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EARLY TORINGIAN SMALL MAMMALS FAUNA FROM FONTANA MARELLA CAVE (VARESE, LOMBARDY, NORTH ITALY)

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Abstract. The Fontana Marella cave, located in the Pre-Alps in Varese province (Lombardy, North Italy), supplied a Middle Pleistocene small mammal fauna, unique for this region.

Thanks to the presence of *Arvicola* cf. *mosbachensis* and *Pliomys episcopalis* it is possible to date this sequence to the Early Toringian. Mostly for the predominant, presence of dominant *Glis glis*, *Chionomys nivalis* and *Dinaromys bogdanovi*, the faunal association is attributed to a temperate period, but cooler and perhaps more arid that the present one. The find of *Macroneomys* is important because it allows to extend the geographic distribution of this rare species.

Riassunto. La grotta di Fontana Marella, situata nelle Prealpi in provincia di Varese (Lombardia, Nord Italia), contiene una fauna a micromammiferi del Pleistocene medio unica per questa regione. Grazie alla presenza di *Arvicola* cf. *mosbachensis* e *Pliomys episcopalis* è possibile datare la sequenza al Toringiano inferiore. Durante la deposizione della serie medio-pleistocenica l'associazione faunistica, soprattutto per il dominio di *Glis glis* e la presenza di *Chionomys nivalis* e *Dinaromys bogdanovi*, indica che dovevano sussistere condizioni temperate, ma più fredde e probabilmente più aride del presente. La segnalazione di *Macroneomys* permette di ampliare l'areale di questa specie assai rara.

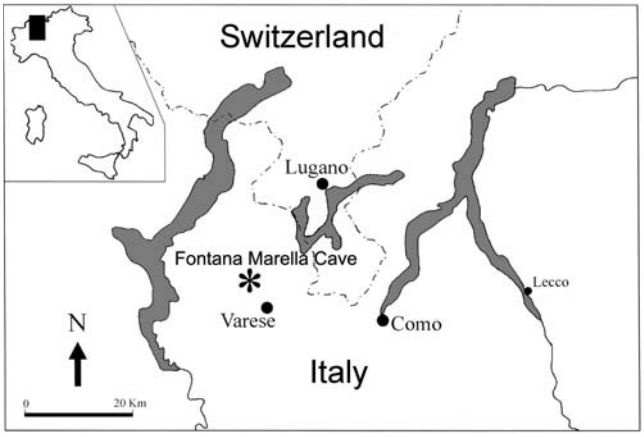
Introduction

The small mammals collection described in the present paper has been collected in 1991 from the Middle Pleistocene levels of Fontana Marella cave (levels 12 to 6).

The Fontana Marella cave is located in the northwestern Lombardy (Northern Italy) (fig. 1), in Pre-Alps facing the plain of the Po, at 1040 m a.s.l. on the northeastern slope of the calcareous-dolomitic massif of Monte Campo dei Fiori (maximum elevation 1226 m a.s.l.), Varese province. It is laterally limited by two deep valleys: Olona Valley and Valcuvia.

The stratigraphical sequence of this cave is about 2 m thick and it has been subdivided in 12 levels (fig. 2). The uppermost four levels have been attributed to Upper Pleistocene according to ^{14}C dating (Zanalda et al. 1997). Its four levels yielding cave bear remains represent a time span not well known for lacking of ^{14}C dates of the lowest level (FM4). Levels FM2 e FM1 have been dated respectively to 26.266 and 25.688 years BP calibrate ^{14}C dating (Perego et al. 2001). The level 5 is a speleothem dated more than 350.000 years by U/Th method (Uggeri et al. 1991). The abundant Middle Pleistocene small mammal fauna here illustrated comes from the lowermost levels, from 6 to 12.

This paper presents the study of remains belonging to two order, Insectivora and Rodentia, and five



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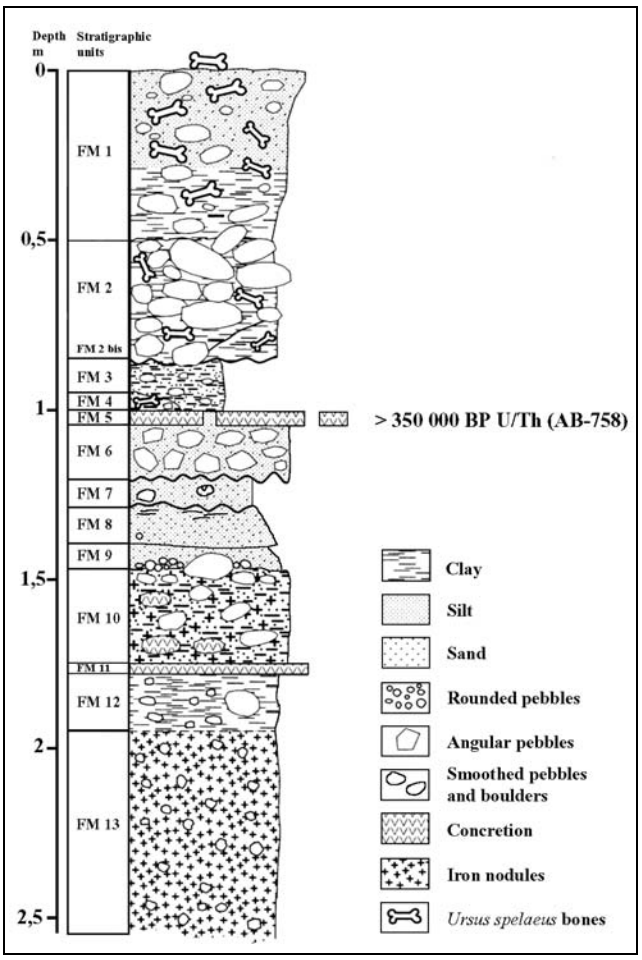

Fig. 2 - Stratigraphical sequence of the Fontana Marella cave (after Perego et al. 2001).

families, Soricidae, Talpidae, Cricetidae, Muridae and Gliridae. Remains of the order Chiroptera will not be described here.

The method used to collect these small remains consisted of two phases: 1- the sieving of sediments during field work, with 0.5 mm mesh sieves; 2- the sifting and the accurate picking of samples in the laboratory of the Milan University.

The collection will be located at the Museo Civico di Storia Naturale of Induno Olona (MCSNIO) (Va).

