

The fossil remains of Soricidae and Leporidae (Mammalia) in the Lower Pleistocene of Pietrafitta (Perugia, Central Italy)

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ABSTRACT - A rich mammalian assemblage, referred to the Early Pleistocene (late Villafranchian, Farneta Faunal Unit), was recovered in the lignite of Pietrafitta (Perugia, Central Italy). This fossil assemblage includes some remains of an insectivore of the family Soricidae and a lagomorph of the family Leporidae. The morphological and morphometrical analysis of these teeth allowed to refer the remains to *Sorex* cfr. *S. minutus* Linnaeus, 1758 and *Oryctolagus* cfr. *O. lacosti* (Pomel, 1853) respectively.

RIASSUNTO - [I resti fossili di Soricidae e Leporidae (Mammalia) del Pleistocene Inferiore di Pietrafitta (Perugia, Italia centrale)] - Nel deposito lignitifero di Pietrafitta (Perugia, Italia centrale) è stata rinvenuta una ricca associazione a mammiferi riferibile al Pleistocene Inferiore (Villafranchiano superiore, Unità Faunistica di Farneta). Tale associazione comprende alcuni resti appartenenti ad un Soricidae (Soricomorpha) e ad un Leporidae (Lagomorpha). L'analisi morfologica e morfometrica del soricide ed il confronto con le specie viventi e fossili di simili dimensioni hanno permesso l'attribuzione a *Sorex* cfr. *S. minutus* Linnaeus, 1758, la specie più longeva dell'attuale fauna europea, comparsa nel Rusciniano. I resti fossili del leporide sono stati attribuiti ad *Oryctolagus* cfr. *O. lacosti* (Pomel, 1853), specie tipica del Villanyiano e del Bihariano inferiore.

INTRODUCTION

The Pietrafitta basin (Umbria, Central Italy; Fig. 1) is an intramontainous tectonic basin, filled by sediments, mostly clastic deposits of pelitic type, about 100 m thick. The upper sedimentary succession of the basin, well known for the lignite excavation made by ENEL (Italian National Company of Electricity), is constituted by clay and organic deposits (lignite) overlaid by thinly stratified silty clay (typical of lacustrine environments). The deposition of the lignite, about 9 m thick, took place in a palustrine environment during the Early Pleistocene (Ambrosetti et al., 1992).

The lignite of Pietrafitta contains a very rich assemblage of fossil vertebrates, invertebrates and plant remains belonging to Farneta Faunal Unit of late Villafranchian Mammal Age (Early Pleistocene, Gliozzi et al., 1997). The particular depositional and environmental conditions of the swamp allowed such a rich and complete preservation. The vertebrate fossil remains are particularly abundant in quantity and number of taxa (Delfino, 2002; Argenti, 2003; Barisone, 2003; Bedetti, 2004). The mammals are all studied with the exception of the few remains described in this paper. The task of this short note is to increase the list of the mammalian fossils found at Pietrafitta. In some preliminary lists (see bibliography in Argenti, 2003) another insectivore, a mole of small size assigned to the genus *Talpa*, has been reported. We have not found remains of this genus among the collection of fossils from Pietrafitta.

SYSTEMATICS

The classification of McKenna & Bell (1997) is followed in this paper. The measures are given in mm.

Order SORICOMORPHA Gregory, 1910
Family SORICIDAE Linnaeus, 1758
Genus SOREX Linnaeus, 1758

Sorex cfr. *S. minutus* Linnaeus, 1766
Fig. 2

Material - Fragment of a left mandibular ramus with M_1 (broken) ($L = 1.17$ mm) and M_2 ($L = 1.08$ mm) (Inv. 1087, stored in the Thermoelectric Station "Città di Roma" of Pietrafitta of ENEL).

Discussion - Only one specimen among the rich mammalian remains collected at Pietrafitta belongs to the insectivores. It is a broken left mandibular ramus bearing M_1 (lacking the trigonid of the crown) and M_2 . The labial cingulum of M_1 is well developed, narrow and slightly undulated. The talonid is wider than the trigonid as in all the members of the genus *Sorex* (Fig. 2).

A big number of fossil and living species belonging to the genus *Sorex* have been described from Europe (Reumer, 1984; Rzebik-Kowalska, 1994, 1998; Fanfani, 2000). The soricid of Pietrafitta belongs to a small species of the genus. Similar dimensions characterise the living *Sorex minutus* Linnaeus, 1766 and some fossil species, *S. subminutus* Sulimski, 1962, *S. praeminutus*



Fig. 1 - Location map of Pietrafitta (Umbria, Central Italy).

