

Quaternary Insectivora (Mammalia) from southwestern France

Jelle W. F. REUMER

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Abstract. Remains of Insectivora from 21 cave deposits from the French Departments of Pyrénées-Atlantiques and Hautes-Pyrénées are studied. These faunas range in age from Middle Pleistocene to Holocene. The mole *Talpa europaea* is the most common insectivore; it is present in virtually all localities. The samples show a slight decrease in size through time. *Talpa minor* is found in one locality of Middle Pleistocene age (Aventignan, Grotte de Gargas). This is the first Middle Pleistocene representative of this species in France. The hedgehog *Erinaceus europaeus* is extremely rare. This could be a taphonomical artifact. A second, larger, species may be present in one locality (Gerde, grotte de la Carrière). Among shrews, the genus *Crocidura* is represented by three species. Gerde has yielded *Crocidura* sp., a species probably related to *C. kornfeldi*. *C. russula* is found in two Late Pleistocene localities, and *C. suaveolens* in one Holocene cave. Altogether, the genus is very rare. Also extremely rare is *Sorex minutus*. This is striking, as this species is known already from the Early Pliocene onwards. The most common shrew is *Sorex araneus*. It is found in several Middle Pleistocene through Holocene localities, although rarely in large quantities. The same, but in still smaller quantities, applies to the water shrew *Neomys fodiens*. Most of the material found represents extant species.

Key words: Mammalia, Insectivora, Soricidae, Talpidae, Erinaceidae, Pleistocene, Weichselian, Holocene, France

Jelle W. F. REUMER, Natuurmuseum Rotterdam, P.O. Box 23452, NL-3001 KI Rotterdam, The Netherlands.

I. INTRODUCTION

Material from 21 cave deposits in southwestern France was sent to the author in the mid-eighties in order to have the insectivores identified. The samples had been assembled by Dr. André CLOT, from Bordères-sur-l'Echez, near Tarbes, France. Unfortunately, Mr CLOT died on January 22, 1991. The material was subsequently returned to his widow in the summer of 1991 and is now being taken care of by the Lourdes museum.

The samples had been collected over a number of years in the Départments of Pyrénées-Atlantiques and Hautes-Pyrénées (Fig. 1), not only by Mr. CLOT, but also by other collectors working in the region. This implies that at present it is often impossible to be certain regarding such elementary data as collecting techniques, dates of recovery, or even who collected the material.



Fig. 1. The study area in southwestern France.

In some cases published reports on the localities involved exist; this will be outlined below (see next section), but for an important part of this work I have had to rely upon a letter sent to me by Mr CLOT in June 1986 (hereafter CLOT in litt.).

The aim of the present article is to publish identifications of the insectivores from the 21 localities.

II. THE LOCALITIES

1. Gerde (Hautes-Pyrénées), grotte de la Carrière. This locality has yielded material of predominantly Middle Pleistocene age. For details on the locality see CLOT (1970, 1971, 1973, 1975). A monograph on the cave, on the collecting techniques used and on its paleontological and prehistorical remains was published in 1987 (CLOT 1987). The insectivores were published in the same monograph (REUMER 1987) but are here mentioned again briefly for the sake of completeness.

2. Aventignan (Hautes-Pyrénées), grotte de Gargas, puits de l'Ourse. Collected by A. CLOT. CLOT (1985b) mentions the faunal list with *Talpa* sp. and possible datings. The locality is considered to be Middle Pleistocene in age: "Proche du Mindel-Riss ou du Riss-Würm, dans un épisode de steppe boisée".

3. Nestier (Hautes-Pyrénées), grotte du Cap de la Bielle. Collected by A. IMBERT (CLOT in litt.). Most information on this site was given by CLOT & MARSAN (1986). Archeologically, the sampled level is dated to the upper Acheulean; the accompanying fauna indicates a late Riss ("la fin du Pleistocène moyen"). Faunal lists are also provided by CLOT & MARSAN (1986); in these lists, *Talpa* sp., *Sorex* sp., *Neomys* sp., and *Crocidura* sp. are mentioned in levels excavated in 1956. *Crocidura* was not present in the sample we studied.

4. Saint-Pé-de-Bigorre (Hautes-Pyrénées), grotte Noëlle ou du Hayou. Collecting was done by A. CLOT and J. OMNÈS. A faunal list appeared in CLOT (1982), in which paper the sediments were

dated to the Riss and the Riss-Würm interglacial, between 150.000–90.000 years. See also CLOT (1986) for details on the archeology.

5. Tibiran-Jaunac (Hautes-Pyrénées), grotte de Tibiran. A microfauna was recovered from level 2 at the bottom of the "puits Regnault". Collecting by A. CLOT and J. JOLFRE (CLOT 1985a). CLOT (1985a) also published a faunal list, with remains dating to the "Würm probable, plutôt supérieur?" (CLOT in litt.). From the same locality, but from a younger level ("Würm très récent, ou Holocène"; CLOT in litt.) comes a sample containing only one *Talpa* (not further dealt with herein).