Sistematic Paleontology

Order **Insectivora**

Family Soricidae Fischer von Waldheim, 1817

Genus *Macroneomys* Fejfar, 1966

Macroneomys cf. **brachygnathus** Fejfar, 1966

Material: Lev 10: one fragment of a horizontal branch with the ascending ramus of a left mandible (MCSNIO 845) (Fig. 3 - 1)

Description. This mandible is represented by the mesio-distal portion of the horizontal branch, beginning from the alveolus of M_2, and by the vertical ramus with the condyle and coronoid process. The angular process is lacking.

The coronoid process is very massive, and nearly perpendicular to the horizontal branch.

The external temporal fossa extends below the upper sigmoid notch. The coronoid spicule is large, long and protruding.

The condyloid process has: a short, narrow and transversal upper facet; a long, not much crooked, interarticular area; a long, little bent lingually, lower facet. There is a little pterygoid spicule.

The internal temporal fossa is small, partially in the shape of a triangle. The mandibular foramen is located centrally, under the internal temporal fossa.

Discussion. The condyloid process is of *Neomys*-type. The above mentioned morphological characters and dimensions (Tab. 1) of the mandible identify it as *Macroneomys*. The unique record present is assigned for prudential reasons to *Macroneomys* cf. *brachygnathus*, because it does not differ from the mentioned species.

The species *Macroneomys brachygnathus* was described by Fejfar (1966) from the karst sediments of the cave C718 near Koneprusy in Bohemia (Czech Republic). Other material of this genus or species came from Kövesvárad in Hungary (Jánossy 1963, fide Jammot 1975; Maul & Rzebik-Kowalska 1998), Kozi Grzbiet (Rzebik-Kowalska 1991) in Poland, Voigtstedt (Maul & Rzebik-Kowalska 1998) in Central Germany, Sugworth and West Runton (Harrison et al. 2006) in Britain, Abimes de la Fage (Jammot 1975) and Montoussé 3 (Clot et al. 1976) in France. In Italy the genus is reported by Fanfani (2000) at Visogliano near Trieste (north-east) and Sant'Arcangelo in Basilicata (south).

This taxon is very rare in the mammal associations and represented only by few material.

In the North-eastern Italy the genus *Nesiotites* is reported from Zoppega II (Bartolomei 1980) and Boscochiesanuova (Bartolomei & Pasa 1970) near Verona, San Vito di Leguzzano (Bartolomei 1966) and Fornaci di Cornedo (Bartolomei 1980) near Vicenza, and San Giovanni di Duino (Bartolomei 1977) near Trieste. All

Specimen	MCSNIO 845
H of ascending ramus	6.81
H of condyle	4.12
H of horizontal branch below the alveolus of M2 (lingual side)	2.49

Tab. 1 - Dimensions of *Macroneomys* cf. *brachygnathus.*

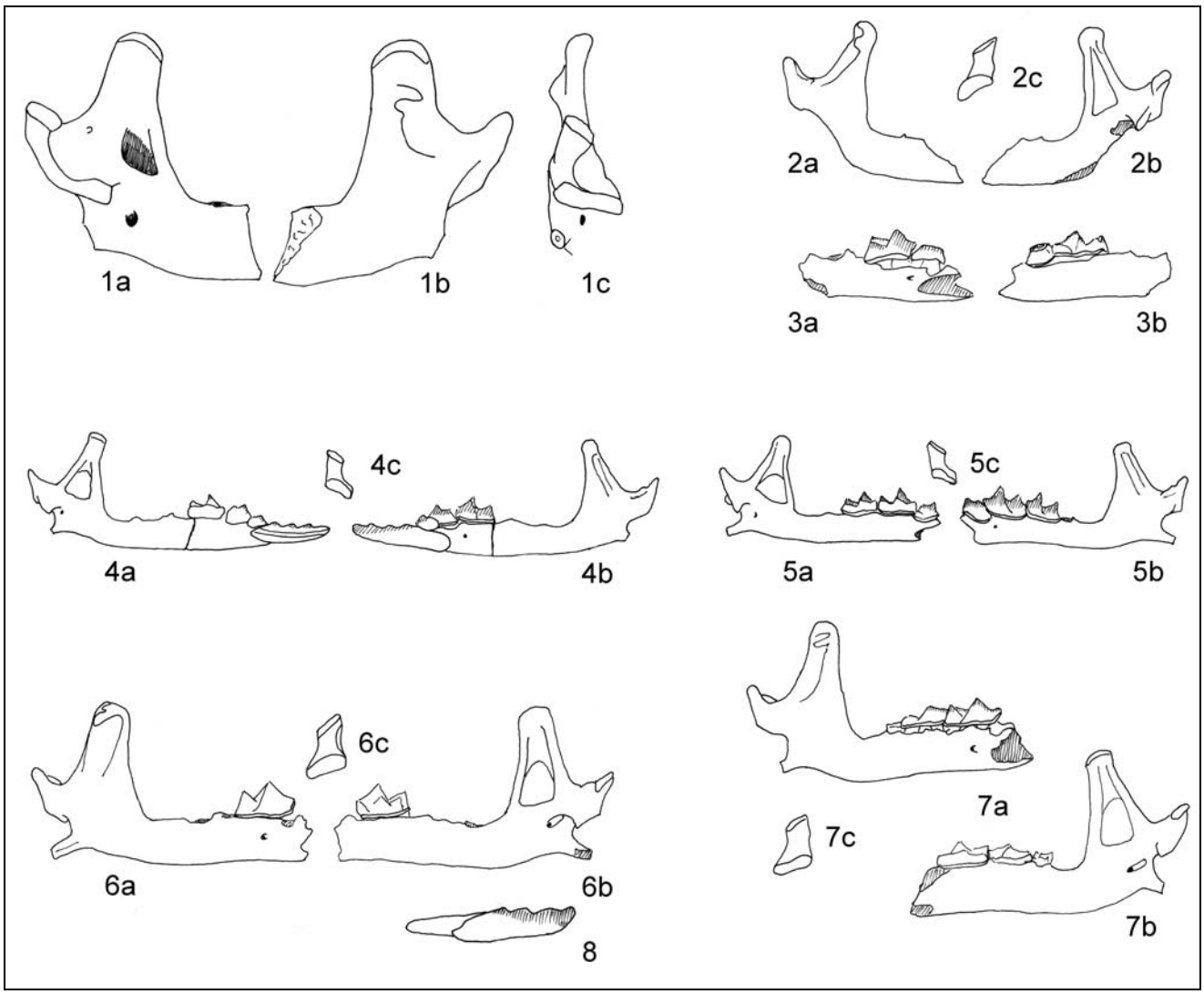

Fig. 3 - *Macroneomys* cf. *brachygnathus*: 1 - fragment of a horizontal branch with the ascending ramus of a left mandible. *Sorex* cf. *runtonensis*: 2 - fragment of right mandible with coronoid and condiloid processes; 3 - fragment of a right mandible with a portion of the horizontal ramus, P_4 and M_1. *Sorex minutus*: 4 - left mandible with I_1, A_1, P_4, M_1; 5 - left mandible with P_4, M_1, M_2. *Sorex* sp.: 6 - right fragmented mandibles with M_1; 7 - right fragmented mandibles with M_{1+2+3}; 8 - I_1.

the material of *Nesiotites* from these localities must be reviewed because it could also be ascribed to *Macroneomys*. Could this doubt be resolved, it is possible that the knowledge of the distribution of *Macroneomys* in Europe changes substantially.

