Atti Accademia Nazionale dei Lincei

Classe Scienze Fisiche Matematiche Naturali

Rendiconti

Elsa Gliozzi

Apodemus sylvaticus tyrrhenicus n. ssp. (Muridae, Rodentia) from the upper Pleistocene of Capri Island (Campania, Southern Italy)

Atti della Accademia Nazionale dei Lincei. Classe di Scienze Fisiche, Matematiche e Naturali. Rendiconti, Serie 8, Vol. **82** (1988), n.2, p. 331–343.

Accademia Nazionale dei Lincei

<http://www.bdim.eu/item?id=RLINA_1988_8_82_2_331_0>

Atti della Accademia Nazionale dei Lincei. Classe di Scienze Fisiche, Matematiche e Naturali. Rendiconti, Accademia Nazionale dei Lincei, 1988.

Atti Acc. Lincei Rend. fis.
(8), LXXXII (1988), pp. 331-343

Paleontologia — Apodemus sylvaticus tyrrhenicus *n. ssp. (Muridae, Rodentia) from the upper Pleistocene of Capri Island (Campania, Southern Italy).* Nota di ELSA GLIOZZI, presentata (*) dal Socio A. AZZAROLI.

ABSTRACT. – Some cranial and appendicular remains referable to the genus *Apodemus* are described. They were collected in a sandy-volcanic succession that fill up the "Vascio 'o funno" cave (SE coast of the Capri island). These deposits are referable to the Late Pleistocene.

The great dimensions of skull and teeth and some archaic dental patterns suggested the attribution of these remains to a new extinct subspecies of *Apodemus sylvaticus* (LINNAEUS) for which the name *Apodemus sylvaticus tyrrhenicus* is proposed.

KEY WORDS: Mammalia (Muridae); New Taxon; Capri Island; Late Pleistocene.

RIASSUNTO. – Apodemus sylvaticus tyrrhenicus n. ssp. (*Muridae Rodentia*), *dai depositi del Pleistocene superiore di Capri* (*Campania, Italia meridionale*). Vengono descritti alcuni resti cranici ed appendicolari di *Apodemus* provenienti dalla successione sabbiosa di riempimento della grotta "Vascio 'o funno" (versante sud-orientale dell'isola di Capri) riferibile al Pleistocene superiore. Le grandi dimensioni di cranio e denti ed alcuni caratteri dentari arcaici suggeriscono il riferimento di tali resti ad una nuova sottospecie di *Apodemus sylvaticus* (Linnaeus) per la quale si propone il nome di *Apodemus sylvaticus tyrrhenicus*.

INTRODUCTION

"Vascio 'o funno" cave opens in the Jurassic limestone cliff which borders Matermania Cove, in the southeastern side of Capri island. It is filled, almost up to its ceiling, by a very thick detrital deposit which leans against two well preserved wave-notches respectively 8 m and 1.5 m a.s.l. The cave-filling succession, described with details by CAI (1974-75) and by Cinque, Gliozzi and Esu (1986), is supposed to be of Late Pleistocene age, probably corresponding to the first Tyrrhenian post cooling (isotopic stage 4). It is ca. 20 m thick and consists of an irregular alternation of more or less coarse yellowish sands, poorly cemented, and gray and black reworked volcanics, loose or cemented, which both gently dip inside the cave. These deposits are all interested by fine horizontal lamination and locally small lenses of clay intercalated. The quiet deposition of sand and volcanics is often interrupted by lens-shaped masses of breccia with angular calcareous elements and scarce sandy matrix.

All the fine-grained terms of this succession are fossiliferous and have yielded abundant remains of land mollusks, amphibians, reptiles, birds and mammals. Mam-

(*) Nella seduta del 20 novembre 1987.

mal remains represent the most abundant fraction of the collected fossil material, but they may be referred to only two rodent genera: *Apodemus* Kaup, 1829 and *Muscardinus* Kaup, 1829. Both Capri rodents show some peculiar characters which suggest that they can be considered as endemic forms (Cinque Gliozzi and Esu, 1986).

In this paper only the remains belonging to the murid form are presented, while those referable to an endemic *Muscardinus* sp. will be published in a next paper together with an analysis of the Pleistocene mammalofaunas already known from Capri.

Osteologic and dental descriptions

Fossil remains collected from "Vascio 'o funno" cave and referred to the genus *Apodemus* are very abundant, even if fragmentary. They were collected from all the cave-filling succession layers (Cinque, Gliozzi and Esu, 1986) (most of all in the lower terms) and do not show any dimensional or morphological differences. Therefore, descriptions, measurements and average values discussed in the next paragraphs are relative to all the available material and are representative of the variability of the Capri murid.

Skull

Only three cranial portions of the murid are available: the first one consists of the frontals and the right maxillary which bears the complete tooth-row; the second one is in a better state of preservation and nasals, maxillaries (with both complete tooth-rows), left zygomatic processes of maxillary and mandibles (bearing complete tooth-rows) are preserved (Fig. 1e); the third cranial portion is still partially enclosed in the cemented sandy matrix and consists of the left intermaxillary and maxillary part of the zygomatic process and the complete left tooth-row. Besides, several maxillary fragments have been collected with the more or less complete molar series.