6. Aventignan (Hautes-Pyrénées), grotte du Renard. Collecting by A. CLOT. A faunal list was given by CLOT (1985a), who mentioned that dating was not possible. CLOT (in litt.) included this locality in his group of Late Pleistocene localities.

7. Saint-Pé-de-Bigorre (Hautes-Pyrénées), trou du Rhinocéros. This locality was not mentioned in the list of localities from Saint-Pé-de-Bigorre published by CLOT (1982). CLOT (in litt.) mentioned a fauna consisting of the following large mammals: *Coelodonta antiquitatis*, *Rangifer tarandus*, *Bison* sp., *Cervus elaphus* and *Rupicapra rupicapra pyrenaica*, in addition to remains of *Talpa*. The site was attributed to "Würm probable" (CLOT in litt.).

8. Buzy (Pyrénées-Atlantiques), gouffre Junqua. Collecting by P. ROBERT. The insectivores originate from the "faune de l'éboulis" (CLOT 1985a, in litt.); the complete faunal list is published in CLOT (1985b). From the same locality one cranium of *Sorex araneus* was recovered from the surface of the "galérie", which contains a fauna of Holocene age; it is treated below as number 23.

9. Lourdes (Hautes-Pyrénées), grotte des Espéluques. Most of the collecting was done by J. OMNÈS and by A. CLOT (CLOT 1983). We had samples from three places in the cave: one mole humerus from material collected in the 19th century; some material from "Espéluques boyau" which has a C14 date of 13170 ± 260 BP (Ly 1406; CLOT in litt.) and some from "Lourdes Calvaire" which is material from Magdalenian levels of the Espéluques cave that had been excavated and subsequently dumped on a slope below the cave. This latter material is denominated "Déblais G Calvaire" in CLOT (1983). In the present analysis all Espéluques material is treated as one sample.

10. Lortet (Hautes-Pyrénées), grotte de Lortet. The material comes from an excavated Magdalenian level and was recovered by J. OMNÈS. There is a C14 date of 12300 ± 200 years BP (Ly 3437; CLOT in litt.).

11. Bagnères-de-Bigorre (Hautes-Pyrénées), grottes d'Aurensan inférieures. This is material from older excavations, done by FROSSARD around 1870 and by QUÉRUEL around 1930–1935. Two C14 dates exist for this locality: 14280 ± 300 BP (Ly 1055) and 13910 ± 230 BP (Ly 1107). CLOT (1983) published a detailed faunal list, including 12 *Talpa europaea*.

One locality, comprising six samples, is situated around the Weichselian/Holocene transition: Arudy (Pyrénées-Atlantiques), grotte de Malarode 1. For details on the levels and sediments see MARSAN (1985). Insectivores are found in the following levels (from older to younger):

12. Malarode 1, level C6b. A C14 date exists from bone fragments of this level: 13620 ± 320 year BP (Ly 3484). Magdalenian stone tools.

13. Malarode 1, level C6a. Magdalenian.

14. Malarode 1, level C4 inférieur, "sous niveau gris".

15. Malarode 1, level C4 inférieur. From this level we have a C14 date based on a charcoal sample: 6300 ± 210 BP (Ly 3483; MARSAN 1985).

16. Malarode 1, level C4 moyen. A sample of burnt acorns and charcoal gave a C14 date of 3740 ± 140 BP (Ly 3982; MARSAN 1985).

17. Malarode 1, level C4 supérieur.

18. Troubat (Hautes-Pyrénées), grotte-abri du Moulin. Material comes from sediments of Holocene age excavated around 1870, and was collected by A. CLOT and J. BARRAGUÉ. CLOT (1985a) provided a faunal list.

19. Lortet (Hautes-Pyrénées), grotte de l'Ours. "Holocène probable" (CLOT in litt.)

20. Asson (Pyrénées-Atlantiques), puits Schatzi. CLOT (1983) mentioned one skull of *Sorex araneus* from the "Grande salle Schatzi", the age was supposed to be "Partie ancienne de l'Holocène (ou fin du Würm?)" (CLOT in litt.).

21. Asson (Pyrénées-Atlantiques), grotte de Monrepos. The sample consists of Holocene material found in a fox's den in the cave. It was collected by P. A. ACQUIER and R. ROBERT (CLOT 1985b, who also published a faunal list).

22. Arthez d'Asson (Pyrénées-Atlantiques), gouffre PH3. The material was found at 50 m depth at the bottom of the entrance chimney (CLOT in litt.).

23. Buzy (Pyrénées-Atlantiques), gouffre Junqua. See above under 8.

24. Poumarous (Hautes-Pyrénées), grotte Paillet. Material collected by J. BARRAGUÉ and A. CLOT in 1983. CLOT (1985a) published a map of the cave and a faunal list. "Faune subactuelle" (CLOT 1985b) or "Holocène récent" (CLOT in litt.).

25. Ilhet (Hautes-Pyrénées), gouffre du Pic des Limes. Material found at the bottom of the entrance chimney, dated to "Holocène, plutôt récent" (CLOT in litt.).

