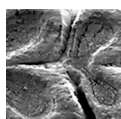


Micromammal faunas from the Mio-Pliocene boundary in the Alcoy Basin (SE Spain): biostratigraphical and palaeoecological inferences

SAMUEL MANSINO, IGNACIO FIERRO, PLINIO MONTOYA & FRANCISCO JAVIER RUIZ-SÁNCHEZ



This paper deals with the fossil rodent and insectivore faunas from the localities of the southern side of the Gormaget ravine (Alcoy Basin, Spain): Alcoi Barranc Sud (ABS-1, ABS-2, ABS-3, ABS-3A, ABS-7, ABS-8, ABS-9, ABS-10), and Alcoi Cristian (AC-0, AC-0B and AC-0C). We infer in this paper an Early Ruscinian age for these sites. Based on the analysis of the fossil micromammal faunas, we consider that the localities ABS-3 and ABS-3A are older than AC-0, which has a similar age as the classic site of Alcoy-Barranco. The palaeoecological interpretation of the fauna recovered from these new sections show dry conditions in the Early Pliocene (MN14) from the Alcoy Basin. • Key words: biostratigraphy, palaeoecology, micromammals, Pliocene, Alcoy Basin, Spain.

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Alcoy Basin in SE Spain is located in the inner Prebetic of the Betic chain, surrounded by the mountain ranges of Menejador, Mariola and Benicadell (Fig. 1). Previously, the geology of this area was studied by Durand Delga *et al.* (1964), Montenat (1973, pp. 1009–1014, fig. 153), Aguirre *et al.* (1975) and Pierson d'Autrey (1987). Despite the Alcoy Basin have been intensively sampled in the past (Thaler *et al.* 1965, Adrover 1969, Esteban Aenlle & Lacomba 1988, López-Martínez 1989, Freudenthal *et al.* 1998, Mansino *et al.* 2013), a relatively scarce number of localities are known. In the Gormaig area, besides the large mammal classic locality of Alcoy-Mina, just a few small mammal localities have been found. Before 2009, four localities containing small mammals were known in the Gormaig area: Alcoy-Barranco (Thaler *et al.* 1965, Adrover 1969), Alcoy-N (López-Martínez 1989), Alcoy-4B (Freudenthal *et al.* 1998), Alcoy-2 (Esteban Aenlle & Lacomba 1988). Of these, Alcoy-4B and Alcoy-2 have been recently relocated, although Alcoy-4B lies now under a dwelling, while the location of the rest (Alcoy-Barranco and Alcoy-N) is uncertain because the intense erosion in the zone has exten-

ded the ravine in both margins, changing the references in the terrain. Nevertheless, an intense process of sampling in the west margin of this lacustrine basin (Gormaget ravine) was initiated in 2005 to relocate these two missing localities, resulting in the location of an important number of levels containing micromammal fossil remains: ABS-1, ABS-2, ABS-3, ABS-3A, ABS-7, ABS-8, ABS-9 and ABS-10 in Alcoi Barranc Sud section, and AC-0, AC-0B and AC-0C in Alcoi Cristian section (Figs 1, 2). The three richest localities in the southern side of the Gormaget ravine are: in Alcoi Barranc Sud (lower part of the deposits from the ravine), ABS-3 and ABS-3A, and in Alcoi Cristian section (upper part of the deposits) the locality AC-0 (Fig. 6). The inferred age for these sites ranges from MN 13 to MN 16, from Late Miocene to Late Pliocene, and their approximate location is shown in Fig. 1.

The aim of the paper is the study of the micromammal remains from the oldest mammal localities known in the Alcoy Basin, some of which have yielded a similar fauna to those of Adrover (1969), and their biostratigraphical and palaeoecological implications.

Material and methods

Since 2005, about 3,200 kg of sediment were extracted from the localities of Alcoi Barranc Sud and Alcoi Cristian in several field campaigns. The resulting fossil collections are stored in the Museu de Geologia de la Universitat de València (MGUV) with the acronyms ABS1'05-, ABS2-, ABS2'05-, ABS3'05-, ABS3'08-, ABS3A-, ABS7'05-, ABS8-, ABS9-, ABS10-, AC0-, AC0B- and AC0C-. ABS1'05, ABS2'05, ABS3'05 and ABS7'05, correspond all of them to the samplings of the year 2005, and ABS3'08 to a sampling in 2008.

The nomenclature and measurement methods are those of Martín-Suárez & Freudenthal (1993) for the family Muridae, Mein & Freudenthal (1971) for the Cricetidae, Daams (1981) and Freudenthal (2004) for the Gliridae, and Reumer (1984) for the insectivores. Measurements are in millimetres and were taken on a Leica MZ7₅ binocular microscope, by means of displacement of a mechanical stage, connected to a Sony Magnescale measuring equipment.

Abbreviations. – ABS – Alcoi Barranc Sud; AC – Alcoi Cristian; AF – Alcoi Forn; AL2-C – Alcoy 2C; AL2-D – Alcoy 2D; ALDH – Aldehuela; ALM-M – Almenara-M; AR-4 – Arquillo 4; AW – anterior width; BL – bucal length; BRA-5B – Brácana 5B; c1 – posterior accessory cusp; CEL-9 – Celadas-9; CLC – Calicasas; CLR – Calexico; CR-6 – Crevillente 6; GOR-A – Gorafe-A; H – height; I – upper incisor; L – length; LB2B – La Bullana 2B; LG-4 – La Gloria-4; LL – labial length; LPE – length posterior emargination; MNA – Mina; PER-E – Peralejos-E; PUR-4 – Purcal 4; MN – European Neogene land mammal units; m1 – first lower molar; m2 – second lower molar; m3 – third lower molar; M1 – first upper molar; M2 – second upper molar; M3 – third upper molar; NGR-1 – Negratín-1; PW – posterior width; RCH-3 – Rambla Chimeneas 3; TCH – Tollo de Chiclana; TLW – talonid width; tma – antero-central cusp; TRW – trigonid width; VAR-1 – Villalba Alta Río 1; VM – Venta del Moro; W – width; YEG – Yeguas; ZOR-3A – Zorreras 3A.

Geological setting

The studied outcrops are located in the Barranco del Gormaig area, in the Alcoy Basin (Fig. 1), which exhibits a magnificent series of Neogene deposits, with continental sediments of Upper Miocene and Pliocene age. This basin belongs to the northern side of the inner Prebetic of the Betic chain, surrounded by the mountain ranges of Menejador, Mariola and Benicadell among others (Fig. 1). In the Alcoy area, the Betic context allowed the development of vast synclinal depressions WSW-ENE oriented. Over them were deposited the characteristic marine marls in “Tap” fa-

cies during the marine Miocene. The sea isolation of the North Prebetic basins of Alicante occurred very early (Tortonian), and marine sediments are only represented in the Unit I of Viseras *et al.* (2004). In this manner, a marine basal Tortonian with carbonate facies and limited thickness was deposited over “Tap” facies in angular discordance. Over these we find the continental facies, essentially constituted by lacustrine and fluvial sediments. These deposits belong to Unit II of Viseras *et al.* (2004), being represented by alluvial fan facies in the margin and fluvio-lacustrine facies in the centre. In this context, the Miocene-Pliocene transition takes place in a continental environment (Aguirre *et al.* 1975).

The general direction of the Betic mountain range in Alcoy area is interrupted by the Alcoy Basin. This forms a depression that can be subdivided into several quadrangular grabens, being the Almudaina Graben where we find the studied deposits.

Two continental facies associations are present above the marine Lower Tortonian (Pierson d'Autrey 1987): a lacustrine white series and a fluvial red one, which fill all the central part of the Alcoy Basin, covering the ancient sediments.

The measured stratigraphic sequence comprises about 44 meters, of which the last 6 meters are covered (Fig. 2). To obtain the stratigraphic data presented in Fig. 2, we dug some trenches in different places to look for the fresh rock, using the information that the environment of the ravine showed us.

Gormaig ravine series relates to fluvial series that develop without discontinuity above the lacustrine facies of the basin, reaching the foot of the southern slopes of the Benicadell and Mariola ranges and the northern slopes of the Menejador range. The studied series, with alluvial facies included in sandy marls with organic layers, presents lacustrine features and floodplain deposits. Upwards, conglomerates take more importance (greater thickness and grain size), organic marls are not present and reddish colours are predominant.

In the studied area, the sandy-marls deposits with gray to brownish colours, which can be several meters thick, are generally dominant. In marls there are frequent isolated pebbles or sandy to conglomerate linear intercalations. Conglomerate levels are relatively common, reaching a thickness of a meter or more. The presence of organic levels of intense dark colour is also remarkable. In about 20 meters in the ABS section, we identify up to 10 of these organic levels (fossil levels ABS-1 to ABS-10).

In ABS the conglomeratic intercalations are frequent, with a slightly erosive base and a yellow sandy matrix. Organic levels are always present in the middle or upper part of the sandy marls, which are placed above each conglomeratic intercalation. In this sense, these deposits seem to respond to specific events that are repeated. Some of the con-

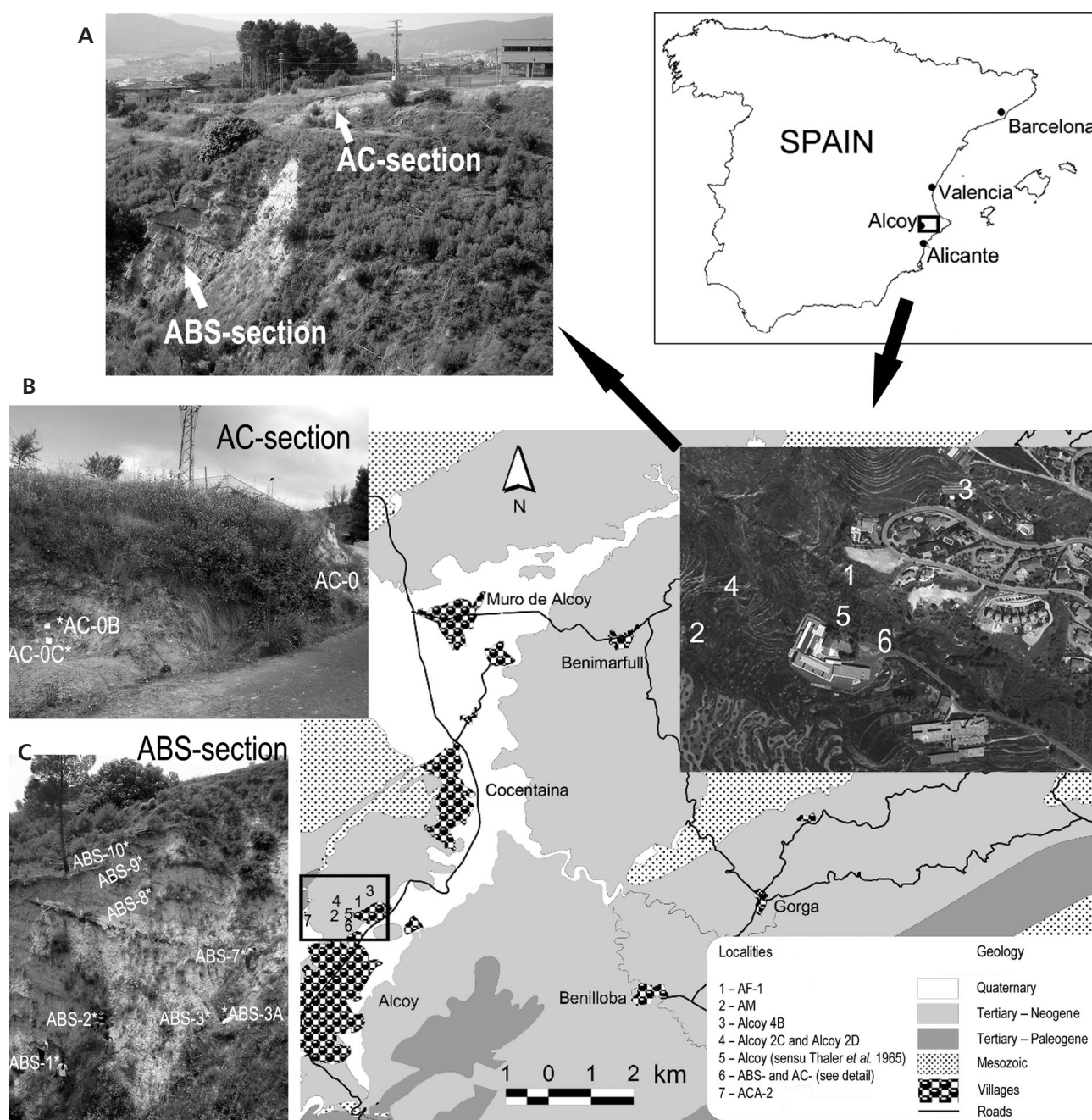


Figure 1. Geographic and geological setting of the Alcoy Basin, showing the location of the outcrops of the Gormaget ravine. A – detail of ABS and AC sections, B – AC-section, C – ABS-section.

glomerates present in ABS are coarsening upwards, and some sandy intercalations show the existence of sedimentary structures that indicate the direction of the current. In some organic and sandy-marl levels, the remains of continental gastropods are common. These conglomerates strata are light coloured (often yellow) with a sandy matrix, and often lack internal structure. In some of them we observe coarsening-upwards pebbles and minor erosive base. They differ from those at the top of the Gormaig ravine

(stratigraphically higher), which have a reddish matrix, a bigger average size of the pebbles and greater thickness of the strata.

