Hypsodont Myomiminae (Gliridae, Rodentia) from the Miocene and the Oligocene-Miocene boundary interval of Spain

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Fifty-one localities from the Oligocene-Miocene boundary interval and the Miocene of Spain have yielded nearly 4000 teeth of hypsodont Gliridae (*Armantomys* and *Praearmantomys*). The phylogeny and palaeoecology are discussed. Two new species of *Armantomys* (*A. parsani* sp. nov. from Ramblar 1 and *A. jasperi* sp. nov. from Córcoles) are described.

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Introduction

The Oligocene-Miocene boundary interval (zones X and Y1, Alvarez Sierra, 1988) in Spain is characterized by the first appearances of various Myomiminae with simple dental pattern, such as *Armantomys bijmai* (Lacomba & Martínez-Salanova, 1988) and a hitherto undescribed species of *Pseudodryomys*. In this paper we deal with the evolution of the hypsodont representatives of the Myomiminae. Although *Peridyromys murinus* Stehlin & Schaub, 1951 is relatively hypsodont, we focused only on *Praearmantomys* and *Armantomys*.

The material consists of nearly 4000 cheek teeth from some 51 localities ranging in age from the Oligocene-Miocene boundary interval to the late Aragonian. The great majority of the localities are situated in the Calatayud-Teruel Basin, and their data have been published in previous papers (Daams et al., 1987; Daams & Freudenthal, 1988). The Loranca Basin yielded faunas from the following localities: Retama, Calomarde, Navalón, Cabeza Rubia, and Córcoles. The localities of Quel 1 (Alvarez Sierra, 1988), Santa Cilia, San Juan, La Galocha 5 (Alvarez Sierra et al., 1991), and Fuenmayor 2 (Martínez-Salanova, 1987) are situated in the Ebro Basin. Data on the faunas from Cetina de Aragón (Almazán Basin, Zaragoza) and from Buñol (Buñol Basin, Valencia) are found in Daams (1976).

The teeth were measured using a NIKON monocular measuring microscope with digital reading equipment. Measurements are given in 0.1 mm units. The way of measuring is as described by Daams (1981).

The nomenclature of parts of the glirid cheek teeth is after Daams (1981), and is given in Fig. 1.

STRATIGRAPHY

The majority of the material comes from published localities from the Calatayud-Teruel Basin. The faunal content and biozonation of these localities will not be repeated in this paper, and the reader is referred to Daams et al. (1987) and Daams & Freudental (1988) for this information.

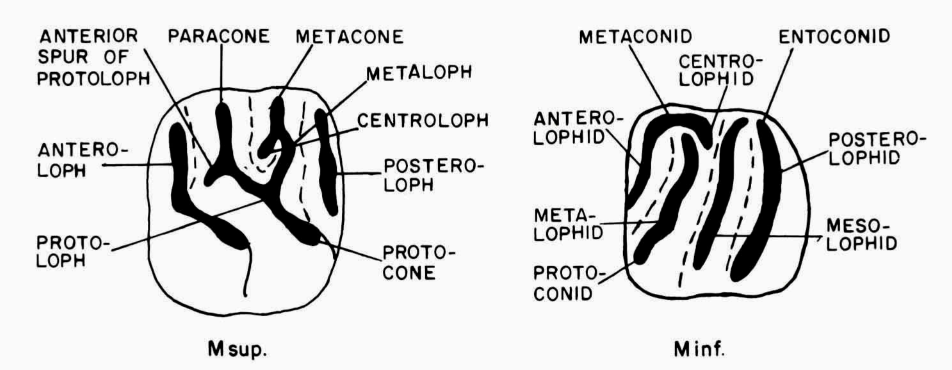

Fig. 1. Nomenclature of parts of the Gliridae cheek teeth used in this paper.

Faunas from the older localities are correlated mainly on the basis of the evolutionary stages of the *Rhodanomys transiens* - *Ritteneria manca* lineage (see Alvarez Sierra, 1988). The fauna of Santa Cilia (Alvarez Sierra, 1988) contains *Rhodanomys oscensis* Alvarez Sierra, 1988 and belongs to zone X. In Cetina de Aragón (Daams, 1976), in Quel 1 (Alvarez Sierra, 1988) and in Fuenmayor 2 (Martínez-Salanova, 1987) the following stage of this lineage, *Ritteneria molinae* Alvarez Sierra, 1988, is present, and these faunas belong consequently to zone Y1. The unpublished fauna of Cabeza Rubia contains *Ritteneria manca* Stehlin & Schaub, 1951 and is therefore placed in zone Y2. San Juan contains one tooth of *Ritteneria* or *Rhodanomys*, and its stratigraphical position is more uncertain if we only consider the Eomyidae content. The most probable correlation of this fauna would be with zone Y2. More stratigraphical details on this fauna, and on those of Santa Cilia and La Galocha 5, are given in Alvarez Sierra et al. (1991).

The faunas of Calomarde (unpublished) and Ateca 1 (de Bruijn, 1966, 1967) are placed in zone A because of the absence of Cricetidae. Although various faunas of zone Z also lack Cricetidae, the still unpublished Eomyidae species from the above mentioned two faunas are more similar to those from the upper part of zone A.

The unpublished fauna of Artesilla is situated below the marls of Vargas 1A. It contains *Megacricetodon*, and is therefore placed in zone C. The partly published fauna of Córcoles is also placed in zone C, although the Eomyidae are extremely rare in this locality. The presence of a primitive *Fahlbuschia* and the relative abundance of *Peridyromys murinus* support this correlation.

The unpublished faunas of Muela Alta, Moratilla 2 and 3 and Retama are provisionally placed in zone D1. All these faunas have two *Megacricetodon* species; one of small size and belonging to the *primitivus-collongensis* group, and the other one of large size, probably the ancestor of *M. crusafonti* (Freudenthal, 1963) (see also Daams & Freudenthal, 1988). The faunas of Muela Alta, Moratilla 2, Moratilla 3 form part of a section which continues with two more faunas (Moratilla 4 and 5). The faunas of Moratilla 4 and 5 only contain one *Megacricetodon* species (*M. collongensis* (Mein, 1958)). We therefore consider these four faunas to be older than those of zone D2.

The fauna of Escobosa (López Martínez et al., 1977) contains *Megacricetodon ibericus* (Schaub, 1944), but it lacks *Hipparion*. It is therefore considered to be the youngest Aragonian fauna of the localities studied.

STORAGE OF THE MATERIAL

The material is stored in the following collections:

Nationaal Natuurhistorisch Museum (RGM), Leiden (The Netherlands): Alcocer 2; Bañón 2; Casetón 1A; La Dehesa; Moratilla 1; Olmo Redondo 1, 2, 3, 5; Ramblar 1; Regajo 2; San Roque 1, 2; Valalto 2B, 2C; Vargas 1A; Valdemoros 3D, 3E; Villafeliche 4A.