26. Lourdes (Hautes-Pyrénées), abri de la Citoyenne. The material was recovered from sediments mixed by burrowing animals, containing abundant microfauna and archeological artifacts from the last two millennia (CLOT in litt.).

CLOT (in litt.) divided these 26 samples from 21 localities into five stratigraphical clusters. Localities nos. 1-3 formed the Middle Pleistocene cluster, nos. 4-8 the Late Pleistocene cluster, and nos. 9-11 were in the late Weichselian ("Würm 4, sites à industrie magdalénienne"). The samples from the Malarode 1 cave (Arudy, nos. 12-17) were clustered in a separate group: "Würm 4 et première moitié de l'Holocène", and, finally, nos. 18-26 were in a Holocene cluster.

As will be clear from the data given above, this subdivision into five clusters can not be maintained. In the present study therefore, only three clusters will be used. The localities 1-4 predate the Weichselian (Würm) and are grouped together as pre-Weichselian. Localities 5-13 are Weichselian, and localities 14-26 form a Holocene cluster.

III. FAUNAL COMPOSITION

Table I gives the faunal composition of the 26 samples named above. The minimum number of individuals (MNI) is indicated. All material has been taken into account in obtaining the MNI. In the case of *Talpa* this was mostly the humerus; in the case of other species dental elements.

The pre-Weichselian cluster has the greatest specific diversity with eight species in four localities. The Weichselian localities contain four taxa, one of which (*Crocidura russula*) in one locality only. The Holocene localities contain five species. Again, a *Crocidura* (*C. suaveolens*) is encountered in one locality only. *Talpa europaea* is by far the most abundant species in all clusters. Table II gives the appropriate percentages for the three clusters.

Table I

Minimum number of individuals of insectivores in the studied samples. Locality numbers (1 through 26) are explained in the text. Species abbreviations: Tmi = *Talpa minor*, Teu = *Talpa europaea*, Eeu = *Erinaceus europaeus*, Esp = *Erinaceus* sp. indet., Sar = *Sorex araneus*, Smi = *Sorex minutus*, Nfo = *Neomys fodiens*, Csp = *Crocidura* sp. indet., Cru = *Crocidura russula*, Csu = *Crocidura suaveolens*. * = present according to CLOT, 1982.

Species Loc. number	Tmi	Teu	Eeu	Esp	Sar	Smi	Nfo	Csp	Cru	Csu
1	—	114	—	7	23	8	2	1	—	—
2	1	—	—	—	—	—	—	—	—	—
3	—	28	—	—	10	—	1	—	—	—
4	—	5	*	—	4	1	1	—	2	—
5	—	3	—	—	2	—	—	—	—	—
6	—	1	—	—	—	—	—	—	—	—
7	—	2	—	—	—	—	—	—	—	—
8	—	1	—	—	—	—	1	—	—	—
9	—	4	—	—	1	—	—	—	3	—
10	—	1	—	—	1	—	—	—	—	—
11	—	13	—	—	—	—	—	—	—	—
12	—	4	—	—	4	—	1	—	—	—
13	—	10	—	—	3	—	1	—	—	—
14	—	9	—	—	3	—	2	—	—	—
15	—	14	—	—	2	—	2	—	—	—
16	—	3	—	—	—	—	—	—	—	—
17	—	1	—	—	—	—	—	—	—	—
18	—	1	2	—	—	—	—	—	—	—
19	—	1	—	—	1	—	1	—	—	—
20	—	—	—	—	1	—	—	—	—	—
21	—	2	2	—	—	—	—	—	—	—
22	—	—	—	—	5	—	1	—	—	—
23	—	—	—	—	1	—	—	—	—	—
24	—	—	1	—	—	—	—	—	—	—
25	—	1	1	—	6	1	—	—	—	—
26	—	77	—	5	—	—	—	—	—	1

Table II

Percentages of insectivore species in the clusters of localities. Pre-Weichselian localities are numbers 1-4; Weichselian localities are numbers 5-13; Holocene localities are numbers 14-26 (see text and Table I). For explanation of species abbreviations see caption of Table I

Species	pre-Weichselian		Weichselian		Holocene	
	n	%	n	%	n	%
Tmi	1	0.5	—	—	—	—
Teu	147	70.7	39	69.6	109	74.1
Eeu	—	—	—	—	11	7.5
Esp	7	3.4	—	—	—	—
Sar	37	17.8	11	19.6	19	12.9
Smi	9	4.3	—	—	1	0.7
Nfo	4	1.9	3	5.4	6	4.1
Csp	1	0.5	—	—	—	—
Cru	2	1.0	3	5.4	—	—
Csu	—	—	—	—	1	0.7

IV. SYSTEMATIC PALAEOONTOLOGY

Order: Insectivora

Family: Erinaceidae

Genus: *Erinaceus* LINNAEUS, 1758*Erinaceus europaeus* LINNAEUS, 1758

Localities and synonymy: Troubat (grotte-abri du Moulin): *Erinaceus europaeus*, in: CLOT 1985a; Asson (grotte de Monrepos): *Erinaceus europaeus*, in: CLOT 1985b; Poumarous (grotte Paillet): *Erinaceus europaeus*, in: CLOT 1985b; Ilhet (gouffre du Pic des Limes); Lourdes (abri de la Citoyenne).

