found in the surroundings of the fossiliferous deposit (not *in stratum*; Blanc 1955, 1956; Piperno 1972; Van der Meulen 1973; Piperno et al. 1984) and are currently stored at SABAPU. The artifacts and the bone remains were considered coeval, as they

Species	Lower level	Upper level
<i>Rana</i> sp.	X	
<i>Talpa fossilis</i>	X	X
<i>Sorex runtonensis</i>	X	X
<i>Beremendia fissidens</i>	X	X
<i>Asoriculus</i> cf. <i>A. castellarini</i>	X	
<i>Neomys</i> cf. <i>N. newtoni</i>		X
<i>Myotis blythii</i> vel <i>myotis</i>	X	
? <i>Miniopterus</i> sp.	X	
<i>Ungaromys nanus</i>	X	X
<i>Pliomys episcopalis</i>	X	
<i>Mimomys savini</i>	X	
<i>Mimomys blanci</i>	X	(X)
<i>Microtus (Allophaiomys) nutiensis</i>	X	
<i>Microtus (Allophaiomys) burgondiae</i>		X
<i>Apodemus sylvaticus</i>	X	X
? <i>Apodemus dominans</i>	X	X
<i>Glirulus</i> sp.	X	
<i>Lepus terraerubrae</i>	X	
<i>Oryctolagus</i> sp.		X

Tab. 1 - Small vertebrates of the upper and lower assemblages of the late Early Pleistocene of Monte Peglia (Umbria, central Italy).

are covered by the same ferromanganese patina (Piperno 1972; Piperno et al. 1984). Eventually, in 1968, a fifth stone tool was found in the upper part of the deposit (level 7 in Piperno et al. 1984). Piperno (1972) identified two flakes and one chopping tool produced on cherty limestone, a quartzite flake and a limestone tool. At the time of the discovery, the lithic industry was attributed to the Günz-Mindel Interglacial, and reputed slightly more recent of Vallonet (France) and Graunceanu (Romania). Before the discoveries of Pirro Nord, Vallonet and Graunceanu represented the evidence of the earliest hominin presence in Europe (Piperno 1972; Arzarello et al. 2012). Recent researches better defined the chronologies of early hominin dispersal in Europe, leading to the identification of several new sites dated between ~1.5-0.9 Ma (Arzarello et al. 2012, 2016; Cheheb et al. 2019; for a comprehensive overview see Sardella et al. 2018). Monte Peglia should be chronologically placed between Pirro Nord (Apricena, Apulia) and Monte Poggiolo (Forlì, Emilia-Romagna). At Pirro Nord, the lithic assemblage was found in association with Villafranchian vertebrates (Abbazzi et al. 1996; Gliozzi et al. 1997; Petronio & Marcolini 2013) and biochronologically

dated at 1.3-1.6 Ma (Arzarello et al. 2007, 2009, 2016). At Monte Poggiolo, where hominins settled near the mouth of a river producing artifacts on local stone (Peretto et al. 1998), faunal remains were not found. ESR established an age of 1 Ma (Peretto et al. 1998; Bahain et al. 2007), albeit magnetostratigraphic and biostratigraphic analyses on marine sediments suggest an age of ~0.85 Ma, i.e. posterior to MIS 22 (Muttoni et al. 2011).

MATERIALS AND METHODS

Abbreviations

- FO: first occurrence datum
 FU/FUs: Faunal Unit(s)
 H: height
 IsIPU: Istituto Italiano di Paleontologia Umana, Anagni (Frosinone, Latium)
 L: length
 LO: Last occurrence datum
 MVSV: Museo Vulcanologico di San Venanzo, Terni (Umbria)
 n. inv.: inventory number
 SABAPU: Soprintendenza Archeologia Belle Arti e Paesaggio dell'Umbria, Ponte San Giovanni (Perugia, Umbria)
 W: width

The medium- and large-sized vertebrate fossils from Monte Peglia are in part housed at the laboratories of IsIPU. Other fossil specimens and the lithic artefacts are curated at the Volumni Hypogaeum of the SABAPU. In the MVSV some casts of the fossils, provided by SABAPU are exposed.

The findings at SABAPU (63 fossil remains and 5 lithic artefacts) are numbered discontinuously from 129 to 415 and often lack taxonomic determination. A few thousand fossil remains are at the IsIPU, mostly fragments of diaphyses of long undetermined bones stored in 23 boxes (n. 15, 16, 87, 88, 89, 133, 134, 167, 168, 180, 182, 236, 246, 765, 901, 902, 907, 928, 944, 1003, 1004, 1005, 1052). In most cases, the fossils are wrapped in both Italian and Dutch old newspaper sheets. Each package and each box is accompanied by notes indicating the site (Monte Peglia) and the original type of encasing sediment ("terra rossa" and "breccia ossifera"; Fig. 2), thus it was possible to deduce that these fossil remains come from the lower levels, below the stalagmitic level. Sometimes, for individual findings, an attempt of taxonomic determination is also reported.

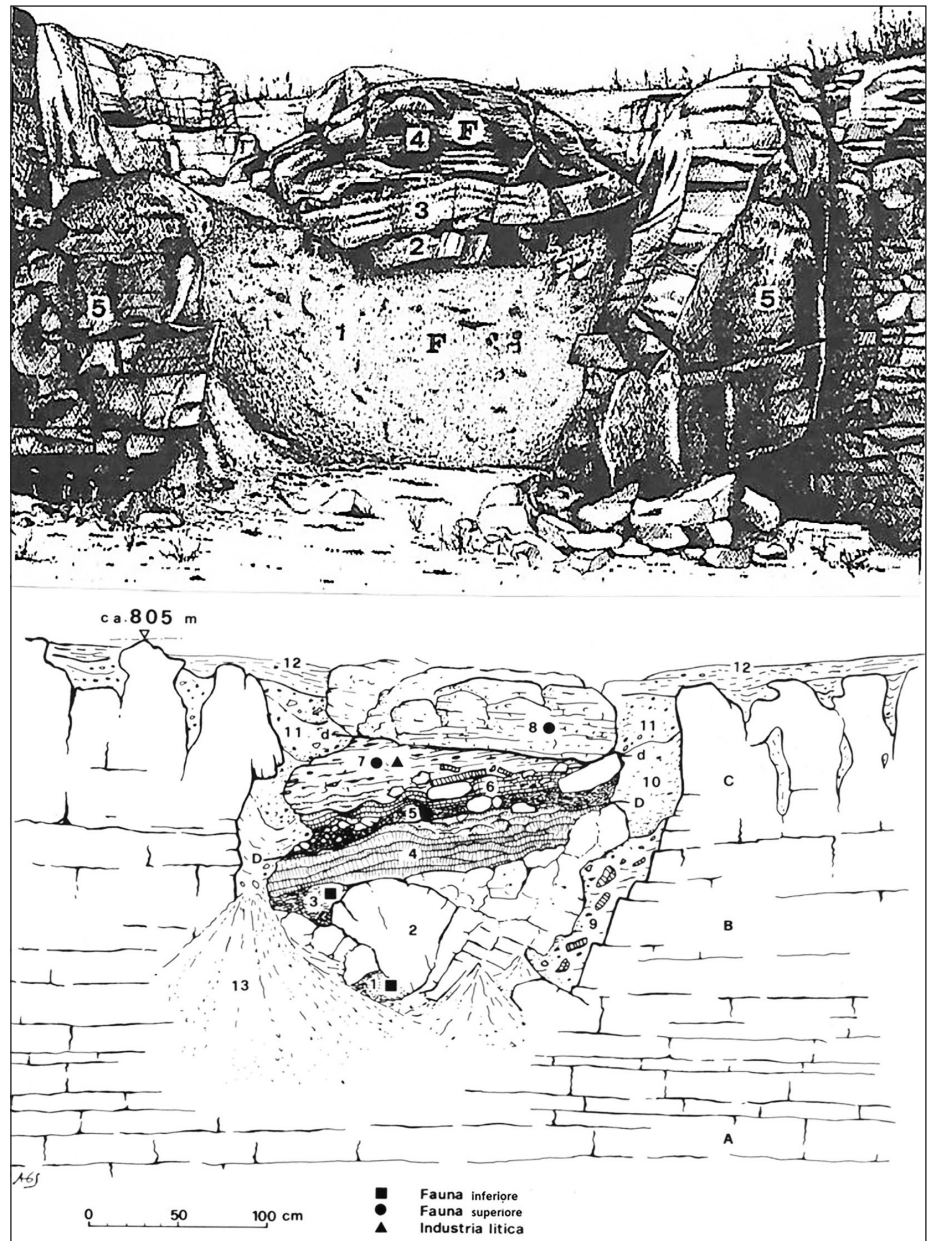
Stratigraphic sketches were provided by Van der Meulen (1973) and Piperno et al. (1984). They are reported and compared in Fig. 3. At present, there is no trace of sediments outcropping in the Monte Peglia karst cavity (Fig. 4).

All the specimens described below are curated at the SABAPU and IsIPU collections, unless otherwise indicated.

For the biochronological data we refer to Gliozzi et al. (1997), updated with Petronio & Sardella (1999); Kotsakis et al. (2003); Masini & Sala (2007, 2011); Sala & Masini (2007); Petronio et al. (2011, 2019). Latest criticisms and proposals of modification/integration (e.g. Raia et al. 2005, 2006; Palombo & Sardella 2007; Petronio et al. 2007; Sardella & Palombo 2007; Palombo 2014, 2018; Bellucci et al. 2015) should be accepted only after a revision of the huge amount of new data collected in the last decades, combined with the revision of older data.

Fig. 3 - Stratigraphy of the Monte Peglia fossiliferous site according to Van der Meulen (1973; above) and Piperno et al. (1984; below).

The carbonate concretion which separates the two faunal assemblages is indicated with "3" by Van der Meulen (1973) and "4" by Piperno et al. (1984). Level "1" in Van der Meulen (1973) corresponds to levels "1" to "3" in Piperno et al. (1984); level "4" in Van der Meulen (1973) corresponds to levels "5" to "11" in Piperno et al. (1984).



SYSTEMATIC NOTES

Avifauna

At SABAPU there are several fossils of birds collected in the lower levels. Also in the IsIPU, several remains of medium and large birds have been observed, particularly distal phalanges and tarsometatarsi. Bedetti (2003) studied the avifauna and attributed the remains to the following taxa: *Hieraaëtus* n. sp., *Aquila* sp., ?Accipitridae indet., *Falco antiquus* Mourer-Chauviré, 1975, *Coturnix coturnix* (Linnaeus, 1758), *Perdix* sp., *Columba livia minuta* Mourer-Chauviré, 1975, and *Corvus pliocaenus* (Portis, 1889).