Above ABS section, and after a covered stretch of about 7 meters, there is a new section named AC (Alcoi Cristian). The facies association has little differences with that of ABS section, since the organic levels of AC are situated in the middle or upper part of sandy marls, which are arranged above each conglomeratic intercalation or just in

contact with the top of conglomerates. AC section shows evidences of paedological structures in marl levels, and of irregular precipitation of carbonates.

Systematic palaeontology

Order Rodentia Bowdich, 1821

Family Muridae Illiger, 1811

Genus *Apodemus* Kaup, 1826

Apodemus gorafensis (Ruiz-Bustos, Sesé, Dabrio, Peña & Padial, 1984)

Figure 3A

Localities. – ABS-3, AC-0, AC-0C.

Material and measurements ($L \times W$). – 1 m1 (ABS3'08-3) ($2.35 \times -$); 1 m2 (AC0-46) (1.53×1.32); 2 M1 (AC0-20) ($- \times 1.50$), (AC0-119); 1 M3 (ABS3'08-34).

Description. – m1. The lingual side of the molar is missing. The tma and labial cingulum are well developed. There is a large oval c1. Roots are not preserved.

m2. The anterolabial cusp is large and connected basally to the protoconid and a well-developed labial cingulum. There is a medium-sized round c1 and a slightly smaller accessory cusp, connected basally to the posterior side of the protoconid (Fig. 3A). The posterior heel is large, oval and lingually displaced. Roots are not preserved.

M1. The specimens are poorly preserved. The t1 and t3 have small distal spurs. There is a well-developed t7. Roots are not preserved.

M3. The labial side of the molar is absent. The t1 is connected to t4-t5-t6. There is a t9 attached to the posterior side of the t8. Roots are not preserved.

Discussion. – The presence of a big tma, well-developed labial cingulum in the lower molars and t7 in M1 and M2 are typical traits of *Apodemus*. Also, some Late Miocene and Early Pliocene populations of *A. atavus* Heller, 1936 and *A. gorafensis* have a t9 in M3 (García-Alix *et al.* 2008a). The studied molars differ from *A. gudrunae* van de Weerd, 1976, by their bigger size and presence of a well-developed t7, and from *A. agustii* Martín Suárez, 1988, by the connection of the t6-t9 in M1 and a smaller tma. The length of the single m1 is consistent with the highest values of *A. gorafensis*, such as the biggest specimens from MNA-2, MNA-4 and CLR-1 (García-Alix *et al.* 2008a). Its size is also close to the values of *A. jeanteti* from Villalba Alta and Arquillo 3. However, this latter species shows a reduced or absent tma, which is well developed in specimen ABS3'08-3.

The size of the molars from AC-0 and AC-0C are consistent with those of *A. gorafensis* from Botardo C (Martín-Suárez 1988), DHS-16, PUR-4, PUR-24A, PUR 25 and PUR-25A (García-Alix *et al.* 2008a), being slightly smaller than the teeth from Gorafe A (type locality, Ruiz-Bustos *et al.* 1984), Gorafe 3, 4 and 5 (Martín-Suárez 1988) MNA-2 and MNA-4 (García-Alix *et al.* 2008a) and AL2-D (Mansino *et al.* 2013). Their size is similar to those of *A. aff. gorafensis* from Peralejos E (Adrover *et al.* 1988), Celadas 9 and La Gloria 4 (Adrover *et al.* 1993), and to the highest values of *A. aff. gorafensis* from PUR-23 (García-Alix *et al.* 2008a).

Genus *Micromys* Dehne, 1841

Micromys sp.

Figure 3B

Localities. – ABS-2, ABS-9.

Material and measurements. – 1 m2 (ABS9-1) (1.05×0.95); 1 M3 (ABS2'05-5).

Description. – m2. The anterolabial cusp is big and isolated. The labial cingulum is low and wide. There is a large round c1. There are no accessory cusps. The posterior heel is big and oval. Roots are not preserved.

M3. Molar broken anteriorly. The t4, t5 and t6 are connected. The t8 is very big and connects labially to a much smaller t9. Roots are not preserved.

Discussion. – The diminutive size of the specimens, brachyodontology of the molars and distinct labial cingulum agree with the genus *Micromys* (Fig. 3B). The m2 is smaller than in *M. steffensi* van de Weerd, 1979, from Kardia, and *M. cingulatus* Storch & Dahlmann, 1995 from Maramena, being consistent with the smallest specimens of *M. bendai* van de Weerd, 1979 and *M. kozaniensis* van de Weerd, 1979 from Ptolemais 1 and Ptolemais 3, respectively. Its size agrees with the biggest molars of *M. praeminutus*, such as the m2 from Sète (Michaux 1969), and *M. tedfordi* Wu & Flynn, 1992, being bigger than *M. caesaris* Minwer-Barakat, García-Alix, Martín-Suárez & Freudenthal, 2008, which is considered a junior synonym of *M. praeminutus* by Horáček *et al.* (2013), *M. minutus* (Pallas, 1771), *M. chalceus* Storch, 1987 and *M. paricioi* Mein, Moissenet & Adrover, 1983.

The absence of accessory cusps differs from *M. cingulatus*, *M. steffensi*, *M. bendai* and *M. kozaniensis*. The m2 has a wider labial cingulum than *M. paricioi*, *M. caesaris* and *M. minutus*. According to Minwer-Barakat *et al.* (2008), the m2 of *M. praeminutus* from Sète has a large anterolabial cuspid, more separated from the protoconid

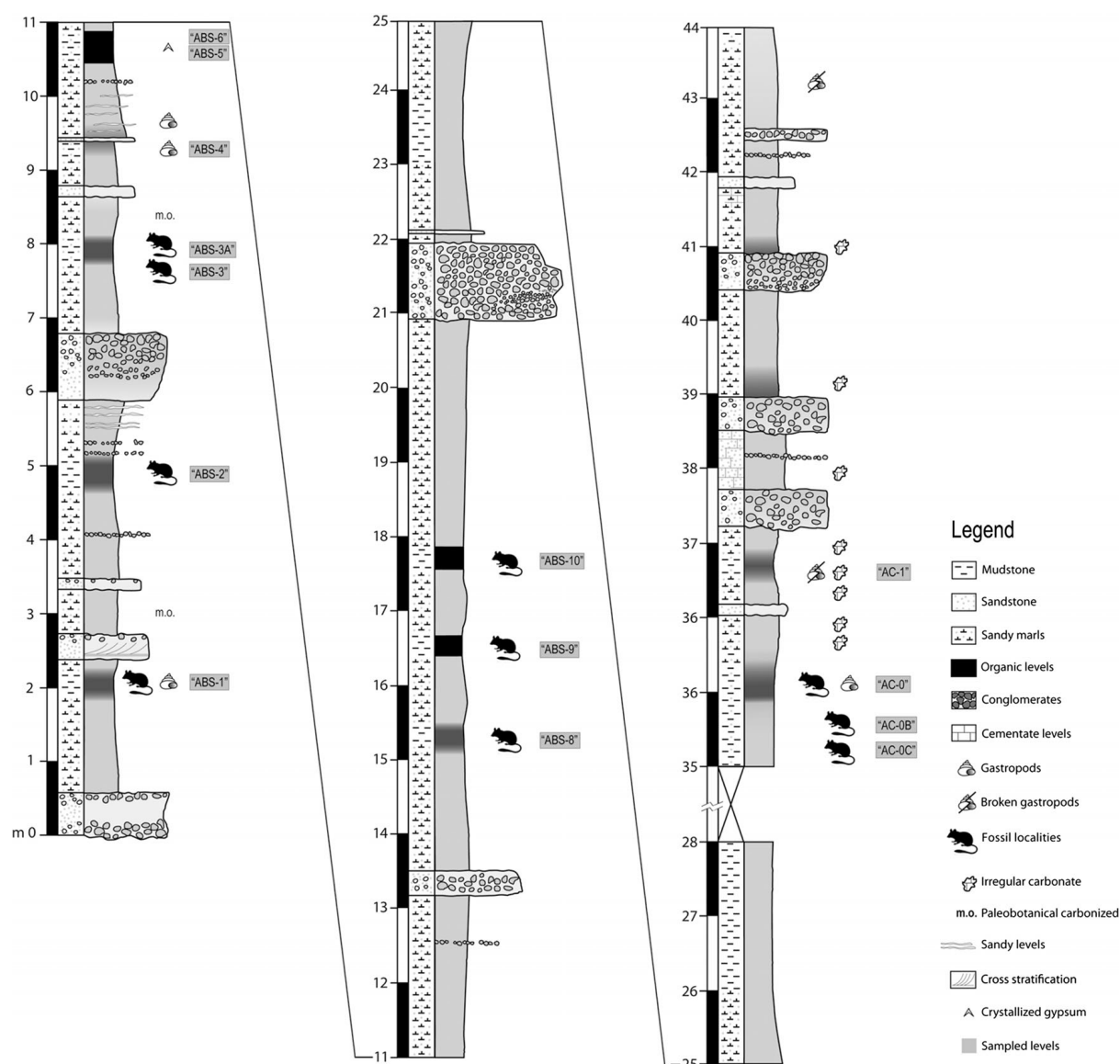


Figure 2. Lithostratigraphic log of the Alcoy-Mina surroundings, with the stratigraphical position of the microvertebrate-bearing localities of ABS-1, ABS-2, ABS-3, ABS-3A, ABS-7, ABS-8, ABS-9, ABS-10, AC-0, AC-0B and AC-0C.

than in *M. caesaris*, a well-developed labial cingulum, and it is wider anteriorly than posteriorly. The specimen ABS9-1 agrees with this morphology (Fig. 3B), but because of the scarcity of the material and lack of diagnostic features, we ascribe the studied material to *Micromys* sp.

Genus *Occitanomys* Michaux, 1969

Occitanomys alcalai Adrover, Mein & Moissenet, 1988

Figure 3C, D

Localities. – ABS-2, ABS-3, ABS-3A, AC-0, AC-0B, AC-0C.

Material and measurements. – 5 m1 (ABS3'08-45), (AC0-66) ($- \times 1.30$), (AC0-107) ($- \times 1.32$), (AC0-109), (AC0C-3) ($- \times 1.24$); 3 m2 (ABS3A-17), (AC0-5) (1.38×1.24), (AC0C-12) ($- \times 1.25$); 2 m3 (ABS3'08-43) ($- \times 0.91$), (AC0-106); 3 M1 (ABS2-36, AC0C-5, AC0-114), 1 M2 (AC0B-12).

Description. – m1. The metaconid and the lingual lobe of the anteroconid are connected by a narrow crest. The labial cingulum is wide. There is a well-developed round c1. One specimen has a big accessory cusp connected to the protoconid. There is a hint of distal spur. The posterior heel is moderate, oval and lingually displaced. Roots are not preserved.

Table 1. Measurements in millimetres of the teeth of *Paraethomys* from ABS-2, ABS-3, ABS-3A, AC-0 and AC-0B. L = length; W = width; m1 = first lower molar; m2 = second lower molar; m3 = third lower molar; M1 = first upper molar; M2 = second upper molar; M3 = third upper molar.