Remark: Except for an unidentified hedgehog in Gerde (see below), all hedgehogs are found in Holocene localities only. It may thus seem that the hedgehog was absent from the region during the late Pleistocene. CLOT (1982), however, mentioned *E. europaeus* from the Grotte Noëlle at Saint-Pé-de-Bigorre. Even if this species can not be found in the sample from this locality that we actually studied, this may indicate that the absence of hedgehogs in our samples does not reflect the true situation. It may be due to taphonomic effects (see below). It is also noteworthy that CLOT & DURANTHON (1990) mention the presence of hedgehogs in nine Weichselian and seven Holocene localities in the French Pyrenees, without, however, naming the localities.

Erinaceus sp. indet

Locality and synonymy: Gerde (grotte de la Carrière): *Erinaceus europaeus*, in: CHALINE 1972, CLOT & DURANTHON 1990; *Erinaceus* sp. (cf. *E. europaeus* L., 1758), in: REUMER 1987.

Remark: A problematical hedgehog is present in Gerde. In 1987 I identified it as cf. *E. europaeus*. It may not be that easy. Fig. 2 shows a scatter diagram of length and width of the trigonid of the first lower molar (m1). Material of *E. europaeus* from several of our Holocene sites (Asson/Monrepos, Ilhet/Pic des Limes, and Lourdes/abri de la Citoyenne), as well as some recent specimens is included, together with the mean of *Erinaceus davidi* from Les Abimes de la Fage (JAMMOT 1973), next to the material from Gerde. *E. davidi* was originally described by JAMMOT (1973) as "la plus grande des espèces européennes de Hérisson du Plio-Pleistocène décrite à ce jour". It is thus striking to note that the two measured teeth from Gerde are larger, and one of them even considerably so.

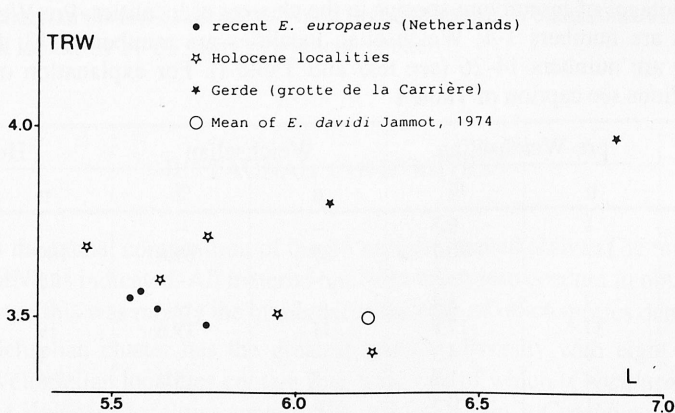


Fig. 2. Diagram of the relationship between trigonid width (TRW) and molar length (L) of m1 in *Erinaceus europaeus* and *E. davidi*.

Fig. 2 also shows that the size difference between *E. europaeus* and *E. davidi* may be rather small. Due to the scantiness of the material from Gerde I now prefer to refer to this hedgehog as *E. sp. indet.*

Family: Talpidae

Genus: *Talpa* LINNAEUS, 1758

Talpa minor FREUDENBERG, 1914

(Fig. 3)

Locality and synonymy: Aventignan (grotte de Gargas, puits de l'Ourse): *Talpa sp.*, in: CLOT 1985a, CLOT & EVIN 1986.

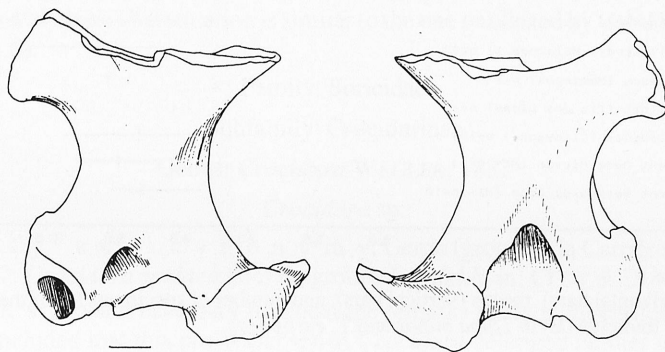


Fig. 3. *Talpa minor*, Aventignan (grotte de Gargas). Humerus. Bar = 1 mm.