Large mammals

Hystrix refossa Gervais, 1852

Three upper jugal teeth of the SABAPU collection (n. inv. 136, 137 and 138) characterized by an occlusal surface with continuous external enamel and several enamel islets interrupting the dentine, with different wear conditions have been attributed to *H. refossa* (Fig. 5): 2 M1/2 (H= 17.0-19.0 mm; L= 10.5-10.8 mm) and a M3 (H= 24.5 mm; L= 11.1 mm). The specimens differ from the most archaic species, *Hystrix primigenia* (Wagner, 1848) and *Hystrix depereti* Şen, 2001, by the marked hypsodonty (H/L>1), and from the Early Pleistocene - middle Holocene extinct species *Hystrix vinogradovi* Argyropulo, 1941, by the larger dimensions (Van Weers



Fig. 4 - Overview of the Monte Peglia outcrop in 2019.

1994; Rook & Sardella 2005, 2013; Salari & Sardella 2011).

Hystrix refossa has been found in several sites in central-southern Italy referred to the middle and late Villafranchian. This species appears in the Coste S. Giacomo FU, it is well represented in the subsequent Olivola and Tasso FUs, and its latest evidence occurs in the Pirro FU (Kotsakis et al. 2003; Salari & Sardella 2011). Also in the rest of Europe, most findings of *H. refossa* are reported from the Early Pleistocene (middle and late Villafranchian). However, the species, which appeared in France and Greece in the Late Pliocene (early Villafranchian, MN16), seems to be still present in the Late Pleistocene of the Near East (Van Weers 1994, 2005; Salari & Sardella 2011; Lazaridis et al. 2019).

Homotherium latidens (Owen, 1846)

Some isolated teeth, probably referable to a sole, large adult specimen and some fragments of

phalanges and metacarpals have been found in the SABAPU collection: P4 (n. inv. 158; L= 45.5 mm; morphologically identical but slightly larger than the one described by Sardella & Iurino 2012); m1 (n. inv. 159; L= 36 mm); upper canine (n. inv. 152; H= 61 mm); canine fragments (n. inv. 150-151); phalanges and a fragment of metacarpal (n. inv. 177, 176, 178, 179,185). Some phalanges and metapodials (some of which are broken), have been found in the IsIPU collection (box n. 944).

Homotherium from Monte Peglia, as reported by Sardella & Iurino (2012), is larger than the specimens found in Pirro Nord (Apulia; Pirro FU; Pavia et al. 2011; Arzarello et al. 2012; Petrucci et al. 2013) and is similar, especially in the morphology of upper canines and P4, to *Homotherium crenatidens* Fabrini, 1890 from Untermassfeld (Hemmer 2001). This taxon has a rather wide biochronological range, although Sardella & Iurino (2012) describe an “evolutionary stage” of the specimen

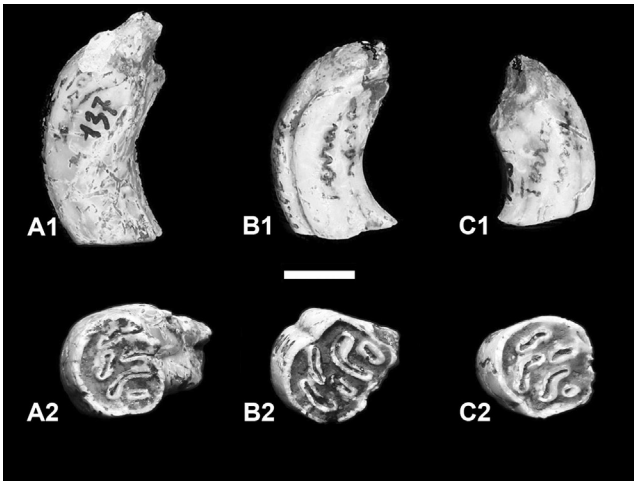


Fig. 5 - *Hystrix refossa*: A1), B1), C1) molars in lateral view; A2), B2), C2) same teeth in occlusal view (scale bar 10 mm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).

from Monte Peglia close to *H. crenatidens*, which, in Italy, characterized the FUs of the end of the Villafranchian (Pirro FU) and the beginning of the Galerian (Colle Curti FU) (Gliozzi et al. 1997; Torre et al. 2001).

Panthera cf. *P. gombaszoegensis* Kretzoi, 1938

In the IsIPU collection, there is an upper carnassial tooth embedded in breccia (box n. 944; Fig. 6A). On its labial surface it is possible to observe only the angles between protocone, paracone and metacone. In particular, the angle between protocone and paracone is almost 90° and the anterior border of the tooth is rounded. These morphological features and the small dimensions (L= ~30 mm) seem to indicate a close correspondence to *P. gombaszoegensis*; the specimen from Monte Peglia is slightly larger than *Panthera* ex gr. *P. toscana-gombaszoegensis* from Pirro Nord (L= 27.1; Petrucci et al. 2013), and its morphology is practically identical to *P. gombaszoegensis* from Cueva Victoria (L= 30.1 mm; Madurell-Malapeira et al. 2015), and falls in the lower part of the variability range of *P. gombaszoegensis* from Châteaux Breccia (L= 30.2-32.4 mm; Argant & Argant 2011). Nevertheless, as in the Monte Peglia specimen only the labial side of the tooth is visible, we decided to classify this upper carnassial as *Panthera* cf. *P. gombaszoegensis*.

Furthemore, some upper and lower canines from the IsIPU collection (box n. 944; Fig. 6B) and several fragments of teeth with sharp cusps, retrieved in the SABAPU collection (n. inv. 232-235),

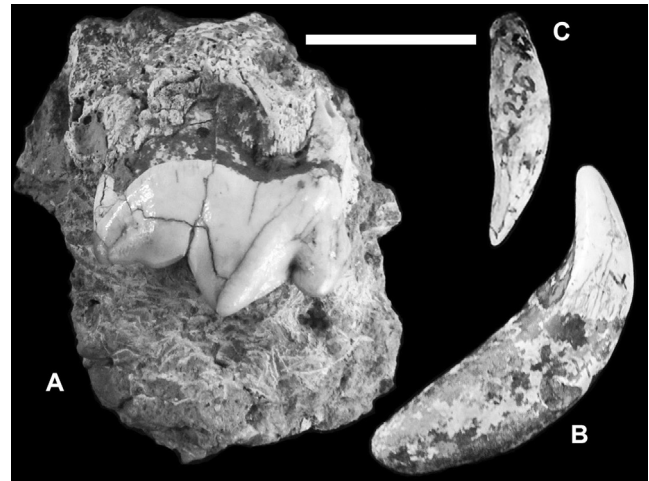


Fig. 6 - *Panthera* cf. *P. gombaszoegensis*: A) upper carnassial tooth embedded in the breccia; B) lower canine; *Felis* cf. *F. lunensis*: C) upper canine (scale bar 2 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).

can be possibly attributed to this taxon.

Panthera gombaszoegensis is a Eurasian jaguar present during most of the late Villafranchian and the Galerian in several Italian fossil sites (Masini & Sala 2007; Petronio et al. 2011; Petrucci et al. 2013; Cherin et al. 2018), as well as in the rest of Europe. Its last record occurs in Poland, where it survived until the early Aurelian (MIS10-9; Marciszak 2014).

Felis cf. *F. lunensis* Martelli, 1906

The few remains available at the SABAPU, an upper canine (n. inv. 236) with L= 7.3 mm; H= 31 mm (Fig. 6C), and some first phalanges (n. inv. 244) and at the IsIPU (a lower canine, some fragmentary canines, a lower molar and a first phalanx – box n. 944) can be assigned with relative certainty to the genus *Felis*, as they are of smaller size than those of the genus *Lynx*. The remains are slightly larger than those of the extant *Felis silvestris* Schreber, 1777, and they may fit in the dimensional range of *Felis lunensis*, a species that, although rare, is still present in the Italian peninsula during the late Villafranchian (Tasso and Farneta FUs). The morphological discriminant characters of *Felis lunensis* with respect to *F. silvestris* are: smaller mandibular diastema, more developed main cusp at the p4, absence of accessory cusp at the p3 (Ficcarelli & Torre 1974). As those characters are not observable on the Monte Peglia specimens, we tentatively assign these remains to *Felis* cf. *F. lunensis*. The modern *F. silvestris* may have occurred during the Middle Pleis-

tocene, maybe during MIS 11 (García et al. 1997; Petronio et al. 2019). However, fossils determined as wildcat with certainty, are recorded only from the Late Pleistocene onwards in southern and northern Africa and the Near East (Yamaguchi et al. 2004; Petronio et al. 2019).

Canis mosbachensis Soergel, 1925

Among the remains of *Canis* in the IsIPU collection, we highlight the presence of a particularly large upper first molar (box n. 180; L= 15 mm; W= 19 mm; Fig. 7A) with a well-characterized labial cingulum, with a paracone larger than the metacone, protocone and metaconule, with a very robust hypocone, and characterized by a deep depression in the center of the occlusal surface. These characters differ from the correspondent ones in *Canis etruscus* Major, 1877, in the small *Canis arnensis* Del Campa, 1913 (Cherin et al. 2013; Bartolini Lucenti et al. 2020), and in *Canis lupus* Linnaeus, 1758 (Mecozzi et al. 2017; Salari et al. 2017), whereas they are rather similar to those described by Sotnikova (2001) and Mecozzi et al. (2017) for *C. mosbachensis*. The casts of an upper canine and an upper incisor preserved in the MVSV, and an upper canine and eight incisors (n. inv. 190, 201, 202, 210, 228-231), three fragmentary phalanges (n. inv. 221, 222, 227), a very fragmented radius (n. inv. 211) and a small astragalus (n. inv. 228) curated at the SABAPU probably belong to *C. mosbachensis* too. The attribution has been made mainly based on the dimensions of the remains, rather on their morphology, due to their poor preservation state.

Piperno et al. (1984) had, instead, attributed the canid remains of Monte Peglia to *Canis* cf. *etruscus* (the larger ones) and to *Canis* cf. *arnensis* (the medium-sized ones). The LO of these taxa occurs in the Tasso FU (Cherin et al. 2014; Bartolini Lucenti & Rook 2016, 2018). *Canis mosbachensis* appears in the Italian peninsula during the last stages of the Villafranchian (Pirro FU; Petronio & Marcolini 2013; Petrucci et al. 2013; Mecozzi et al. 2017) until the Galerian (MIS 11; Fontana Ranuccio FU; Petronio et al. 2019; Mecozzi et al. 2020).