El.	Loc.	Sp.	Par.	n	Min.	Mean	Max.
m1	ABS-3	<i>P. aff. abaigari</i>	L	1	–	2.29	–
			W	2	1.42	1.45	1.48
	AC-0	<i>P. aff. abaigari</i>	L	1	–	2.22	–
			W	2	1.44	1.46	1.48
m2	ABS-3	<i>P. aff. abaigari</i>	L	1	–	1.63	–
			W	1	–	1.40	–
		<i>P. meini</i>	L	2	1.47	1.52	1.57
			W	1	–	1.38	–
	ABS-3A	<i>P. aff. abaigari</i>	L	1	–	1.71	–
			W	2	1.43	1.46	1.49
		<i>P. meini</i>	L	3	1.42	1.46	1.52
			W	3	1.29	1.33	1.40
	AC-0	<i>P. aff. abaigari</i>	L	3	1.63	1.67	1.69
			W	5	1.46	1.53	1.61
m3	ABS-2	<i>P. aff. abaigari</i>	W	1	–	1.28	–
	ABS-3	<i>P. meini</i>	L	1	–	1.12	–
			W	2	1.16	1.19	1.23
	AC-0	<i>P. meini</i>	W	2	1.16	1.19	1.22
M1	ABS-3	<i>P. aff. abaigari</i>	W	1	–	1.73	–
	ABS3-A	<i>P. meini</i>	L	1	–	2.31	–
			W	1	–	1.46	–
	AC-0	<i>P. aff. abaigari</i>	L	2	2.55	2.62	2.69
			W	3	1.58	1.63	1.68
	AC-0B	<i>P. meini</i>	L	1	–	2.30	–
M2	ABS-2	<i>P. aff. abaigari</i>	L	1	1.74	1.83	1.91
	ABS-3A	<i>P. aff. abaigari</i>	L	3	1.80	1.84	1.91
			W	3	1.59	1.66	1.70
	AC-0	<i>P. aff. abaigari</i>	L	2	1.78	1.82	1.85
			W	3	1.52	1.59	1.69
	AC-0B	<i>P. aff. abaigari</i>	W	1	–	1.69	–
M3	ABS-2	<i>P. meini</i>	L	1	–	1.00	–
			W	1	–	1.10	–
	ABS-3	<i>P. aff. abaigari</i>	L	1	–	1.23	–
			W	1	–	1.17	–
	ABS-3A	<i>P. aff. abaigari</i>	L	2	1.23	1.26	1.30
			W	3	1.18	1.20	1.23
	AC-0	<i>P. aff. abaigari</i>	L	2	–	1.23	–
			W	2	1.23	1.24	1.25

m2. The anterolabial cusp is big, round and connected basally with the protoconid and a reduced labial cingulum. The c1 is much reduced, and there are no accessory cusps. There is a hint of longitudinal spur. The posterior heel is well developed and round. Roots are not preserved.

m3. One molar is broken anteriorly and the other one posteriorly. There is no anterolabial cusp. The protoconid and metaconid are separated from the hypoconid-entoconid by a deep valley. There is no c1. Roots are not preserved.

M1. The t1 is displaced backwards and connects basally with the lingual side of t5. There are a well-developed t1 bis and a weak t2 bis. The t6 and t9 are connected. The t12 is small but distinct. Roots are not preserved.

M2. The specimen is broken anterolabially. The t1 is connected to t5 by a low crest. There is a t1bis. The t3 is reduced and isolated. There is no t7. Roots are not preserved.

Discussion. – *Occitanomys alcalai* ranges in age from the Late Turolian to the Ruscinian. Several authors considered this taxon an immigrant in the Iberian Peninsula (Adrover *et al.* 1988, Freudenthal & Martín-Suárez 1999), and the phylogenetic relationship with other species of the genus is not clear. The molars from ABS-2, ABS-3, ABS-3A, AC-0, AC-0B and AC-0C show a symmetric anteroconid, relative high crown, well-developed t1 bis, absence of isolated cusps in the upper molars, and lack of complete longitudinal crests in the lower molars, which are typical traits of *O. alcalai*. The size of the measurable specimens from AC-0 and AC-0C is similar to the maxima of *O. alcalai* from the Ruscinian localities of Peralejos E (Adrover *et al.* 1988), La Gloria 4 and 5, Celadas 9 and the Late Turolian sites of Villastar and Valdecebro 3 and 6 (Adrover *et al.* 1993), and slightly bigger than *O. alcalai* from the localities of the Granada Basin (García-Alix *et al.* 2008a). Their size is also close to the lower measurements of *O. adroveri* (Thaler, 1966), but this species has more developed longitudinal connections in m1 and m2, an asymmetrical anteroconid and less developed longitudinal crests in the upper molars. Also, the absence of anterolabial cusp in m3 and the t1-t5 connection in M2 are more frequent in *O. alcalai* (Minwer-Barakat *et al.* 2009a). The specimens studied differ from *O. sondaari* by its bigger size, greater development of t1 bis, less developed longitudinal crests in the lower molars, higher t6-t9 connection and more developed labial cingulum, and from *O. brailloni* by their smaller size and less-developed spurs and crests in the upper molars.

Genus *Paraethomys* Petter, 1968

Paraethomys aff. abaigari Adrover, Mein & Moissenet, 1988

Figure 3E–I

Localities. – ABS-2, ABS-3, ABS-3A, AC-0, AC-0B.

Material. – 7 m1 (ABS3'08-1, ABS3'08-5, ABS3A-36, AC0-19, AC0-35, AC0-41, AC0-51); 11 m2, (ABS3'05-2,

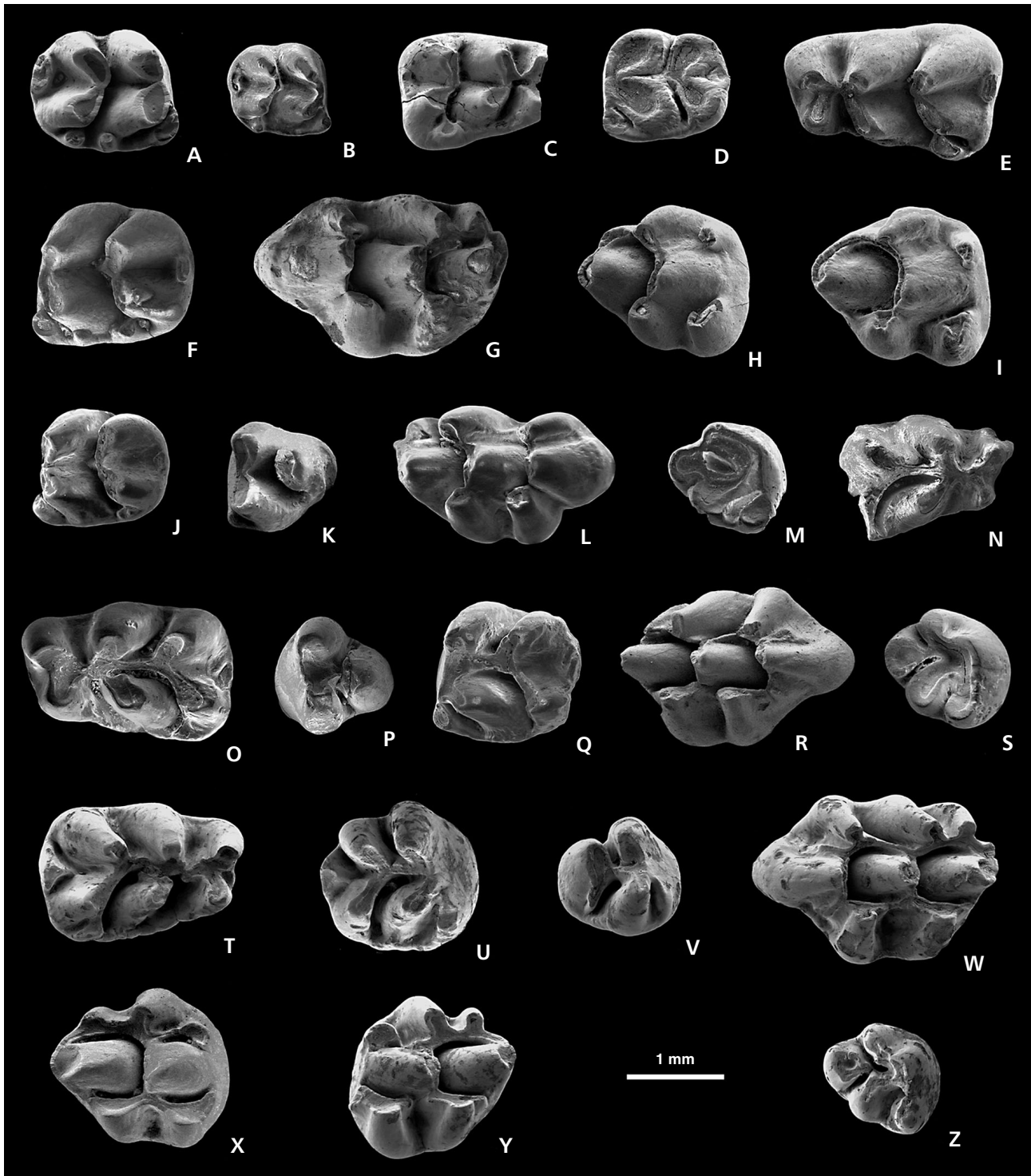


Figure 3. Fossil rodents from ABS-2, ABS-3, ABS-3A, ABS-9, AC-0 and AC-0C. • A – *Apodemus gorafensis*; right m2, AC0-46. • B – *Micromys* sp.; right m2, ABS9-1. • C, D – *Occitanomys alcalai*; C – right m1, AC0C-3; D – left m2, AC0C-5. • E–I – *Paraethomys* aff. *abaigari*; E – left m1, ABS3'08-1; F – left m2, AC0-110; G – right M1, AC0-43; H – right M2, ABS3A-2; I – right M2, ABS3A-21. • J–M – *Paraethomys meini*; J – left m2, ABS3A-42; K – left m3, ABS3'08-15; L – right M1, ABS3A-20; M – right M3, ABS3'08-31. • N–S – *Stephanomys dubari*; N – right m1, ABS2-33; O – left m1, ABS3'08-2; P – left m3, ABS3A-18; Q – left m2, ABS3'08-8; R – right M1, ABS2-34; S – right M3, ABS3'08-33. • T–W – *Stephanomys* aff. *cordii*; T – right m1, AC0-1; U – right m2, AC0-8; V – right m3, AC0-11; W – left M1, AC0-12; X – left M2, AC0-15; Y – right M2, AC0-15; Z – right M3, AC0-10. Scale: 1 mm.

ABS3'05-3, ABS3'08-6, ABS3'08-11, ABS3A-12, ABS3A-15, AC0-3, AC0-4, AC0-18, AC0-47, AC0-110); 2 m3 (ABS2-20, ABS3'05-4); 8 M1 (ABS3'08-18, ABS3'08-19, ABS3'08-27, ABS3A-19, AC0-28, AC0-43, AC0-44, AC0-113); 15 M2 (ABS2'05-4, ABS2-35, ABS3'08-28, ABS3'08-29, ABS3A-2, ABS3A-21 to ABS3A-24, AC0-7, AC0-26, AC0C-49, AC0-117, AC0B-5, AC0B-6); 7 M3 (ABS3'08-31, ABS3A-25 to ABS3A-27, AC0-9, AC0-16, AC0C-10).

Measurements. – See Table 1.

Description. – m1. Slightly asymmetrical anteroconid. The two anterior pairs of cusps are connected by a narrow crest. Two specimens have a reduced longitudinal spur. Moderate labial cingulum, which bears one or two small accessory cusps. The posterior heel is big, round or oval and lingually displaced. Roots are not preserved.

m2. The anterolabial cusp is big and connected basally with the protoconid and the labial cingulum. The c1 is well developed, and a small accessory cusp attached to the labial side of the protoconid may be present. There is a longitudinal spur in 8 out of 11 specimens. The posterior heel is laminar in three specimens, oval in the others. Roots are not preserved.

m3. The specimens are broken anteriorly. There is no longitudinal connection. There is neither c1 nor accessory cusps. Roots are not preserved.

M1. The t1 is displaced backwards. The connection between t1 and t2 is lower than the connection between t2 and t3. The t2 and t3 are very close together. There are distal spurs on t1 and t3, although much reduced in some specimens (Fig. 3G). The connection between t4 and t8 is very low. There is a small t12. There are three roots.

M2. The t1 and t3 are isolated. The t3 is reduced. In 7 out of 13 specimens there is a reduced spur in t1. One molar has a slightly swollen t9 (Fig. 3H), which is reduced in the others (Fig. 3I). There is no t12. There are four roots.