Heller, 1963, and *S. biharicus* Terzea, 1970. After Jammot (1977) the two later species are synonymous of *S. minutus*, an opinion confirmed and extended also to the first species by Rzebik-Kowalska (1991, 2000). Two other small species, *S. minutissimus* Zimmermann, 1780 and *S. bor* Reumer, 1984 are smaller and slightly bigger of *S. minutus* respectively. *Sorex feffari* Horáček & Ložek, 1988 is a species large as the big specimens of *S. bor*. After Rzebik-Kowalska (1998) it is possible that the Pliocene remains referred to this species represent *S. bor* and those from the Early Pleistocene localities belong to *S. runtonensis* Hinton 1911, a larger species. The fossil of Pietrafitta is morphologically identical to *S. minutus* but also to *S. bor* because no diagnostic characters are present in the preserved remains (Reumer, 1984; Rzebik-Kowalska, 1991; Popov, 2003). On the contrary the dimensions of our fossil are identical to *S. minutus* (Tab. 1). However, the material is very scanty and for this reason we classify this soricid as *Sorex* cfr. *S. minutus* Linnaeus.

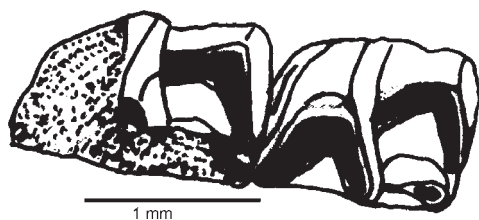


Fig. 2 - *Sorex* cfr. *S. minutus*. Left M1-M2 (reversed). Occlusal view. Pietrafitta (Umbria, Central Italy), Early Pleistocene.

Small-size *Sorex* are reported from several Italian localities of Late Pliocene and Early Pleistocene age. They are assigned to *S. bor* by Fanfani (2000) (Rivoli Veronese, Montagnola Senese, Pirro Nord, Cava dell'Erba (?), Soave/Cava Sud). After this author, Valdemino (Liguria) and Visogliano (Friuli Venezia Giulia) of early Toringian (Middle Pleistocene) age are the oldest Italian localities where *S. minutus* is present. The species is relatively common in sites of late Middle Pleistocene and Late Pleistocene age of the Italian peninsula (Fanfani, 2000; Kotsakis et al., 2003). The presence of this species at Pietrafitta is the oldest one in the Italian peninsula (Early Biharian), whilst in Europe is known from Early Ruscinian (MN 14) (Rzebik-Kowalska, 1998). Today *S. minutus* is distributed from the Atlantic border of Europe to Yenesei River and Lake Baikal, south to Altai and Tien Shan Mountains (Hutterer, 2005).

Species/Localities	Number of specimens	M/2 L min	M/2 L max	M/2 L mean
<i>S. bor</i>				
Osztramos9	2	1.18	1.20	1.19
Osztramos1	5	1.07	1.16	1.12
Osztramos7	6	1.19	1.30	1.24
Podlesice	1			1.14
Węże1	33	1.10	1.17	1.13
Rębiełice Królewskie 1a	34	1.05	1.22	1.15
Rębiełice Królewskie 2	7	1.14	1.20	1.18
Kielniki 3B	1			1.20
Kadzielnia 1	2	1.15	1.22	1.18
Kamyk	11	1.11	1.23	1.17
Kielniki 3A	3	1.24	1.27	1.26
Pirro Nord	32	1.05	1.35	1.22
Cava dell'Erba (aff.)	1			1.32
Cava Sud	1			1.26
<i>S. minutus</i>				
Ostramos7	16	1.00	1.18	1.21
Csarnota2	15	1.02	1.22	1.11
Tegelen	14	1.13	1.26	1.19
Villány3	4	1.22	1.36	1.30
Ostramos3/2	33	1.10	1.29	1.19
Podlesice	15	0.94	1.08	1.01
Zalesiaki 1B	4	0.92	1.10	1.05
Węże1	22	0.96	1.07	1.00
Rębiełice Królewskie 1a	20	0.95	1.10	1.03
Rębiełice Królewskie 2	1			1.07
Kielniki 3B	6	1.04	1.18	1.12
Kadzielnia	3	1.13	1.14	1.14
Kielniki 3A	2	1.12	1.12	1.12
Zalesiaki 1A	6	1.04	1.10	1.07
Zamcowa Dolna cave C	22	1.05	1.18	1.14
Kozi Grzbiet	18	0.98	1.08	1.04
Recent Poland	40	0.99	1.10	1.10
Betfia XIII	7	1.03	1.13	1.08
Betfia XI	1			1.10
Betfia IX	57	1.00	1.11	1.05
Betfia VII/1	20	0.96	1.11	1.04
Betfia V	1			1.13
Betfia VII/3	5	0.98	1.05	1.02
Varshets (cfr.)	39	1.10	1.35	1.18
Valdemino	2	0.81	0.95	0.88
Castelcivita	1			1.09
Recent Italy	19	1.01	1.27	1.12
Pietrafitta (cfr.)	1			1.06
<i>S. minutissimus</i>				
Kozi Grzbiet	8	0.88	1.00	0.96
Mummutova cave	2	1.01	1.01	1.01
Betfia VII/3	1			0.94