The range of distribution of this species includes Biharian and Toringian faunas (see discussion in Maul & Rzebik-Kowalska 1998).

According to Maul and Rzebik-Kowalska (1998), the Biharian faunas, in which the *Macroneomys* is present, may indicate a temperate climate; it is more difficult the ecological interpretation of the Toringian faunas with *Macroneomys*. If the above mentioned *Nesiotites* is really *Macroneomys*, and the drawings and the description of Bartolomei seem to confirm this attribution, also the ecology of its Toringian remains would become clear.

Genus *Sorex* Linnaeus, 1758

Sorex minutus Linnaeus, 1758

(synonimy in Reumer 1984)

Material: Lev 6: one left M_2 (MCSNIO 846); One left mandible with I_1, A_1, P_4, M_1 (MCSNIO 847) (Fig. 3 - 4); Lev 7-8-9: one left mandible with P_4, M_1, M_2 (MCSNIO 848) (Fig. 3 - 5).

Description and discussion. The teeth have pigmented cusps. I_1 tricuspulate at the buccal side extends backwards under the second cusp of P_4. A_1 is long and low with a single cusp and a well developed cingulum at the buccal side. P_4 is slender and high with two cusps. The anterior cusp is higher than the posterior one. At the buccal side, a well developed cingulum is present. M_1 and M_2 confirm the description of Reumer (1984, pg. 28).

The horizontal branch is slender; the apex of the ascending ramus is not vertical to the horizontal one, but strongly bent forward. The coronoid spicule is present but not well developed.

The external temporal fossa is a groove parallel to the distal edge of the coronoid process.

The internal temporal fossa is high, large and triangle shaped.

The condyle is well separated backwards from the vertical ramus. The upper articular facet is cylindrical; the lower one is shaped like a truncated cone; the interarticular area is broad.

The mandibular foramen is placed below the posterior angle of the internal temporal fossa.

All the above mentioned characters and the dimensions (Tab. 2) of the remains are distinctive of *Sorex minutus.*

Specimen	MCSNIO 847	MCSNIO 848
H of ascending ramus	3.13	2.95
H of orizontal branch below M_2	0.99	0.79
H of condyloid process	1.53	1.42
L. A_1	0.67	-
L. P_4	0.88	0.81
L. M_1 (buccal)	1.24	1.19
L. M_2 (buccal)	-	1.05

Tab. 2 - Dimensions of *Sorex minutus.*

Sorex cf. **runtonensis** Hinton, 1911

(synonimy, according to Harrison 1996: *S. aranoides* Heller, 1930; *S. helleri* Kretzoi, 1959; *S. kennardi* Hinton, 1911)

Material: Lev 6: a fragment of a right mandible with coronoid and condiloid processes (MCSNIO 849) (Fig. 3 - 2); Lev 10: a fragment of a right mandible with a portion of the horizontal ramus, P_4 and M_1 (MCSNIO 850) (Fig. 3 - 3).

Description and discussion. MCSNIO 850 is very bad preserved; being the teeth not well inserted in alveoli it is difficult to know the position of the mental foramen. The teeth are pigmented.

The horizontal branch of MCSNIO 849 is only partially present, broken below the alveolus of M_2. Due to the lack of the angular process and of a portion of horizontal ramus, the mandibular foramen is not present.

Because of the reduced portion of the horizontal branch, it is difficult to know if the ascending ramus is vertical. The coronoid spicule is large and not very protrudent. The external temporal fossa is parallel to the distal edge of the coronoid process.

The internal temporal fossa is very high, triangular, with two sides parallel to the anterior and posterior edges of the coronoid process. A break corresponds to the groove that should have contained the two mandibular foramina (the anterior foramen is probably present with the anterior edge).

The condyloid process is high, with a cylindrical upper facet, a narrow interarticular area, and a wide, large, bean shaped lower facet. The pterygoid spicule is hardly drawn.

In spite of the scarce and very fragmented material available, the before mentioned characters and dimensions (Tab. 3) allow to ascribe MCSNIO 849 to *Sorex* cf. *runtonensis*. For its dimensions, also MCSNIO 850 can be attributed doubtfully to the same species.

Specimen	MCSNIO 849	MCSNIO 850
H of horizontal branch below M2	1.18	1.20
H of condyloid process	1.94	-
L P_4 (occl.)	-	1.03
W P_4 (occl.)	-	0.6
L M_1 (occl.)	-	1.52
W M_1 (occl.)	-	1.00

Tab. 3 - Dimensions of *Sorex* cf. *runtonensis.*

Sorex sp.

Material: Lev 6: three right fragmented mandibles with some molars (MCSNIO 851 (Fig. 3 - 6), 852 (Fig. 3 - 7), 853), one I_1 (MCSNIO 854) (Fig. 3 - 8); Lev 7-8-9: two M^1 (MCSNIO 855, 856), two M^2 (MCSNIO 857, 858).

Description. The teeth are pigmented. The lower margin of the horizontal branch below M_2 is slightly concave. The coronoid process is straight and narrow. The coronoid spicule is protrudent. The external temporal fossa is deep, large and parallel to the posterior edge of the coronoid process.

The internal temporal fossa is high, triangular, deep but not in the apex.

The mandibular foramen, situated in a groove, is below the low margin of the internal temporal fossa, not under its posterior corner.

The condyloid process is well separated by the coronoid one; the upper facet is cylindrical and transversal; the interarticular area is narrow and long enough; the lower facet is well but not too much developed.

The mental foramen is placed below the trigonid of M_1.

In MCSNIO 852 the molar is dark and it is impossible to recognize the distribution of the red color on the cusps.