M3. The t1 is large and isolated. The t3 is absent. The t8 is connected to the t4-t5-t6 junction. There are three roots.

Discussion. – Two different lineages of *Paraethomys* can be distinguished in the Early Pliocene: the small sized *P. meini* (Adrover, 1969), and the bigger forms of the anagenetic lineage *P. aff. abaigari*-*P. abaigari*-*P. jaegeri* Montenat & de Bruijn, 1976. Besides the difference in size, Adrover *et al.* (1988) noted a greater development of the distal spurs in t1 and t3 in the upper molars of the bigger species. These differences are clear in *P. jaegeri* and *P. abaigari*, but the older *P. aff. abaigari* is more similar to *P. meini* and the size of both species can overlap, making specific adscription complicated (García-Alix *et al.* 2008a). That is the case in some localities such as PUR-4 in

the Granada Basin (García-Alix *et al.* 2008a) and AF-1 (Mansino pers. comm.), where *Paraethomys* has a great variability in size but two species cannot be discriminated (García-Alix *et al.* 2008a). This situation is the same as in the assemblages studied in this paper from the Alcoi Barranc Sud and Alcoi Cristian sections, where a reduced number of *Paraethomys* remains have been located. We cannot assess if there is a continuous distribution ranging from the smallest to the biggest specimens as in PUR-4 and AF-1. However, the size of the molars ascribed to *P. aff. abaigari* matches the biggest specimens from these localities, with some specimens being clearly bigger, falling within the range of variation of *P. aff. abaigari* from CLC-5A and PUR-13 (García-Alix *et al.* 2008a), Celadas 9 and La Gloria 4 (Adrover *et al.* 1993) and AL2-C and AL2-D (Mansino *et al.* 2013). Adrover *et al.* (1988) noted that *P. abaigari* and *P. jaegeri* have more developed distal spurs in t1 and t3 in M1, and that the molars are relatively wider. However, these differences are not as conspicuous between *P. aff. abaigari* and *P. meini*, since the shape of the molars of both species is similar and some specimens of *P. meini* have moderately developed spurs, which are absent in some molars of *P. aff. abaigari*. Since more data are needed to clarify the morphological differences between both taxa, we ascribe the biggest specimens from these localities to *P. aff. abaigari*.

Paraethomys meini (Michaux, 1969)

Figure 3J–M

Localities. – ABS-2, ABS-3, ABS-3A, AC-0, AC-0B.

Material. – 2 m1 (AC0-102, AC0B-8); 6 m2 (ABS3'08-10, ABS3'08-11, ABS3A-13, ABS3A-14, ABS3A-42, AC0-53); 6 m3 (ABS3'08-15 to ABS3'08-17, ABS3A-28, AC0-111, AC0B-9); 3 M1 (ABS3'08-21, ABS3A-20, AC0B-7); 1 M3 (ABS2'05-2).

Measurements. – See Table 1.

Description. – m1. Slightly asymmetrical anteroconid. The two anterior pairs of cusps are connected by a narrow crest. One specimen has a reduced longitudinal spur. Moderate labial cingulum, which bears a big accessory cusp in one specimen. The posterior heel is big, oval and central. Roots are not preserved.

m2. Moderate anterolabial cusp, in contact with the labial cingulum and the anterior side of the metaconid. There is a much reduced longitudinal spur. One specimen has a very small c1, absent in the others. The posterior heel is much reduced. Roots are not preserved.

m3. The anterolabial cusp is absent or reduced. There is neither c1 nor accessory cusps. Roots are not preserved.

M1. The t1 is displaced backwards. The connection between t1 and t2 is lower than the connection between t2 and t3. The t2 and t3 are very close together. One specimen has low longitudinal connections between t1-t5 and t3-t6 (Fig. 3L). The other two molars have a spur in t1, and one of them also in t3. There is a small t12. Roots are not preserved.

M3. The t1 is large and isolated. The t3 is absent. The t8 is connected to the t4-t5-t6 junction. Roots are not preserved.

Discussion. – The morphology of this group of specimens is consistent with *P. meini*, although the presence of distal spurs in M1, especially in t3, is more frequent in *P. abai-gari* (Adrover et al. 1998). However, some specimens of *P. meini* can also develop this feature (García-Alix et al. 2008a, Mansino et al. 2013) and the size of the molars described is similar to that of *P. meini* from CLC-5A, PUR-13 (García-Alix et al. 2008a), Peralejos E (Adrover et al. 1988), Celadas 9, La Gloria 4 (Adrover et al. 1993), AL2-C and AL2-D (Mansino et al. 2013), and LB2B (Mansino pers. comm.). Because of this, we ascribe the specimens from Alcoi Barranc Sud and Alcoi Cristian to *P. meini*.

Genus *Stephanomys* Schaub, 1938

Stephanomys dubari Aguilar, Michaux, Bachelet, Calvet & Faillat, 1991

Figure 3N–S

Localities. – ABS-1, ABS-2, ABS-3, ABS-3A.

Material. – 8 m1 (ABS2-33, ABS2-38, ABS3'05-1, ABS3'08-2, ABS3'08-37, ABS3A-8 to ABS3A-10); 9 m2 (ABS2-1, ABS3'08-7 to ABS3'08-9, ABS3'08-12, ABS3'08-13, ABS3'08-22, ABS3A-1, ABSA-16); 3 m3 (ABS3'08-14, ABS3'08-39, ABS3A-18); 3 M1 (ABS2-2, ABS2-34, ABS2-37); 4 M2 (ABS3'08-23 to ABS3'08-26); 4 M3 (ABS1-1, ABS2-3, ABS3'08-32, ABS3'08-33).

Measurements. – See Table 2.

Description. – m1. The anteroconid is slightly asymmetrical, connected to the protoconid-metaconid pair by a narrow crest. The labial cingulum is low and narrow. There is a well-developed longitudinal crest that connects the posterior cusps with the metaconid. The c1 is big and subtriangular. The posterior heel is big and oval. Roots are not preserved.

m2. The anterolabial cusp is high and big, connected to the protoconid and a moderately developed labial

cingulum. The longitudinal crest is lingually displaced towards the metaconid. The c1 may be absent, small or well developed. The c1 ranges from very small to well developed. There are no accessory cusps. The posterior heel is large and oval. There are two roots.

m3. The anterolabial cusp is absent in the specimen from ABS-3A (Fig. 3O), and reduced in ABS-3. There is a longitudinal crest that reaches the protoconid-metaconid junction. There are two roots.

M1. The t1 is displaced backwards. The t1 bis and t2 bis are well developed. The posterior crest of t1 and the labial longitudinal crest of t3 are complete, but the crest in t1 is usually lower (Fig. 3R). The t12 is reduced. Roots are not preserved.

M2. The t1 has a small t1bis attached to its anterior side. The longitudinal crest of t1 is low in two specimens, and the t3 is isolated in another two. The t12 is well developed. These molars have three roots.

M3. The t1 and t8 are connected to the t4-t5-t6 junction. The t3 is absent. There are three roots.

Discussion. – The height of the crown, development of longitudinal crests in the lower molars and distal crests or spurs in t1 and t3 of the upper molars suggest that the specimens studied belong to the genus *Stephanomys*. These molars are smaller, less hypsodont and with a less pronounced stephanodonty than younger *Stephanomys* such as *S. donnezani* (Déperet, 1890), *S. balcellsii* Gmelig-Meyling & Michaux, 1973, *S. vandeweerdii* Adrover, 1986, *S. thaleri* López-Martínez, Michaux & Hutterer, 1998 and *S. minor* Gmelig-Meyling & Michaux, 1983. In addition, *S. balcellsii* and *S. minor* differ from other species of the genus by having a tubercular posterior heel. *Stephanomys debruijnii* de Giuli, 1989 differs from our specimens by having a small tma in some m1, a reduced and rounded posterior heel and a t1 situated extremely backwards in the M1. *Stephanomys dubari* is bigger, more hypsodont and with a more pronounced stephanodonty than *S. ramblensis* van de Weerd, 1976. This latter species presents sometimes the longitudinal crest of the m1 directed to the protoconid, and the t1 and t3 of the M1 and M2 rarely develop full longitudinal crests (García-Alix 2006).

The studied specimens fall within the range of variation of *S. dubari* from Castelnou 3, its type locality (Aguilar et al. 1991), being slightly smaller than *S. cordii* Ruiz-Bustos, 1986 from Alcoy (Cordy 1976) AL2-C and AL2-D (Mansino et al. 2013). One m1 from ABS-2, much worn and broken posteriorly, seems much smaller than the other molars of *S. dubari* (Fig. 3N), even the specimens from the same locality (compare with Fig. 3O), but because of the great development of the longitudinal crest, which reaches the metaconid-protoconid connection, reduced labial cingulum and height of the crown, we ascribe this molar to *Stephanomys*. These molars also differ from *S. cordii* by

Table 2. Measurements in millimetres of the teeth of *Stephanomys dubari* from ABS-1, ABS-2, ABS-3, ABS-3A and *Stephanomys aff. cordii* from ABS-8, AC-0, AC-0B and AC-0C. L = length; W = width; m1 = first lower molar; m2 = second lower molar; m3 = third lower molar; M1 = first upper molar; M2 = second upper molar; M3 = third upper molar.

Element	Locality	Sp.	Parameter	n	Min.	Mean	Max.
m1	ABS-3	<i>dubari</i>	L	1	–	2.29	–
			W	1	–	1.38	–
	AC-0	<i>aff. cordii</i>	L	4	2.11	2.21	2.33
			W	4	1.33	1.43	1.52
m2	ABS-2	<i>dubari</i>	W	1	–	1.47	–
	ABS-3	<i>dubari</i>	L	3	1.53	1.63	1.69
			W	5	1.46	1.50	1.55
	ABS-3A	<i>dubari</i>	L	1	–	1.62	–
	AC-0	<i>aff. cordii</i>	L	1	–	1.63	–
			W	1	–	1.59	–
	AC-0C	<i>aff. cordii</i>	W	1	–	1.58	–
m3	ABS-3	<i>dubari</i>	L	1	–	1.48	–
			W	1	–	1.35	–
	ABS-3A	<i>dubari</i>	L	1	–	1.27	–
			W	1	–	1.22	–
	AC-0	<i>aff. cordii</i>	L	4	1.31	1.34	1.36
			W	6	1.19	1.23	1.28
	AC-0B	<i>aff. cordii</i>	W	1	–	1.34	–
M1	ABS-2	<i>dubari</i>	L	1	–	2.43	–
			W	3	1.59	1.73	1.88
	AC-0	<i>aff. cordii</i>	L	2	2.59	2.63	2.67
			W	5	1.77	1.84	1.96
M2	ABS-3	<i>dubari</i>	L	4	1.66	1.74	1.86
			W	4	1.62	1.71	1.83
	ABS-8	<i>aff. cordii</i>	L	1	–	1.92	–
			W	1	–	1.66	–
	AC-0	<i>aff. cordii</i>	L	5	1.50	1.75	1.96
			W	7	1.56	1.71	1.82
	AC-0C	<i>aff. cordii</i>	L	1	–	1.95	–
			W	1	–	1.83	–
M3	ABS-1	<i>dubari</i>	L	1	–	1.16	–
			W	1	–	1.13	–
	ABS-3	<i>dubari</i>	L	2	1.18	1.23	1.28
			W	2	1.03	1.13	1.23
	AC-0	<i>aff. cordii</i>	L	2	1.20	1.24	1.29
			W	5	1.13	1.19	1.25
	AC-0C	<i>aff. cordii</i>	L	1	–	1.19	–
			W	1	–	1.29	–

the t1 displaced backwards (Fig. 3R), the longitudinal crest of the m3 reaching the protoconid-metaconid junction instead of the protoconid and the less developed distal crests in M1 and M2.

Stephanomys aff. cordii Ruiz-Bustos, 1986

Figure 3T–Z

Localities. – ABS-8, AC-0, AC-0B, AC-0C.

Material. – 8 m1 (AC0-1, AC0-2, AC0-98 to AC0-101, AC0-108, AC0C-6); 4 m2 (AC0-8, AC0B-2, AC0C-4, AC0C-11); 7 m3 (AC0-11, AC0-42, AC0-56, AC0-103 to AC0-105, AC0B-1); 7 M1 (AC0-12 to AC0-14, AC0-45, AC0-133, AC0B-10, AC0C-1); 10 M2 (ABS8-1, AC0-6, AC0-15, AC0-48, AC0-50, AC0-115, AC0-116, AC0-118, AC0-134, AC0C-7); 6 M3 (AC0-10, AC0-17, AC0-58, AC0-59, AC0-121, AC0C-8).