Vulpes alopecoides Major, 1877

Blanc (1955) was the first to attribute the fossil remains of small canids found in Monte Peglia to the genus *Vulpes*. Remains of a small canid have been found in the SABAPU collection (a calcaneus,

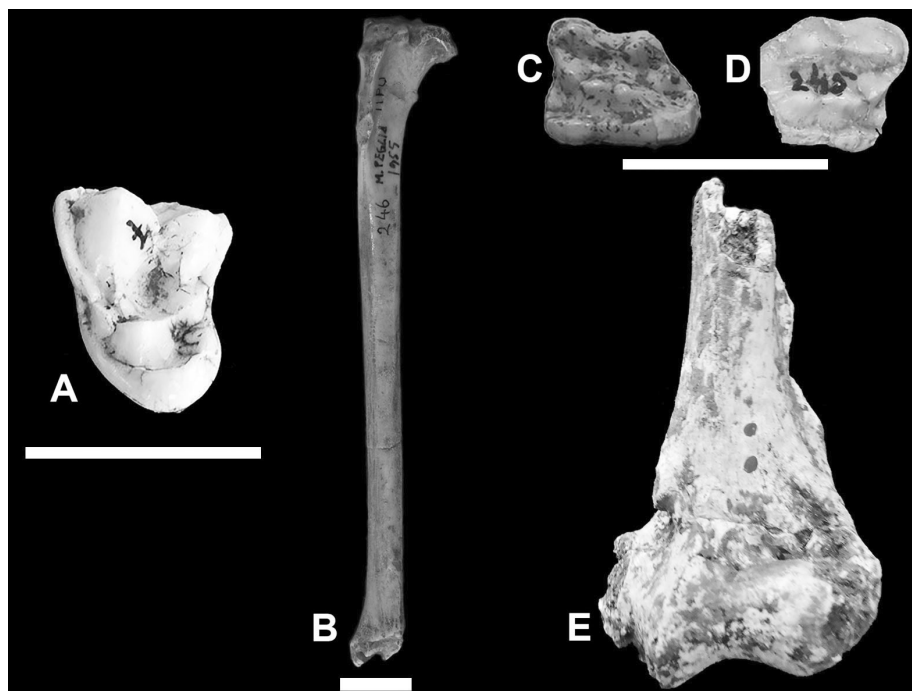
n. inv. 248 and two third phalanges without n. inv.), at the IsIPU (boxes n. 167 and 1004; fragment of humerus, distal portion of tibia, calcaneus, three premolars and a fragmentary maxilla with second and third molar), and at the MVSV (the cast of a tibia; Fig. 7B). The tibia is well preserved and has a length of 13 cm, an average transverse diameter of ~5 mm. The length is comparable with the lower values of the variability of extant and fossil *Vulpes vulpes* (Linnaeus, 1758), whereas the average transverse diameter of the bone is smaller than in *V. vulpes* and *Vulpes praeglacialis* Kormos, 1932 (see Bonifay 1971; Ballesio 1979; Petronio et al. 2006). The ratio between the two measurements and the particular thinness and sinuosity of the bone (Petronio et al. 2006) allow its attribution to *Vulpes alopecoides*. Furthermore, shape and size of the teeth (e.g., M1: L= 7.5 mm, W= 10.1 mm) are closer to *V. alopecoides* from Upper Valdarno (Bonifay 1971; Bartolini Lucenti & Madurell-Malapeira 2020) and Pirro Nord (Petrucci et al. 2013) than to *V. praeglacialis* from L'Escaie (Bonifay 1971) and Apollonia 1 (Koufos 2018). However, according to Bartolini Lucenti & Madurell-Malapeira (2020) both *V. praeglacialis* and *Vulpes praecorsac* Kormos, 1932 would be junior subjective synonyms of *V. alopecoides*, the sole Late Pliocene-Early Pleistocene fox species of Europe.

Vulpes alopecoides is recorded in the middle and late Villafranchian of Italy (Saint Vallier FU - Pirro FU; Di Stefano et al. 1994; Petronio et al. 2011; Petrucci et al. 2013). A few remains attributed to this species are recorded from Viatelle ("Brecce di Soave", Veneto; early Middle Pleistocene; Bon et al. 1991), but they need a taxonomic revision, in fact they were not considered by Bartolini Lucenti & Madurell-Malapeira (2020). According to Bona & Sardella (2012), the "Brecce di Soave" complex consists of three different main assemblages (late Villafranchian, earliest Galerian, and late Galerian). Based on the large felids, the Viatelle assemblage should correspond to the earliest Galerian (Bona & Sardella 2012). At present, the remains from Monte Peglia can be considered as the LO of *Vulpes alopecoides* in Italy.

Meles meles (Linnaeus, 1758)

Among the fossils from Monte Peglia, we observed a few remains of a badger: two canines, a premolar, a molar (M1 dex: L= 10.9 mm; W= 14.2 mm), and a distal fragment of a humerus in the IsIPU collection (box n. 1003; Figs. 7C and 7E);

Fig. 7 - *Canis mosbachensis*: A) first upper molar (scale bar 2 cm); *Vulpes alopecoides*: B) tibia (scale bar 10 mm); *Meles meles*: C), D) first upper molars; E) distal humerus (scale bar 2 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).



a molar (M1 dex missing the rear portion – n. inv. 245, L= 11.0 mm; W= 11.4+ mm) in the SABAPU collection (Fig. 7D). In these upper molars paracone and metacone are well developed. The metaconule is shorter than the previous cones. The protocone is massive. The postprotocrista in the intact molar does not reach the metaconule. The general contour of the tooth indicates that the angle formed by the metacone and the metaconule is large. There is no labial incision between the metacone and the metaconule (measures and terminology follow Baryshnikov et al. (2003)). The dimensions correspond to those of extant and Late Pleistocene specimens of *M. meles* (see Mallye 2018).

The above illustrated morphological characters exclude the attribution of the fossil from Monte Peglia to *Meles thoralis* Viret, 1951, to *Meles dimitrius* Koufos, 1992, and to *Meles iberica* Arribas & Garrido, 2007 which show a contour with a much narrower angle between metaconule and metacone (see also Koufos & Kostopoulos 1997). It must be noted, though, that *M. iberica* and the material of *M. dimitrius* from the type locality have been put in synonymy with *M. thoralis* by Madurell-Malapeira et al. (2011a) but the validity of *M. dimitrius* has been confirmed by Koufos (2018). The morphology of the studied tooth is identical with that of *M. meles* (Linnaeus, 1758), *Meles atavus* Kormos, 1914, and *Meles hollitzeri* Rabeder, 1976. Madurell-Malapeira et al. (2011a) considered *M. atavus* and *M. hol-*

litzeri (and *M. dimitrius* of the locality Apollonia; but see Koufos 2018) as synonyms of *M. meles*. These authors also consider *M. atavus* as subspecies of *M. meles*. Without entering into the discussion about the systematics of the genus *Meles*, basing our observations on only two teeth (one of which broken), we assign our finding to *M. meles*. In Italy, the species *M. meles* appears in the late Villafranchian (Pirro FU; Petrucci et al. 2013) and is present throughout the Middle and Late Pleistocene, although quite rare (Mecozzi et al. 2019). In Europe, the most ancient findings of fossils with morphologies identical or very similar to *M. meles* date back to the late Villafranchian, more or less coeval with Pirro FU (Fonte Nueva 3, Spain; Madurell-Malapeira et al. 2011b).

Pannonictis cf. *P. nestii* (Martelli, 1906)

The few dental remains of this species have been found only in the SABAPU collection (a canine – n. inv. 251; a premolar – n. inv. 252) and among these only a lower molar (n. inv. 253) is significant for taxonomic purposes (m1 dex: L= 12.3 mm; W= 5.3 mm; n. inv. 253; Fig. 8A). In this tooth, the protoconid is very well developed. The paraconid, slightly shorter than the protoconid, is robust. The metaconid is located a little behind the protoconid. The talonid appears as a concavity. A highly developed hypoconid and a hypoconulid are observed along the edge of the talonid.

The m1 from Monte Peglia is rather robust; its dimensions and morphology permit to exclude an attribution to the extant species *Martes martes* (Linnaeus, 1758) and *Martes foina* (Erxleben, 1777), and to the extinct Middle Pleistocene species *Martes vetus* Kretzoi, 1942 (Rabeder 1976; Wolsan et al. 1985; Wolsan 1989; Baryshnikov 2009; Pacher & Döpes 2014; Marciszak et al. 2017a). Slightly larger than the three previous species, though smaller than the Monte Peglia specimen, is the extinct species *Martes wenzensis* Stach, 1959 (Stach 1959). Any relationship with the much smaller genera *Vormela*, *Oxyvormela* and *Baranogale* must also be excluded (Rabeder 1973; Spassov 2001). The fossil from Monte Peglia pertains to the group of large mustelids that have been attributed to the genera *Pannonictis* and *Enhydriictis*. Several recent works have discussed the systematics of *Pannonictis* and *Enhydriictis* and the relationships between the different species (García & Howell 2008; García et al. 2008; Peters & Vos 2012; Colombero et al. 2012; Bartolini Lucenti 2018). The dimensions of the studied specimen allow to exclude the larger species *Pannonictis pliocaenica* Kormos, 1933 (García & Howell 2008), the insular Sardinian forms *Pannonictis baroniensis* Rook, Bartolini Lucenti, Tuveri, Arca, 2018, *Enhydriictis galictoides* Major, 1901, *Enhydriictis praegalictoides* Rook, Bartolini Lucenti, Tuveri, Arca, 2018, and the Sicilian species *Pannonictis (Mustelercta) arzilla* (De Gregorio, 1886) (Burgio & Fiore 1987; Rook et al. 2018). The distinction between *Pannonictis nestii* and *Martellictis ardea* (Gervais, 1852) is impossible on a dimensional basis. The first lower molar (m1) does not contain morphological elements that allow a distinction between these species. However, the perfect morphological similarity between the Monte Peglia fossil and the m1 of the mandible from Pietrafitta (Rook 1995) and with the remains from Pirro Nord (Colombero et al. 2012) allow to tentatively assign this molar to *Pannonictis* cf. *P. nestii*. The genus *Pannonictis* has a wide distribution in Eurasia during the Late Pliocene and the Early Pleistocene. *Pannonictis nestii* is present in the late Villafranchian of several European localities (García et al. 2008; Bartolini Lucenti 2018). In Italy, the species is present in the Upper Valdarno (Tuscany, central Italy; Tasso FU), in Pietrafitta (Umbria, central Italy; Farneta FU), in Pirro Nord (Apulia, southern Italy; Pirro FU) (Martelli 1906; Rook 1995; Colombero et al. 2012). The presence of *P. cf. P. nestii* in Monte Peglia represents the LO of the species in Italy.