Discussion. Due to the lacking of the antemolars, the most important diagnostic features, it is not possible to understand if the teeth are exoedaenodont. The dimensions fall within the size range of *Drepanosorex prearaneus,* an older species that shares some characters with the specimens from Fontana Marella. Usually in

Sorex araneus the coronoid process is large, with a more retreated apex; also the internal temporal fossa is high and deep towards the apex. However, these specimens share a lot of characters with *Sorex araneus*.

The material, for its dimensions (Tab. 4) and some morphological characters, traces back to *Sorex* gr. *araneus*, but its determination remains doubtful.

Specimen	MCSNIO 851	MCSNIO 852	MCSNIO 853
L M_1	1.52	1.45	-
W M_1	1.77	1.80	-
L M_2	1.28	1.26	-
W M_2	1.56	1.60	-
H of ascending ramus	4.49	4.41	-
H of horizontal branch below M_2	1.32	1.33	1.34
H of condyloid process	2.01	1.82	-
L I_1 (no roots)	3.77	-	-
L M_1 (occl.)	1.59	1.69	-
W M_1 (occl.)	1.05	0.97	-
L M_2	1.40	1.44	-
W M_2	1.03	0.92	-

Tab. 4 - Dimensions of *Sorex* sp.

Family Talpidae Fischer von Waldheim, 1817

Genus *Talpa* Linneus, 1758

Talpa europaea Linnaeus, 1758

(synonimy in Corbet 1978)

Material: Lev 6: one fragment of right humerus (MCSNIO 859) and one of right tibia (MCSNIO 860).

Description and discussion. MCSNIO 859 is represented by the lateral and distal portions, MCSNIO 860 by the proximal epiphysis and a small part of diaphysis.

The morphological characters of these two fragments even if incomplete are well preserved, their dimensions do not differ from the recent material of *Talpa europaea*, so the two bones are ascribed to this species.

Talpa cf. **caeca** Savi, 1822

(synonimy in Niethammer 1990)

Material: Lev 7-8-9: one right radius (MCSNIO 861).

Description and discussion. MCSNIO 861 is well preserved and complete. The comparison with recent material of *Talpa* does not reveal morphological differences and its dimensions (greatest length 11,18 mm; breadth of the distal end 3.76 mm) are similar to the sample of *Talpa caeca* preserved in the department of Biology and Evolution of the University of Ferrara.

The radius, while complete lacks of morphological characters, thus not allowing a sure determination; therefore it is referred to *Talpa* cf. *caeca*.

Talpa sp.

Material: Lev 7-8-9: one left radius (MCSNIO 862); Lev 10: one left (MCSNIO 863) and one right humerus (MCSNIO 864).

Description and discussion. Of the two bad preserved humeri the proximal epiphysis is missing. The radius is present with its proximal portion.

The three specimens have very small dimensions, similar to *Talpa minor*, but their preservation does not help to understand if they belong to young or adult animals. Waiting for an in-depth study, this material is assigned to *Talpa* sp.

Order **Rodentia**

Family Cricetidae Rochebrune, 1883

Genus *Cricetulus* Milne-Edwards, 1867

Cricetulus sp.

(synonymy *Allocricetus*, the synonimy is not unanimous)

Material: Lev 12: one fragment of a left maxillary bone without teeth (MCSNIO 844) (Pl. 1, fig. 31)

Description and discussion. MCSNIO 844 unfortunately doesn't have teeth but thanks to the perfectly preserved set of alveola (Tab. 5), according to Niethammer & Krapp (1982), it can be attributed to *Cricetulus* sp.

Specimen	MCSNIO 844
Alveolar M1-M3 lenght	4.80

Tab. 5 - Dimensions of *Cricetulus* sp.

Family Arvicolidae Gray, 1821

Genus *Pliomys* Méhely, 1914

Pliomys episcopalis Méhely, 1914

(synonimy *Pliomys bolkayi* Kormos, 1931 and *Pliomys coronensis* Méhely, 1914; for the latter one the synonimy is not unanimous)

Material: Lev 6: 1 M_1 dx (MCSNIO 811) (Pl. 1, fig.16); Lev 7-8-9: 1 M^2 dx (MCSNIO 812) (Pl. 1, fig.17); 1 M^2 sx (MCSNIO 813) (Pl. 1, fig. 18); Lev 10: 1 M^2 sx (MCSNIO 836) (Pl. 1, fig. 19).

Description and discussion. M_1 is constituted by a posterior loop, five triangles and an asymmetrical AC2 more developed buccally, similar to the morphology of the anterior loop of *Cletrionomys*. The tooth shape is characterized by three salient and three re-entrant angles on the lingual side and three salient and four re-entrant angles on buccal side. No cement is present

on the re-entrant angles. The enamel is thick and shows a positive differentiation. T1 is slightly confluent with T2 as well as T3 with T4. T5 is confluent with AC2. The *linea sinuosa* reaches the occlusal surface.

The tooth belongs to a young-adult individual. The not completely developed roots prove that this specimen was not fully grown, but the occlusal surface is typical of adult individuals. The length of this tooth (Tab. 6) falls within the size range of *Pliomys episcopalis* suggested by Bartolomei (1969) and Marchetti et al. (2000).

M^2 have a simple shape characterized by a posterior loop, three triangles, two on the buccal side and one on the lingual side. The BSA1 is sharp, T2 is triangular, T3 is fundamentally quadrangular and T4 is similar to T3. The sinuous line do not reach the chewing surface. The enamel is thin and little differentiated. In the re-entrant angles the cement is absent. The roots are not completely developed.

In the specimen MCSNIO 836 T2 is more quadrangular.

Specimen	MCSNIO 811	MCSNIO 812	MCSNIO 813	MCSNIO 836
	M_1	M^2	M^2	M^2
L	2.34	1.42	1.41	1.60
A	1.11			
W	0.99	0.88	0.90	0.99
A/L	47.44			

Tab. 6 - Dimensions of *Pliomys episcopalis.*

Cf. **Pliomys**

Material: Lev. 7-8-9: 1 M_1 dx very young (MCSNIO 814) (Pl. 1, fig. 20)

Description and discussion. The specimen belongs to a very young individual. The very immature chewing surface doesn't allow a clear attribution but the complete absence of cement in the re-entrant angles permit, even if with some reserve, to attribute the tooth to the genus *Pliomys*. Roots are not yet present. The enamel is thin. The tooth shows the posterior loop, four triangles, a possible fifth broken, and a portion of the anterior loop.

Genus *Dinaromys* Kretzoi, 1955

Dinaromys bogdanovi (Martino, 1922)

Material: Lev. 12: 1 rigth hemimandible with M_{1+2+3} (MCSNIO 843) (Pl. 1, fig. 32)

Description. The hemimandible is broken both at the buccal and the lingual sides, but all the teeth are still present: the incisor and the three molars. Teeth dimensions are carried in Tab. 7. For an accurate description and discussion of these teeth refer to Zanalda (1994).