From the available cranial specimens it is possible to get an idea only of the aspect of the snout, whereas too scarce portions of neurocranium were collected: an occipital and part of an interparietal. It bears the character of *Apodemus* and is rather large (with dimensions comparable to large specimens of *Apodemus flavicollis* (Melchior, 1834) and even larger) (Tab. 1), stout, with high rostrum; frontals and nasals appear flat and in lateral view show a straight profile. In ventral view the palate is elongated and narrow, with narrow and proportionally short *foramina incisiva*. The diastema is elongated and is almost twice as long as the molar series. The general form of the rostrum has been estimated calculating some ratios between the lengths of the diastema, the upper molar series, the *foramina incisiva* and minimum palatal width to palatal total length (*Palation-Henselion*) (Tab. 2). These ratios show that the Capri murid bears a narrower and more elongated muzzle even than that of *A.*

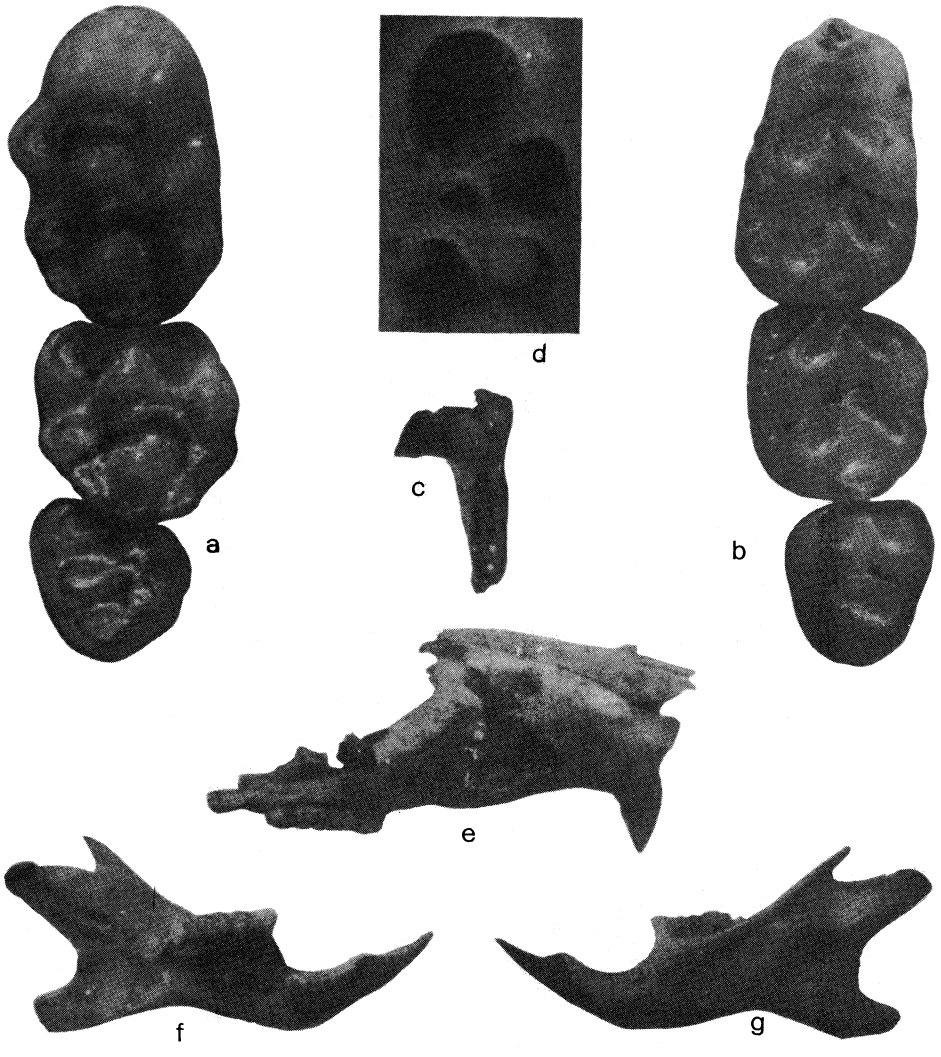

Fig. 1 - *Apodemus sylvaticus tyrrhenicus* n. ssp. a. left upper molar series M18405 in occlusal view (x17); b. left lower molar series M18406 in occlusal view (x17); c. alveolar pattern of right upper molar series (M18407) (x2.5); d. detail of M^1 alveolar pattern (the same specimen of c.) (x17); e. cranial portion M18404 (holotype) in right lateral view (x2.5); left mandible M18408 in medial view (x2.5); g. left mandible M 1408 in lateral view (x2.5).