Department of Palaeontology-Stratigraphy of the University of Utrecht (The Netherlands): Ateca 1; Buñol; Cetina de Aragón; Manchones; Las Planas 4A, 4B; Valdemoros 1A, 3B; Villafeliche 2A, 4B.

Museo Nacional de Ciencias Naturales, Madrid (Spain): Agreda; Artesilla; Cabeza Rubia; Calomarde; Escobosa de Calatañazor; Moratilla 2, 3; Muela Alta; Navalón; Ramblar 3B, 4A, 5A, 7; Retama; Valhondo 1, 3A.
Department of Paleontology of the Universidad Complutense, Madrid (Spain): Córcoles; Fuenmayor 2; La Galocha 5; Quel 1; San Juan; Santa Cilia.

ABBREVIATIONS

For practical reasons locality names are abbreviated in the majority of the figures and tables. They are listed below in stratigraphical order.

Escobosa	ESC
Alcocer 2	AC2
Manchones	MAN
Valalto 2C	VT2C
Valalto 2B	VT2B
Las Planas 4B	LP4B
Las Planas 4A	LP4A
Regajo 2	RG2
Valdemoros 3E	VA3E
Valdemoros 3D	VA3D
Villafeliche 4B	VL4B
Villafeliche 4A	VL4A
Valdemoros 3B	VA3B
Retama	REM
Casetón 1A	CS1A
Valdemoros 1A	VA1A
Moratilla 3	MOR3
Moratilla 2	MOR2
Muela Alta	MUE
Buñol	BU
Olmo Redondo 5	OR5
Vargas 1A	VR1A
Córcoles	COR
Artesilla	ART
Villafeliche 2A	VL2A
San Roque 2	SR2
San Roque 1	SR1
Olmo Redondo 3	OR3
Olmo Redondo 2	OR2
Olmo Redondo 1	OR1
Ateca 1	AT1
Calomarde	CAM
Moratilla 1	MOR1
Bañón 2	BN2
Agreda	AGR
La Dehesa	DH
Ramblar 5A	RA5A
Ramblar 7	RA7
Ramblar 4A	RA4A
Ramblar 3B	RA3B
Valhondo 3A	VH3A
Valhondo 1	VH1
Ramblar 1	RA1
Navalón	NAL
La Galocha 5	GAL5
San Juan	SJ
Cabeza Rubia	CAB
Fuenmayor 2	FU2
Cetina	CET
Quel 1	QU1
Santa Cilia	STC

Acknowledgements

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Historical review

Five species of *Armantomys* have hitherto been described, of which four are retained. These species with their respective type localities and age of the type locality are:
1. *A. aragonensis* de Bruijn, 1966, Villafeliche 2A, Calatayud-Teruel Basin, Province of Zaragoza, zone B, Early Aragonian, Early Miocene.
2. *A. giganteus* de Bruijn, 1967, Valdemoros 1A, Calatayud-Teruel Basin, Province of Zaragoza, zone D1, Middle Aragonian, Early Miocene. We consider it to be a junior synonym of *A. aragonensis* (see below).
3. *A. tricristatus* López, 1977, in López, Sesé & Sanz, 1977, Escobosa de Calatañazor, Province of Soria, zone G3, Late Aragonian, Middle Miocene.
4. *A. bijmai* (Lacomba & Martínez Salanova, 1988), Quel 1, Ebro Basin, Province of La Rioja, zone Y1, Oligocene-Miocene boundary interval.
5. *A. daamsi* (de Visser, in Alvarez Sierra et al., 1991), San Juan, Ebro Basin, Province of Huesca, zone Y2, Early Miocene.

Two new species are described in this paper. These species with their type localities and age are:
1. *A. parsani* sp. nov., Ramblar 1, Calatayud-Teruel Basin, Province of Teruel, zone Z, Early Miocene.
2. *A. jasperi* sp. nov., Córcoles, Loranca Basin, Province of Guadalajara, zone C, Early Miocene.

De Bruijn (1966) defined *Armantomys* as follows: 'Large Gliridae with simple dental pattern consisting of ridges which are high relative to the crown basis. Occlusal surfaces concave. Metaloph and protoloph separated. M1 larger than M2'. The type species is *A. aragonensis* de Bruijn, 1966, and the type locality is Villafeliche 2A. The original diagnosis is '*Armantomys* whose cheek teeth have neither centroloph nor centrolophid. The metaloph ends in the posterior valley, or is connected to the posteroloph. M3 reduced, P4 cuspidate'.

In 1967 de Bruijn defines a subspecies, *A. aragonensis giganteus*, with Valdemoros 1A as type locality. The original diagnosis is as follows: '*Armantomys* similar to *A. aragonensis aragonensis*. The dental patterns of M1 and M2 of both subspecies of *Armantomys* are identical. The two posterior ridges are complete in M_3. All teeth are large. M1 larger than M2.' In his differential diagnosis de Bruijn (op cit., p. 58) says that *A. a. giganteus* is larger than *A. a. aragonensis*, it has one more cusp in P_4, and it has a less reduced M_3. However, P_4 and M_3 of *A. a. giganteus* are not present in the type locality, and the only specimens that can be attributed to *A. a. giganteus* are an M_1 (no. 163: 23.5 x 21.4) and an M^2 (no. 169: 21.3 x 24.9) and an M^3 (no. 170: 15.0 x 20.8). Some fragments of M_1 attributed to *A. a. giganteus* by de Bruijn (1967) can not be measured and are not considered in the discussion. Consequently the only remaining difference between these two subspecies would be the larger size of *A. a. giganteus*. De Bruijn (op. cit., p. 63) also mentions the presence of an M_2 (no. 167: 16.8 x 18.3) of *A. a. aragonensis* in Valdemoros 1A. Of the various specimens, considered by de Bruijn (1967) to represent *A. a. giganteus*, only the M^2 and M_1 are relatively large, as the length of both elements exceeds the limits of variation of the other *A. aragonensis* assemblages. The width falls, however, within these limits

(Tables 12 and 16, Figs. 32 and 35). Although the M_2 is relatively small compared to the M_1 and the lengths of M_1 and M^2 exceed slightly the size limits of the other assemblages, we do not consider these differences sufficient to warrant subspecific separation. Hence, we consider *A. a. giganteus* to be a junior synonym of *A. a. aragonensis.*

López Martínez (in López Martínez et al., 1977) defined *Armantomys tricristatus* from the Upper Aragonian of Escobosa de Calatañazor, a fissure filling in Mesozoic limestones of the province of Soria. The translated original diagnosis is as follows: 'Large-sized *Armantomys*, larger than *A. a. giganteus*, and very hypsodont teeth. Occlusal surface is flat instead of concave. The dental pattern is simple and it only has three parallel ridges, which are oblique to the longitudinal axis, and of increasing inclination from M1 to M3'.