Specimen	MCSNIO 843				
	M_1	M_2	M_3	M_1-M_3 Alveol	M_1-M_3 occlusal
L	3.70	2.30	2.30	9.30	8.50
A	1.63				
W	1.60	1.52	1.28		
A/L	44.05				

Tab. 7 - Dimensions of *Dinaromys bogdanovi.*

Genus *Microtus* Schrank, 1798

Microtus (M.) agrestis Linnaeus, 1861

(synonimy in Corbet 1978)

Material: Lev. 6: 2 M_1 (MCSNIO 801 sx (Pl. 1, fig. 1); MCSNIO 802 dx (Pl. 1, fig. 2)); Lev. 7-8-9: 5 M_1 (MCSNIO 815, 816, 817, 818 sx (Pl. 1, figs 3-6); MCSNIO 819 dx (Pl. 1, fig. 7)).

Description and discussion. The lingual triangles are twice as big as the buccal ones. The axis of the teeth is quite rectilinear. The triangles from T1 to T5 are alternate, only T3-T4 of MCSNIO 817 show a slightly confluence. In the specimen MCSNIO 817, T6 and T7 are extremely confluent; in the others T6 and T7 are confluent. In some specimen LRA5 and BRA4 are closer than the others forming a narrow passage from T7 to AC3. In the specimens MCSNIO 801 and 802, AC3 is not present. The teeth enamel shows a positive differentiation. On the lingual side AC3 is flattened forming a "beak" shape. The LSA are sharp, the BSA are quadrangular due to a bulge on the concave side. Abundant cement is present in the re-entrant angles. The length of the teeth (Tab. 8) falls within the size range of *Microtus agrestis* (Nadachowski 1985)

According to Nadachowski (1985) in FM *Microtus* (*M.*) *agrestis* samples it is at least possible to recognize two different morphotype. The specimens MCSNIO 815, 816, 818, 819 show a narrowing between the fields T6 and T7 typical of "coronensis" morphotype. The M_1 MCSNIO 817, owing to the presence of T6 and T7 forming a rhombus shape and a probably incipient LRA6, could be ascribed to "agrestis" morphotype.

Microtus (M.) arvalis Pallas, 1778

(synonimy in Corbet 1978)

Material: Lev. 7-8-9: 1 M_1 dx (MCSNIO 820) (Pl. 1, fig. 8).

Description and discussion. The only tooth of *Microtus arvalis* found in FM deposit shows a poor bucco-lingual asymmetry. The lingual triangles are

Specimen	MCSNIO 800	MCSNIO 802	MCSNIO 815	MCSNIO 816	MCSNIO 817	MCSNIO 818	MCSNIO 819	Max	Min	Mean	SD
L	3.10	3.03	3.14	3.20	2.99	2.74	-	3.20	2.74	3.03	0.16
A	1.68	1.59	1.66	1.66	1.54	1.40	1.64	1.68	1.40	1.60	0.10
W	1.31	1.15	1.18	1.12	1.04	1.01	-	1.31	1.01	1.14	0.11
A/L	54.19	52.48	52.87	51.88	51.51	51.09	-	54.19	51.09	52.33	1.11

Tab. 8 - Dimensions of *Microtus agrestis.*

slightly bigger than the buccal ones and show sharp LSA. The buccal triangles are fundamentally quadrangular. The tooth, being narrow, shows a slender shape. T6 and T7 are widely reciprocally confluent and with the anterior loop. The AC3 is generally symmetric with a rounded shape, and it is turned toward the buccal side. The triangles from T1 to T5 are alternate, T3-T4 show a slightly confluence. The tooth axis is quite rectilinear. The enamel shows a positive differentiation. Abundant cement is inside the deep re-entrant angles.

The above mentioned characters and dimentions (Tab. 9) are typical of *Microtus arvalis*.

Microtus (Terricola) gr. multiplex-subterraneus

Material: Lev. 6: 1 M_1 dx (MCSNIO 803) (Pl. 1, fig. 9); Lev. 7-8-9: 2 M_1 dx (MCSNIO 822, 823) (Pl. 1, figs 10, 11).

Description and discussion. The specimen MCSNIO 803 shows a posterior loop, T1, T2 e T3 alternate but with slightly confluences, T4 and T5 are extremely confluent, forming a pitymyoid rhombus, and T6 and T7 are confluent with AC3. In a different way, the specimens MCSNIO 822 and 823 show only the anteroconide complex where it is well detected the pitymyoid rhombus, and T6 and T7 confluence with AC3. BSA3 and LSA4 are not completely aligned but similar to extant *M. (T.) subterraneus*. BRA4 and LRA5 are well developed. The teeth axis is rectilinear with a slight concavity to the buccal side. The lingual triangles are bigger than the buccal ones. The teeth enamel shows a *Microtus* thickness differentiation. The cement is abundant in the re-entrant angles.

For the lengthened appearance, the narrow neck of the anterior cap and the morphology of the pitymyoid rhombus, it can be assumed that these teeth belong to *Microtus* (*T.*) gr. *multiplex-subterraneus.* For the irregular form of the pitymyoid rhombus and the slight confluence of triangles, the material is similar to *Microtus arvalidens*. The specific determination remains doubtful because two of the three diagnostic molars are fragmented. Teeth length in Tab. 10.

Microtus sp.

Material: Lev. 7-8-9: 1 M_1 dx (MCSNIO 835), 1 M_1 sx (MCSNIO 834); Lev. 10: 1 M_1 dx (MCSNIO 837); Lev. 12: 1 M_1 dx (MCSNIO 841).

Description and discussion. This material is composed by four incomplete first lower molars, three right and one left. On MCSNIO 835 and 837 only the talonid complex is present. MCSNIO 834 and 841 show only the anteroconid complex lacking of the anterior loop. Thanks to the presence of sharp triangles, the enamel positive differentiation and the absence of roots it is possible to ascribe these four teeth to *Microtus* sp.

Genus *Chionomys* Miller, 1908

Chionomys nivalis Martins, 1842

(synonimy *Microtus nivalis* in Corbet 1978)

Material: Lev. 7-8-9: 1 M_1 dx (MCSNIO 821) (Pl. 1, fig. 29); Lev. 12: 1 M_1 sx (MCSNIO 842) (Pl. 1, fig. 28).