Mustela palerminea (Petényi, 1864)

In the IsIPU collections there is a left mandibular fragment (box n. 1004; Fig. 8B with m1 (L= 5.08 mm, W= 1.93 mm) and the small alveolus of m2 (L= 1.52 mm). The protoconid is the dominant cusp, the paraconid is well developed, and a hypoconid is present; the metaconid is absent. The labial edge of this tooth curves regularly and does not show a swelling in correspondance of the protoconid (terminology and measures after Crégut-Bonnoure et al. 2018)

The attribution of isolated remains of small mustelids presents considerable difficulties since a recent systematic review of all European fossil forms attributed to the genus *Mustela* is lacking. However, for dimensional reasons, the extant large species *Mustela everesmanii* (Lesson, 1827), *Mustela putorius* Linnaeus, 1758, *Mustela lutreola* (Linnaeus, 1761) and the extinct species *Mustela stromeri* Kormos, 1934 (Kormos 1934; Marciszak et al. 2017b; Bourgeois 2018) can be excluded. The smaller fossil species *Mustela praenivalis* Kormos, 1934 can also be excluded, as it has dimensions of m1 smaller than the fossil under study (Kormos 1934; Rabeder, 1976; Marciszak & Socha 2014; Bourgeois 2018). Among other fossil forms *Mustela plioerminea* Stach, 1959 was established based on a skull without a jaw (Stach, 1959). Morlo & Kundrát (2001) attributed to this species an isolated m1, which has a length similar to that of our fossil, however, the m1 of *M. plioerminea* has a “hypoconid clearly separated from the posterior cingulid cusps” (Morlo & Kundrát 2001), a character not present at the Monte Peglia fossil. *Mustela pliocaenica* Stach, 1959, another fossil species, has dimensions similar to those of our fossil, however, Rabeder (1976) suppose that the various remains attributed by Stach (1959) to this species belong to different species and all the material needs a revision which, as far as we know, has so far, not been undertaken. The size of the tooth does not fall within the range of variability of the majority of the populations of *Mustela nivalis* Linnaeus, 1766 (Abramov & Baryshnikov 2000; Marchiszak & Socha 2014) but in some populations the sizes of m1 of the males are similar and even greater than those of our specimen (Baryshnikov 2009; Marciszak 2016). The same reasoning, but in reverse, is valid for *Mustela erminea* Linnaeus, 1758. In this case, the majority of the males have larger m1 than the fossil under study but female individuals have similar and even smaller di-

Fig. 8 - *Pannonictis* cf. *P. nestii*: A) first lower molar (scale bar 10 mm); *Mustela palerminea*: B) mandibular fragment with first lower molar (scale bar 5 mm); *Ursus* cf. *U. etruscus*: C), D) fragments of lower molars; E) lower canine (scale bar 2 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).



mensions (Marciszak & Socha 2014; Baryshnikov & Alekseeva 2017). From a morphological point of view, these two species have on the labial side of m1 a swelling corresponding to the protocoenid, more marked at *M. erminea* but also evidently present at *M. nivalis* (Rabeder, 1976). Both morphology and dimensions fit with those reported by Rabeder (1976) as *Mustela palerminea*. For this reason, the fossil from Monte Peglia is assigned to the latter species.

Mustela palerminea is present in several European sites (France, Spain, Italy, Germany, Hungary) of Early- and early Middle Pleistocene age (Bourgeois 2018; Gasparik & Pazonyi 2018 both with references). In Italy the species is reported from Pirro Nord (Apulia, southern Italy; Pirro FU; Petrucci et al. 2013). Also for this species, as for the previous one, Monte Peglia represents the LO in Italy.

Ursus cf. *U. etruscus* G. Cuvier, 1823

In the IsIPU collection, two lower molar fragments have been found (box n. 1003; Figs. 8C-D) which, due to their small size and the small number of visible accessory tubercles indicate a possible affinity to the arctoid group. The dimensions of an upper fourth premolar (L= 21.0 mm; W= 12.8 mm) and a particularly sharp lower canine (available as a cast), found in the SABAPU

collection (n. inv. 188-189; Fig. 8E), fit in the dimensional variability range of *U. etruscus* Cuvier, 1823 (Torres 1984; Capasso Barbato et al. 1990; Petrucci et al. 2013). However, also in this case, the morphological characters can not provide any further discriminating information.

Ursus etruscus is the only Italian arctoid bear of Villafranchian age (Gliozzi et al. 1997; Petronio et al. 2011; Petrucci et al. 2013), but the available morphological characters are not sufficient for a confident specific attribution.

Macaca sylvanus florentinus Cocchi, 1872

The remains of *Macaca* have not been found in the SABAPU and in the IsIPU. Basilici et al. (1991) mention the presence of a specimen, still encased in the breccia, of a left mandibular branch with teeth, truncated posteriorly behind m1 and anteriorly at the level of the symphysis menti. The authors observed that, compared with the holotype of *M. sylvanus*, the p4 of the above mentioned specimen appeared to be much larger, whereas the canine was slightly smaller and less robust. Other features matched instead those of *M. sylvanus*, as a large-sized p3 with a remarkably developed posterior tubercle and a p4 more developed than m1. On these premises, Basilici et al. (1991) hypothesized that the Monte Peglia jaw could be a more evolved form than the Villafranchian specimens (*Macaca sylvanus florentinus*).

Equus altidens (von Reichenau, 1915)

A second lower premolar and a fragmentary third or fourth lower premolar (Fig. 9A-B) present in the IsIPU collection (box n. 1004) must be referred to this species. The morphology of the metaconid and the metastylid of the premolars, particularly of p3/4, as well as the profound postprotoconal fold between them, is identical to *Equus altidens* (see Alberdi & Palombo 2013).

According to Alberdi et al. (1998) and Piñero & Alberdi (2015) *Equus altidens* may represent the last horse of the stenonoid group. This species is present in Italy during the late Villafranchian (since Farneta FU; Gliozzi et al. 1997; Arzarello et al. 2012; Alberdi & Palombo 2013), however it has a very extensive biochronological interval up to the middle Galerian (Isernia FU; Petronio et al. 2011).

Stephanorhinus cf. *S. hundsheimensis* Toula, 1902

The dimensions of a few ribs retrieved at the IsIPU are compatible with those of pachyderms smaller than the elephant. Their taxonomic assignment can be made only as Rhinocerotidae family. A fragment of jaw of a rhinoceros (Fig. 9C) was found in a box labeled n.16, wrapped in a newspaper dated October 23, 1955 (Fig. 9C) and without any further specification about the site or the stratigraphy. This taxon does not appear in older fauna lists (Blanc 1955, 1956; Piperno et al. 1984). It is quite possible that this jaw may be the rhino jaw collected by P.C. Fajella in the “sabbie arrossate Villafranchiane” a few km from the Monte Peglia quarry, next to Villa Vogorides (Borgo S. Faustino, Orvieto) and attributed by Blanc (1956) to *Rhinoceros etruscus*.

The specimen is badly preserved and the teeth are relatively worn. In particular, the most anterior tooth (a p4 or m1) is very damaged. In occlusal view, the buccal groove is deep and reaches the base of the crown; the labial cingulum is absent. Deep and sharp vestibular grooves are usually recorded in *S. hundsheimensis* (see Lacombe 2005). This character has been observed in several specimens from the Middle Pleistocene sites in Germany (Pandolfi & Erten 2017). In *Stephanorhinus etruscus* (Falconer, 1868) instead, the vestibular grooves are normally open and shallow (Pandolfi & Erten 2017 and references therein). Due to the poor preservation state of the specimen, several useful diagnostic characters can not be observed (e.g., the presence of lingual cingula and the mor-

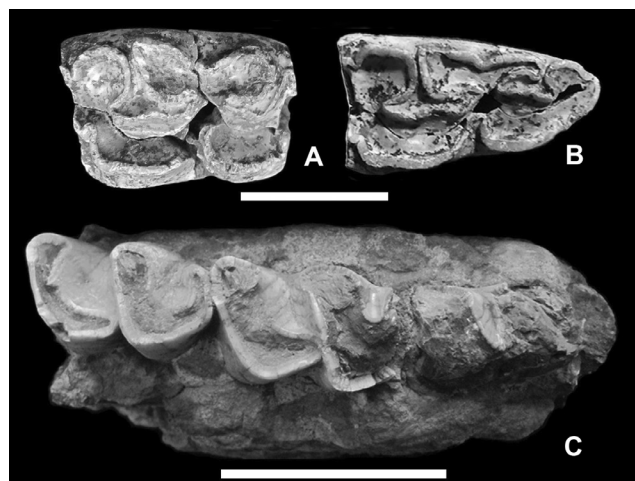


Fig. 9 - *Equus altidens*: A-B) lower premolars (scale bar 2 cm); *Stephanorhinus* cf. *S. hundsheimensis*: C) fragment of mandible (scale bar 5 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).

phology of the lingual valleys). For this reason, we prefer to classify the specimen as *S.* cf. *S. hundsheimensis*.

The FO and LO of Villafranchian and Galerian rhinoceroses were a matter of debate during the past years (Mazza et al. 1993; Van der Made 2010; Pandolfi & Petronio 2011). The latest Villafranchian rhinoceroses of Italy, recently revised by Pandolfi et al. (2017), have been attributed to *S. etruscus* (Pandolfi & Petronio 2011; Pandolfi et al. 2015; Pandolfi et al. 2017). *Stephanorhinus etruscus* persisted in the Italian peninsula until the end of the Early Pleistocene (Pandolfi & Marra 2015). According to Pandolfi & Marra (2015), Pandolfi & Erten (2017) and Pandolfi et al. (2017), *S. hundsheimensis* appeared in Italy around 1.1 Ma (Colle Curti FU). The Hundsheim rhinoceros was documented in Italy at least until the middle part of the Middle Pleistocene (Fontana Ranuccio FU), when it was replaced by *Stephanorhinus hemitoechus* (Falconer, 1859) (Pandolfi et al. 2013; Marra et al. 2014; Pandolfi & Marra 2015).

Sus sp.