Tab. 1 - Skull measurements of *A. sylvaticus tyrrhenicus* n. ssp. and comparison with other insular and continental forms of middle-sized *Apodemus*. (All measurements are in mm). (a) Alcover, 1977; (b) Sans-Coma and Kahmann, 1977; (c) Kahmann and Niethammer, 1971; (c) Felten and Storch 1970; (d) Van der Straeten and Van der Straeten-Harrie 1977; (e) Niethammer, 1978a, 1978b.

measurements	*A. sylvaticus tyrrhenicus* n.ssp.	*A. sylvaticus eivissiensis* (a)	*A. sylvaticus frumentariae* (b)	*A. sylvaticus ilvanus* (c)	*A. sylvaticus dichrurus* (d)	*A. sylvaticus hermani* (d)	*A. sylvaticus* (e)	*A. flavicollis* (e)
nasal length	10.7 (1)	10.5 (13)	—	—	—	—	8.7 (164)	10.1 (78)
palatal length	14.3 (1)	13.6 (45)	12.3 (41)	12.9 (12)	—	—	10.3 (167)	11.7 (80)
diastema length	8.7 (2)	7.4 (23)	7.3 (41)	7.2 (13)	7.1 (39)	7.5 (7)	6.4 (167)	7.3 (81)
foramina incisiva length	6.7 (1)	6.1 (23)	5.7 (41)	6.6 (12)	5.8 (38)	6.3 (7)	5.3 (167)	5.5 (81)
mandible length	15.9 (6)	15.9 (70)	—	15.2 (13)	14.8 (39)	15.9 (7)	13.8 (30)	15.7 (30)
interorbital width	4.4 (1)	4.3 (23)	4.3 (41)	4.5 (13)	4.2 (39)	4.3 (6)	3.9 (167)	4.2 (74)
zygomatic width	15 (1)	14.9 (15)	—	—	—	—	12.2 (159)	13.6 (54)
min. palatal width	3.1 (1)	—	—	—	—	—	2.7 (167)	2.8 (80)

flavicollis, whose snout is, in its turn, in general more slender than in *Apodemus sylvaticus* (Linnaeus, 1758).

As the Capri murid clearly can be placed among the middle-sized *Apodemus* forms particular attention was paid to those cranial characters which, according to various Authors, can be used to distinguish the two present species *A. sylvaticus* and *A. flavicollis*, namely: the position reached by the posterior border of the *foramina incisiva*, which is behind (*A. sylvaticus*) or in front of (*A. flavicollis*) the anterior root of M^1 (Steiner, 1968; Krapp, 1975: Recco, Federici and Cristaldi, 1978; Filippucci *et alii*, 1984; Amori and Contoli, 1985); three biometric functions elaborated by Van der Straeten (1976) and Van der Straeten and Van der Straeten-Harrie (1977), which put in mathematical relations several biometrical parameters; a complex biometric index, elaborated by Filippucci *et alii* (1984) which takes into account the sum of $M^1 - M^3$ length, palatal bridge length, interorbital width and *foramina incisiva* lenght.

Tab. 2 - Values of some skull ratios of *A. sylvaticus tyrrhenicus* n. ssp., *A. sylvaticus* (mainland) and *A. flavicollis*. (a) Van der Straeten and Van der Straeten-Harrie, 1977.

	A. sylvaticus tyrrhenicus n.ssp.	*A. sylvaticus* (a)	*A. flavicollis* (a)
diastema length / palatal length	63.6%	62.2%	61.9%
foramina incisiva length / palatal length	46.8%	51.7%	47.1%
M^1-M^3 length / palatal length	30.8%	37.0%	37.0%
min. palatal width / palatal length	21,7%	25.9%	23.9%

Both the biometric functions and the biometric index do not give any useful value because of the large size of the Capri specimens; in fact, as far as the biometric functions of Van der Straeten are concerned, values obtained for the Capri murid are always greater than those indicated as typical for *A. sylvaticus* and even greater than those reported for *A. flavicollis*: x_2 = 115.6 for Capri murid, 90.4 for *A. sylvaticus* and 108.4 for *A. flavicollis*; x_3 = respectively 201.1, 72.7 and 90.5 (Van der Straeten and Van der Straeten-Harrie, 1977). As regards the biometric index of Filippucci *et alii* (1984) the value calculated for the Capri specimens is 7.4; according to the Authors *A. sylvaticus* specimens show values less then 6.9 while *A. flavicollis* ones show values greater than 8. Attention should be called to the fact that the same biometric index applied to twelve specimens of *Apodemus sylvaticus ilvanus* Kahamann and Niethammer, 1971, the "giant" field mouse of the Elba island, gives the same ambiguous results (8 specimens out of 12 show values between 6.9 and 8; 2 specimens show values greater than 8 and, in consequence, are referable to *A.*

flavicollis, and only 2 specimens out of 12 show values in accordance with those of the species *A. sylvaticus* to which this subspecies actually pertains) (measurements data from Filippucci *et alii*, 1984).

So, the only characters that can be utilized for discriminating purposes are of a qualitative nature (even if not all the Authors agree on their diagnostic value). In respect to the posterior border of the *foramina incisiva*, all three skulls available from Capri show it behind the anterior root of M^1. The Capri murid is, therefore, similar to *A. sylvaticus*.

Upper and lower tooth-rows

The collected material is represented by 52 maxillary portions, 21 of which bear the complete molar series, 53 mandibular portions, 22 of which with the complete lower molar series and some 80 loose teeth (Tab. 3 and 4).