Description and discussion. MCSNIO 821 (Tab. 11) is formed by a posterior loop and five alternated triangles of which T5 is confluent with an asymmetrical AC2. The specimen MCSNIO 842 is broken and preserves only the anteroconid complex where, due to the presence of a deep BRA3, T5 is slightly confluent with AC2. In both teeth AC2, thanks to the presence of an incipient T6, has a well developed buccal side. Lingual triangles are much larger than buccal ones. The buccal triangles have a quadrangular shape. Enamel has the positive differentiation. The cement is present in the re-entrant angles.

The morphotype of the specimen MCSNIO 821 have been described by Nadachowski (1984) as "nivalid-ratticepid" because of the presence of a narrow connection between areas T5 and T6. According to Nadachowski (1984), MCSNIO 842 due to the complete separation of T5 and T6 could be considered a typically "nivalid" morphotype.

Genus *Clethrionomys* Tilesius, 1850

Clethrionomys sp.

Material: Lev. 6: 1 hemimandible dx with M_1 e M_2 (MCSNIO 807) (Pl. 1, fig. 13); 1 partial M_2 sx (MCSNIO 809); 1 M_2 dx (MCSNIO 808); 1 M_3 dx (MCSNIO 810); Lev. 7-8-9: 2 M_2 sx

Specimen	MCSNIO 820
L	2.55
A	1.43
W	0.91
A/L	56.08

Tab. 9 - Dimensions of *Microtus arvalis.*

Specimen	MCSNIO 803	MCSNIO 822
L	2.82	-
A	1.52	1.54
W	0.96	-
A/L	53.90	-

Tab. 10 - Dimensions of *Microtus (Terricola)* gr. *multiplex-subterraneus.*

Specimen	MCSNIO 821
L	2.90
A	1.35
W	1.23
A/L	46.55

Tab. 11 - Dimensions of *Chionomys nivalis.*

(MCSNIO 827, 828); 1 M^1 sx (MCSNIO 826) (Pl. 1, fig. 14); 1 M^2 dx (MCSNIO 825); 1 M^3 dx (MCSNIO 824) (Pl. 1, fig. 12); Lev. 10: 1 M_3 dx (MCSNIO 838); Lev. 12: 1 M^1 sx (MCSNIO 839) (Pl. 1, fig. 15); 1 M^2 dx (MCSNIO 840).

Description and discussion. M_1 is characterized by the presence of PL, five slightly confluent triangles and a broad and asymmetrical AC2. AC2 is mesially flattened and buccally turned. T5 is widely confluent with AC2. T2 is quadrangular, T4 and T5 have well rounded apex. The enamel is undifferentiated and thick and it lacks on lingual and buccal side of PL and on the buccal side of AC2. The re-entrant angles have abundant cement. According to the above mentioned characters it is possible to ascribe MCSNIO 807 to an adult individual.

M_2 are morphological simple. The enamel is thick and undifferentiated. The re-entrant angles have abundant cement. MCSNIO 808 shows deep re-entrant angles morphology; in these latter the axis become parallel to the tooth beginning from the half of its development.

M_3 are small sized teeth with enamel thick and undifferentiated. MCSNIO 838 due to the more developed roots and to the thickness of the enamel belongs to an old individual.

M^1 show enamel thick and undifferentiated. In MCSNIO 826 apex of T2 is sharp. MCSNIO 839 is similar in size to MCSNIO 826, having thicker enamel, more developed roots and more rounded shape of triangles, it belongs to an older individual.

M^2 show well rounded SA; the enamel is thick and undifferentiated; roots are well developed.

M^3 is rather complex and characterized by the presence of: a longitudinally flattened AL1; two triangles, three valleys and an incipient T6 highlighted by a fold on the buccal side that testifies an incipient BRA4; two triangles and two valleys on lingual side. All triangles have rounded apex. T2 with T3 and T3 with T4 are slightly confluent. T5 is widely confluent with the incipient T6 and with PC1. The enamel is thick and undifferentiated, no lacks on the occlusal surface. Abundant cement is present in the re-entrant angles.

All the teeth present morphological characters of the genus *Clethrionomys*, which don't permit, however, a sure specific determination. Dimentions of all teeth are reported in Tab. 12.

Genus *Arvicola* Lacépède, 1799

Arvicola cf. **mosbachensis** (Schmidtgen, 1911)

(synonimy *Arvicola cantianus* Hinton, 1910)

Material: Lev. 6: incomplete M^1 sx (MCSNIO 804) (Pl. 1, fig. 21) and M^2 sx (MCSNIO 805) (Pl. 1, fig. 22); Lev. 7-8-9: 1 M^1 dx (MCSNIO 829) (Pl. 1, fig. 23); 2 M^2 sx (MCSNIO 830, 832) (Pl. 1, figs 25, 27); 1 M^3 sx (MCSNIO 831) (Pl. 1, fig. 26); 1 M_2 sx (MCSNIO 833) (Pl. 1, fig. 24).

Description and discussion. Unfortunately the *Arvicola* material does not present any lower first molars. All the collected teeth show a nearly undifferentiated enamel, with a mimomyian differentiation on few triangles and cement in the re-entrant angles.

M^1 consist only in a mesial part showing AC2 with a sharp T1 and a rounded T2, and in a large and complete tooth with LSA2 and LSA3 forming a prominent acute angle. Triangles are slightly confluent.

M^2 show triangles with any confluence.

M^3 is complete. The triangles are well separated by well developed re-entrant angles. The enamel is undifferentiated. Triangles are rounded.

M_2 show alternate slightly rounded triangles. Teeth dimensions are shown in Tab. 13.

The above described morphological characters for the teeth of *Arvicola* appear in evolved form of *Arvicola mosbachensis*.

Family Muridae Gray, 1821

Genus *Apodemus* Kaup, 1829

Apodemus sp.

Material: Lev. 6: M_3 sx (MCSNIO 806) (Pl. 1, fig. 30).

Specimen	MCSNIO 807			MCSNIO 808	MCSNIO 809	MCSNIO 810	MCSNIO 824	MCSNIO 825	MCSNIO 826	MCSNIO 827	MCSNIO 828	MCSNIO 838	MCSNIO 839	MCSNIO 840
	M_1	M_2		M_2	M_2	M_3	M^3	M^2	M^1	M_2	M_2	M_3	M^1	M^2
L	2.41	1.56		1.32	1.43	1.51	1.51	1.39	1.96	1.50	1.54	1.28	1.94	1.38
A	0.84	-												
W	1.14	0.99		0.92	0.89	0.76	0.79	0.92	1.10	0.95	0.96	0.68	1.00	0.95
A/L	34.69	-												
M_1-M_2 lenght			3.99											

Tab. 12 - Dimensions of *Clethrionomys* sp.