Tab. 1 - Length measurements (in mm) of M/2 in small species of the genus *Sorex* (data from: Reumer, 1984; Rzebik-Kowalska, 1991, 2000; Fanfani, 2000; Popov, 2003).

Order LAGOMORPHA Brandt, 1855
 Family LEPORIDAE Fischer von Waldheim, 1817
 Genus ORYCTOLAGUS Lilljeborg, 1873

Oryctolagus cfr. *O. lacosti* (Pomel, 1853)
 Fig. 3

Material - A fragment of a right maxillary with P² - M² (Inv. 1907, stored in the Thermoelectric Station "Città di Roma" of Pietrafitta of ENEL); fragments of postcranial skeleton very badly preserved.

Discussion - The only fragment belonging to a lagomorph among the great quantity of fossils of Pietrafitta is a right maxillary fragment with P²-M² (L = 113,33 mm). The dimensions of the teeth are the following: P²: L = 1.52 mm; W = 2.38 mm. P³: L = 2.19 mm; W = 4.30 mm. P⁴: L = 2.30 mm; W = 4.12 mm. M¹: L = 2.26 mm; W = 3.82 mm.

The maxillary is broken along the anterior border of P² and along the hypoflex of M². P² is slightly damaged in the buccal side. Mesoflex and hypoflex are shallow whilst paraflex is clearly deeper (dental nomenclature from Lopez Martinez, 1989 and Nocchi & Sala, 1997). In the other teeth the anterior edge of the deep hypoflex is strongly crenulated.

Four species of rabbits have been described till now: *Oryctolagus laynesis* Lopez Martinez, 1977 from the Villanyian (= Early and Middle Villafranchian, Middle and Late Pliocene) of the Iberian peninsula, *Oryctolagus lacosti* (Pomel, 1853) known from several Late Villanyian and Early Biharian (Middle and Late Villafranchian, Late Pliocene and Early Pleistocene) assemblages of Western Europe, *Oryctolagus burgi* Nocchi & Sala, 1998, a Middle Pleistocene (Early Toringian, Middle Galerian) form recently described and known till now only from its type locality of Borgio Verezzi (Liguria, North Western Italy) and the living *Oryctolagus cuniculus* (Linnaeus, 1758) known as fossil in some Middle and Late Pleistocene assemblages of Western Mediterranean Europe (Corbet, 1994; Nocchi & Sala, 1997, 1998).

Our specimen is different from *O. laynesis* because the hypoflex of the two posterior premolars and of the molars is very deep whilst in the Iberian species the hypoflex reaches up half of the width of these teeth (Lopez Martinez, 1989). The fossil of Pietrafitta is different from *O. burgi* because its P² is very crushed mesio-distally (Nocchi & Sala, 1998). It is also different from *O. cuniculus* because of its bigger dimensions. *O. lacosti* is an extremely polymorphic species. In some populations mesoflex and hypoflex of P² are deep whilst in others they are present as little notches. The cranial characters and those of P₃ are also variable. Some of the cranial and post-cranial characters are hare-like and for this reason some fossils assigned by Viret (1954) and Lopez Martinez (1989) to this taxon have been ascribed in the past to several species of the genus *Lepus*: *L. valdarnensis* Weithofer, 1889, *L. etruscus* Bosco, 1899 (Weithofer, 1889; Bosco, 1899, 1900; Forteleoni, 1974). It is possible that more than one species are grouped under the specific name *O. lacosti* and a general revision of all the material assigned to this species is necessary. However, our specimen is very similar to that

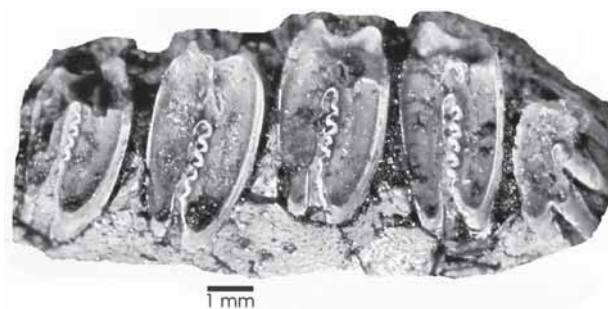


Fig. 3 - *Oryctolagus* cfr. *O. lacosti*. Fragment of right maxillary with P²-M² (Inv. 1907). Occlusal view. Pietrafitta (Umbria, Central Italy), Early Pleistocene.

of El Carmel (Spain) described and illustrated by Lopez Martinez (1989, fig. 58/3) and for this reason we ascribe the lagomorph from Pietrafitta to *Oryctolagus* cfr. *O. lacosti*.