A mandible fragment with two premolars, a lower molar (Fig. 10A), and two fragmentary canines curated at the IsIPU (box n. 1004), and a canine, three fragmented teeth and a carpal bone housed in the SABAPU (n. inv. 134-137) can be attributed to the genus *Sus*. The size of the canines could be discriminant at the specific level, but the remains are too scarce for a reliable taxonomic attribution.

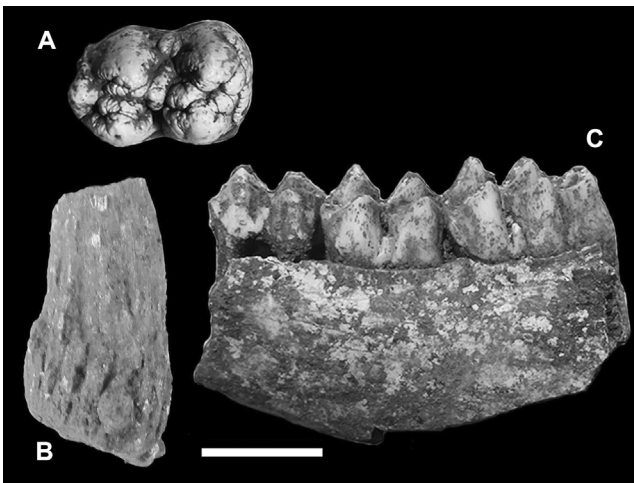


Fig. 10 - *Sus* sp.: A) lower molar; *Capreolus* sp.: B) basal fragment of antler; *Axis eurymonos*: C) fragment of mandible (scale bar 2 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).

Capreolus sp.

A premolar and a small molar in the SABAPU (n. inv. 415), and a few lower (L. 18 mm; L. 14 mm) and upper molars (box n. 180), plus a basal fragment of an antler (Fig. 10B) and a fragmentary mandible in the IsIPU (box n. 246) belongs to small cervid. Both the morphology and the dimensions testify in favor of the presence of a member of the genus *Capreolus*.

In central-western Europe *Capreolus cusanoi* H.-D. Kahlke, 2001 is present during the final Early Pleistocene and *Capreolus suessenbornensis* H.-D. Kahlke, 1956 during the Middle Pleistocene (Kahlke 2001; Valli 2010). Unfortunately, the available material does not allow classification beyond the genus level.

Axis eurymonos (Azzaroli, 1947)

In the SABAPU two lower- and two upper molars (n. inv. 337, 393), a fragmentary calcaneus (n. inv. 394), and other bone fragments of a cervid (n. inv. 405, 413, 4140) have been recovered. Also in the IsIPU several remains, mostly first and second phalanges (box n. 236), lower and upper teeth and fragments of mandibles (boxes n. 1003, 1004) (Fig. 10C) and of long bones (boxes n. 167, 901, 1005) of the same taxon are curated. Moreover, in the debris of the Monte Peglia Quarry a metacarpal diaphysis incorporated in the bone breccia was recently recovered. The structure and morphology of the molars, which appears particularly ad-

vanced, suggest their attribution to *Axis eurymonos* (see Di Stefano & Petronio 2002) and exclude affinities with the more archaic Villafranchian forms *Axis lyrae* (Azzaroli, 1992) and *Axis nestii* (Azzaroli, 1947). The diaphysis of the metacarpus (very narrow: W= 1.3 cm), should belong to a female. In general, the morphology and the dimensions (Di Stefano & Petronio 1998, 2002) of these fossils can be referred to *Axis eurymonos*.

Blanc (1955) and Piperno et al. (1984) hypothesized the presence in Monte Peglia of *Cervus* cf. *C. perrieri* Croizet & Jobert, 1828. *Cervus perrieri*, whereas previously argued (Di Stefano & Petronio 2002; Petronio et al. 2011), never dispersed into Italy.

The biochronological range of *Axis eurymonos* is quite large (Di Stefano & Petronio 2002; Petronio et al. 2011), and goes from the last FU of the Villafranchian to almost the entire Galerian; hence the presence of this taxon is biochronologically irrelevant.

Hemitragus cf. *H. orientalis* Crégut-Bonnoure & Spassov, 2002

Two upper molars (M1 – n. inv. 129; M2 – n. inv. 130) have been found in the SABAPU collection (Figs. 11A-B). They are hypsodont and show the small enamel “pli” characteristic of Caprinae on the posterior lobe. The “pli” has a quite complex outline and constitutes the edge of a carena on the occlusal surface. The above mentioned teeth also have a convex crown, slightly curved labio-lingually, a mesostyle more protruding at the base than the other lateral cusps, and the root of the posterior lobe occupies the half of the base of the lobe. These morphological features are typical of the genus *Hemitragus*. The M1 shows a medium degree of wear (H= ~34 mm, close to the average value of *H. orientalis* from Villány-Kalkberg, Hungary, middle Villafranchian), and the M2 is slightly worn (H= ~44 mm, close to the maximum value of *Hemitragus bonali* Harlé & Stehlin, 1913 from Escalé, France, Galerian). The dimensions of the M1 (occlusal L= ~21 mm; L at the base= ~17 mm) are close to the maximum values of *H. orientalis* from Slivnitsa (Bulgaria, early late Villafranchian) and Villány-Kalkberg, larger than those of *H. bonali* from Escalé and Arago (France, Galerian) and of *Hemitragus albus* (Moyà-Solà, 1987) from Venta Micena (Spain, late Villafranchian; Moyà-Solà 1987;

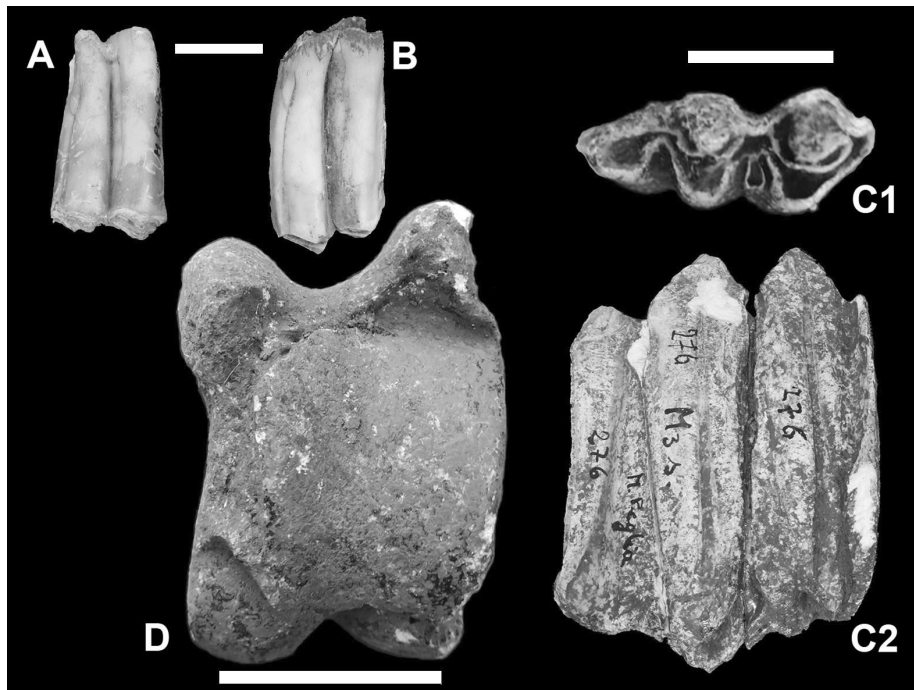


Fig. 11 - *Hemitragus* cf. *H. orientalis*: A), B) upper molars (scale bar 2 cm); *Bison degiulii*: third lower molar C1) occlusal view, C2) lateral view (scale bar 2 cm); D) astragalus (scale bar 5 cm). Late Early Pleistocene of Monte Peglia (Umbria, central Italy).

Crégut-Bonnoure & Spassov 2002; Rivals 2004). The dimensions of the M2 (occlusal L= 22.3 mm; L at the base= ~19 mm) are close to the maximum values of *H. orientalis* from Villány-Kalkberg and Kozarnika (Bulgaria, early Villafranchian), larger than those of *H. bonali* from Escale and Arago and *H. albus* from Venta Micena (Crégut-Bonnoure & Spassov 2002; Rivals 2004; Fernandez & Crégut-Bonnoure 2007). The width values of both M1 and M2 from Monte Peglia (M1: W of anterior lobe= 10.0 mm; W of posterior lobe= 9.5 mm; M2: W of anterior lobe= 9.6 mm; W of posterior lobe= 10.0 mm) are close to the minimum values of all the considered species (Crégut-Bonnoure & Spassov 2002; Rivals 2004; Fernández & Crégut-Bonnoure 2007). For these reasons, the tahr remains from Monte Peglia are attributed to *Hemitragus* cf. *H. orientalis*.

Furthermore, a few first and second fragmentary phalanges comparable in size and morphology to Caprinae, found in the IsIPU, can be attributed to this taxon.

According to Crégut-Bonnoure (2007), *H. orientalis*/*H. cf. H. orientalis* occurs in the Early Pleistocene (MNQ 17, 18, 19 and 20; middle Villafranchian - earliest Galerian). Its core distribution is in eastern Europe, but there are reports also from western Europe (e.g., Senèze, Le Vallonet, Soleilhac). In Italy, "*Hemitragus* cf. *H. stehlini*" from Collepardo (Cassoli & Segre Naldini 1994; Gliozzi et

al. 1997) probably has to be referred to *H. orientalis* (see Crégut-Bonnoure 2007; Masini et al. 2013).

Bison degiulii Masini, 1989

This taxon is the most common among the Monte Peglia fossil remains preserved at the SABAPU (n. inv. 266, 275, 276, 277, 280, 283, 295, 301, 302, 303, 305, 312, 314, 317, 319, 320-326, 328). It is also quite common at the IsIPU collection (boxes n. 180, 236, 246; 901, 1005). The remains mainly consist in lower and upper teeth, phalanges, and other short limb bones. The morphology of the lower third molars (SABAPU n. inv. 276, 277; IsIPU box n. 236) with the typical very narrow labial valley between the talonid and the hypoconid and with a very evident ectostylid; Fig. 11C) and the morphology of the articulation surface of the astragalus (with a particularly narrow intertrochlear fossa in dorsal view and the articular surface in plantar view; IsIPU boxes n. 901 and 1005; Fig. 11D) is similar to that of *Bison* (see Sala 1986).