Specimen	MCSNIO 829	MCSNIO 830	MCSNIO 831	MCSNIO 832	MCSNIO 833
	M^1	M^2	M^3	M^2	M_2
L	3.25	2.28	2.63	2.35	2.29
Width	1.82	1.46	1.39	1.44	1.43

Tab. 13 - Dimensions of *Arvicola* cf. *mosbachensis.*

	N	Max.	Min.	Mean	SD
LP_4	75	1.48	1.04	1.29	0.11
WP_4	75	1.50	1.05	1.31	0.11
LM_1	81	2.14	1.52	1.85	0.16
WM_1	81	2.12	1.44	1.83	0.16
LM_2	75	2.17	1.57	1.93	0.14
WM_2	75	2.21	1.60	1.96	0.14
LM_3	62	2.19	1.47	1.89	0.16
WM_3	61	2.02	1.35	1.75	0.16
LP^4	76	1.67	1.01	1.33	0.12
WP^4	76	1.70	1.15	1.50	0.15
LM^1	108	2.04	1.50	1.84	0.12
WM^1	108	2.29	1.54	1.94	0.17
LM^2	79	2.03	1.49	1.85	0.11
WM^2	79	2.28	1.59	2.06	0.17
LM^3	43	1.74	1.17	1.52	0.14
WM^3	43	2.02	1.35	1.73	0.19

Tab. 14 - Dimensions of *Glis glis.*

Description and discussion. Small tooth with t1 and t2. Both cusps are well worn. The features of MCSNIO 806 allow to ascribe the specimen to the genus *Apodemus*.

Unfortunately the presence of a single M_3 with a severe wear does not allow the determination at species level.

Family Gliridae

Genus *Glis* Brisson, 1761

Glis glis (Linnaeus, 1766) (= *Myoxus glis*)

Material: Lev. 6: 25 P^4; 42 M^1; 32 M^2; 11 M^3; 5 D_4; 14 P_4; 23 M_1; 23 M_2; 22 M_3; 6 Hemimandibles; 1 Maxillary bone; Lev. 7-8-9: 31 P^4; 38 M^1; 28 M^2; 17 M^3; 6 D_4; 24 P_4; 39 M_1; 38 M_2; 24 M_3; 19 Hemimandibles; 2 Maxillary bones; Lev. 10: 16 P^4; 26 M^1; 15 M^2; 13 M^3; 1 D_4; 21 P_4; 18 M_1; 13 M_2; 14 M_3; 6 Hemimandibles; 2 Maxillary bones; Lev. 12: 4 P^4; 5 M^1; 6 M^2; 4 M^3; 5 P_4; 6 M_1; 4 M_2; 7 M_3; 9 Hemimandibles.

Description and discussion. The dormouse is the best represented animal of this deep part of the site (12÷6 levels). The large amount of teeth reveal a homogeneous population, with a well defined dimensional range (Tab. 14). Their morphology and dimensions reflect the characters of the species. Unique distinctiveness it is seen in M^2: in rare specimens this tooth has the presence of a tubercle between the central ridges, in one case there is an outline of supernumerary ridges. This character is considered as typical of an archaic morphology that may appear in a large population.

Paleoecological and chronological inferences

In the levels from 12 to 6 of Fontana Marella cave, the Middle Pleistocene sequence, *Glis* is dominant while the species today typical of alpine meadows and rocky slope (*Microtus, Chionomys* and *Dinaromys*) are poorly represented; there are also remains of moles and shrews (among these, the rare *Macroneomys* cf. *brachygnathus*).

According to the small mammal assemblage (Tab. 15), it is also possible to make some inferences on the probable paleoecological meaning of the environment around the cave during the deposition of the 12-6 levels. The presence of *Chionomys nivalis* and *Dinaromys bogdanovi* at 1.000 m. a.s.l. in a pre-alpine environment, probably testifies a climatic situation colder than today. The area was likely characterized by the spread of grasslands in presence of woods mainly along the slopes, not reaching the top of the mountain.

It is possible to date this sequence to the Early Toringian, owing to the presence of *Arvicola* cf. *mosbachensis* and *Pliomys episcopalis*, whose last occurrence falls before the upper part of the Middle Pleistocene.

The subgenus *M. (Terricola)* has a morphology which remembers *Microtus arvalidens*; *Chionomys nivalis*, *Microtus arvalis* and *Microtus agrestis* show advanced features; *Arvicola* has sometimes undifferentiated enamel, sometimes mimomyian one. All these data point out a faunal association typical of the recent part of the Early Toringian.

The upper part of the Early Toringian suggested by the fauna from the levels 12-6 of Fontana Marella is

Level	6			7-8-9			10			12			Tot		
Taxon	n	NI	%NI	n	NI	%NI	n	NI	%NI	n	NI	%NI	n	NI	%NI
Rodentia															
Arvicola cf. *mosbachensis*	2	1	1.8	5	2	3.2							7	3	1.8
Chionomys nivalis				1	1	1.6				1	1	7.1	2	2	1.2
Cletrionomys sp.	4	1	1.8	6	2	3.2	1	1	3	2	1	7.1	13	5	3.0
Dinaromys bogdanovi										1	1	7.1	1	1	0.6
Microtus agrestis	2	2	3.6	5	5	8.0							7	7	4.2
Microtus arvalis				1	1	1.6							1	1	0.6
Microtus sp.				2	2	3.2	1	1	3	1	1	7.1	4	4	2.4
Pliomys episcopalis	1	1	1.8	2	2	3.2	1	1	3				4	4	2.4
Cf. *Pliomys*				1	1	1.6							1	1	0.6
Microtus (Terricola) sp.	1	1	1.8	2	2	3.2							3	3	1.8
Cricetulus sp.										1	1	7.1	1	1	0.6
Apodemus sp.	1	1	1.8										1	1	0.6
Glis glis	205	42	76.4	266	39	63.1	145	26	79	50	9	64.5	666	116	71.1
Insectivora															
Macroneomys cf. *brachygnathus*							1	1	3				1	1	0.6
Sorex minutus	2	1	1.8	1	1	1.6							3	2	1.2
Sorex cf. *runtonensis*	1	1	1.8				1	1	3				2	2	1.2
Sorex sp.	3	3	5.4	4	2	3.2							7	5	3.0
Talpa cf. *caeca*				1	1	1.6							1	1	0.6
Talpa sp.				1	1	1.6	2	2	6				3	3	1.8
Talpa europaea	2	1	1.8										2	1	0.6

Tab. 15 - Faunal assemblage and frequences of the different taxa throughout the stratigraphic sequence of Fontana Marella cave.

in accordance with the U/Th dating (more than 350 Ky) of the stalagmitic crust of level 5 (Uggeri et al. 1991).