Remarks: Some postcranial material of a small talpid is attributed to *T. minor*. As can be seen in Fig. 4, the humerus from Aventignan is considerably smaller than the material from the other studied localities. *T. minor* is - as its name indicates - a small mole. It is known from the Late Pliocene up to the Middle Pleistocene (Holsteinian). Its main distribution is in Central Europe (Hungary, Poland, Austria, Germany, the Netherlands). RODERS (1987) studied *T. minor* from Tegelen, the Netherlands. Her measurements indicated a width of the diaphysis of the humerus (D) of 3.2-3.9 (mean 3.5) mm, and a width of the distal epiphysis (E) of 6.7-7.6 (mean 7.0) mm. Our specimen from Aventignan measures D=3.13 mm and E=5.58 mm; it is thus smaller than the Tegelen material (see also Fig. 4). KOENIGSWALD (1972) gives the values D=3.1 mm and E=6.7 mm for a specimen from Sudmer-Berg-2 (Elsterian, Germany); here D conforms to the size of our specimen. The sizes of *T. minor* from Petersbuch 1 (Holsteinian, Germany) show a D between 2.7-3.3 mm and E between 5.4-6.5 mm (KOENIGSWALD 1970). These sizes match our sizes, which corroborates the identification of our material from Aventignan as *T. minor*.

In France, *T. minor* has so far been mentioned only from the Early Pleistocene of Montoussé 5 (Hautes-Pyrénées; CLOT et al. 1976a, 1976b).

Talpa europaea LINNAEUS, 1758

(Figs 5 & 6)

Localities and synonymy: Gerde (grotte de la Carrère): *Talpa* and *Talpa europaea*, in: CLOT 1971; *Talpa europaea*, in: CHALINE 1972, CLOT 1973, REUMER 1987; *Talpa aff. romana*, in: CLOT & DURANTON 1990; Nestier (grotte du Cap de la Bielle): *Talpa europaea*, in: CHALINE 1972, CLOT & MARSAN 1986; *Talpa aff. romana*, in: ROBERT 1983, CLOT & MARSAN 1986, CLOT & DURANTON 1990; *Talpa sp.*, in: CLOT & MARSAN 1986; Saint-Pé-de-Bigorre (grotte Noëlle): *Talpa europaea*, in: CLOT 1982; Tiberan-Jaunac (grotte de Tiberan): *Talpa europaea*, in: CLOT 1985a; CLOT & EVIN 1986; Aventignan (grotte de Renard): *Talpa europaea*,

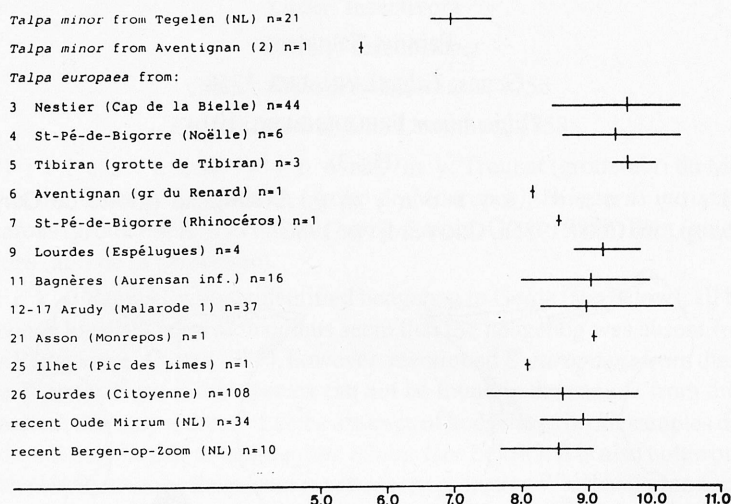


Fig. 4: Ranges (horizontal bars), means (vertical bars), and number of specimens (n) of the width of the distal epiphysis of the humerus (E) in *Talpa minor* and *T. europaea*.

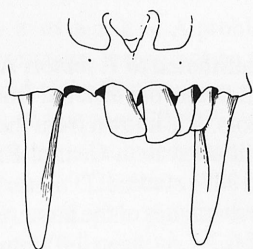


Fig. 5. *Talpa europaea*, Tibiran (grotte de Tibiran, puits Regnault, couche II). Frontal view of anterior dentition. Bar = 1 mm.

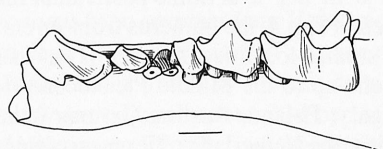


Fig. 6. *Talpa europaea*, Lourdes (abri de la Citoyenne). Left mandibular fragment with p1, p2, a supernumerary element, p3, p4 and m1. The extra premolar is indicated by two root-bearing alveoli; its crown is not present. Bar = 1 mm.

in: CLOT 1985a; Saint-Pé-de-Bigorre (trou du Rhinocéros); Buzy (gouffre Junqua); Lourdes (grotte des Espéluques): *Talpa europaea*, in: CLOT 1983; Lortet (grotte de Lortet); Bagnères-de-Bigorre (grottes d'Aurensan inférieures): *Talpa europaea*, in: CLOT 1983; Arudy (grotte de Malarode 1); Troubat (grotte-abri du Moulin): *Talpa europaea*, in: CLOT 1985a; Lortet (grotte de l'Ours); Asson (grotte de Monrepos): *Talpa europaea*, in: CLOT 1985b; Ilhet (gouffre du Pic des Limes); Lourdes (abri de la Citoyenne).