Quercomys was defined by Lacomba & Martínez-Salanova (1988) on the basis of material from Quel 1 (Ebro Basin) from the Oligocene-Miocene boundary interval (zone Y1). The original diagnosis of *Quercomys* is as follows (translated): 'Medium-sized Gliridae. Hypsodont. Concave occlusal surface. Symmetrical and more or less vertical ridges. Protoloph connected to metaloph in $M^{1,2}$. Centrolophs and centrolophids may be present. The connection between protoloph and anterior centroloph, if present, may have the shape of the Greek letter tau. Extra ridges are absent. Various ridges may be sinuous.' In their differential diagnosis these authors separate this new genus from *Praearmantomys* and *Armantomys* by its smaller size, by the constantly present connection between protoloph and metaloph in $M^{1,2}$, by the presence of centrolophs and centrolophids (only *Armantomys* does not have centrolophids), and by the more or less vertical or symmetrical ridges. The type species *Quercomys bijmai* from Quel 1 is defined with a similar diagnosis as for the genus. In this paper we propose the synonimization of *Quercomys* with *Armantomys*, the latter one having priority (see under discussion on p. 11).

The original diagnosis of *A. daamsi* (de Visser, in Alvarez Sierra et al., 1991) reads as follows: 'A *Quercomys* species of large size, of which the $M^{1,2}$ may have one or two short, centroloph-like ridges, and of which the $M^{1,2}$ may have a short centrolophid'.

Hitherto two species of *Praearmantomys* are known of which only one is retained. These species with their respective type localities and ages are:

1. *P. crusafonti* de Bruijn, 1966, Ateca 1, Calatayud-Teruel Basin, Province of Zaragoza, zone A , Late Ramblian, Early Miocene.
2. *P. ginsburgi* Antunes & Mein, 1972, Quinta das Pedreiras (Portugal), Early Aragonian, Early Miocene. We consider it to be a junior synonym of *P. crusafonti* (see below).

The original diagnosis of *Praearmantomys* de Bruijn, 1966 is as follows: 'Large Gliridae with simple dental pattern. The relatively thick ridges are as high as the basis of the crown. Occlusal surface of cheek teeth concave. Extra ridges absent. Anteroloph not connected to the protocone. M1 larger than M2.' In his remarks de Bruijn says that 'the genus *Praearmantomys* is introduced for species of large size. The crowns of the cheek teeth are low. The metaloph shows a tendency to connect to the posteroloph instead of to the protoloph. *Praearmantomys* is considered to be the ancestor of *Armantomys*. The differences between their dentitions are such as to be of supraspecific importance.'

The original diagnosis of the type species *P. crusafonti* de Bruijn, 1966 is as follows: '*Praearmantomys* with molars that lack the centroloph, but do have a small centrolophid. The metaloph of P^4 and M^1 is either ending free or is attached to the protoloph. The metaloph of M^2 and M^3 is always connected to the protoloph. Mesolophid and posterolophid of P_4 and M_3 are reduced.'

The reduced mesolophid and posterolophid of P_4 and M_3 are features present in both *Praearmantomys* and *Armantomys*. *Praearmantomys* thus differs from *Armantomys* by lower-crowned cheek teeth, by the presence of a centrolophid in $M_{1,2}$ and by the connection between the metaloph and protoloph in $M^{1,2}$.

Antunes & Mein (1972) created *Praearmantomys ginsburgi* for material from the Lower Miocene of Portugal on the basis of a maxilla with P^4, M^1 and M^2, and an isolated M_3. This species would be characterized by a relatively small P^4 compared to that of *P. crusafonti*. Its measurements (10.9 × 13.6) nearly lie within the size range of the P^4 of *P. crusafonti* (length: 12.0-14.0; width: 13.3-16.6 in San Roque 2), and we do not consider this slight size difference sufficient to warrant specific separation. Therefore, *P. ginsburgi* is considered to be a junior synonym of *P. crusafonti*.

Systematic descriptions

Armantomys de Bruijn, 1966

Type species — *Armantomys aragonensis aragonensis* de Bruijn, 1966.

After the detailed study of the various *Armantomys* assemblages, the original diagnosis appeared in need of revision. In his original diagnosis of *Armantomys* de Bruijn (1966) says that M1 is larger than M2, without differentiating between upper and lower molars. However, this is only true for the upper molars. The M^1 has a subquadrate circumference, whereas the M^2 has a more rectangular shape. M^2 is shorter than M^1, but it is of comparable width. The M_1 and M_2 are of similar length, but the M_2 is on the average wider.

Emended diagnosis of Armantomys — Medium- to large-sized Myomiminae with simple dental pattern and high, nearly symmetrical to inclined, and even overturned ridges. M^1 is longer than M^2, and M_2 is wider than M_1. One or two short centrolophs, forming a τ-shaped pattern with the labial ends of the protoloph and metaloph respectively, may be present.

Armantomys parsani sp. nov.
Pl.1, figs. 1-22; Pl. 2, figs. 1-13.

Holotype — M^1 sin., RGM 337 724 (Pl. 1, fig. 4).
Type locality — Ramblar 1, near Navarrete del Río (Teruel), Calamocha area, Calatayud-Teruel Basin.

Type level — Zone Z (Lower Ramblian).
Derivatio nominis — *parsan* is the combination of the last names of Eduardo Pardo and Maria Carmen Sanchez, owners of restaurant Parsán in Calamocha, where we used to enjoy our lunch when working in the Calamocha area.

Diagnosis — Medium-sized *Armantomys* with moderately hypsodont teeth. Centrolophs and centrolophids are scarcely present.

Differential diagnosis — *Armantomys parsani* sp. nov. differs from *A. jasperi* sp. nov. from Córcoles by its larger size, its larger anterocone of P^4, the more continuous protoloph of M^1, the metaloph joining the protoloph in M^3, the presence of some M^3 with posterior centroloph and by the more reduced dental pattern of M_3.

A. parsani differs from *A. daamsi* by its significantly larger size, by the scarcity of τ-shaped centrolophs in $M^{1,2}$, by the more frequently isolated metaloph in $M^{1,2}$, and by the more variable dental patttern of M_3.

A. parsani differs from *A. bijmai* by its significantly larger size, by the presence of the anterior spur of the protoloph in various $M^{1,2}$, by the scarcity of τ-shaped centrolophs in all upper molars, by the more isolated metaloph in $M^{1,2}$, by the low frequence of centrolophids in $M_{1,2}$, and by the dental pattern of M_3.

A. parsani differs from *A. aragonensis* and *A. tricristatus* by its smaller size, by the presence of protoloph spurs and centroloph(id)s, by the posterior part of the M_3, and by the generally more sinous ridges.

Material and measurements — See Tables 2-9.