Also in this case the characters which separate *A. sylvaticus* from *A. flavicollis*, such as the relative position of T4 and T7 of M^1 (3 and 4 wearing group, according to Felten, 1952), the degree of reduction of T9 on M^2, M_2 length/width ratio and, only indicatively, the degree of development of tma on M_1 and M^2 length/width

Tab. 3 - Dimensions of upper and lower molars of *A. sylvaticus tyrrhenicus* n. ssp. (All measurements are in mm).

		min-max	$\bar{m}$	n.sp.
M^1	length	2.03-2.28	2.15	53
	width	1.30-1.50	1.40	53
M^2	length	1.30-1.53	1.38	52
	width	1.25-1.43	1.36	52
M^3	length	1.00-1.15	1.08	32
	width	0.93-1.15	1.03	32
M^2	length / width	0.96-1.11	1.03	52
M_1	length	1.85-2.35	2.01	52
	width	1.15-1.40	1.26	52
M_2	length	1.15-1.45	1.35	49
	width	1.10-1.33	1.36	49
M_3	length	0.98-1.23	1.13	42
	width	0.90-1.15	1.09	42
M_2	length / width	1.00-1.14	1.07	49

Tab. 4 - Upper and lower molar series length in *A. sylvaticus tyrrhenicus* n. ssp. and in other living and fossil forms of middle-sized *Apodemus*. (All measurements are in mm). (a) Kahmann and Niethammer, 1971; (b) Krapp, 1969; (c) Felten and Storch, 1970; (d) Storch, 1970; (e) Sans-Coma and Kahmann, 1977; (f) Alcover, 1977; (g) Niethammer, 1978a; Van der Straeten and Van der Straeten-Harrie, 1977; (h) Niethammer, 1978b.

		min-max	m̄	n.sp.
A. sylvaticus tyrrhenicus n. ssp	upper	4.1-5.0	4.4	21
	lower	4.3-4.6	4.4	22
A. sylvaticus dichrurus (Sicily) (a)	upper	3.8-4.6	4.0	55
	lower	—	—	—
A. sylvaticus ? dichrurus (Marettimo) (b)	upper	4.3-4.6	4.5	3
	lower	4.2-4.4	4.3	3
A. sylvaticus ? dichrurus (Sardinia) (a)	upper	4.0-4.4	4.1	46
	lower	—	—	—
A. sylvaticus ? dichrurus (Corsica) (a)	upper	3.8-4.0	3.9.	25
	lower	—	—	—
A. sylvaticus (Holocene, Pantelleria) (c)	upper	—	4.6	1
	lower	4.3-4.6	4.5	4
A. sylvaticus hermani (c)	upper	4.1-4.3	4.2	7
	lower	4.0-4.3	4.2	7
A. sylvaticus (Holocene, Malta) (d)	upper	3.9-4.4	4.2	46
	lower	4.1-4.5	4.3	38
A. sylvaticus frumentariae (Formentera) (e)	upper	3.6-4.2	4.0	41
	lower	—	—	—
A. sylvaticus eivissiensis (Ibiza) (f)	upper	3.8-4.2	4.0	14
	lower	3.7-4.1	4.0	10
A. sylvaticus ilvanus (a)	upper	4.0-4.6	4.3	13
	lower	4.0-4.5	4.3	13
A. sylvaticus (mainland) (g)	upper	—	3.8	276
	lower	3.4-4.1	3.7	166
A. flavicollis (mainland) (h)	upper	—	4.3	495
	lower	3.8-4.6	4.3	83

ratio, were first investigated (Pasquier, 1974; Recco, Federici and Cristaldi, 1978; Filippucci *et alii*, 1984; Krapp, 1984; Amori and Contoli, 1985).

As far as these characters are concerned the study of the material collected in the "Vascio 'o funno" cave shows that: in 86.5% of the specimens T4 and T7 are joined or, at most, separated by a narrow and shallow groove and only in 13.5% of the specimens they are clearly divided; as regards the degree of reduction of T9 on M^2, this tubercle appears stout and well developed in 55.2% of the specimens, it is reduced in 27.6% and is nearly absent only in 17.2% of the specimens; tma on M_1 is almost always well developed (89%); the average value of length/width ratio of M_2, calculated out 52 specimens, is 1.03, that of M^2 (49 specimens) is 1.07. For all these

characters the murid of Capri is more similar to *A. sylvaticus* than to *A. flavicollis.*

From a morphological point of view the grinding surface of both upper and lower molar series are quite similar to those shown by present middle-sized *Apodemus* (Fig. 1a, b). Some slight differences can be noticed in the relative positions of the tubercles. A detailed analysis showed that M_1^1 and M_2^2 of the Capri mouse share some characters with some *Apodemus* continental populations of the Early and Middle Pleistocene of Europe (Pasquier, 1974): M^1 — absence of T1bis and T3bis, feeble joints between T1-T5 and T3-T5; T1 in a backward position if compared with T3; M^2 — T8 and T9 joined each others by the posterior cingulum; M_1 — absence of CO in the posterior zone of the cingular margin and, both in M_1 and M_2 — little development of the median longitudinal crest.

Besides these just mentioned characters, other primitive features are to be noticed in the root and alveolar pattern of the upper molars, especially the presence of consistently 5-rooted M^1 (4 well developed and stout roots and a fifth one still stout but shorter than the others). The corresponding alveolar morphotype is that indicated by Kahmann (1969) as A (fig. 1c, d); only in a few cases (4 out of 34) the tendency of the fifth root to divide induces the occurrence of B morphotype. For the continental populations of *A. sylvaticus* and *A. flavicollis* the normal alveolar pattern (AN for German Authors) corresponds to morphotype C and its many variations (4-rooted M^1) which are considered to be derived from A and B 5-rooted patterns (Herold, 1956-57).