Measurements. – See Table 2.

Description. – m1. The anteroconid is slightly asymmetrical, connected to the protoconid-metaconid pair by a narrow crest. The labial cingulum is moderately developed. There is a well-developed longitudinal crest that connects the posterior cusps with the metaconid or the protoconid-metaconid junction. The c1 is moderate in size and subtriangular. The posterior heel is big, oval or subtriangular. There are two roots.

m2. The anterolabial cusp is high and big, connected to the protoconid and a moderately developed labial cingulum. The longitudinal crest is lingually displaced towards the metaconid. The c1 is reduced. There are no accessory cusps. The posterior heel is large, ranging from round to laminar. Roots are not preserved.

m3. The anterolabial cusp is low and reduced. The longitudinal crest can reach the metaconid (1) the protoconid-metaconid junction (3) or the protoconid (3). Roots are not preserved.

M1. The position of t1 and t3 is almost symmetrical (Fig. 3W). The t1 bis and t2 bis are well developed. The posterior crest on t1 and the labial longitudinal crest on t3 are high and complete except in one specimen, which has a lower distal crest on t1. The t12 is reduced. Roots are not preserved.

M2. The t1 has a small t1bis attached to its anterior side. The longitudinal crest on t1 is absent in 1 out of 9 specimens and low in three. The longitudinal crest on t3 is absent in 2 out of 9 specimens and low in another one (Fig. 3Y). The t12 is well developed. Roots are not preserved.

M3. The t1 and t8 are connected to the t4-t5-t6. The t3 is absent. There are three roots.

Discussion. – The material from ABS-8, AC-0, AC-0B and AC-0C has been directly compared with the collection of *S. cordii* from AL2-C and AL2-D (Mansino *et al.* 2013) housed at the Museu de Geologia de la Universitat de València. In general, the morphology of the speci-

mens is similar to *S. cordii*, which has as a reduced labial cingulum and tubercular posterior heel in m1 and m2, a poorly-developed anterolabial cusp in m3, a longitudinal crest of m3 usually united to the protoconid and a symmetrical position of t1 and t2 in M1. In the m3 from AL2-C and AL2-D, the longitudinal crest reaches the protoconid in eight specimens, the protoconid-metaconid junction in five and cannot be observed properly in another six. This proportion is slightly higher than in the specimens from AC-0 and AC-0B (3 out of 7). The relative positions of t1 and t3 in the M1 are also similar, but the longitudinal crests are higher in M1 and M2 from AL2-C/AL2-D.

Stephanomys dubari is considered the likely descendant of *S. ramblensis* and the ancestor of *S. cordii* by several authors (e.g. Minwer-Barakat 2005 or García-Alix et al. 2008a among others). There is an increase in size, stephanodontology and hypsodonty in the lineage *Occitanomys adroveri*-*S. ramblensis*-*S. dubari*-*S. cordii* (García-Alix et al. 2008a), which will continue in some of their Middle and Late Pliocene descendants (for a complete phylogeny of the genus see García-Alix 2006). The size of the specimens studied falls within the range of variation of *S. cordii* from Alcoy (Cordy 1976) and AL2-C and AL2-D (Mansino et al. 2013). Its average sizes are also similar to *S. dubari* described in this paper, but some of the smaller specimens of this latter taxon cannot be measured properly (see Fig. 3N) and the highest values usually correspond to *S. aff. cordii* (see Table 2). For these reasons, we ascribe the material from ABS-8, AC-0, AC-0B and AC-0C to *S. aff. cordii*, which has a similar size but lower longitudinal connections than *S. cordii*.

Stephanomys sp.

Localities. – ABS-7, ABS-9.

Material. – 1 m2 (ABS7'05-3); 1 M1 (ABS9-3).

Description. – m2. The molar is broken anteriorly and much worn. Most of the enamel has been lost. There is a full longitudinal crest that reaches the metaconid. The posterior heel is big and subtriangular.

M1. The specimen is broken, only the t3, t5 and t6 can be observed. The t3 has a high and full distal crest that reaches the t5-t6 connection.

Discussion. – The full longitudinal crests and great height of the crown agree with *Stephanomys*. However, the scarcity of the material and poor state of preservation prevent us from reaching a specific ascription, since we cannot discriminate if they belong to *S. dubari* or *S. cordii*.

Family Cricetidae Fischer, 1817

Subfamily Cricetinae Fischer, 1817

Genus *Apocricetus* Freudenthal, Mein & Martín Suárez, 1998

Apocricetus cf. *barrierei* (Mein & Michaux, 1970)

Figure 4A

Locality. – ABS-3A.

Material. – 1 M1 (ABS3A-37) (2.67 × 1.72).

Description. – M1. Weak cingulum ridge. Double anterolophule, arising from a short preloph. Absent anterior protolophule, mesoloph and ectomesoloph. Present anterior metalophule. Absent posterior metalophule. The posterior part of the posterosinus is shallow, whereas the anterior part is much deeper. The posteroloph, and not the metacone, constitutes the posterior side of the tooth. There are four roots.

Discussion. – Usually, size has been the main criterion used to distinguish between species of the genus *Apocricetus*, especially in the youngest part of the phylogenetic lineage defined by Freudenthal et al. (1998). The size of the M1 of *A. cf. barrierei* from ABS-3A coincides approximately with the mean length and width values of *A. barrierei* (see data from Ruiz-Sánchez et al. 2014; Fig. 4A–C). The length of this tooth is clearly smaller than *A. angustidens* (Depéret, 1890) and longer than those of *A. aff. plinii*, *A. plinii* (Freudenthal, Lacomba & Martín-Suárez, 1991) and *Apocricetus alberti* Freudenthal, Mein & Martín-Suárez, 1998. A weak cingulum ridge is present in some specimens of *A. alberti* (Mansino et al. 2014) and *A. barrierei* (Ruiz-Sánchez et al. 2014), being more developed in *A. angustidens* (Freudenthal et al. 1998). The double anterolophule and the absence of mesoloph in M1 distinguish *A. cf. barrierei* from ABS-3A from *A. plinii* from Crevillente 15 (type locality) and *A. aff. plinii* from Crevillente 23. The development of the preloph of the specimen from ABS-3A is similar to that of *A. barrierei* from La Bullana 2B (Fig. 4C, Ruiz-Sánchez et al. 2014). This crest is absent in *A. aff. plinii* and *A. plinii*, and much rarer and less developed in *A. alberti*, while it has not been described in the populations of *A. angustidens* (Mansino et al. 2014). The anterior protolophule is more frequent in *A. aff. plinii*, *A. plinii* and *A. alberti*, and less frequent in *A. barrierei* and *A. angustidens* (Mansino et al. 2014, Ruiz-Sánchez et al. 2014). The proportion of specimens with posterior metalophule in M1 decreases from the older to the younger species of the genus, being absent in *A. barrierei* and *A. angustidens* (Mansino et al. 2014). Hence, on the base on metric and morphological features,

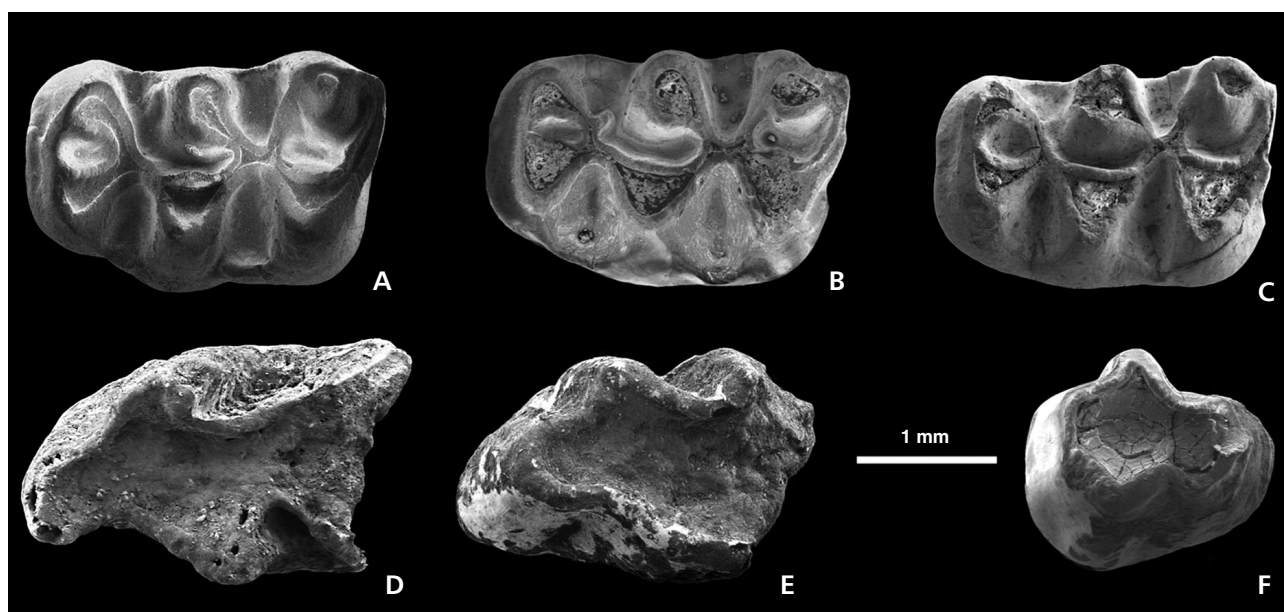


Figure 4. Fossil rodents from ABS-3A, AC-0, AC-0B and La Bullana 2B (LB2B). • A–C – *Apocricetus* cf. *barrierei*; A – left M1, ABS3A-37; B – left M1, LB2B-261; C – left M1, LB2B-223. • D–F – *Ruscinomys* cf. *lasallei*; D – left m1, AC0-68; E – left m2, AC0-69; F – left m3, AC0B-14. Scale: 1 mm.

the material of the genus *Apocricetus* from ABS-3A may be assigned to *A. barrierei*. Nonetheless, due to the scarcity of material we ascribe this molar to *A. cf. barrierei*.

Genus *Neocricetodon* Schaub, 1934

Neocricetodon sp.

Figure 5A

Locality. – AC-0C.

Material. – 1 m3 (AC0C-9) (1.12 × 0.86).

Description. – m3. Subtriangular outline, the posterior part is narrower than the anterior part (Fig. 5A). The anterosinusid is very small. A very short lingual anterolophulid is present. The metalophulid is very short and transversal. The labial anterolophulid reaches the base of protoconid, enclosing a narrower protosinusid. The mesosinusid and sinusid are closed by a cingulum ridge. A trace of mesolophid, low and connected to the metaconid, is present. The ectomesolophid is absent. The posterolophid is connected to the entoconid. Roots are not preserved.

Discussion. – Size has been the criterion used to distinguish the species *N. lavocati* (Hugueney & Mein 1965) from another bigger species in its type locality (Lissieu). In this latter locality, Freudenthal *et al.* (1998) mentioned two very small m3: one of the size of the small specimens from Crevillente 2 (*Neocricetodon occidentalis* Aguilar,

1982) and another one even smaller (1.14 × 0.96). This latter specimen is much worn (Hugueney & Mein 1965, pl. 2, fig. 55) and the morphology cannot be clearly observed, but the outline is very similar to the m3 from AC-0C. According to Freudenthal *et al.* (1998) the mesolophid is very developed in the m1 from Lissieu, nearly always reaching the margin of the molar, but this trait cannot be observed in the much worn m3. The small size of the specimen resembles *N. lavocati*, but because of the scarcity of the material and lack of any unworn m3, we ascribe this molar to *Neocricetodon* sp. until more material becomes available.

Cricetinae indet.

Locality. – AC-0B.

Material. – 1 m3 (AC0B-11).

Description. – m3. The specimen is broken anteriorly, posteriorly and labially. The only cusps that can be observed are the entoconid, the metaconid and the lingual portion of the hypoconid. There is no mesolophid. Roots are not preserved.

Discussion. – This molar is clearly bigger and more hypsodont than the m3 ascribed to *Neocricetodon* sp. from AC-0C. Because of the poor state of preservation of the specimen we cannot reach a generic ascription, and therefore we assign this molar to Cricetinae indet.