Description (see also Figs. 2-10)

P^4 — The anterocone is an isolated cusp halfway the anterior wall of the tooth. In some specimens the anterocone is labially elongated, without reaching the tooth border however. The protoloph is continuous in 23 out of 24 specimens. In several of these 23 specimens a shallow and narrow furrow is present halfway the protoloph, which disappears with progressive wear. The metaloph is an isolated transverse ridge in 22 specimens, it joins the protoloph in one, and it curves backwards to meet the posteroloph in one specimen. The posteroloph is labially isolated from the metacone, but lingually it joins the protocone below the occlusal surface in unworn or little worn specimens.

M^1 — The anteroloph is labially separated from the paracone by a furrow of variable depth, which may lead to the closing of the anterior valley in several moderately worn specimens. The metaloph joins the protoloph in 5 specimens, the metaloph is an isolated transverse ridge in 25, and it curves backwards to join the posteroloph in 1 specimen. Three specimens have a τ-shaped posterior centroloph. Two specimens have an almost longitudinal, forward-pointing spur sprouting from the labial part of the protoloph. The posteroloph is labially separated from the metacone, lingually this ridge may join the protocone, or a furrow of variable depth is present.

M^2 — The anteroloph is labially separated from the paracone. The metaloph joins the protoloph in 29 specimens, and it forms an isolated transverse ridge in the other 13. The posteroloph is as in M^1.

Types M^1 M^2 Localit.			N			N	Armantomys species
VL 4A	-	1	1	-	-	-	A. jasperi
CS 1A	-	1	1	-	-	-	
COR	7	4	11	2	4	6	
ART	8	4	12	-	8	8	
VL 2A	-	-	-	1	1	2	
SR 2	2	1	3	2	4	6	
SR 1	2	1	3	1	6	7	
OR 1	-	1	1	-	1	1	
CAM	-	-	-	-	1	1	A. parsani
AT 1	1	-	1	-	-	-	
MOR 1	2	1	3	1	-	1	
BN 2	4	-	4	2	2	4	
AGR	6	1	7	9	5	14	
RA 4A	-	-	-	-	2	2	
RA 3B	2	-	2	2	2	4	
VH 3A	2	1	3	1	1	2	
RA 1	5	27	32	6	33	39	
NAL	4	7	11	4	12	16	
GAL 5	2	3	5	1	1	2	
SJ	3	8	11	3	9	12	d.
FU 2	-	5	5	1	5	6	A.bijm.
QU 1	-	16	16	-	16	16	
STC	-	6	6	-	8	8	

Fig. 2. Variation of the anterior spur of the protoloph in M^1 and M^2 of the small-sized *Armantomys* species.

M^3 — The anteroloph is labially separated from the paracone by a furrow of variable depth which may lead to junction between anteroloph and paracone in an early stage of wear. Lingually the anteroloph is generally separated from the protocone, but in two specimens the lingual end of the anteroloph touches the protocone beneath the occlusal surface. In one specimen a complete endoloph is present. The protoloph shows an anterior longitudinal spur in 4 out of 27 specimens. In 3 of these 4 specimens the anterior end joins the anteroloph. Two specimens have a posterior centroloph. The metaloph joins the protoloph in 24 specimens, and it is isolated from the protoloph in 3. With few exceptions the posterior valley is labially open, and lingually closed by the posteroloph, either at, or below the occlusal surface.

P_4 — This element has a reduced dental pattern. The metaconid is large and elongated obliquely backwards. The entoconid and the hypoconid are distinct and isolated cusps. The posterolophid is separated from the hypoconid in 6 specimens, and it joins this cusp in 9. A deep furrow separates the posterolophid from the entoconid.

$M_{1,2}$ — The anterolophid is separated from the protoconid by a furrow of variable depth in M_1, in M_2 this furrow is always deep. The metalophid joins the metaconid. Five out of 33 M_1, and 1 out of 43 M_2 have a short centrolophid. The mesolophid and posterolophid are separated at the entoconid by a furrow of variable depth. In various slightly worn specimens these two ridges join each other. There are two roots in M_1 and three in M_2.

M_3 — The anterolophid is separated from the protoconid. The metalophid joins the metaconid. The mesolophid joins the posterolophid at its labial end in 8 specimens, it joins the posterolophid halfway in 21 specimens, the medium-long mesolophid is labially isolated from the posterolophid in 8, and mesolophid and posterolophid form a composite ridge with a small furrow on the posterior wall of the tooth in 3 specimens. The M_3 has three roots.

Types M^1 Localit.					N	Armantomys species
VL 4A	-	-	-	1	1	A. jasperi
CS 1A	-	-	-	1	1	
REM	-	-	-	1	1	
MOR 3	-	-	-	2	2	
COR	-	-	-	12	12	
ART	-	-	-	12	12	
SR 2	-	-	-	5	5	
SR 1	-	-	-	4	4	
OR 1	-	-	1	-	1	
AT 1	-	-	-	1	1	A. parsani
MOR 1	-	-	-	1	1	
BN 2	-	2	1	-	3	
AGR	-	1	1	4	6	
RA 4A	-	1	-	-	1	
RA 3B	-	-	-	2	2	
VH 3A	2	-	-	1	3	
RA 1	-	-	3	31	34	
NAL	-	-	–	11	11	
GAL 5	-	-	2	2	4	
SJ	3	4	-	3	10	A.d.
FU 2	-	3	-	2	5	A.bijm.
QU 1	-	11	-	-	11	
STC	1	6	-	3	10	

Fig. 3. Variation of the centroloph in M^1 of the small-sized *Armantomys* species.

Armantomys jasperi sp. nov.
Pl. 2, figs. 14-24; Pl. 3, figs. 1-17.

Holotype — M^2 sin., COR G70 (Pl. 2, fig. 17).
Type locality — Córcoles, Loranca Basin, province of Guadalajara.
Type level — Lower Aragonian (zone C).
Derivatio nominis — After my father Jasper Daams, who has always stimulated me in my palaeontological interest since my childhood.

Diagnosis — A small to medium-sized *Armantomys* with an anterior spur of the protoloph in M^{1,2}, without centrolophs and centrolophids, and an M$_3$ in which the mesolophid joins the posterolophid at the labial tooth border. In unworn or slightly worn specimens the ridges have an undulating outline.

Differential diagnosis — *A. jasperi* differs from *A. parsani* sp. nov. by its significantly smaller size , by the smaller anterocone of P^4, by the metaloph being separated from the protoloph in M^3, by the absence of M^3 with posterior centrolophs, and by the less continuous protoloph of M^1.

A. jasperi differs from *A. daamsi* from San Juan by the absence of τ-shaped centrolophs in M^{1,2} and by the absence of centrolophids in M$_{1,2}$.

A. jasperi differs from *A. bijmai* by its larger size, by the presence of an anterior spur of the protoloph in M^{1,2}, by the absence of centrolophs and centrolophids, by the more isolated metaloph in M^{1,2}, and by the more complete dental pattern of M$_3$.

A. jasperi differs from *A. aragonensis* and *A. tricristatus* by its smaller size, its more sinuous ridges, its protoloph spur, and by the Y-shaped pattern of protoloph and metaloph in M$^{1-3}$.