Piperno et al. (1984) referred the large bovids from Monte Peglia to *Leptobos* sp.. *Leptobos* was replaced during the latest Villafranchian (Pirro FU) by the small *Bison* (*Eobison*) *degiulii*, whereas the heavy and larger *Bison schoetensacki* is recorded in the Galerian (Colle Curti FU; Gliozzi et al. 1997; Petronio et al. 2011; Masini et al. 2013; Petronio & Marcolini 2013). Recently, the role of *B. degiulii* as a marker of the latest Villafranchian is a matter of discussion.

Tab. 2 - Large mammals of Monte Peglia lower assemblage (late Early Pleistocene) according to Blanc (1955, 1956), Piperno et al. (1984), and this work.

¹Considering also Sardella & Iurino (2012).

²From Basilici et al. (1991).

³The mandible fragment was probably recovered in the Villafranchian reddened sands near "Villa Vogorides" in San Faustino village, few Km from the Monte Peglia quarry (see Blanc 1955).

Blanc 1955, 1956	Piperno et al. 1984	This work
<i>Hystrix etrusca</i>		<i>Hystrix refossa</i>
<i>Machairodus</i> cf. <i>M. latidens</i>	<i>Homotherium crenatidens</i>	<i>Homotherium latidens</i> ¹
	<i>Panthera</i> cf. <i>P. toscana</i>	<i>Panthera</i> cf. <i>P. gombaszoegensis</i>
	<i>Felis</i> cf. <i>F. lunensis</i>	<i>Felis</i> cf. <i>F. lunensis</i>
<i>Canis etruscus</i>	<i>Canis</i> cf. <i>C. etruscus</i>	<i>Canis mosbachensis</i>
	<i>Canis</i> cf. <i>C. arnensis</i>	<i>Canis mosbachensis</i>
<i>Vulpes</i> sp.		<i>Vulpes alopecoides</i>
		<i>Meles meles</i>
		<i>Pannonictis</i> cf. <i>P. nestii</i>
		<i>Mustela palerminea</i>
<i>Ursus</i> sp.	<i>Ursus</i> cf. <i>U. etruscus</i>	<i>Ursus</i> cf. <i>U. etruscus</i>
<i>Macaca</i> sp.	<i>Macaca florentina</i>	<i>Macaca sylvanus florentinus</i> ²
		<i>Equus altidens</i>
<i>Rhinoceros etruscus</i> ³		<i>Stephanorhinus</i> cf. <i>S. hundsheimensis</i> ³
<i>Sus</i> sp.		<i>Sus</i> sp.
<i>Cervus perrieri</i>	<i>Cervus</i> cf. <i>C. perrieri</i>	<i>Axis eurygonos</i>
		<i>Capreolus</i> sp.
"Antelope"	<i>Hemitragus</i> sp.	<i>Hemitragus</i> cf. <i>H. orientalis</i>
<i>Bos</i> vel <i>Bison</i>	<i>Leptobos</i> sp.	<i>Bison degiulii</i>

However, in Ellera (Umbria), *B. degiulii* appears together with *Praemegaceros* cf. *P. verticornis* (faunal list in Cherin et al. 2012), a species which is considered as a marker of the beginning of the Galerian (Glozzi et al. 1997). Other uncertainties about the value of *B. degiulii* as a marker of the latest Villafranchian, are the dating of the incomplete skeleton of Capena in Lazio (Slivia FU?; Marra et al. 2018), and the report of *B. degiulii* from Cava Redicicoli (Lazio; Marra et al. 2014). The bison remains found in Promano (Città di Castello, Umbria) are instead attributed to *Bison* cf. *B. schoetensacki*. Promano is one of the few local faunas referred to the Colle Curti FU (Argenti 2004).

Small mammals

The small mammals collected at Monte Peglia were studied in detail by Van der Meulen (1973) who identified five insectivore taxa, nine rodent taxa, and two taxa of lagomorphs. In the lower layer (under the calcite layer), the following species were reported: *Talpa* cf. *T. fossilis*, *Sorex runtonensis*, *Beremendia fissidens*, ?*Episoriculus* cf. *E. castellarini*, *Ungaromys nanus*, *Pliomys episcopalis*, *Mimomys savini*, *Mimomys blanci*, *Allophaiomys* sp. A, *Apodemus* cf. *A. sylvaticus*, *Apodemus* cf. *A. dominans* form A, *Glirulus* sp., *Lepus terraerubrae*. In the upper layer, above the calcite layer, the following species were reported: *Talpa* cf. *T. fossilis*, *Sorex runtonensis*, *Beremendia fissidens*, *Neomys* cf. *N. newtoni*, *Ungaromys nanus*, *Mimomys blanci*, *Allophaiomys* sp. B, *Apodemus* cf. *A. sylvaticus*, *Apodemus* cf. *A. dominans* form B, *Lepus* sp.

The purpose of this chapter is to simply update the systematic attributions and analyze the bio-

chronological distribution of the different taxa based on recent scientific literature. In the examined material, the small mammals of the upper layer are totally missing, whereas there are few remains coming from the lower layer.

Talpa cf. *T. fossilis* Petényi, 1864

The validity of this species was challenged by van Cleef-Roders & van den Hoek Ostende (2001 with references), who put this species in synonymy with *Talpa europaea* Linnaeus, 1758. Its validity was instead confirmed by Sansalone et al. (2015). In Europe, *T. fossilis* is widespread since the Pliocene to the Middle Pleistocene. In Italy, the FO of the species occurs at the Miniera della Polveriera (Monte Argentario, Tuscany, central Italy; early Biharian, Farneta FU) (Siori et al. 2014). *Talpa fossilis* is also present at Cengelle and Viatelle (Veneto, north-eastern Italy; late Biharian?-early Toringian?; Pasa 1947; Bon et al. 1991). According to Fanfani (2000), *Talpa fossilis* from Montagnola Senese (Tuscany, central Italy; late Villányian, Coste San Giacomo FU; Fondi, 1972) is instead *Talpa minor* Freudenberg, 1914. Finally, *T. fossilis* from Visogliano (Venezia Giulia, north-eastern Italy, between Isernia FU and Fontana Ranuccio FU) reported by Fanfani (2000), is instead ascribed to *T. europaea* by Abbazzi et al. (2000).

Sorex runtonensis Hinton, 1911

This soricid is very similar to *Sorex subaraneus* Heller, 1958, which is why Fanfani (2000) classifies many fossil remains of Italian sites such as *Sorex* gr. *S. subaraneus*-*S. runtonensis*. Rofes et al. (2016) con-

sider *S. subaraneus* as a synonym of *S. runtonensis*. On the contrary, Rzebik-Kowalska & Pereswiet-Soltan (2018) consider the two species as distinct. In Europe, *S. runtonensis* is present in a large area since the Early Pleistocene (late Villányian) until the end of the Late Pleistocene, and could have survived until the Holocene (Osipova et al. 2006; Rofes et al. 2016 with references). In Italy, its biochronological distribution extends from Monte Peglia (late early Biharian) to the late Middle Pleistocene (early Toringian) (Fanfani 2000; Kotsakis et al. 2003; Bona et al. 2008).

Beremendia fissidens (Petényi, 1864)

This is a species that covers a vast Eurasian area and is present in Europe since the beginning of the Pliocene (early Ruscinian, MN 14) until the beginning of the Middle Pleistocene (late Biharian) (Rzebik-Kowalska 1998; Rofes & Cuenca-Bescós 2009). In Italy, the species is present since the Late Pliocene (early Villányian, Triversa FU) to the end of the Early Pleistocene (late early Biharian, Colle Curti FU) (Kotsakis et al. 2003; Bona et al. 2015).

Asoriculus cf. *Asoriculus castellarini* (Pasa, 1947)

A few remains, present only in the Monte Peglia lower assemblage, were doubtfully attributed by Van der Meulen (1973) to this species, once assigned to the genus *Neomys* by Pasa (1947). After Van der Meulen (1973), the characteristics of this species do not fall within the definition of *Neomys* but are more easily compared to those of *Episoriculus*. Later, the European fossil members of the genus *Episoriculus* were transferred to the genus *Asoriculus* (see Hutterer 1994). Rzebik-Kowalska (2013) considered *A. castellarini* as synonym of *A. gibberodon*, but Fanfani (2000), studying again the material described by Pasa (1947), confirmed the validity of *A. castellarini*. This species is present only in three Italian fossiliferous sites: Soave Cava Sud and Cengelle (both in Veneto, north-eastern Italy; late early Biharian) and Monte Peglia (Pasa 1947; Van der Meulen 1973; Fanfani 2000 with references) and in a Greek site “Ravin of Voulgarakis” (Koliadimou & Koufos 1998) which is considered to be slightly younger than Monte Peglia, framed between 1.4 and 1.0 Ma after Doukas & Papayanni (2016).

Neomys cf. *Neomys newtoni* Hinton, 1911

The species is not very common as a fossil, however it is known from a few European and

Asian sites. *Neomys newtoni* is present in Europe during the Early and Middle Pleistocene (early Biharian - early Toringian) (Botka & Mészáros 2017). In Italy, the species is reported from Soave Cava Sud (Veneto, north-eastern Italy; late early Biharian) and Monte Peglia (Kotsakis et al. 2003 with references). The remains from Soave Cava Sud have been revised by Fanfani (2000) who confirmed the attribution of Pasa (1947). Fanfani (2000), based on the illustrations of Van der Meulen (1973), confirmed also the presence of *N. cf. N. newtoni* in Monte Peglia.

Ungaromys nanus Kormos, 1933

Rabeder (1981) established a new species (*Ungaromys meuleni*) for the fossil remains of Monte Peglia. Carls & Rabeder (1988) considered *U. meuleni* as the last species of an evolutionary line comprising *Ungaromys debmi* Carls & Rabeder, 1988-*U. nanus*-*U. meuleni*. Tesakov (1998) accepted *U. meuleni* as a valid species. On the contrary, Maul & Markova (2007) did not accept this species as valid. Wu & Flynn (2017) instead, seem to accept its validity. *Ungaromys nanus* has a wide European diffusion and a chronological range from 1.8 to ~1.1 Ma, covering almost the entire early Biharian (Maul & Markova 2007). In Italy, besides Monte Peglia, *U. nanus* is present at Castagnone (Piedmont, north-western Italy) whose age is attributed to the Jaramillo Subchron (late early Biharian, Colfiorito FU) (Giraudi et al. 2003; Siori & Sala 2007). Pending the revision of the *Ungaromys* material of Monte Peglia stored in Utrecht, we prefer to continue to attribute these remains to *U. nanus*.