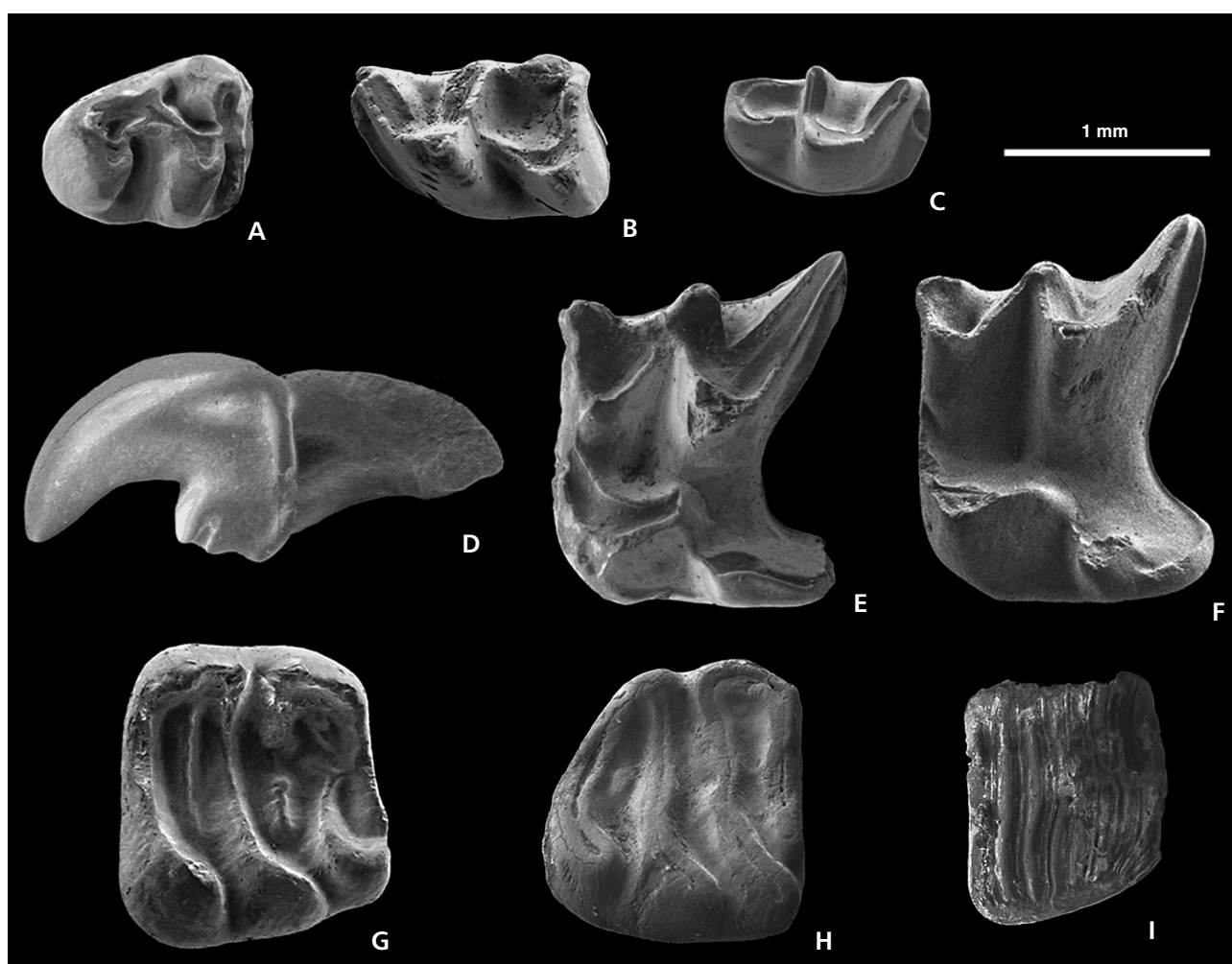


Figure 5. Fossil rodents from ABS-3, ABS-3A, ABS-10 and AC-0. • A – *Neocricetodon* sp.; right m3, AC0-9. • B–F – *Asoriculus gibberodon*; B – left m1,2, AC0-57; C – right m3, ABS10-1; D – left I1, ABS3'08-35; E – left M1, AC0-90; F – left M2, ABS3A-39. • G – *Eliomys yevesi*; right m1,2, ABS3A-38. • H – *Eliomys intermedius*; right m3, AC0-88. • I – *Muscardinus* sp., left M3. Scale: 1 mm.

Subfamily Cricetodontinae Stehlin & Schaub, 1951

Genus *Ruscinomys* Depéret, 1890

Ruscinomys cf. *lasallei* Adrover, 1969

Figure 4D–F

Localities. – ABS-3A, AC-0, AC-0B, AC-0C.

Material. – 2 m1 (AC0-30, AC0-68); 1 m2 (AC0-69); 3 m3 (ABS3A-41, AC0-31, AC0-129); 1 M1 (AC0-72) ($- \times 2.68$); 1 M2 (AC0-70) ($- \times 2.22$); 4 M3 (AC0-71) (1.95×1.57), (AC0-73) (1.83×1.62), (AC0B-14) (1.98×1.63), (AC0C-15); 3 frag. indet. (AC0-74, AC0-128, AC0-130).

Description. – m1. Both molars are much worn. The specimens are broken posteriorly, and one of them is also broken anteriorly. The anteroconid is rounded (Morphotype 3,

García-Alix *et al.* 2008b). The anterolophid is absent. The mesolophid cannot be observed. The sinusoid is deep and narrow. Roots are not preserved.

m2. This molar is broken anteriorly and extremely worn. The anteroconid is shorter than in m1. The posterolophid cannot be observed. The sinusoid is deep and narrow. Roots are not preserved.

m3. All specimens are broken anteriorly and much worn. The posterolophid cannot be observed. The sinusoid is deep and narrow. Roots are not preserved.

M1. The molar is broken posteriorly and extremely worn. Roots are not preserved.

M2. The specimen is poorly preserved and broken anteriorly. The ectolophids cannot be observed. Roots are not preserved.

M3. The specimens are much worn. These teeth are bilobed, the anterior lobe being much bigger than the posterior one. Roots are not preserved.

Discussion. – Several authors have proposed the phyletic lineage *R. schaubi*-*R. lasallei*-*R. europaeus* (Adrover 1969, van de Weerd 1976, García-Alix *et al.* 2008b, among others) in which there is a continuous increase in size and hypsodonty, as well as changes in some morphological features such as the shape of anterocone and anteroconid, along time. The specimens studied are smaller than *R. europaeus* Déperet, 1890, and agree in size with *R. lasallei* Adrover, 1969, from the localities of Alcoy (Adrover 1969), BRA-5B, PUR-4 and PUR-13 (García-Alix *et al.* 2008b), being similar to *R. cf. lasallei* from, Arquillo1, Arquillo 4, La Gloria 5 (Adrover *et al.* 1993) and Caravaca (van de Weerd 1976) and slightly bigger than *R. cf. lasallei* from Valdecebro 3, Valdecebro 6 and Villastar (Adrover *et al.* 1993). Because of the advanced wear of the specimens it is impossible estimating hypsodonty of these molars, as well as the observation of the diagnostic features of the occlusal surface. However, the relatively flat surfaces of the labial sides of the m1 and m2 and the reduction of the M3 agree better with *R. lasallei* than with *Ruscinomys schaubi* Villalta & Crusafont Pairó, 1956. For these reasons, we ascribe the molars from ABS-3A, AC-0, AC-0B and AC-0C to *R. cf. lasallei*.

Family Gliridae Muirhead, 1819
Subfamily Dryomyinae de Bruijn, 1967

Genus *Eliomys* Wagner, 1840

***Eliomys yevesi* Mansino, García-Alix,
Ruiz-Sánchez & Montoya, 2014**
Figure 5G

Locality. – ABS-3A.

Material. – 1 m1,2 (ABS3A-38) (1.30 × 1.45).

Description. – m1,2. Trapezoidal outline. The anterolophid is connected to the protoconid basally. No anterotropid. The metalophid does not reach the metaconid. The centrolophid is not continuous, and its labial end is separated from the metalophid by a wide furrow. The metaconid and entoconid are separated. Well-developed posterotropid. Large hypoconid. Roots are not preserved.

Discussion. – The presence of a mixture of characters typical of *E. truci* Mein & Michaux, 1970 and *E. intermedius* Friant, 1953 in some populations of *Eliomys* from the Granada and Alcoy basins and the locality of Venta del Moro led Mansino *et al.* (in press), to create a new species, *E. yevesi*. The single specimen from ABS-3A share some characters with the populations of *E. truci*, like the absence of connections between metalophid-metaconid

as well as the presence of a large posterotropid, usually absent or reduced in *E. intermedius*. This molar is bigger and has higher cusps than *E. truci*, and is smaller and relatively narrower, with a more quadrangular shape than *E. intermedius*.

***Eliomys intermedius* Friant, 1953**

Figure 5H

Locality. – AC-0.

Material. – 1 m3 (AC0-88) (1.27 × 1.41); 1 M1,2 (AC0-87).

Description. – m3. Sub-trapezoidal outline. The anterolophid and the protoconid are separated. No anterotropid. The metalophid is connected to the metaconid. There is a short centrolophid, not connected to the metalophid (Fig. 3S). The metaconid and entoconid are separated. No posterotropid. Roots are not preserved.

M1,2. Subrectangular outline. The anteroloph and paracone are connected basally. The protoloph and metaloph are distinctly sinuous. Both centrolophs are present. The posteroloph is connected to the endoloph. There are three roots.

Discussion. – The molars from AC-0 are slightly smaller than those of *E. intermedius* from younger localities (Mansino *et al.* in press.), but they agree in size with the population from Sète, type locality of the species (Adrover 1986) and are clearly bigger, more concave, more rounded and with more developed centrolophs than *E. yevesi* and *E. truci* (Mansino *et al.* in press).

Subfamily Glirinae Muirhead, 1819

Genus *Muscardinus* Kaup, 1829

***Muscardinus* sp.**
Figure 5I

Locality. – AC-0.

Material. – 1 M3 (AC0-89) (> 1.10 × –).

Description. – M3. The specimen lacks the medial part of the labial border, and the posterior border is much worn, thus its length is slightly underestimated. The outline is sub-trapezoidal. The occlusal surface has eight low ridges, the anterior one straight and the others slightly convex towards the posterior side of the molar. The lingual sides of the ridges reach a continuous endoloph. There are four roots.

Table 3. Faunal lists of the localities Alcoy-Barranco, ABS-3, ABS-3A and AC-0.

Alcoy-Barranco (Thaler <i>et al.</i> 1965, Adrover 1969)	ABS-2 (This paper)	ABS-3 (This paper)	ABS-3A (This paper)	ABS-7 (This paper)	ABS-8 (This paper)	ABS-9 (This paper)	AC-0B (This paper)	AC-0C (This paper)	AC-0 (This paper)
<i>Apodemus</i> sp.	–	<i>Apodemus gorafensis</i>	–	–	–	–	–	<i>Apodemus gorafensis</i>	<i>Apodemus gorafensis</i>
<i>Anthracomys ellenbergeri</i>	<i>Paraethomys meini</i>	<i>Paraethomys meini</i>	<i>Paraethomys meini</i>	–	–	–	<i>Paraethomys meini</i>	–	<i>Paraethomys meini</i>
–	<i>Paraethomys aff. abaigari</i>	<i>Paraethomys aff. abaigari</i>	<i>Paraethomys aff. abaigari</i>	–	–	–	<i>Paraethomys aff. abaigari</i>	–	<i>Paraethomys aff. abaigari</i>
–	<i>Micromys</i> sp.	–	–	–	–	<i>Micromys</i> sp.	–	–	–
<i>Parapodemus</i> sp.	–	–	–	–	–	–	–	–	–
–	–	<i>Occitanomys alcalai</i>	<i>Occitanomys alcalai</i>	–	–	–	<i>Occitanomys alcalai</i>	<i>Occitanomys alcalai</i>	<i>Occitanomys alcalai</i>
<i>Stephanomys aff. donnezani</i>	<i>Stephanomys dubari</i>	<i>Stephanomys dubari</i>	<i>Stephanomys dubari</i>	<i>Stephanomys</i> sp.	<i>Stephanomys aff. cordii</i>	<i>Stephanomys</i> sp.	<i>Stephanomys aff. cordii</i>	<i>Stephanomys aff. cordii</i>	<i>Stephanomys aff. cordii</i>
<i>Cricetus aff. angustidens</i>	–	–	<i>Apocricetus cf. barrierei</i>	–	–	–	–	–	–
–	–	–	–	–	–	–	–	<i>Neocricetodon</i> sp.	–
–	–	–	–	–	–	–	Cricetinae indet.	–	–
<i>Ruscinomys lasallei</i> –	–	–	<i>Ruscinomys cf. lasallei</i>	–	–	–	<i>Ruscinomys cf. lasallei</i>	<i>Ruscinomys cf. lasallei</i>	<i>Ruscinomys cf. lasallei</i>
<i>Eliomys aff. intermedius</i>	–	–	<i>Eliomys yevesi</i>	–	–	–	–	–	<i>Eliomys intermedius</i>
<i>Muscardinus</i> sp.	–	–	–	–	–	–	–	–	<i>Muscardinus</i> sp.
–	–	<i>Asoriculus gibberodon</i>	–	–	–	–	–	–	<i>Asoriculus gibberodon</i>
<i>Galerix</i> sp.	–	–	–	–	–	–	–	–	Erinaceidae indet.
<i>Sorex</i> sp.	–	–	–	–	–	–	–	–	Soricidae indet.