Types M2 / Localit.					N	Armantomys species
CS 1A	-	-	-	1	1	A. jasperi
COR	-	-	-	5	5	
ART	-	-	-	8	8	
VL 2A	-	-	-	2	2	
SR 2	-	-	-	6	6	
SR 1	-	-	-	6	6	
OR 1	-	-	-	1	1	
CAM	-	-	-	2	2	A. parsani
MOR 1	-	-	-	3	3	
BN 2	-	2	-	2	4	
AGR	-	-	-	15	15	
RA 4A	-	1	-	2	3	
RA 3B	-	-	-	3	3	
VH 3A	-	1	-	1	2	
RA 1	-	-	-	36	36	
NAL	-	-	-	15	15	
GAL 5	1	-	1	2	4	
SJ	-	5	-	10	15	A.d
FM 2	-	2	-	4	6	A. bijm.
QU 1	-	10	-	-	10	
STC	-	7	-	-	7	

Fig. 4. Variation of the centroloph in M^2 of the small-sized *Armantomys* species.

Material and measurements — See Tables 2-9.

Description (see also Figs. 2-10)

P^4 — The anteroloph is formed by a small cusp at the anterior side of the tooth. The paracone is an isolated cusp. The protocone is transversely elongated into the protoloph, and forms an isolated unit. The metacone is also transversely elongated and also forms an isolated unit. The long and narrow posteroloph runs from halfway the metacone base to the lingual base of the protocone.

M^1 — The anteroloph is labially isolated from the paracone in 9 out of 11 specimens. In the other two this ridge joins the base of the paracone. The anteroloph runs transversely from the paracone, and midway it curves obliquely backwards. The protoloph is continuous in 11 specimens, and interrupted in 1. In 7 specimens the protoloph has an anterior longitudinal spur lingually of the paracone. The metaloph is an isolated ridge in 9 out of 12 specimens. Generally the lingual end of the metaloph curves backward towards the posteroloph, without reaching it however. The posteroloph is separated from the metacone in 5 specimens. In the other 7 it joins the base of this cusp. The posteroloph becomes narrower towards the protocone, where it joins this cusp just below the occlusal surface in not or little worn specimens.

M^2 — The anteroloph is labially separated from the paracone. The protoloph is interrupted in 1 specimen. The metaloph joins the protoloph in 2 specimens, in 2 others it ends free, and in 1 specimen it curves backwards to join the posteroloph. The posteroloph is connected to the protocone at the same height of the occlusal surface in unworn specimens. Labially it joins the base of the metacone.

M^3 — The anteroloph is separated from the paracone in 3 out of 5 specimens, and lingually it joins the protocone in 3 out of the 5 specimens. In the centre of the tooth the protoloph curves obliquely backwards. The metaloph ends free in 3 cases, it

Types M^1 Localit.				N	Armantomys species
VL 4A	-	1	-	1	A. jasperi
CS 1A	-	1	-	1	
REM	-	1	-	1	
COR	3	9	-	12	
ART	-	10	1	11	
SR 2	-	3	-	3	
SR 1	-	3	-	3	
OR 1	1	-	-	1	
AT 1	-	1	-	1	A. parsani
MOR 1	2	1	-	3	
BN 2	1	1	-	2	
AGR	4	3	-	7	
RA 4A	1	-	-	1	
RA 3B	2	1	-	3	
VH3A	3	-	-	3	
RA 1	5	25	1	31	
NAL	6	5	-	11	
GAL 5	2	2	-	4	
SJ	5	5	1	11	A.d.
FU 2	6	-	-	6	A. bijm.
QU 1	16	-	-	16	
STC	9	1	-	10	

Fig. 5. Variation of the situation of the metaloph in M^1 of the small-sized *Armantomys* species.

is connected to the posteroloph in one, and in another specimen the metaloph is absent. The posteroloph is separated from the protocone by a narrow valley in 3 specimens and in the other two cases this ridge joins the protocone. In unworn or slightly worn specimens the metaloph is higher than the posteroloph.

M_1 — The anterolophid is separated from the protoconid. Mesolophid and posterolophid are separated at the entoconid by a deep furrow.

M_2 — This element also has a very simple dental pattern. The posterior wall of the anterolophid may be crenulated. In one specimen a longitudinal spur sprouts from the posterior wall of the anterolophid. In one specimen the metaconid is a distinct cusp, separated from the anterolophid and metalophid respectively by shallow and narrow furrows. The mesolophid and posterolophid are separated at the lingual border by a shallow furrow, which disappears with progressive wear. In 1 specimen the labial end of the posterolophid curves forward to reach the posterior wall of the mesolophid.

M_3 — The anterolophid is separated from the protoconid by a deep furrow. The mesolophid and posterolophid are separated at the entoconid, but they meet at the labial border, thus forming an oblique V-pattern.

LINEAGES OF *ARMANTOMYS*

We recognize two lineages in *Armantomys*. The first one consists of the small to medium-sized, successive species *A. bijmai* - *A. daamsi* - *A. parsani* - *A. jasperi*. The second one is that of the large-sized *A. aragonensis* and *A. tricristatus*. Various convergent but not contemporaneous developments are observed between the *A. bijmai* - *A. jasperi* lineage on the one hand and the *A. aragonensis* - *A. tricristatus* lineage on the other. These are: towards overturned ridges, towards a more complete posterolophid in M_3, towards a disconnection of protoloph and metaloph.

Types M^2 Localit.				N	Armantomys species
CS1A	-	1	-	1	A. jasperi
MOR 3	-	1	-	1	
COR	3	1	1	5	
ART	7	1	1	9	
VL 2A	1	1	-	2	
SR2	1	5	-	6	
SR1	4	3	-	7	
OR1	1	-	-	1	
MOR1	1	-	-	1	A. parsani
BN2	4	-	-	4	
AGR	16	-	-	16	
RA4A	2	-	-	2	
RA3B	4	3	-	7	
VH3A	2	-	-	2	
RA1	29	13	-	42	
NAL	15	-	-	15	
GAL 5	4	-	-	4	
SJ	12	1	-	13	A.d.
FU2	6	-	-	6	A.bijm.
QU1	16	-	-	16	
STC	7	-	-	7	

Fig. 6. Variation of the situation of the metaloph in M^2 of the small-sized *Armantomys* species.

Types M^3 Localit.			N	Armantomys species
CS1A	-	3	3	A. jasperi
REM	-	1	1	
COR	-	5	5	
ART	-	1	1	
SR 2	-	4	4	
SR 1	-	4	4	
BN 2	1	1	2	A. parsani
AGR	-	10	10	
RA 7	-	1	1	
RA 3B	-	1	1	
RA1	2	25	27	
NAL	1	16	17	
GAL 5	-	3	3	
SJ	-	3	3	A.d.
FM 2	-	9	9	A.b.
QU1	12	6	18	

Fig. 7. Variation of the centroloph in M^3 of the small-sized *Armantomys* species.