A faunal association which shares some taxa with Fontana Marella, is Boscochiesanuova in the Lessini mountains near Verona (Bartolomei & Pasa 1970). In this site *Arvicola* is not present, may be for ecological conditions, but "*Nesiotites*" (probably *Macroneomys*; see above), and *Pitymys arvaloides* (recte *Microtus arvalidens*) are reported together with *Sorex runtonensis*, *Dolomys episcopalis* (recte *Pliomys episcopalis*), *Microtus incertus* (recte *Microtus arvalis*) and other species. This fauna is ascribed to the late Early Toringian too.

Conclusive considerations

The Fontana Marella cave has furnished a small mammal fauna of the Middle Pleistocene, unique in Lombardy but documented in the near Venetian. The fossil record is poor and sometimes bad preserved but, in spite some uncertain determinations, the resulting biochronological indications are reliable. The faunal association is attributed to a temperate period, cooler and perhaps more arid that the present one. This has been revealed by the presence of *Chionomys nivalis* and *Dinaromys bogdanovi*, today reported in sites of higher altitude or of rocky ground scarcely covered by wood. The find of *Macroneomys* is important because it could indicate a further presence of this animal in Northern Italy, where the above mentioned six sites have yielded remains of this insectivore. The fauna of Fontana Marella cave is assigned to the late Early Toringian.

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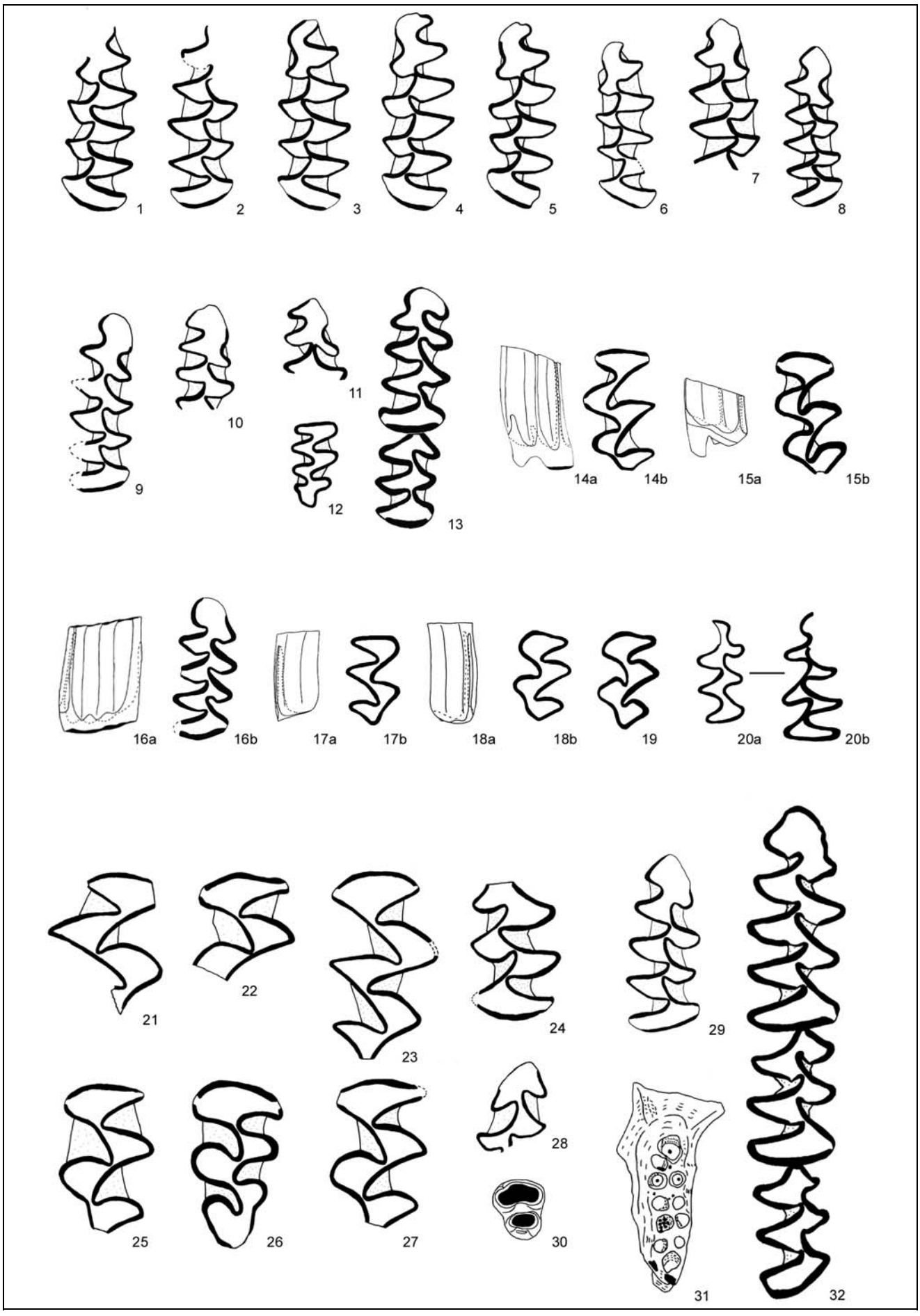
PLATE 1

Figs.1-7: *Microtus agrestis*: M_1. Fig. 8: *Microtus arvalis*: M_1. Figs. 9-11: *Microtus (Terricola)* gr. *multiplex-subterraneus*: M_1. Figs. 12-15: *Clethrionomys* sp.: 12: M^3; 13: M_1-M_2; 14-15: M^1. Figs. 16-19: *Pliomys episcopalis*: 16: M_1; 17-19: M^2. Fig. 20: cf. *Pliomys*: 20a: occlusal view; 20b: radical view. Figs. 21-27: *Arvicola* cf. *mosbachensis*: 21, 23: M^1; 22, 25, 27: M^2; 26: M^3; 24: M_2. Figs. 28-29: *Chionomys nivalis*: M_1. Fig. 30: *Apodemus* sp.: M_3. Fig. 31: *Cricetulus* sp.: left maxillary bone. Fig. 32: *Dinaromys bogdanovi* (after Zanalda 1994):M_{1+2+3}.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