R e m a r k s: *T. europaea* is clearly the most abundant insectivore in our samples. A slight decrease in size can be noted from the data presented in Fig. 4. Two Recent samples from the Netherlands are added to the figure for comparison: Oude Mirrum (province of Friesland) and Bergen-op-Zoom (province of North Brabant), both taken from RODERS (1987). Their sizes compare best with Holocene French samples, although considerable overlap in size ranges occurs with the other samples. The measurement data do not indicate any taxonomic distinction between

the studied samples. Although the variation is sometimes rather large, it is not possible to find species other than *T. europaea* (i. e., *T. caeca* or *T. romana*). The anterior dentition (Fig. 5) of a skull found in the Weichselian locality of Tibiran (loc. no. 5) shows a morphology which is identical to the one given by VAN DEN BRINK (1978) as being typical for *T. europaea*.

ROBERT (1983) identifies the remains from Nestier (grotte du Cap de la Bielle, no. 3) as *T. aff. romana*. CLOT & DURANTHON (1990) follow this identification and extend it to the remains from the "galérie nord-ouest" of Gerde (grotte de la Carrière, no. 1). As Fig. 4 clearly shows, the moles from Nestier are of the same size as those from the grotte de Tibiran (no. 5). The latter samples are clearly identified as *T. europaea*.

The Holocene locality of Lourdes (abri de la Citoyenne, no. 26) has yielded a mandible with a supernumerary premolar (Fig. 6). Two alveoli still bearing roots are found between p2 and p3; the crown is unfortunately lost. This situation is similar to the one published by VAN HEURN & HUSSON (1960: fig. 1b, p. 6).

Family: Soricidae

Subfamily: Crocidurinae

Genus: *Crocidura* WAGLER, 1832

Crocidura sp.

Locality and synonymy: Gerde (grotte de la Carrière): *Crocidura* sp., in: REUMER 1987; *Crocidura spelaea* (sic) du groupe *kornfeldi*, in: CLOT & DURANTHON 1990.

Remarks: It is not necessary to repeat the remarks made in an earlier paper (REUMER 1987). It was concluded that this pre-Weichselian *Crocidura* belonged neither to *C. russula*, nor to *C. leucodon* or *C. suaveolens*. A relationship to *C. kornfeldi* was suggested. This implies that the *Crocidura* from Gerde represents an extinct species; together with *Talpa minor* from Aventignan and possibly also *Erinaceus* sp. from Gerde the only fossil species in our samples.

The designation *C. spelaea* in CLOT & DURANTHON (1990) is based on an editorial error: throughout this monograph the abbreviation "sp." has been interpreted as "*spelaea*" and printed as such.

Crocidura russula (HERRMANN, 1780)

(Fig. 7)

Localities: Saint-Pé-de-Bigorre (grotte Noëlle); Lourdes (grotte des Espéluques).

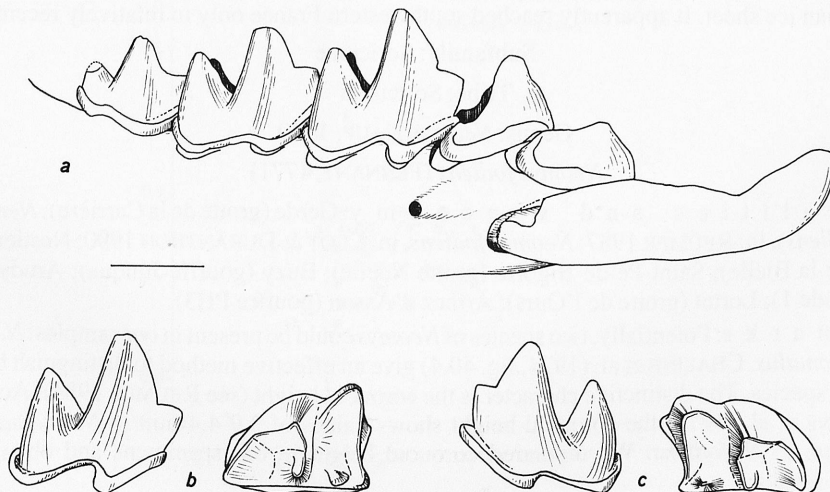


Fig. 7. *Crocidura russula*. a: Saint-Pé-de-Bigorre (grotte Noëlle), right mandibular ramus with complete dentition. b, c: Lourdes (grotte des Espéluques), right m1 (b) and left m2 (c). Bar = 1 mm.

R e m a r k s: Our material consists only of lower jaws. Nevertheless, the material from Saint-Pé and Lourdes can safely be attributed to *C. russula*, after comparison with recent owl-pellet material from Loubieng (Pyrénées-Atlantiques). The mandible from Saint-Pé (see Fig. 7) has a length of m1-m3 of 4.06 mm. This is within the range given by CHALINE et al. (1974) and POITEVIN (1984) for *C. russula*. As is shown by POITEVIN (1984) *C. russula* is characterized by a constriction in the buccal cingulum of m2 (see Fig. 7), which is present in our specimens.