Pliomys episcopalis Méhely, 1914

This arvicolid is widespread in great part of Europe since the late Villányian (Kowalski 2001). It persists until the early Toringian in central Europe and it disappears at the end of the early Biharian in Eastern Europe (Maul & Markova 2007). In Italy, it is known from the beginning of the early Biharian (Tasso FU) to the early Toringian (Fontana Ranuccio FU) (Kotsakis et al. 2003; Masini & Sala 2007; Sala & Masini 2007 all with references).

Mimomys savini Hinton, 1910

This large arvicolid, very common throughout Europe, characterizes the entire Biharian and has been the subject of several publications (Maul

et al. 1998; Kowalski 2001; Markova 2005; Lozano-Fernández et al. 2013, among others). Fejfar & Heinrich (1990) proposed the division of faunas of Neogene and Quaternary small mammals of Europe in Zones characterized by the most common rodents of the assemblages. *Mimomys savini* and *Mimomys pusillus* (Méhely, 1914) characterize the early Biharian, whereas *M. savini* and some species of *Microtus* (not of the subgenus *Allophaiomys*) characterize the late Biharian. It is worth to remark that in Eastern Europe *M. savini* continues to be present even long after its disappearance in western Europe (Maul & Markova 2007). In Italy, the FO of *M. savini* is signaled in the Upper Valdarno (Tuscany, central Italy; early Biharian, Tasso FU) and its LO in San Lorenzo (Basilicata, southern Italy; late Biharian, Ponte Galeria FU) (Kotsakis et al. 2003; Masini & Sala 2007; Sala & Masini 2007 all with references).

Mimomys blanci Van der Meulen, 1973

This species was established by Van der Meulen (1973) based on material from the lower level of Monte Peglia. According to this researcher, the species that most resembles *M. blanci* is *M. pusillus*. According to Rabeder (1981), *M. blanci* could be a more advanced species in the evolutionary line leading to *M. pusillus*. *Mimomys blanci* was considered valid and reported from France (Bachelet 1990; Aguilar et al. 1993), England (Mayhew & Stuart 1986), Netherlands (van Kolfschoten 1988, 1990); *M. cf. M. blanci* was also reported from Spain (Galobart & Agustí 2003), and Bulgaria (Popov 2017). Specimens of different ages (late early Biharian or latest Villányian-earliest Biharian) were assigned to *M. blanci*. Tesakov (1998) and Mayhew (2015) attributed the fossil specimens of older ages previously assigned to *M. blanci* from England and the Netherlands (see also van Kolfschoten 2001) to another species (*Mimomys tigliensis* Tesakov, 1998). Kowalski (2001), based on the publications classifying the populations of small-sized *Mimomys* of the latest Villányian as *M. blanci*, considers it as a “primitive” form of *M. pusillus*. Other researchers (Maul et al. 1998; Maul & Markova 2007; Serdyuk 2010) consider *M. blanci* a synonym of *M. pusillus*. Siori & Sala (2007) are of the same opinion. Pending a revision of the Monte Peglia material, for the moment we prefer to keep the specific name *M. blanci*.

Microtus (Allophaiomys) nutiensis (Chaline, 1972)

Van der Meulen (1973) officially classified the arhizodont arvicolid species, collected in the lower layer of Monte Peglia as *Allophaiomys* sp. A. However, Van der Meulen (1973, p. 98) hypothesized that this species could be identical to *Allophaiomys pliocaenicus nutiensis* Chaline, 1972 established for remains coming from Les Valerots (France). This identification of the subspecies proposed by Chaline (1972), raised to a species level, was later confirmed by Van der Meulen (1978) and widely accepted (cfr., among others, Agustí 1992; Chaline et al. 1999; Laplana et al. 2000). This species is also present in several fossiliferous sites in Europe (and doubtfully in Anatolia) (Markova & Vislobokova 2016 with references; Lozano-Fernández et al. 2019 with references) often together with the species *Microtus (Allophaiomys) burgondiae* Chaline, 1972. The presence of *M. (A.) nutiensis* seems to characterize the last phases of the early Biharian in central and western Europe (1.4–0.9 Ma) (Lozano-Fernández et al. 2019). *Microtus (Allophaiomys) nutiensis* seems to persist also during the first phases of the late Biharian in eastern Europe (Markova & Vislobokova 2016). In Italy, besides Monte Peglia, it is doubtfully reported from Castagnone (Piedmont, north-western Italy; late early Biharian, Colle Curti FU) (Siori & Sala 2007).

Microtus (Allophaiomys) burgondiae Chaline, 1972

Van der Meulen (1973) officially classified the arhizodont arvicolid recovered in the upper layer of Monte Peglia as *Allophaiomys* sp. B. Also in this case, in the discussion, Van der Meulen (1973, p. 98) hypothesized the identity of this species with *Microtus malei burgondiae* Chaline, 1972, an opinion reiterated by Van der Meulen (1978) and widely accepted by (Agustí 1992; Laplana et al. 2000 among others). This subspecies was raised to the specific rank and transferred to the genus *Allophaiomys* (now considered a subgenus of *Microtus*) (Laplana et al. 2000 with references). *Microtus (Allophaiomys) burgondiae* is present, very often together with *M. (A.) nutiensis*, in some Iberian sites and in the type locality of Les Valerots (France). Unlike *M. (A.) nutiensis*, *M. (A.) burgondiae* is not widespread throughout Europe although it is reported from Romania (Markova & Vislobokova 2016) and Bulgaria (Popov 1994). According to Cuenca-Bescós et al. (2010, 2013), in the Atapuerca sequences the presence of *M. (A.) burgondiae* and *M. (A.) nutiensis* characterizes the pre-

Jaramillo faunas of the early Biharian. In Italy, the species is known only from Monte Peglia (Kotsakis et al. 2003).

Apodemus cf. *A. sylvaticus* (Linnaeus, 1758)

Van der Meulen (1973) classified doubtfully the remains of a murid recovered from both the layers of Monte Peglia as *A. cf. A. sylvaticus* Argenti (1999) assigned these remains to *A. sylvaticus*.

Recently, the presence of the extant species *A. sylvaticus* and *Apodemus flavicollis* (Melchior, 1834) in the Early Pleistocene (reported in many papers, see Knitlová & Horáček 2017 with references) has been questioned by Knitlová & Horáček (2017). In Italy, *A. sylvaticus* is reported from Miniera della Polveriera (Tuscany, central Italy; early Biharian, Farneta FU) (Siori et al. 2014) and becomes very common during the Toringian (Kotsakis et al. 2003 with references).

Apodemus dominans Kretzoi, 1959

Another species of *Apodemus*, *A. dominans*, was reported from Monte Peglia by Van der Meulen (1973). He distinguished two forms: form A in the lower layer, and form B in the upper layer. Argenti (1999) proposed to classify these specimens as *Apodemus* cf. *A. maastrichtiensis* van Kolfschoten, 1985 for morphological reasons, even if their dimensions exceed the upper limits of the variability of the small type-population, of Middle Pleistocene age (van Kolfschoten, 1985). The validity of *A. dominans* has been questioned. This species was considered as a synonym of *Apodemus atavus* Heller, 1934 by Fejfar & Storch (1990) and later by many others (see Knitlová & Horáček 2017 with references). However, many researchers continue to consider *A. dominans* as a valid species (van den Hoek Ostende et al. 2015; Pazonyi et al. 2016; Şen et al. 2019). In Italy, *A. dominans* / *A. atavus* is present from the latest Miocene (late Turolian, MN 13; Colombero et al. 2017) to the early Biharian (Kotsakis et al. 2003 with references) The biochronological range of *A. maastrichtiensis* covers in central and north-western Europe the early Toringian and the first part of the late Toringian (van Kolfschoten 1985, 2000).

Glirulus sp.

This genus, present in Monte Peglia with only one specimen (now lost), is present in Italy since the latest Miocene (late Turolian, MN 13; Co-

lombero et al. 2017). Monte Peglia is the youngest Italian site in which it is present (Kotsakis 2003).

Lepus terraerubrae Kretzoi, 1956

This species has been described on the basis of Biharian materials from Hungary (Kretzoi 1956, 1965). Though erected and described in a footnote, *Lepus terraerubrae* is a valid species (see Gasparik & Pazonyi 2018 for the latest update). However, some authors noticed the extremely general terms used for the diagnosis, not sufficient for a valid characterization (López Martínez 1980), and others repute *L. terraerubrae* as a *nomen dubium* (see details in Angelone et al. 2020). The remains attributed to *L. terraerubrae* are the oldest known representatives of the genus *Lepus* in Europe, whose dispersal can be followed during the Biharian of eastern and central Europe (see Averianov 2001 with references). Van der Meulen (1973) reported *L. terraerubrae* from the lower level of Monte Peglia. López Martínez (1980) noticed that the specimen pictured in Van der Meulen (1973, p. 27, fig. 8) shows the earliest stages of the characters, later developed in recent species of *Lepus*, in particular in *Lepus europaeus* Pallas, 1778.

Oryctolagus sp.

Van der Meulen (1973) reported the presence of *Lepus* sp. in the upper level of Monte Peglia and illustrated two teeth. López-Martínez (1980, 1989) considered these fossils as belonging to the genus *Oryctolagus*, an opinion shared by Angelone & Rook (2012) and Angelone (2013). After these authors, the specimens from Monte Peglia probably belong to *Oryctolagus valdarnensis* (Weithofer, 1889); however, in the absence of a review of the material, they preferred to classify these remains to a generic level only. This would be the last representative of Old *Oryctolagus* Population before a long hiatus in the temporal distribution of the genus *Oryctolagus* in Italy (see discussion in Angelone et al. 2020).

New material of small vertebrates

In the ISIPU collections, there is a limited number of specimens of small vertebrates, all collected in the lower layer “Terra Rossa”, corresponding to the *M. blanci* association.

Rana sp.: Two distal parts of humerus with the distal part of the ventral crest (box n. 1004); the first one without other crests belongs to a fe-

male, and the second one with well-developed medial and lateral crests is of a male. The morphology of these remains makes it possible to ascribe them with certainty to the family Ranidae (see Rage, 1974; Bailon, 1999). In Italy, the family Ranidae is currently represented (and was also during the Quaternary) by two genera: *Rana* and *Pelophylax*. In the specimens from Monte Peglia, the diaphysis is rather narrow and the medial ridge of the male humerus is quite developed, curving dorsally. This character would be indicative, after Bailon (1999), of the “red frogs” belonging to the genus *Rana*. The dimensions seem to exclude the attribution to the largest of Italian species of the genus, *Rana temporaria* Linnaeus, 1758 (Bartolini et al. 2014). However the available material does not allow a classification beyond an attribution to *Rana* sp.