Discussion. – During the Late Miocene and Pliocene, three lineages have been discerned within the genus *Muscardinus*: the *M. vireti*-*M. meridionalis*-*M. helleri* lineage, *M. pliocaenicus* lineage and *M. davidi*-*M. aff. dacius* lineage (García-Alix *et al.* 2008c). The presence of four roots in M3, like in the specimen from AC-0, has been observed in *M. avellanarius* (Linnaeus, 1758), *M. dacicus* Kormos, 1930, *M. cyclopeus* Agustí, Moyà Solà & Pons-Moyà, 1982, *M. pliocaenicus* Kowalski, 1963 and *M. vireti* Hugueney & Mein, 1965. Of these taxa, only *M. cyclopeus* and *M. vireti* have eight ridges in their M3. *M. meridionalis* García-Alix, Minwer-Barakat, Martín-Suárez & Freudenthal, 2008, have also eight ridges in the M3, but the number of roots is unknown (García-Alix *et al.* 2008c).

The specimen studied is smaller than *M. cyclopeus*, being close to the maxima of *M. vireti* from Lissieu and *M. meridionalis* from PUR-4 (García-Alix *et al.* 2008c). Because of the size of the specimen and high number of ridges in M3, we consider the molar from AC-0 a form related to the line *M. vireti*-*M. meridionalis*-*M. helleri*, which maintains a medium-large size and a high number of ridges

in the upper teeth (García-Alix *et al.* 2008c). No M3 of *M. helleri* have been recovered. For these reasons, we assign the M3 from AC-0 to *Muscardinus* sp.

Order Soricomorpha Gregory, 1910

Family Soricidae Fischer, 1814

Subfamily Soricinae Fischer, 1814

Tribe Nectogalini Anderson, 1879

Genus *Asoriculus* Kretzoi, 1959

***Asoriculus gibberodon* (Petényi, 1864)**

Figure 5B–F

Localities. – ABS-3, ABS-10, AC-0.

Material. – 3 m1,2 (ABS10-2) (TRW: 0.81), (AC0-57) (L: 1.33 × TRW: 0.90 × TLW: 0.93), (AC0-94) (L: 1.34); 1 m3 (ABS10-1) (L: 1.03 × W: 0.57); 1 I1 (ABS3'08-35) (L: 1.29 × W: 1.05; LT: 0.61); 1 M1 (AC0-90) (LPE: 1.11;

LL: 1.44; BL: 1.42; AW: 1.48; PW: 1.74); 6 M2 (ABS3A-39) (LPE: 1.20; LL: 1.51; BL: 1.44; AW: 1.60; PW: 1.93), (AC0-22, AC0-91, AC0-92, AC0-93, AC0-95).

Description. – m1,2. The talonid and the trigonid width are very similar. The difference between both values is usually bigger in m1 than in m2. The entoconid is large, high and very close to the entostylid. The entoconid crest is slightly lower, and connects basally with the metacoenid. There is no mesoconid. The labial cingulum is low and narrow. The lingual cingulum is broken in two specimens and well-developed in the other one. Roots are not preserved.

m3. The hypoconid and entoconid are distinct, and the talonid basin is long and narrow. The labial cingulum is more developed than in m1,2, and higher than the lingual cingulum. The protoconid is the highest cusp. Roots are not preserved.

I1. Bifid and moderately fissident tooth. Well developed labial cingulum, wider ventrally than dorsally. The posterior margin is very straight. A narrow cingulum is also present along the lingual posterior border. Roots are not preserved.

M1. The metacone is bigger and much higher than the paracone. The metastyle protrudes markedly over the labial border. The protocone is connected to the paracone by a high crest and to the hypocone by a lower crest. The hypocone is smaller and lower than the protocone, and connected to the posteroloph (Morphotype B, Reumer 1984). The hypoconal flange is wide. The posterior emargination is smooth. The posteroloph extends in a continuous posterior cingulum, which reaches the base of the metastyle. Roots are not preserved.

M2. The metacone is much higher than the paracone. The metastyle protrudes over the labial border. The protocone is connected to the paracone by a high crest. The hypocone and the protocone are separated by a narrow valley. The hypocone is the lowest and smallest cusp, and reaches the posteroloph (Morphotype B, Reumer 1984). The hypoconal flange is narrower than in the m1. The posterior emargination is smooth. The posteroloph extends in a continuous posterior cingulum, which reaches the base of the metastyle. Roots are not preserved.

Discussion. – *Asoriculus gibberodon* (Petényi, 1864) is a very common soricid in the Pliocene and Early Pleistocene of Europe, also present in the latest Miocene from Maradena (Doukas *et al.* 1995). In the studied material, the presence of a high entoconid crest in the lower molars, a talonid basin in m3, fissident upper incisors and a moderate posterior emargination agree with this species (Reumer 1984). The presence of a small hypocone connected to the posteroloph is consistent with the Morphotype B of Reumer (1984).

Asoriculus gibberodon shows a wide biometrical variability, differing greatly from one locality to another (Reumer 1984, Minwer-Barakat *et al.* 2010). The lower molars from the studied localities are consistent with the smaller sizes of the specimens from Villány 3, Csarnóta 2, Osztramos 1 and 9 (Reumer 1984), Varshets (Popov 2003), Venta Micena 1 (Martín-Suárez 1988) and TCH-1, TCH-1B and TCH-3 (Minwer-Barakat *et al.* 2010), Fuente Nueva 3 and Barranco León (Furió 2007), while the upper molars are relatively bigger.

Soricidae indet.

Locality. – AC-0.

Material. – 1 m3 (AC0-97).

Description. – m3. The anterior part of the molar is missing. The talonid basin is not reduced. Roots are not preserved.

Discussion. – The shape of the m3 resembles *Asoriculus*. Nevertheless its size is much bigger and clearly out of the measure range than those of *Asoriculus gibberodon* described above.

Order Erinaceomorpha Gregory, 1910

Family Erinaceidae Fischer, 1814

Erinaceidae indet.

Localities. – AC-0, AC-0B.

Figure 6. Distribution chart of the rodent species studied in this paper and, according to bibliography of other species of similar age. Abbreviations: GOR-A – Gorafe-A (Ruiz-Bustos *et al.* 1984); YEG – Yeguas (Minwer-Barakat *et al.* 2012); PUR-3, PUR-4, PUR-7, PUR-13 – Purcal 3, 4, 7 and 13; CLC-3B, CLC-5A – Calicasas 3 B and 5A; DHS-16 – Dehesa-16; MNA-4 – Mina 4 (García-Alix 2006, García-Alix *et al.* 2008a); VAR-1 – Villalba Alta Río 1; ALDH – Aldehuela (Adrover 1986); CEL-9 – Celadas-9; LG-4 – La Gloria-4; AR-4 – Arquillo 4 (Adrover *et al.* 1993); PER-E – Peralejos-E (Mein *et al.* 1990); NGR-1 – Negatín-1 (Minwer Barakat *et al.* 2009a); RCH-3 – Rambla Chimeneas 3 (Minwer-Barakat *et al.* 2009b); ALM-M – Almenara-M (Agustí *et al.* 2011); ZOR-3A – Zorerras 3A (Martín-Suárez *et al.* 2000); VM – Venta del Moro (Montoya *et al.* 2006b); CR-6 – Crevillente 6 (Martín-Suárez & Freudenthal 1998). For making of this table the following synonymies have been taken in account: *Apodemus dominans* as *A. atavus*; *Castillomys crusafonti gracilis* as *C. gracilis*; *Paraethomys anomalus* as *P. meini*; *Stephanomys medius* and *Stephanomys donnezani cordii* as *S. cordii*; *Cricetus barrierei* as *Apocricetus barrierei*; *Cricetus kormosi* and *Apocricetus kormosi* as *Apocricetus alberti*; *Protatera almenarensis* as *Debruijnimys almenarensis* and *Protatera* sp. as *Debruijnimys* sp. The locality ABS-10 has not been included since it has yielded no rodent remains.

MIOCENE	PLIOCENE		Series	
Late	Early			
Turolian	Ruscinian		Continental Stage	
13	14		MN Zone (Mein 1975)	
			Localities	
GOR-A			<i>Apodemus atavus</i>	Muridae
YEG			<i>Apodemus gorafensis</i>	
VAR-1			<i>Apodemus gudrunae</i>	
ALDH			<i>Castillomys crusafonti</i>	
AL2-D			<i>Castillomys gracilis</i>	
AL2-C			<i>Huerzelerimys turolensis</i>	
CEL-9			<i>Micromys praemiatus</i>	
LG-4			<i>Micromys sp.</i>	
AC-0			<i>Occitanomys adroveri</i>	
AC-0B			<i>Occitanomys alcalai</i>	
AC-0C			<i>Occitanomys brailloni</i>	
PUR-13			<i>Parapodemus barbarae</i>	
CLC-5A			<i>Paraethomys abaigari</i>	
CLC-3B			<i>Paraethomys meini</i>	
PER-E			<i>Rhagapodemus hautimagnensis</i>	
ABS-9			<i>Stephanomys cordi</i>	
ABS-8			<i>Stephanomys dubari</i>	
ABS-7			<i>Stephanomys margaritae</i>	
ABS-3A			<i>Stephanomys ramblensis</i>	
ABS-3			<i>Stephanomys sp.</i>	
ABS-2			<i>Eliomys intemedius</i>	Gliridae
ABS-1			<i>Eliomys truci</i>	
PUR-7			<i>Eliomys sp.</i>	
PUR-4			<i>Eliomys yvesi</i>	
NGR-1			<i>Glis sp.</i>	
RCH-3			<i>Muscardinus meridionalis</i>	
ALM-M			<i>Muscardinus sp.</i>	
PUR-3			<i>Apocricetus alberti</i>	
ZOR-3A			<i>Apocricetus angustidens</i>	
DHS-16			<i>Apocricetus barrierei</i>	Cricetidae
MNA-4			<i>Blancomys neglectus</i>	
AR-4			<i>Blancomys sanz</i>	
VM			<i>Blancomys sp.</i>	
			<i>Celadensia nicolae</i>	
			<i>Neocricetodon sp.</i>	
			<i>Neocricetodon seseae</i>	
			<i>Ruscinomys europaeus</i>	
			<i>Ruscinomys gilothei</i>	
			<i>Ruscinomys lasallei</i>	
			<i>Ruscinomys schaubi</i>	
			<i>Ruscinomys sp.</i>	
			<i>Atlantoxerus margaritae</i>	Sciuridae
			<i>Atlantoxerus rhodius</i>	
			<i>Atlantoxerus sp.</i>	
			<i>Pliopetaurista plioceanica</i>	
			<i>Pliopetaurista sp.</i>	Trilophomyidae
			<i>Trilophomys castroi</i>	
			<i>Trilophomys vandeweerdi</i>	Arvicolidae
			<i>Polonomys insuliferus</i>	
			<i>Dipoides problematicus</i>	Castoridae
			<i>Dipoides sigmodus</i>	
			<i>Hystrix depereti</i>	Hystriidae
			<i>Calomyscus sp.</i>	
			<i>Debruijnimys almenarensis</i>	Gerbillidae
			<i>Debruijnimys sp.</i>	
			<i>Myocricetodon jaegeri</i>	
			<i>Pseudomeriones abbreviatus</i>	

Table 4. Percentages of species according to humidity, temperature and habitat parameters in the locality AC-0. The taxa with unknown preferences are not shown.