In Italy remains assigned to *O. lacosti* (or to *O. cfr. O. lacosti*) have been described from several localities: Montagnola Senese (Tuscany), Casa Sgherri (Tuscany), Torre di Picchio (Umbria) and some localities of Upper Valdarno (Tuscany) belonging to Olivola F.U. or Tasso F.U. (Weithofer, 1889; Bosco, 1899, 1900; Fondi, 1972; Forteleoni, 1974; Marcolini et al., 2000; Girotti et al., 2003) of Late Villanyian or earliest Biharian age and from Pirro Nord (Apulia) of late Early Biharian age (De Giuli et al., 1987).

CONCLUSIONS

The study of these few mammalian remains of Pietrafitta makes possible to increase the faunal list of this site with two more species: *Sorex* cfr. *S. minutus* and *Oryctolagus* cfr. *O. lacosti*. The leporid is known from Italian sites of older age and survive in the Peninsula till the end of the Villafranchian. The soricid makes in the fossiliferous site of Pietrafitta its first occurrence in Italy and is still living.

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REFERENCES

- Ambrosetti P., Argenti P., Basilici G., Gentili S. & Ikome F. (1992). The fossil vertebrates of the Pietrafitta basin (Perugia, Umbria, Italy): preliminary analysis of the processes responsible for "paleontological production". Résumé EPA Workshop, Strasbourg, 26/27 July 1992: 20-21, Strasbourg.
- Argenti P. (2003). Plio-Quaternary mammalian fossiliferous sites of Umbria (Central Italy). *Geologica Romana*, 37: 1-18.
- Barisone G. (2003). Neogene and Quaternary *Castor* (Castoridae, Rodentia) of Central and Western Europe: systematics, palaeobiogeography and patterns of evolution. PhD Thesis, Università degli Studi Roma Tre, 158 pp. and appendix, Roma.
- Bedetti C. (2004). Le avifaune fossili del Plio-Pleistocene italiano: sistematica, paleoecologia ed elementi di biocronologia. PhD Thesis, Università degli Studi di Roma "La Sapienza", 188 pp. and appendix, Roma.