Talpa fossilis: three damaged humeri (box n. 1004). The minimal width of these humeri (3.06, 3.25, 3.75 mm) fits perfectly into the variability of the population studied by Van der Meulen (1973).

Sorex runtonensis: a proximal fragment of a right mandible (box n. 1004). Morphology and height of the coronoid process (3.80 mm) fall within the population variability published by Van der Meulen (1973, Pl. I, f. 4).

Beremendia fissidens: a robust proximal fragment of a left mandible (box n. 1004). Also in this case the morphology and height of the coronoid process (6.85 mm) fall within the population variability illustrated by Van der Meulen (1973, Pl. II, f. 2).

Myotis sp. (large size): in the collection there is a fragment of a left mandible bearing a m1 belonging to a bat (box n. 944). The morphology of the ascending ramus and the size allow to assign this specimen to a large species of the genus *Myotis*. Unfortunately, the lack of a diagnostic m3 in the mandible makes it impossible to distinguish between the two extant species *Myotis myotis* (Borkhausen, 1797) and *Myotis blythii* (Tomes, 1857). *Myotis blythii* is present in Italian Quaternary faunas since the Early Pleistocene (Tata & Kotsakis 2005; Salari et al. 2013), whereas *M. myotis* is reported since the Middle Pleistocene (Kotsakis & Barisone 2008; Salari et al. 2019). Another species of a large *Myotis*, the extinct Early Pleistocene *Myotis ghardalensis* Storch, 1974, known only from one site in the island of Malta (Storch, 1974), differs in the morphology of the m1.

cf. *Miniopterus* sp.: a right mandibular fragment with part of the ascending ramus preserved (box n. 1004). The morphology of the lower part allows only to attempt an attribution to the genus *Miniopterus*, known in Italy since the Early Pleistocene (Tata & Kotsakis 2005; Salari et al. 2013).

Mimomys savini: one left m1 (L= 3.38 mm) heavily worn (box n. 1004), belongs to the large arvicolid *M. savini*.

Mimomys blanci: three left m1 and two right m1 (box n. 1004). They belong to the small *M. blanci* (L= 2.33-2.57) and show morphologies similar to those illustrated by Van der Meulen (1973, Pl. V, figs 6 and 15).

Microtus (Allophaiomys) nutiensis: twelve left m1 and thirteen right m1 (box n. 1004) (several of them quite worn) (L= 2.36-2.71 mm) with predominant morphologies such as those illustrated by Van der Meulen (1973, Pl. VII, figs 9, 12 and 14).

Apodemus sp.: two edentulous mandibular branches (left-right) (box n. 1004).

Lepus terraerubrae: three right p3 (box n. 1004) whose morphology confirms the presence of a representative of the genus *Lepus* described by Van der Meulen (1973). A few postcranial bone fragments are stored in the IsIPU collection (boxes n. 236, 1003, 1004). The collections of SABAPU include a damaged astragalus (n. inv. 253) and a first phalanx (n. inv. 254).

Biochronological and palaeological conclusions

The taxa identified in the site are summarized in Tab. 1-2. The two faunal assemblages of Monte Peglia are clearly separated by a time gap, as attested by the presence of a calcite layer between the two. The problem is to quantify the actual age difference between the lower and the upper assemblages.

Van der Meulen (1973) and Piperno et al. (1984) hypothesized that the age difference between the two assemblages should be quite short, and that the assemblages could represent two consecutive climatic phases (see below) dated to the late early Biharian (= *Allophaiomys* sp. A Range Zone in Van der Meulen 1973). Fejfar & Heinrich (1983) confirmed the attribution of both assemblages to the latest phases of the early Biharian.

The presence of *Bison degiulii*, *Vulpes alopecoides*, *Hystrix refossa*, of an archaic form of *Felis* simi-

lar to *F. lunensis*, and of the genus *Pannonictis* in the lower levels of Monte Peglia suggest the last part of the Villafranchian as the possible age of the assemblage. The above listed taxa are not recorded with certainty in fossil sites related to the Colle Curti FU such as Promano (Argenti 2004), Castagnone (Giraudi et al. 2003), and Colle Curti (Coltorti et al. 1998), nor in other Galerian assemblages. The small mammals of the lower levels, in particular *Mimomys blanci*, *Microtus (Allophaiomys) nutiensis*, plus *Beremendia*, *Glirulus*, and *Ungaromys* (which presence in Monte Peglia represent the Italian LOs) point to the transition between early and late Biharian. Maul et al. (1998), based on the evolutionary degree of *Mimomys* and *Allophaiomys*, argue that the age of both Monte Peglia assemblages can be framed between 1.3–1.1 Ma. On the other hand, Lozano-Fernández et al. (2019), because of the presence of *M. (A.) nutiensis* and the absence of more advanced arvicolids, consider a larger age interval (1.4–1.0 Ma) for the Monte Peglia lower level. The absence of advanced arvicolids (e.g., *Iberomys*, *Stenocranius*, *Terricola*) in Monte Peglia lower levels combined with the presence of an advanced form of the *M. pusillus* lineage, seems to attest to an older age compared to Bois de Riquet, i.e., between 1.0 and 0.9 Ma (Lozano-Fernández et al. 2019). Several authors correlated the two assemblages of Monte Peglia with Les Valerots (France) and Colle Curti (Italy; Fejfar & Heinrich 1983; Gliozzi et al. 1997; Kotsakis et al. 2003; Sala & Masini 2007; Masini & Sala 2007, 2011). The Colle Curti local fauna has been collected at the base or slightly below the Jaramillo magnetic reversal (Coltorti et al. 1998), which corresponds to 1.072 Ma BP (Kirscher et al. 2018). The Colle Curti large mammal assemblage is characterized by the FO of *Megacerooides verticornis* (= *Praemegaceros verticornis*) and the persistence of several Villafranchian taxa, thus it is conventionally used to mark the beginning of the Galerian Mammal Age (Gliozzi et al. 1997). According to Bellucci et al. (2015), instead, Colle Curti and Slivia FUs would be part of the Epivillafranchian, a Mammal Age originally introduced to include central European Villafranchian/Galerian mammal assemblages (see among others Kahlke, 2007) and eventually extended to Italy (Bellucci et al. 2015). However, in our opinion, the use of the term Epivillafranchian in the Italian area must be carefully evaluated, due to the

absence/diachronicity in the Italian territory of some events that characterize the Mammal Age itself, namely the appearance of *Bison menneri* (absent in Italy), and the occurrence of *Arvernoceos giulii* (present in Italy already during the late Pirro FU; Petronio & Pandolfi 2011; Mancini et al. 2012). These observations do not undermine the validity of the Epivillafranchian as a Mammal Age, but evidence the necessity to reconsider its use in the Italian peninsula. We envisage to deepen the discussion in the light of a shared revision of new and older data of the Italian area (see also Materials and methods).

The assemblage recovered in the upper levels is characterized by the absolute predominance of *Microtus (Allophaiomys) burgondiae*, which is absent in the lower levels. However, *M. (A.) nutiensis* and *M. (A.) burgondiae* coexist in Le Valerots (Laplana et al. 2000) and Atapuerca Faunal Unit 1 (Cuenca-Bescós et al. 2010). Thus, the difference in the faunal composition between the two assemblages could be explained by an environmental variation as pointed out by Van der Meulen (1973). In this case, the age difference could be quite short, at least as long as the time of precipitation of the calcite layer. The presence of a noticeable number of Villafranchian forms among the large mammals, higher in percentage with respect to the Colle Curti local fauna (Coltorti et al. 1998), may indicate that the age of the Monte Peglia assemblages could be slightly older than Colle Curti. At present, however, Monte Peglia is assigned to the Colle Curti FU.

According to Van der Meulen (1973) the two assemblages represent a warmer phase (the lower one) and a cooler phase (upper one): The lower level is characterized by taxa of open landscapes with wooded areas, whereas the assemblage of the upper level represents an open landscape. Our revision confirms those environmental considerations. In the older assemblage, the two predominant species are *Microtus (A.) nutiensis* and *Mimomys blanci* (both > 40%). The species of the subgenus *Allophaiomys* are considered to represent open and grassy landscapes (Popov 2018). As for *Mimomys blanci*, it is known that its supposed ancestor, *M. pusillus*, may have lived in a wet environment with well developed vegetation (Martín Suárez & Mein 2004). *Mimomys savinii*, one of the small mammal species present

in Monte Peglia lower levels with percentages higher than 1%, is related to wet environments and in particular to the presence of ponds and creeks (López Antoñanzas & Cuenca-Bescós 2002). *Beremendia fissidens* is, according to Reumer (1985), an opportunistic species present in both woodland and in steppe environments. On the other hand, according to Rofes & Cuenca-Bescós (2009), the presence of this species requires a rather stable environment. *Sorex runtonensis* is an eurytopic species living in a variety of environments (Osipova et al. 2006). For *Ungaromys nanus*, Popov (2018) hypothesizes shrub and steppe as life environments, whereas Lozano-Fernández et al. (2015) prefer to avoid any paleoecological indication based on this species. Among the large mammals of the older assemblage, the presence of *Axis eurygonos* may suggest the combination of wooded areas and more open environments (see Mishra 1982 about the Indian living species of the genus *Axis*). The genus *Macaca* suggests a rather warm climate, and the presence of wooded areas, even if not necessarily continuous (Fa 1986; Camperio Ciani et al. 2005). The presence of *Coturnix coturnix* among the avian assemblage indicates grasslands (Carrera et al. 2018). *Hemitragus orientalis*, as well as *Columba livia*, indicate a rocky environment (Crégut-Bonnoure & Spassov 2002; Bedetti & Pavia 2007).

In the upper levels, the assemblage is dominated by *Microtus (A.) burgondiae* (more than 97%), a species considered as an indicator of open vegetation (Van der Meulen 1973). Popov (2018) considers it characteristic of a meadow and steppe environment. Only the murid *Apodemus* is present with a percentage higher to 1%. This genus indicates the presence of woodland or bush. However, this percentage difference attests to an absolute predominance of open spaces and the presence of marginal and limited areas covered by trees.

If we accept the correlation of the Monte Peglia assemblages with the Colle Curti local fauna (see above), which can be dated to 1.072 Ma (MIS 31; Scherer et al. 2008), the lower assemblage of Monte Peglia may correspond to one of the warm oscillations that precede Jaramillo (MIS 35/33; see Voelker et al. 2015 for details), whereas the upper assemblage could correspond to one of the cold oscillations (MIS 34/32).

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