Post-cranial skeleton

From the filling-deposit of "Vascio 'o funno" cave abundant post-cranial skeleton bones were collected: many vertebrae, scapula and pelvis portions and a lot of limb bones. Nevertheless only few of these bones are complete: 2 humeri, 1 ulna, 1 radius, 2 femurs and 3 tibias. All of them show the morphological characters of the genus *Apodemus*. In comparison with *A. sylvaticus* all the bones show, as may be

Tab. 5 - Limb bones length with epiphysis in *A. sylvaticus tyrrhenicus* n. ssp. and in other living and fossil forms of middle-sized *Apodemus* (number of specimens in brackets). (all measurements are in mm). (a) Kahmann and Niethammer, 1971; (b) Storch, 1970; (c) Felten and Storch, 1970; (d) Niethammer 1978a.

	Humerus	Ulna	Radio	Femur	Tibia
A. sylvaticus tyrrhenicus n. ssp.	14.4 (3)	16.6 (1)	13.6 (1)	19.1 (3)	22.9 (3)
A. sylvaticus ilvanus (a)	15.2 (19)	—	—	21.0 (25)	25.2 (17)
A. sylvaticus (Holocene, Malta) (b)	14.1 (18)	—	—	19.7 (28)	24.0 (1)
A. sylvaticus hermani (c)	—	—	—	19.6 (4)	—
A. sylvaticus (Holocene, Pantelleria) (c)	14.8 (2)	—	—	21.5 (1)	—
A. sylvaticus (mainland) (d)	12.9 (28)	15.5. (32)	—	17.2 (28)	21.1 (28)
A. flavicollis (mainland) (d)	15.1 (26)	17.7 (25)	—	20.2 (25)	24.1 (25)

expected, larger size but they do not exceed (as the teeth do) the variability field of *A. flavicollis* (Tab. 5).

COMPARISONS WITH OTHER FOSSIL AND LIVING MEDITERRANEAN INSULAR FORMS OF *APODEMUS* AND CONCLUSIONS.

Record of findings of forms referable to the genus *Apodemus* in the Mediterranean insular districts are numerous (Kotsakis, 1984), but those concerning endemic forms (at the level of species or subspecies) are more scarce. Apart from the Miocene peculiar fauna of Baccinello (Tuscany) and the Pliocene palaeoislands of Gargano (Apulia) from which remains of probably endemic species of *Apodemus* are recorded (Kotsakis, 1984), in the Mediterranean islands two endemic species have been recognized: *Apodemus mannu* Thaler, 1973, from the Early Pliocene (MN 14 zone) of Mandriola (Sardinia) (Pecorini, Rage and Thaler, 1973; Esu and Kotsakis, 1980, 1983) and *Apodemus maximums* Thaler, 1972 from the Villafranchian *s.l.* of Monte Pellegrino (Sicily) (Thaler, 1972). Both of them are very large-sized species, much larger than the Capri murid (upper and lower molar series length respectively of 8.0 mm and 7.8 mm for *A. maximus*) and they show some peculiar dental characters which are not present in the Capri murid (*A. mannu*: more primitive dental pattern; *A. maximus*: presence of very developed T1bis on M^2 grinding surface). Besides, from Middle Pleistocene deposits of Naxos (Aegean Sea) Sondaar (1971) recorded the presence of a large-sized endemic *Apodemus*, not yet described.

More recent fossil remains belonging to the genus *Apodemus* from the Mediterranean islands are scarce and only forms referable to the species *A. sylvaticus* were recorded (except for the Holocene findings of Chios island (Aegean Sea), probably referable to an endemic large-sized subspecies of *Apodemus mystacinus* Danford and Alton, 1977 (Kotsakis, 1984)): from the Holocene layers of Spinagallo and Donnavilla Cave (Sicily) (Kotsakis, 1984), of Ghar Dalam cave (Malta) (Storch), 1970 and from Holocene deposits of Pantelleria (Felten and Storch, 1970). In all the cases they are large-sized forms in comparison with the continental *A. sylvaticus*.

"Giant" living populations of field mouse are known from several Mediterranean islands. In the Western Mediterranean at least two endemic large-sized subspecies are recognized: *A. sylvaticus frumentariae* Sans-Coma and Kahmann, 1977, from Formentera and *A. sylvaticus eivissiensis* Alcover, 1977, from Ibiza (Pityuses) (Sans-Coma and Kahman, 1977; Alcover, 1977), but large-sized mice are reported also from Menorca (Sans-Coma and Kahmann, 1977); in the Tyrrhenian Sea they amount to a least three insular subspecies: *A. sylvaticus ilvanus* Kahmann and Niethammer, 1971 from Elba, *A. sylvaticus dichrurus* (Rafinesque, 1814) from Sicily and, perhaps from the Egadi islands (Marettimo and Favignana according to Krapp, 1969) and *A. sylvaticus sicilianus* Lehmann and Schaefer, 1976), still in Sicily, but areally limited to the mount Etna slopes (Kahmann and Niethammer, 1971; Lehmann and Schaefer, 1976; Niethammer, 1978a). According to Miller (1912) large-

sized field mice are present also in Sardinia and Corsica and he refers them to *A. sylvaticus dichrurus*, but a modern revision of Corsican and Sardinian populations may presumably lead to new subspecific attributions. Besides, in the Sicilian Channel a fourth different subspecies is known from Pantelleria: *A. sylvaticus hermani* Felten and Storch, 1970, and in the Eastern Mediterranean another form from Crete: *A. sylvaticus creticus* Miller, 1910 (Felten and Storch, 1970; Niethammer, 1978a).