Locality	Humidity			Temperature			Habitat		
	Wet	Dry	Eurytopic	Cold	Warm	Eurytopic	Open	Forested	Eurytopic
AC-0	19.79	41.73	35.16	13.19	43.96	39.56	13.19	9.89	73.63

Material. – 1 p4 (AC0B-19); 1 P1,2 (AC0-63) (1.60 × 0.87); 1 P4 (AC0-131); 1 M2 (ABS3-10).

Description. – p4. The posterior side is missing. The protoconid is very large. There is no metaconid. The paraconid is connected to the protoconid by a low paralophid. Roots are not preserved.

P1,2. The low and small paraconid is connected to the protoconid by a low paralophid. There is no metaconid. There is no posterior cingulum. Roots are not preserved.

P4. The labial side of the specimen is missing. The protocone and hypocone are well developed, but the former is higher. There is a well-developed posterior cingulum. Roots are not preserved.

M2. The specimen is broken anteriorly and lingually. The parastyle is small and protrudes from the anterolabial part of the molar. The labial cingulum is low and wide. There is a low mesostyle. The metacone is big and high. The metastyle is well developed. Roots are not preserved.

Discussion. – The scarcity and poor state of preservation of the material prevent us from reaching a generic ascription.

Discussion

Biostratigraphy

The faunal lists of the localities ABS-3, ABS-3A and AC-0 are given in Table 3 and Fig. 6. Considering subsequent synonymies, the faunal list of Alcoy-Barranco (Thaler *et al.* 1965, Adrover *et al.* 1969) is very similar to the new faunas from AC-0. In particular, *Stephanomys* aff. *donnezani* from Alcoy-Barranco was renamed as *Stephanomys medius* by Cordy (1976), which is considered a synonym of *S. cordii* (García-Alix *et al.* 2008a), *Anthracomys ellenbergeri* was considered as *Anthracomys meini* by Michaux (1969), and included later within the genus *Paraethomys* by Jaeger *et al.* (1975), and finally, *Cricetus* aff. *angustidens* is considered *Apocricetus barrierei* by Freudenthal *et al.* (1998).

Based on the faunal list of Alcoy-N, López-Martínez (1989) gives a Late Miocene age for this locality. This site has yielded remains of *Prolagus michauxi*, *Trischizolagus* cf. *maritsae*, *Eliomys* sp., *Ruscinomys lasallei*, *Cricetus* cf. *kormosi* (synonym of *Apocricetus alberti* according to Freudenthal *et al.* 1998), Gerbilidae indet., *Occitanomys*

sp., *Stephanomys* sp., *Apodemus primaevus* (synonymized as *Rhagapodemus primaevus* in Martín-Suárez & Mein 1998), *Paraethomys miocaenicus* and *Paraethomys* cf. *anomalus* (both considered synonyms of *Paraethomys meini* by several authors, see García-Alix *et al.* 2008a for a complete list). *Cricetus* cf. *kormosi* (*Apocricetus alberti* in synonymy) is a biostratigraphic marker from the Late Miocene (MN13). The presence of an unclassified gerbillid in Alcoy-N does not allow determining the exact age because this group arrives to the Iberian Peninsula during MN13 (*Debruijnmys almenarensis* Agustí, 1990), surviving until MN15 (*Debruijnmys julii* Castillo & Agustí, 1996). Both *Debruijnmys* sp. (Agustí & Casanovas-Vilar 2003) and *D. julii* are present in early MN14 (Mansino pers. comm.), being uncertain if the form present in Alcoy-N is related to *D. almenarensis* or to these other taxa. In the northern side of the Gormaget ravine, a locality containing gerbil remains, Alcoy-4B (Freudenthal pers. comm.), is present. Probably, Alcoy-4B represents a Ruscinian (Early Pliocene) level, probably younger than Alcoy-N. The presence of *Cricetus* cf. *kormosi* (*Apocricetus alberti*) in Alcoy-N (López-Martínez 1989) would be the main argument to assign this locality to the MN13.

On the other hand, Mansino *et al.* (2013) considered a probable equivalent stratigraphic position for the classic locality of Alcoy-Mina and AL2-C and AL2-D, placing these localities in Early Ruscinian (MN14). The faunal content of AL2-C and AL2-D shows that they are younger than the localities from the ABS and AC sections, having yielded *Stephanomys cordii* and *Apocricetus* cf. *angustidens*, being their age probably close to the Early-Late Ruscinian boundary (MN14-MN15, Mansino *et al.* 2013).

In ABS-3 and ABS-3A, the occurrence of *Stephanomys dubari*, *Apodemus gorafensis* and *Paraethomys meini* is typical of the latest Turolian–earliest Ruscinian (García-Alix *et al.* 2008a). The presence of *Ruscinomys lasallei* is common in the Early Ruscinian, although it is also present in the Late Turolian of Granada (García-Alix *et al.* 2008b) and *R.* aff. *lasallei* is found in the Late Turolian of Teruel (Adrover *et al.* 1993, García-Alix *et al.* 2008b). *Stephanomys cordii* appears in MN14 (Mein *et al.* 1990, Sesé 2006, Minwer-Barakat 2005, Minwer-Barakat *et al.* 2012), and the presence in AC-0 of a very close form, *S.* aff. *cordii*, suggest an Early Ruscinian age for this locality.

Eliomys yevesi has been described with material from the Late Turolian locality of Venta del Moro, being present

also in some Early Ruscinian localities like PUR-4, CLC-3B in the Granada Basin, and AF-1'06 and AF-1'07 in the Alcoy Basin (Mansino *et al.* in press). This taxon is the ancestor of *E. intermedius* (Mansino *et al.* in press), which is present in AC-0.

The presence of *Muscardinus* sp. in AC-0 is consistent with the Turolian and Ruscinian populations of the lineage *M. vireti*-*M. meridionalis*-*M. helleri* (García-Alix *et al.* 2008c). Thaler *et al.* (1965) mentioned the presence of two M1 of *Muscardinus* in Alcoy-Barranco, with six transversal ridges each. Despite the scarcity of material of this glirid in AC-0, the morphology described in this locality is clearly consistent with a form of the previously cited lineage.

The presence of *Stephanomys* aff. *cordii* in ABS-8, AC-0, AC-0C and AC-0B supports an Early Ruscinian age for these localities (Minwer-Barakat 2005, Minwer-Barakat *et al.* 2012), slightly younger than ABS-1, ABS-2, ABS-3 and ABS-3A (Fig. 2), in which *S. dubari*, ancestor of *S. cordii*, is present. The cricetid *Apocricetus barrierei* is considered a guide taxon for the Early Ruscinian in the Iberian Peninsula (Freudenthal *et al.* 1998, García-Alix *et al.* 2008b), and its presence supports an Early Ruscinian age for ABS-3A. In the same way, the presence of a big sized *Paraethomys*, *P.* aff. *abaigari*, in ABS-2, ABS-3, ABS-3A, AC-0 and AC-0B supports an Early Ruscinian age for these sites (Mein *et al.* 1990, García-Alix *et al.* 2008a) also. Therefore, all taxa yielded by this section confirm an Early Ruscinian age for the new micromammal localities represented in the sections of Alcoi Barranc Sud (ABS) and Alcoi Cristian (AC).

Palaeoecology

The species spectrum of micromammal assemblages has been widely used as a palaeoclimatic indicator. For these analysis, some authors have proposed a minimum sample size of at least 100 specimens (Daams *et al.* 1999, García-Alix *et al.* 2008d), while others used a minimum of 50 specimens (Casanovas-Vilar & Agustí 2007), arguing that in most cases the bigger samples only add one or two new species to the assemblage, and the abundance of these new species is less than 1%. The locality of AC-0 has yielded 91 identifiable specimens, whereas in the other localities the sample is too scarce to perform a proper analysis.

Following García-Alix *et al.* (2008d), we have considered the taxa *Apodemus gorafensis*, *Micromys*, *Paraethomys meini*, *Occitanomys alcalai* and *Asoriculus gibberodon* as warm weather indicators, and *Ruscinomys* as a cold indicator. Also, *Apodemus gorafensis*, *Occitanomys alcalai*, *Asoriculus gibberodon* and Soricidae indet. are regarded as wet environment indicators, whereas

Ruscinomys and *Paraethomys meini* are associated with dry conditions. Traditionally the genera *Eliomys* and *Muscardinus* have been considered wet environment indicators (see García-Alix *et al.* 2008d, and references therein), but Freudenthal *et al.* (2014) state that these taxa cannot be considered as indicators of humidity based on their current distribution.

Regarding the habitat, most of the taxa from AC-0 are eurytopic (Table 4) except *Ruscinomys*, which indicate open environments, and *A. gibberodon* and *Muscardinus*, which are associated with forested habitats (García-Alix *et al.* 2008d, Freudenthal *et al.* 2014). The genus *Eliomys* is a habitat generalist, with extant representatives ranging from environments with a moderate forest cover and a high annual precipitation to open semi-desertic environments (Freudenthal *et al.* 2014).

According to Agustí (1990), the presence of *Eliomys* instead of *Glis* in the western basins of the Iberian Peninsula suggests dryer and warmer conditions than in the Catalanian basins (NE Spain). The analysis of the faunal assemblage of AC-0 in which both *Eliomys* and *Muscardinus* are present agrees with this interpretation, suggesting warm and relatively dry conditions (see Table 4).

As discussed before, the scarcity of the remains from the other localities prevents a proper palaeoenvironmental interpretation, although the relative percentages of the taxa present in ABS-3 and ABS-3A indicate similar conditions to those of AC-0. However, the localities ABS-9, ABS-10 and AC-0C have yielded mostly taxa considered as humid indicators. ABS-9 has yielded *Micromys* sp. and *Asoriculus gibberodon*, both wet environments indicators, and the only micromammal fossils recovered from ABS-10 belong to *A. gibberodon*. In the assemblage from AC-0C *Apodemus* cf. *gorafensis* and *O. alcalai* are considered indicators of humidity. Therefore, ABS-9, ABS-10 and AC-0C may represent a wetter environment hiatus in the series, although these changes could also be explained by local or regional environments rather than general trends (García-Alix *et al.* 2013, Freudenthal *et al.* 2014).

Conclusions

In the lower deposits from the ABS section (Gormaget area, Alcoy Basin), two new localities (ABS-3 and ABS-3A) have yielded abundant mammal fossil remains. The presence in ABS-3 of *Apodemus gorafensis*, *Paraethomys* aff. *abaigari*, *Paraethomys meini*, *Occitanomys alcalai*, *Stephanomys dubari* and *Asoriculus gibberodon* and in ABS-3A of *Paraethomys* aff. *abaigari*, *Paraethomys meini*, *Occitanomys alcalai*, *Stephanomys dubari*, *Apocricetus* cf. *barrierei*, *Ruscinomys* cf. *lasallei* and *Eliomys* cf. *yevesi* allow us to assign an Early Ruscinian age, close to the Mio-Pliocene boundary, for these sites.

Near the top of the youngest stratigraphic sequence here studied, a new locality (AC-0) has yielded also a rich fossil mammal assemblage, comprising to *Apodemus gora-fensis*, *Occitanomys alcalai*, *Paraethomys meini*, *Paraethomys* aff. *abaigari*, *Stephanomys cordii*, *Asoriculus gibberodon*, *Ruscinomys* cf. *lasallei*, *Muscardinus* sp., *Eliomys intermedius*, Erinaceidae indet. and Soricidae indet. This faunal assemblage suggests an Early Ruscinian age for this locality.

The palaeoecological context of the studied deposits shows, from the bottom to the top of the stratigraphic sequence, a changing palaeoenvironment. While the scarce data from some of the lower deposits (localities ABS-9, ABS-10 and AC-0C) suggest wetter conditions for these sites, the taxa present in AC-0 indicate warm and relatively dry conditions. According to the stratigraphic position and the environment requirements from the small mammal fauna located in these localities, a progressive aridification process may occur along the lower part of the Early Pliocene in the Alcoy Basin.

The presence of *Micromys* and *Muscardinus* in several localities from the new sections of the Alcoy Basin represent the first record of these genera in the area.

Finally, and based on the faunal content of AC-0, characterized by the presence of *R. lasallei* and *Stephanomys cordii*, its relative stratigraphic position, deduced age and geographic proximity, we consider AC-0 as a probable coetaneous level to that of the classical site described by Adrover (1969), Alcoy-Barranco.

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