The *A. bijmai* - *A. daamsi* - *A. parsani* - *A. jasperi* lineage

The oldest *Armantomys* assemblages of relatively small-sized species were found in the Ebro Basin. Later assemblages are found in the Calatayud-Teruel and Loranca basins, where Early Ramblian representatives are abundant, and Late Ramblian and Early-Middle Aragonian ones are rare, though regularly found.

Description — Generally the ridges are not smooth structures. Especially in unworn or little worn specimens the upper part of the ridges may be crenulated and sinuous.

P^4 — Variable features in P^4 are the connections between the main cusps. Generally in the older assemblages the cusps are connected, but in the younger ones they tend to become isolated. The anterocone is always present, with the exception of the P^4 of *A. jasperi* from Retama and Casetón 1A.

$M^{1,2}$ — The ridges are more or less vertical to slightly inclined. The M^1 is more square-shaped than the subrectangular M^2. The anteroloph of M^1 generally shows a strong bending point midway (Pl. 1, figs. 4, 6-8), but in M^2 this ridge bends more smoothly (Pl. 1, fig. 5).

Another variable feature of $M^{1,2}$ is the spur of the protoloph. In M^1 an anterior spur may sprout from the protoloph, running obliquely towards the antero-lingual border. This spur is generally situated in the labial half of the tooth. In M^2 this spur may also be present, but it is generally shorter and situated in the lingual half of the tooth. Figure 2 shows that $M^{1,2}$ of *A. bijmai* lack this spur with the exception of one M^2 in Fuenmayor 2. In *A. daamsi* and in the older assemblages of *A. parsani* this spur is regularly present, and in the younger assemblages of *A. parsani* and those of *A. jasperi* this spur is predominantly present in M^1, and less frequent in M^2.

Types M^3 Localit.				N	Armantomys species
CS1A	2	1	-	3	A. jasperi
REM	-	1	-	1	
COR	3	2	-	5	
ART	1	-	-	1	
SR2	1	1	1	3	
SR1	2	2	-	4	
CAM	-	-	1	1	A. parsani
BN2	2	-	-	2	
AGR	12	-	-	12	
RA7	1	-	-	1	
RA3B	1	-	-	1	
RA1	24	3	-	27	
NAL	16	1	-	17	
GAL5	3	-	-	3	
SJ	3	-	-	3	A.d.
FM2	9	-	-	9	A.b.
QU1	13	4	1	18	

Fig. 8. Variation of the situation of the metaloph in M^3 of the small-sized *Armantomys* species.

Short centrolophs may sprout from both the paracone and the metacone. The posterior centroloph forms a τ-shaped pattern with the labial part of the metaloph, and the anterior centroloph forms a mirror image of this pattern with the labial part of the protoloph. Four morphotypes are recognized (Figs. 3 and 4): one with two centrolophs, one with the anterior centroloph only, one with the posterior centroloph only, and one without centrolophs. It appears that *A. bijmai* has predominantly M^1 with the anterior centroloph only; in *A. daamsi* M^1 with both centrolophs, or with the anterior one only, are frequent; in *A. parsani* M^1 with centrolophs are rare, and in *A. jasperi* these ridges are practically absent.

Another variable feature is the course of the metaloph. This ridge may be connected to the protoloph, it may be an isolated ridge, or it may curve backwards to join the posteroloph. Figures 5 and 6 show that in *A. bijmai* the metaloph is virtually always connected to the protoloph, thus forming a Y-shaped pattern. In the M^1 of *A. daamsi* the first two types predominate, but the M^2 of the same species has the metaloph predominantly connected to the protoloph. In the M^1 of the remaining species the metaloph forms generally an isolated ridge, but in M^2 the most frequent type is the one in which the metaloph is connected to the protoloph.

M^3 — The lingual end of the anteroloph always ends free. Labially it may be either separated from or connected to the paracone.

A short posterior centroloph, connected to the metacone, may be present. Figure 7 shows that in *A. bijmai* from Quel 1 specimens with a centroloph predominate, and that this morphotype is rare or absent in the other assemblages.

The situation of the metaloph is as in $M^{1,2}$; it may be connected to the protoloph, it may be an isolated ridge, or it may join the posteroloph. Figure 8 shows that the metaloph is predominantly connected to the protoloph in the three older species, and that in *A. jasperi* M^3 with isolated metalophs are relatively more frequent.

The posteroloph ends free labially, and lingually it is either connected to the protocone, or separated from this cusp by a shallow and narrow furrow.

Types M_1 M_2 Localit.			N			N	Armantom. species
CS 1A	-	-	-	-	1	1	A.jasperi
COR	-	1	1	-	8	8	
ART	-	6	6	-	12	12	
SR 2	-	4	4	-	3	3	
SR 1	-	4	4	-	4	4	
OR 2	-	2	2	-	-	-	
OR 1	-	-	-	-	1	1	
MOR 1	-	1	1	-	-	-	A.parsani
BN 2	-	4	4	-	3	3	
AGR	-	14	14	-	12	12	
RA 4A	-	-	-	-	3	3	
RA 3B	-	4	4	-	2	2	
VH 3A	1	1	2	-	2	2	
RA 1	5	28	33	1	42	43	
NAL	2	14	16	-	17	17	
GAL 5	-	2	2	-	5	5	
SJ	4	7	11	1	13	14	A.d.
FU 2	2	-	2	4	3	7	A.bijmai
CET	1	-	1	1	-	1	
QU 1	16	-	16	15	1	16	
STC	3	-	3	-	3	3	

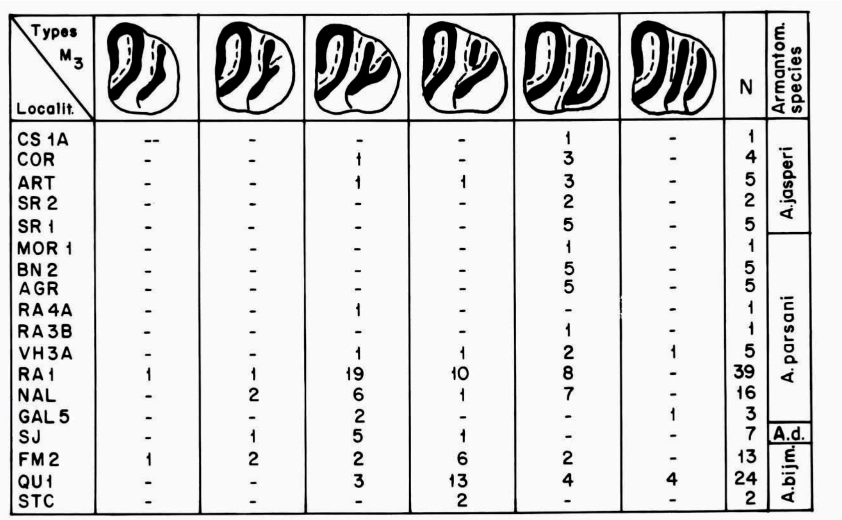
Fig. 9. Variation of the centrolophid in M_1 and M_2 of the small-sized *Armantomys* species.