All these living subspecies (except for *A. sylvaticus creticus*) have been separated from the continental one merely, if not only, because of their large size; nevertheless, none of them reaches the large size attained by the Capri mouse.

Some cranial and skeletal differences between the Capri murid and the endemic insular fossil and living forms previously listed can be discerned: cranial dimensions are greater than those shown by *A. sylvaticus frumentariae*, *A. sylvaticus eivissensis*, *A. sylvaticus dichrurus* and *A. sylvaticus sicilianus*, while they are similar (only slightly greater) to those measured for *A. sylvaticus ilvanus* and *A. sylvaticus hermani* (Tabs. 1 and 4); the limb bones are in proportion with skull dimensions and for this character *A. sylvaticus ilvanus* is clearly separated from the other forms; in fact Alcover (1977) has already stressed how the Elba field mouse bears long limb bones in comparison with its skull (Tab. 5). The Capri murid shows morphological peculiarities in its alveolar morphotypes: whereas in all insular living and fossil forms a considerable variability can be observed (presence of several alveolar morphotypes for each upper molar) (Kahmann, 1969; Storch, 1970; Alcover, 1977) the Capri murid shows only two morphotypes for M^1 (A and B), one for M^2 (a) and one for M^3 (α); besides, the most frequent morphotype for M^1 is represented by A (5-rooted M) while *A. sylvaticus dichrurus* from Sicily, Sardinia and Corsica and *A. sylvaticus eivissiensis* show as the AN morphotype the more evolved B one (5-rooted M with the 5th wich undergoes division) (respectively 22.7%, 33.3%, 60.0% and 51.2%). In these latter subspecies even C morphotype (4-rooted M) is well represented (respectively 41.0%, 26.7%, 19.5% and 26.4%) (Kahmann, 1969: Alcover, 1977).

Holocene specimens of *A. sylvaticus* from Malta bears a high percentage of 4-rooted M^1 (C morphotype according to Kahmann, 1969, but indicated as A by Storch, 1970), and only in 32% of the cases they show a 5-rooted M^1 (Storch, 1970).

Alcover (1977) stressed the difficulties to attribute the Mediterranean insular mice of the genus *Apodemus* to either *A. sylvaticus* or *A. flavicollis* because of the anomalous large dimensions they show. Anyway, all endemic living Mediterranean subspecies have been referred to *A. sylvaticus* on the basis of genetic or biometrical data. While genetic data are certain, biometrical data do not always show clear distinctive criteria, as may be seen in the Elba mouse (tail length, foot length, condylo-basal length, etc., Kahmann and Niethammer, 1971), for the Formentera mouse (tail length, Sans-Coma and Kahaman, 1977), for the Ibiza mouse (condylo-basal length, Alcover, 1977) and for the Capri mouse too (see above).

As a matter of fact it is impossible to apply genetic criteria to the fossil specimens collected from "Vascio 'o funno" cave; nevertheless the analysis of some

morphological distinctive features visible on skull and tooth rows seems to warrant the attribution of the Capri murid to the species *A. sylvaticus*. The large size of the Capri mouse and some peculiar archaic dental features suggests to create for it a new separate subspecies:

Apodemus sylvaticus tyrrenicus n. ssp.

Diagnosis: field mouse of large size, larger than other endemic subspecies of *A. sylvaticus* known for the Mediterranean islands, and even larger than the continental *A. flavicollis*. Morphology of the grinding surface of upper and lower molars more archaic than that shown by continental populations of *A. sylvaticus*. M^1 always bearing 5 roots (4 well developed ones and the 5th short but stout).

Holotype: M18404: cranial portion with nasals, maxillaries with complete tooth rows, left zygomatic process of maxillary and both mandibles with complete tooth rows (Museo di Paleontologia, University of Naples).

Paratypes: M18405: left maxillary with M^1-M^3; M18406: left mandibular portion with M_1-M_3; M18407: right maxillary bearing M^1-M^3 alveoles; M18408: left complete mandible (Museo di Paleontologia, University of Naples).

Locus typicus: "Vascio 'o funno" cave, southeastern coast of Capri island.

Stratum Typicum: sandy-volcanic cave-filling deposits of Upper Pleistocene post Tyrrhenian age (isotopic stage 4?).

Derivatio nominis: from the latin name for Tyrrhenian sea, which surrounds Capri island.

Apodemus sylvaticus tyrrenicus probably populated Capri during the Middle Pleistocene, up to the last connection of the island with the mainland related to the Würm glaciation. Recent findings of rich subfossil micromammal associations from Capri, which bear continental normal-sized *Apodemus sylvaticus* (pers. comm. Prof. Barbera and Dr. Cimmino) (Cinque, Gliozzi and Esu, 1986) suggest that its extinction may be related to competition with these new immigrants

ACNOWLEDGEMEMTS

I wish to thank Prof. A. Azzaroli and Dr. T. Kotsakis for the critical revision of the manuscript.