- Bosco C. (1899). I roditori pliocenici del Valdarno superiore. Nota preliminare. *Rendiconti della Regia Accademia dei Lincei*, s. 5, 8: 261-265, Roma.
- Bosco C. (1900). I roditori pliocenici del Valdarno superiore. *Palaeontographia Italica*, 5 [1899]: 85-104.
- Corbet G.B. (1994). Taxonomy and origins. In Thompson H.V. & King C.M. (eds.), *The European Rabbit*, Oxford University Press, 1-7, Oxford.
- De Giulio C., Masini F. & Torre D. (1987). The latest Villafranchian faunas in Italy: the Pirro Nord fauna (Apricena, Gargano). *Palaeontographia Italica*, 74: 51-62.
- Delfino M. (2002). Erpetofauna italiane del Neogene e del Quaternario. PhD Thesis, Università degli Studi di Modena e Reggio Emilia, 382 p., Modena.
- Fanfani F. (2000). Revisione degli insettivori (Mammalia) tardo neogenici e quaternari dell'Italia peninsulare. PhD Thesis, Università degli Studi di Modena e Reggio Emilia, 282 pp., Modena.
- Fondi R. (1972). Fauna cromeriana della Montagnola Senese. *Palaeontographia Italica*, 68: 1-27.
- Forteleoni G. (1974). The Upper Valdarno lagomorph *Lepus valdarnensis* Weithofer. *Palaeontographia Italica*, 67 [1971]: 55-68.
- Girotti O., Capasso Barbato L., Esu D., Gliozzi E., Kotsakis T., Martinetto E., Petronio C., Sardella R. & Squazzini E. (2003). The section of Torre di Picchio (Terni, Umbria, Central Italy): a Villafranchian site rich in vertebrates, molluscs, ostracods and plants. *Rivista Italiana di Paleontologia e Stratigrafia*, 109: 77-98.
- Gliozzi E., Abbazzi L., Argenti P., Azzaroli A., Caloi L., Capasso Barbato L., Di Stefano G., Esu D., Ficarelli G., Girotti O., Kotsakis T., Masini F., Mazza P., Mezzabotta C., Palombo M.R., Petronio C., Rook L., Sala B., Sardella R., Zanalda E. & Torre D. (1997). Biochronology of selected mammals, molluscs and ostracods from Middle Pliocene to the Late Pleistocene in Italy. The state of art. *Rivista Italiana di Paleontologia e Stratigrafia*, 103: 369-388.
- Hutterer R. (2005). Order Soricomorpha. In Wilson D.E. & Reeder D.A.M. (eds.), *Mammal species of the World. A taxonomic and Geographic reference*. 3rd ed., Vol. 1, The John Hopkins University Press, 220-311, Baltimore.
- Kotsakis T., Abbazzi L., Angelone C., Argenti P., Barisone G., Fanfani F., Marcolini F. & Masini F. (2003). Plio-Pleistocene biogeography of Italian mainland micromammals. *Deinsea*, 10: 313-342.
- Jammot D. (1977). Les musaraignes (Soricidae-Insectivora) du Plio-Pléistocène d'Europe. PhD Thesis, Université de Dijon, 341 pp., Dijon.
- López Martínez N. (1989). Revisión sistemática y biostratigráfica de los Lagomorpha (Mammalia) del Terciario y Cuaternario de España. *Memorias del Museo Paleontológico de la Universidad de Zaragoza*, 3: 350 pp., Zaragoza.
- Marcolini F., Bonadonna F.P., Kotsakis T., Mazza P. & Zanchetta G. (2000). Preliminary data on the micro- and macromammal remains from Casa Sgherri, Lower Valdarno (Tuscany, Italy). *Bollettino della Società Paleontologica Italiana*, 39: 243-252.
- McKenna M.C. & Bell, S.K. (1997). *Classification of Mammals*. 630 pp., Columbia University Press, New York.
- Nocchi G. & Sala B. (1997). The fossil rabbit from Valdemino cave (Borgio Verezzi, Savona) in the context of Western Europe Oryctolagini of Quaternary. *Palaeovertebrata*, 26: 167-187.
- Nocchi G. & Sala B. (1998). *Oryctolagus burgi* n. sp. (Mammalia: Lagomorpha) from the Middle Pleistocene levels of Grotta Valdemino (Borgio Verezzi, Savona, north-west Italy). *Paleontologia i Evolució*, 30/31 [1997]: 19-38.
- Popov V.V. (2003). Late Pliocene Soricidae (Insectivora, Mammalia) from Varshets (North Bulgaria). *Acta Zoologica Cracoviensia*, 46: 43-72.
- Reumer J.W.K. (1984). Ruscinian and Early Pleistocene Soricidae (Insectivora, Mammalia) from Tegelen (The Netherlands) and Hungary. *Scripta Geologica*, 73: 1-173.
- Rzebik-Kowalska B. (1991). Pliocene and Pleistocene Insectivora (Mammalia) of Poland. VIII. Soricidae: *Sorex* Linnaeus, 1758, *Neomys* Kaup, 1829, *Macroneomys* Fejfar, 1966, *Paenelimmecus* Baudelot, 1972 and Soricidae indeterminata. *Acta Zoologica Cracoviensia*, 34: 323-424.
- Rzebik-Kowalska B. (1994). Pliocene and Quaternary Insectivora (Mammalia) of Poland. *Acta Zoologica Cracoviensia*, 37: 77-136.
- Rzebik-Kowalska B. (1998). Fossil history of shrews in Europe. In Wójcik, J.M. & Wolsan, M. (eds.), *Evolution of shrews: 23-92*, Mammal Research Institute, Polish Academy of Science, Białowieża.
- Rzebik-Kowalska B. (2000). Insectivora (Mammalia) from the Early and early Middle Pleistocene of Betfia in Romania. I. Soricidae Fischer von Waldheim, 1817. *Acta Zoologica Cracoviensia*, 43: 1-53, Kraków.
- Viret J. (1954). Le loess a banc durcis de Saint Vallier (Drôme) et sa faune de mammifères villafranchiens. *Nouvelles Archives du Museum d'Histoire Naturelle de Lyon*, 4: 1-197.
- Weithofer K.A. (1889). Ueber die tertiären Landsäugethiere Italiens. *Jahrbuch der kaiserliche königliche Geologische Reichsanstalt*, 39: 56-82.

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