P_4 — The anterior part consists of one large cusp which may be elongated. In some cases a small cusp is leaning on the postero-labial slope of this large anterior cusp. The entoconid is an isolated cusp. The posterolophid sprouts from the cuspidate hypoconid, and is narrow at its lingual end. In various specimens there is a relatively deep furrow betweeen hypoconid and posterolophid. The P_4 has one root.

$M_{1,2}$ — The anterolophid is always separated from the protoconid. The variation of the centrolophid made us define two standard morphotypes. The first one has a short centrolophid, and the metalophid is either connected to, or separated from the metaconid. The second type has no centrolophid, and the metalophid is always connected to the metaconid. Figure 9 shows that in *A. bijmai* all M_1 and the majority of the M_2 have a centrolophid. In *A. daamsi* the major part of M_1 and nearly all M_2 lack a centrolophid. In *A. parsani* from La Galocha 5, Navalón, Ramblar 1, and Valhondo 3A various M_1 still have a centrolophid, but in M_2 this ridge is practically absent. In the remaining assemblages of *A. parsani* and in *A. jasperi* centrolophids are absent.

The mesolophid is separated from the posterolophid at the entoconid by a furrow of variable depth, although it tends to be relatively deep. In much worn specimens these two ridges may meet at the entoconid. M_1 has two roots, and M_2 three.

M_3 — The M_3 is most variable in its posterior part (Fig. 10). The most simple type 1 has the meso- and posterolophid completely fused into one composite ridge. Type 2 has these two ridges also fused but the posterolophid shows a lingual extension, thus leaving a furrow on the posterior wall of the tooth. In type 3 the meso- and posterolophid are also fused, but the posterolophid is relatively long, thus forming an oblique Y-shaped composite ridge. In type 4 the mesolophid is a short and isolated ridge, and the posterolophid is as long as in type 3. In type 5 the meso- and posterolophid are complete transverse ridges. They are separated at the entoconid but they join each other at the labial tooth border. The posterior part of type 6 consists of a



Types M_3 / Localit.							N	Armantom. species
CS 1A	--	-	-	-	1	-	1	A.jasperi
COR	-	-	1	-	3	-	4	
ART	-	-	1	1	3	-	5	
SR 2	-	-	-	-	2	-	2	
SR 1	-	-	-	-	5	-	5	
MOR 1	-	-	-	-	1	-	1	A. parsani
BN 2	-	-	-	-	5	-	5	
AGR	-	-	-	-	5	-	5	
RA 4A	-	-	1	-	-	-	1	
RA 3B	-	-	-	-	1	-	1	
VH 3A	-	-	1	1	2	1	5	
RA 1	1	1	19	10	8	-	39	
NAL	-	2	6	1	7	-	16	
GAL 5	-	-	2	-	-	1	3	
SJ	-	1	5	1	-	-	7	A.d.
FM 2	1	2	2	6	2	-	13	A.bijm.
QU 1	-	-	3	13	4	4	24	
STC	-	-	-	2	-	-	2	

Fig. 10. Variation of the posterior part of the dental pattern of M_3 of the small-sized *Armantomys* species.

complete mesolophid and posterolophid, which are separated from each other both at the labial and at the lingual tooth border. Figure 10 shows that the predominant type of *A. bijmai* is the M_3 in which the mesolophid is a short and isolated ridge (type 4), but at the same time that the M_3 has a very variable dental pattern. In *A. daamsi* and *A. parsani* the most frequent morphotype is the one in which the mesolophid is connected to the posterolophid at the labial border (type 3), but the variation is still large. In the younger assemblages of *A. parsani* and *A. jasperi* the most frequent type is the one in which the mesolophid joins the posterolophid at the labial tooth border. This element has three roots.

Size (Tables 2-9, Figs. 28-35) — There is a considerable size difference among all elements of *Armantomys* from the various localities. From *A. bijmai* to *A. parsani* there is an evident tendency towards size increase. *A. parsani* is the largest representative of the genus. *A. jasperi* is on the average smaller than *A. parsani*, which is clearest in M^1, M^2, part of M^3, M_1, part of M_2, and part of M_3. *A. jasperi* and *A. daamsi* are of comparable size.

Discussion — *Quercomys* is considered to be a junior synonym of *Armantomys*. The features mentioned by Lacomba and Martínez-Salanova (1988) to differentiate *Quercomys* from *Armantomys* only serve to distinguish *Q. bijmai* from the remaining *Armantomys* stock on the species level. *Q. bijmai* and its descendants (*daamsi*, *parsani*, *jasperi*) fit better with *Armantomys* as defined by de Bruijn (1966). The common features are hypsodonty and ridge shape of both upper and lower molars. An emended diagnosis of *Q. bijmai* is given below.

Armantomys daamsi from San Juan differs from *Armantomys bijmai* from Santa Cilia and its type locality Quel 1 by its larger size, the scarcity of centrolophids, its more inclined ridges, and by the presence of M^1 with an isolated metaloph. On the other hand *A. daamsi* shows the centroloph-like ridge in several M^1 and few M^2. Of the 8 M_3 of *A. daamsi* only one has the typical shape of the relatively small-sized *Armantomys* species (Pl. 1, fig. 19), and the other specimens show the reduced posterior part, typical for *Armantomys aragonensis*.

Armantomys parsani from La Galocha 5 is larger than *A. daamsi* from San Juan and it lacks centrolophids. Furthermore, centroloph-like ridges are present in M^1 and M^2. Only 2 M^1 and none of the M^2 have an isolated metaloph.

Revision of the type collections of *Armantomys aragonensis* and *Praearmantomys crusafonti* (Villafeliche 2A and Ateca 1 respectively), led to the conclusion, that both assemblages also contain *Armantomys jasperi*. In Villafeliche 2A two M^2 (nos. VL2A 307 and 314), considered by de Bruijn (1966) to belong to *A. aragonensis*, appeared to be too small and are now attributed to *A. jasperi*. The same is true for an M^1 from Ateca 1 (no. 60-369), which was considered to fall within the variation of *Praearmantomys crusafonti* by de Bruijn (1966).

The *Armantomys bijmai - A. daamsi - A. parsani - A. jasperi* lineage is characterized by the following trends:
Size increase in the interval between Santa Cilia (zone X) and Ramblar 1 (lower part of zone Z), followed by relative size stability until the level of Agreda (zone A). In the interval between Agreda and Córcoles (zone C) size decreases. Some large teeth from zone D suggest a size increase again, but the material is too scarce to affirm this.
Gradual loss of centrolophs and centrolophids. The last locality with centrolophs in $M^{1,2}$ is San Roque 2 (zone B), the last one with centrolophs in M^3 is Bañon 2 (zone A) and the last one with centrolophids in $M_{1,2}$ is Ramblar 1 (lower part of zone Z).
Towards a more complete dental pattern of M_3.
Towards a disconnection of meta- and protoloph in the upper molars.