REFERENCES

ALCOVER J.A. (1977) - *The long-tailed field mouse or wood mouse "Apodemus sylvaticus" (Linnè, 1758) from the island of Ibiza, Pityusics*, "Säugetierk. Mitt", *25 (3)*, 204-213, 5 ff., 7 tabb., Stuttgart.

AMORI G. and CONTOLI L. (1985) - *Nuovi reperti di Apodemus (Sylvaemus) flavicollis (Melchior, 1834) nell'Italia peninsulare*, "Atti Soc. Ital. Sci. Nat. Museo Civ. St. Nat. Milano", *126 (1-2)*, 54-58, 1 tab., Milano.

C.A.I. Napoli (1974-75) - *Il riempimento della grotta di "Vascio 'o funno" (Loc. Matermania - Capri)*, "Annuario Speleologico", *1974-75*, 57-60, 1 f., 1 pl., Napoli.

CINQUE A., GLIOZZI E., and ESU D. (1986) - *Il riempimento della grotta "Vascio 'o funno" a Capri. Primi risultati dello studio geomorfologico e paleontologico*, "Pubb. Dip. Sci. Terra, Napoli", *33*, 105-116, 2 ff., 1 tab. Napoli.

ESU D. and KOTSAKIS T. (1983) - *Paleobiogeografia dei vertebrati e dei molluschi continentali del Terziario e del Quaternario della Sardegna*, "Lav. Soc. Ital. Biogeogr.", *8*, 53-82, 6 ff, 1 pl., Forlì.

ESU D. and KOTSAKIS T. (1980) - *Les vertébrés et les mollusque continentaux du Tertiaire de la Sardaigne: paléobiogéographie et biostratigraphie*, "Geol. Rom.", *22*, 177-206, 6 ff., 1 tab., Roma.

FELTEN H. (1952) - *Untersuchungen zur Ökologie und Morphologie der Waldmaus (Apodemus sylvaticus L.) und der Gelbhalsmaus (Apodemus flavicollis Melchior) im Rheim-Main-Gebiet*, "Bonn. Zool. Beitr", *1-4*, 187-206, 16 ff., 6 tabb., Bonn.

FELTEN H. and STORCH G. (1970) - *Kleinsauger von der italianische Mittelmeer Inseln Pantelleria und Lampedusa (Mammalia)*, "Senkenberg. Biol.", *51 (3-4)*, 159-175, 2 ff., 9 tabb., Frankfurt.

FILIPPUCCI M.G., CRISTALDI M., TIZI L. and CONTOLI L. (1984) - *Dati morfologici e morfometrici in popolazioni di Apodemus (Sylvaemus) dell'Italia centro-meridionale determinati elettroforeticamente*, "Atti I Seminario As.Te.Ro.: Recenti acquisizioni sul genere *Apodemus* in Italia, 1982, Suppl. Ric. Biol. Selv.", *9*, 85-126, 13 ff., 8 tabb., Bologna.

HECHT P. (1970) - *Vergleichende anatomische und biometrische Utersuchungen an Os coxae, Scapula, Femur und Humerus bei Waldmaus (Apodemus sylvaticus), Gelbhasmaus (Apodemus flavicollis), Feldmaus (Microtus arvalis) und Rötelmaus (Clethrionomys glareolus)*, "Säugetierk. Mitt.", *19*, 132-157, 7 pls., 24 graphs, Stuttgart.

HEROLD W. (1956-57) - *Über die Variabilität der Molaren-Wurzeln des Oberkiefers bei einigen Apodemus-Arten*, "Wiss. Z. Humbolt. Univ. Berlino", *6 (3)*, 237-244, 10 ff., 4 tabb., Berlin.

KAHMANN H. (1969) - *Die Alveolenmuster der Oberkieferzahnreihe der Waldmaus, Hausratte und Hausmaus aus Populationen der grossen Tyrrhenischen Inseln*, "Z. f. Säugetierk.", *34 (3)*, 164-183, 7 ff., 17 tabb., Hamburg.

KAHMANN H. and NIETHAMMER J. (1971) - *Die Waldmaus (Apodemus) von der Inseln Elba* "Senkenberg. Biol.", *52 (6)*, 381-392, 5 ff., 10 tabb., Frankfurt.

KOTSAKIS T. (1984) - *Gli Apodemus (Muridae, Rodentia) fossili delle isole mediterranee*, "Atti I Seminario As.Te.Ro.: Recenti acquisizioni sul genere *Apodemus* in Italia, 1982, Suppl. Ric. Biol. selv.", *9*, 25-49, 1 tab., Bologna.

KRAPP F. (1969) - *Terrestrische kleinsäugetiere von den Ägadischen Inseln (Mammalia: Insectivora, Rodentia) (Provinz Trapani, Sizilien)*, "Mem. Mus. Civ. St. Nat. Verona", *17*, 331-347, 4 tabb., Verona.

KRAPP F. (1975) - *Säugetiere (Mammalia) aus dem Nördlichen und Zentralen Apennin im Museo Civico di Storia Naturale di Verona*, "Mem. Mus. Civ. St. Nat. Verona", *23*, 193-216, Verona.

KRAPP F. (1984) - *Gli Apodemus d'Italia in rapporto alla situazione europea del genere*, "Atti I Seminario As.Te.Ro.: Recenti acquisizioni sul genere "*Apodemus*" in Italia, 1982, Suppl. Ric. Biol. Selv", *9*, 51-63, Bologna.