Crocidura suaveolens (PALLAS, 1811)

(Fig. 8)

L o c a l i t y: Lourdes (abri de la Citoyenne).

R e m a r k s: There is but one lower jaw in all the studied samples that can be attributed to this species. The length of m1-m3 measures 3.85 mm, which is below the values given by CHALINE et al. (1974) and POITEVIN (1984) for *C. russula*. The size conforms rather well with the values given for *C. suaveolens*. The m2 does not have the buccal cingular constriction, which also indicates an identification as *C. suaveolens*.

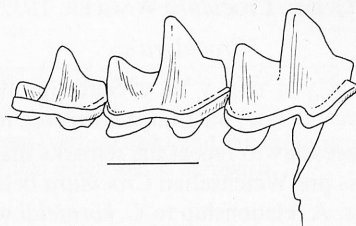


Fig. 8. *Crocidura suaveolens*, Lourdes (abri de la Citoyenne). Right m1-m3. Bar = 1 mm.

The fact that this species is only found in a sample of late Holocene age could imply that *C. suaveolens* did not live in the region during the Pleistocene and the early Holocene. It may have entered the region in subrecent times. This conclusion is in accordance with the hypothesis of CATZEFLIS (1984), who suggested that *C. suaveolens* invaded Europe after the retreat of the Weichselian ice sheet. It apparently reached southwestern France only in relatively recent times.

Subfamily: Soricinae

Tribe: Soriculini

Genus: *Neomys* KAUP, 1829

Neomys fodiens (PENNANT, 1771)

L o c a l i t i e s a n d s y n o n y m y: Gerde (grotte de la Carrière): *Neomys* sp. (cf. *N. fodiens*), in: REUMER 1987; *Neomys fodiens*, in: CLOT & DURANTHON 1990; Nestier (grotte de Cap de la Bielle); Saint-Pé-de-Bigorre (grotte Noëlle); Buzy (gouffre Junqua); Arudy (grotte de Malarode 1); Lortet (grotte de l'Ours); Arthez d'Asson (gouffre PH3).

R e m a r k s: Potentially, two species of *Neomys* could be present in our samples: *N. fodiens* and *N. anomalus*. CHALINE et al. (1974, fig. 40.4) give an effective method to distinguish between these two species. The distinctive character is the coronoid height (see REUMER 1984). According to CHALINE et al. (1974) the coronoid height shows values of 3.9-4.4 mm in *N. anomalus* and 4.4-5.3 mm in *N. fodiens*. We measured coronoid height in our specimens and obtained the following results:

Nestier: 4.75 mm;

Arudy/Malarode: 4.63, 4.75, 4.83, 4.87, 4.97 and 5.06 mm;

Lortet: 4.80 mm.

This clearly demonstrates that all our material most probably belongs to *N. fodiens*. The material from Gerde was previously identified as *N. sp.* (cf. *N. fodiens*). Comparison of this material and its sizes with the other studied material now allows identification as *N. fodiens*.

Tribus Soricini

Genus *Sorex* LINNAEUS, 1758

Sorex araneus (LINNAEUS, 1758)

(Fig. 9)

Localities and synonymy: Gerde (grotte de la Carrière): *Sorex* cf. *araneus*, in: CHALINE 1972; *Sorex* sp., groupe *araneus*, in: REUMER 1987; Nestier (grotte du Cap de la Bielle): *Sorex*, in: JAMMOT 1975; *Sorex alpinus*, in: CLOT & MARSAN 1986; *Sorex* sp., in: CLOT & MARSAN 1986; *Sorex* cf. *araneus*, in: CLOT & MARSAN 1986; Saint-Pé-de-Bigorre (grotte Noëlle): *Sorex*, in: JAMMOT 1975; *Sorex alpinus*, in: CLOT & MARSAN 1986; *Sorex* sp., in: CLOT & EVIN 1986; Lourdes (grotte des Espélugues): *Sorex araneus*, in: CLOT 1983; Lortet (grotte de Lortet); Arudy (grotte de Malarode 1); Lortet (puits de l'Ours); Asson (puits Schatzi): *Sorex araneus*, in: CLOT 1983; Arthez d'Asson (gouffre PH3); Buzy (gouffre Junqua, surface): *Sorex araneus*, in: CLOT 1985b, CLOT & EVIN 1986; Ilhet (gouffre du Pic des Limes).

Remarks: The taxonomy of several Eurasian species of the genus *Sorex* is based on cytogenetics rather than on morphological/osteological characters. This naturally causes problems for paleontologists, who do not have chromosomes or proteins at their disposal. At present two sibling species of *Sorex* inhabit the region under study: *Sorex araneus* (*in casu* the subspecies *S.*

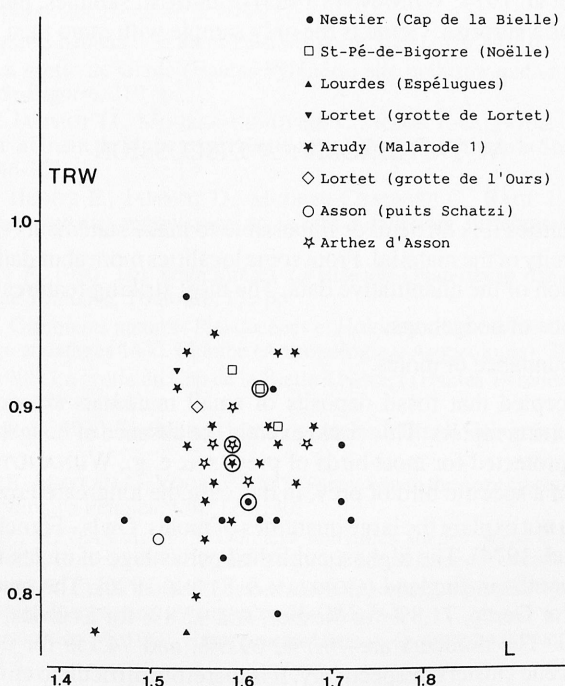


Fig. 9. Diagram of the relationship between trigonid width (TRW) and molar length (L) of m1 in *Sorex araneus*. Circled values are the means of the samples.

araneus pyrenaicus MILLER, 1909) and *S. coronatus* MILLET, 1828. HAUSSEUR et al. (1975, 1985) give cytogenetic, biogeographic and taxonomic details on the matter. It is possible to distinguish between living *S. araneus* and *S. coronatus* based on morphological characters (HAUSSEUR & JAMMOT 1974). However, these characters are not always very clear, and such a distinction appears impossible to obtain in fossil material. HAUSSEUR & JAMMOT (1974) made use of an apparatus (so-called "bloc comparateur optique") that was invented and developed by JAMMOT in order to obtain the biometrical distinction. This apparatus shows, e. g., a mandible from the buccal side (needed for orientation) and at the same time from the lingual side (needed for actually taking the measurements). Not having such an apparatus we were unable to take the proper measurements.

It has also to be taken into account that speciation within the *S. araneus* group is most probably of rather recent date, and that the ecological differentiation between the sibling species is so small that it is of no use in paleoecological reconstructions. For these reasons we prefer to identify our material as *S. araneus*. CLOT (1985a) is the only author to have made mention of *S. coronatus* in a fossil sample (Troubat, grotte de Troubat, a locality not included in the present study).

Fig. 9 shows the relationships between the length of m1 and the width of the trigonid of the same tooth. We observe great variation but no clear distinction between localities. The means of the measurements from localities with sufficient material appear rather closely grouped.

Sorex minutus (LINNAEUS, 1766)

L o c a l i t i e s a n d s y n o n y m y: Gerde (grotte de la Carrière): *Sorex minutus*, in: REUMER 1987; Saint-Pé-de-Bigorre (grotte Noëlle); Ilhet (gouffre du Pic des Limes).

R e m a r k s: The pigmy shrew is distributed over the whole of France (CHALINE et al. 1974) and exists since the Pliocene (REUMER 1984). It is thus no surprise to find this species in Pleistocene samples. Its low abundance is, however, striking. *S. minutus* is never very abundant in owl pellets (CHALINE et al. 1974; WIJNANDTS 1983) or in fossil samples, but its absence in most of our samples comes as a surprise. Gerde is the only sample with more than one individual.

V. TAPHONOMY: A DISCUSSION

For most of the localities it is difficult or impossible to make statements on the taphonomy of the finds, due to the scarcity of the material. From some localities more abundant material is present, allowing an interpretation of the quantitative data. The most striking features are:

1. The virtual absence of hedgehogs.
2. The enormous abundance of moles.

It is commonly accepted that fossil deposits of small mammals are quite often fossilized regurgitation pellets of avian raptors. This could explain the absence of hedgehogs, which are both too large and too well protected for most birds of prey (see, e. g., WIJNANDTS 1983 for a picture of the size-preference of a specific bird of prey, in this case the long-eared owl, *Asio otus*).

Avian predation can not explain the large quantities of moles. Owls - French owls - only seldom eat moles (CHALINE et al. 1974). The highest published percentage of moles in the diet of owls is 15% during summer months in England (GORMAN & STONE 1990). The percentage of moles in our samples is 73.5% for Gerde, 71.8% for Nestier, and 92.8% for Lourdes, to use the localities with the most material. The numbers are 70.7%, 69.6%, and 74.1% for the pre-Weichselian, Weichselian, and Holocene clusters, respectively. It is therefore difficult to envisage these samples as composed entirely of fossilized owl pellets. Clearly, some other agent must have contributed to the bone accumulation, e. g., burrowing. Another argument against deposition of the material through predatory agents is the relatively undamaged nature of the bone and the teeth, which show

no excessive corrosion due to stomach acids. The high percentage of moles remains largely unexplained.

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