LEHMANN H. and SCHAEFER H.E. (1976) - *Kreuzingsergbnisse mit Waldmaus (Apodemus) der Inseln Sizilien*, "Saugetierk. Mitt.", *24*, 180-184, 1 f., 1 tab., Stuttgart.

MICHAUX J. (1971) - *Muridae (Rodentia) neogene d'Europe sud-occidentale. Evolution et rapports avec les formes actuelles.* "Paleobiol. Continentale", *2(1)*, 1-67, 8 ff., 12 pls., 16 tabb., Montpellier.

MILLER G.S. (1912) - *Catalogue of the Mammals of Western Europe*, "Trustees Brit. Mus (Nat. Hist.) London", 1019 pp. 213 ff., London.

NIETHAMMER J. (1962) - *Die Säugetiere von Korfu*, "Bonn. Zool. Beitr.", *1-3*, 1-49, 8 ff., 12 tabb., Bonn.

NIETHAMMER J. (1969) - *Zur Frage der introgression bei den Waldmäusen Apodemus sylvaticus und Apodemus flavicollis (Mamm. Rod.)*, "Z. Zool. System. Evolforsch.", *8*, 77-127.

NIETHAMMER J. (1978a) - *Apodemus sylvaticus (Linnaeus, 1758) - Waldmaus, In*: NIETHAMMER J. and KRAPP F. (Eds.): "Handbuch der Säugetiere Europas", Band 1, Rodentia 1, 377-358, 2 ff., 13 tabb., Akad. Verlag., Wiesbaden.

NIETHAMMER J. (1978b) - *Apodemus flavicollis (Melchior, 1834) - Gelbhalsmaus, In:* NIETHAMMER J. and KRAPP F. (eds.): "Handbuch der Säugetiere Europas", Band 1, Rodentia 1, 325-336, 1 f., 3 tabb., Akad. Verlag. Wiesbaden.

PASQUIER L. (1974) - *Dynamique evolutive d'une sous-genre de Muridae "Apodemus (Sylvaemus)". Etude biometrique des caractères dentaires de populations fossiles et actuelles d'Europe occidentale*, These, Academie de Montpellier, 185 pp. 38 ff., 36 tabb., 4 pls., 23 tabb. out of text, Montpellier.

PECORINI G., RAGE J.C. ad THALER L. (1973) - *La formation continentale de Capo Mannu, sa faune de Vertébrés pliocènes et la question du Messinien en Sardaigne*, "Rend. Sem. Sci. Univ. Cagliari", *43 (Suppl.)* 305-319, 7 f., Cagliari.

PFEIFFER H. and NIETHAMMER J. (1972) - *Versuche zur nahrungswhl von Wald- und Gelbhalsmaus (Apodemus sylvaticus und Apodemus flavicollis)*, "Z. f. Säugetierk.", *37*, 57-65, Hamburg.

RECCO M.A., FEDERICI R. and CRISTALDI M. (1978) - *Presenza simpatrica di Apodemus flavicollis e di Apodemus sylvaticus nelle zone di Tolfa e Manziana: considerazioni critiche*, "Boll. Mus. Civ. St. Nat. Verona", *1978*, 313-353, 5 ff., 8 tabb., Verona.

SANS-COMA V. and KAHMANN H. (1977) - *Die Waldmaus (Apodemus) der Pityuseninsel Formentera*, "Saugetierk. Mitt.", *25 (1)*, 35-43, 5 ff., 7 tabb., Stuttgart.

SONDAR P.Y. (1971) - *Paleozoogeography of the Pleistocene Mammals from the Aegean*, "Op. Botan.", *30*, 65-70, 1 tab., Lund.

STEINER H.M. (1968) - *Untersuchungen über die Variabilität und Bionomic der Gattung Apodemus (Muridae, Mammalia) der Donau-Auen von Stockereau (Niederösterreich)*, "Z. f. Wiss. Zool.", *177 (1-2)*, 1-96.

STORCH G. (1970) - *Holozäne Kleinsäugerfunde aus der Ghar-Dalam-Höle, Malta*, "Senkenberg. Biol.", *51 (3-4)*, 135-145, 3 ff., Frankfurt.

THALER L. (1972) - *Les rongeurs (Rodentia et Lagomorpha) du Monte Pellegrino et la question des anciens isthmes de la Sicilie*, "C.R. Acad. Sci. Paris", *274*, 188-190: 1 pl., Paris.

TVRTKOVIC' N. (1976) - *Les caractéres morphologiques de l'espèce Apodemus sylvaticus Linné, 1758 dans les îles de l'Adriatique*, "Rapp. Comm. Inter. Mer Médit.", *23 (6)*, 35-36, 1 f.

VAN DER STRAETEN E. (1976) - *Maatgegevens van Apodemus sylvaticus (Linnaeus, 1758) en Apodemus flavicollis (Melchior, 1934) en Belgie*, "Lutra", *18*, 15-22.

VAN DER STRAETEN E. and VAN DER STRAETEN-HARRIE B. (1977) - *Etude de la biometrie cranienne et de la repartition d'Apodemus sylvaticus (Linnaeus, 1758) et d'Apodemus flavicollis (Melchior, 1834) en Belgique*, "Acta Zool. Pathol. Antverpiensa", *69*, 169-182, 4 ff., Antwerpen.