The *Armantomys aragonensis - A. tricristatus* lineage

The large-sized *Armantomys* make their first appearance in the Early Ramblian, where they are frequent representatives of the micromammal faunas. Afterwards they occur regularly, but in low frequencies in the Late Ramblian and Aragonian faunas.

Description (see also Figs. 11-15)

P^4 — The anteroloph may be either present or absent. When present, it varies from a short ridge to a tiny cusp with all possible intermediates. Figure 11 shows that most assemblages of *A. aragonensis* have P^4 with an anterocone, that in the younger assemblages of the same species there is a mixture of both types, and that in *A. tricristatus* the anterocone is absent. Specimens without an anterocone have more oblique protolophs and metalophs. The posteroloph is low and narrow, and its lingual end joins the base of the protocone.

$M^{1,2}$ — The anteroloph forms an isolated ridge. The metaloph may join the posteroloph near or at its lingual end. The metaloph is either connected to the protoloph, or it is an isolated ridge. The posteroloph does not join the protocone. Figures 12 and 13 show that specimens with the metaloph and protoloph connected are rare and only present in *A. aragonensis* from the Ramblian. The most common type in *A.*

Types P^4 Localit.			N	Species
ESC	-	9	9	A.t.
VL 4B	1	-	1	Armantomys aragonensis
VL 4A	1	2	3	
CS 1A	4	4	8	
REM	23	13	36	
MOR 3	1	-	1	
MOR 2	3	-	3	
MUE	2	-	2	
COR	6	-	6	
ART	1	-	1	
VL 2A	3	-	3	
CAM	1	-	1	
MOR 1	5	-	5	
BN 2	3	-	3	
AGR	3	-	3	
DH	1	-	1	
RA 7	27	-	27	
RA 4A	15	-	15	
RA 3B	16	-	16	
VH 3A	3	-	3	
VH 1	10	-	10	

Fig. 11. Variation of the anterocone of P^4 of the large-sized *Armantomys* species.

Types M^1 Localit.				N	Species
ESC	-	11	17	28	A. tricristatus
VT 2C	-	-	1	1	
VT 2B	-	-	1	1	
LP 4A	-	1	-	1	
RG 2	-	-	1	1	
VA 3E	-	3	1	4	
VL 4B	-	2	-	2	Armantomys aragonensis
VL 4A	-	1	6	7	
VA 3B	-	-	1	1	
CS 1A	-	7	1	8	
REM	-	26	8	34	
MOR 3	-	2	-	2	
MOR 2	-	-	3	3	
OR 5	-	-	1	1	
BU	-	2	-	2	
COR	-	6	5	11	
ART	-	2	1	3	
VL 2A	-	3	-	3	
SR 1	-	2	2	4	
MOR 1	-	3	1	4	
AGR	1	9	-	10	
DH	-	2	-	2	
RA 5A	1	3	1	5	
RA 7	-	35	1	36	
RA 4A	1	12	2	15	
RA 3B	-	34	6	40	
VH 3A	-	9	-	9	
VH 1	-	22	-	22	

Fig. 12. Variation of the situation of the metaloph in M^1 of the large-sized *Armantomys* species.

aragonensis is the one with the isolated metaloph, and in *A. tricristatus* the one in which the metaloph joins the posteroloph.

M^3 — The anteroloph is an isolated ridge. The protoloph-metaloph unit is the most variable part of the tooth. The protoloph and metaloph may join, forming a composite Y-shaped ridge (type 1). In type 2 the metaloph is an isolated ridge. In type 3 the protoloph joins the metaloph, but the labial part of the protoloph forms a short isolated ridge. In type 4 the lingual end of the metaloph curves backwards to join the posteroloph, either in the middle or towards its lingual end. Figure 14 shows that in M^3 of *A. aragonensis* from the Ramblian (zones Z and A) types 1 and 2 are equally represented, and predominant. In the M^3 of the other *A. aragonensis* assemblages type 1 is poorly represented, and type 2 and 3 are more frequent. In *A. tricristatus* type 4 prevails.

P_4 — This element has a rounded subtriangular outline. The anterior part consists of one cusp which in some cases may tower above the rest of the dental pattern. In some specimens the anterior part shows a centrolophid and a short anterolophid. The anterior cusp may have an elongated shape, and it may be isolated, connected to the entoconid, or connected to the labial end of the posterolophid. The entoconid is an isolated cusp, if not connected to the anterior cusp. The posterolophid is narrow at its lingual end and wide at its labial.

$M_{1,2}$ — As far as the ridge pattern is concerned, little variation was observed.

Types M^2 Localit.				N	Species
ESC	-	5	28	33	A.tricr.
VT 2B	-	-	1	1	
RG 2	-	-	1	1	
VA 3D	-	2	-	2	Armantomys aragonensis
VL 4A	-	2	3	5	
VA 3B	-	-	2	2	
CS 1A	-	9	1	10	
VA 1A	-	1	-	1	
REM	-	41	18	59	
MOR 3	-	1	1	2	
MOR 2	-	-	2	2	
OR 5	-	-	1	1	
VR 1A	-	-	1	1	
BU	-	-	1	1	
COR	-	3	3	6	
ART	-	4	4	8	
VL 2A	-	2	1	3	
SR 1	-	-	2	2	
MOR 1	-	5	1	6	
BN 2	-	2	-	2	
AGR	-	3	-	3	
RA 5A	-	4	-	4	
RA 7	1	41	2	44	
RA 4A	-	22	1	23	
RA 3B	1	38	6	45	
VH 3A	-	5	-	5	
VH 1	1	13	3	17	
RA 1	1	-	-	1	

Fig. 13. Variation of the situation of the metaloph in M^2 of the large-sized *Armantomys* species.

The anterolophid is always separated from the protoconid, centrolophids are absent, and the mesolophid is separated from the posterolophid at the entoconid by a deep furrow. Some slight variation can be observed in the anterior part of M_1; in *A. tricristatus* it is relatively narrower than in *A. aragonensis*. Another difference between *A. tricristatus* and *A. aragonensis* is the shorter anterolophid of the former species (Pl. 4, figs. 7 and 16). M_1 has two roots and three roots are present in M_2.

M_3 — In M_3 the same set of standard morphotypes as in the *Armantomys bijmai* - *A. jasperi* lineage was observed. Figure 15 shows that type 3 with the meso- and posterolophid forming a composite Y-shaped ridge is the predominant type in *A. aragonensis*. *A. tricristatus* is characterized by type 6 in which mesolophid and posterolophid are two complete, transverse, and isolated ridges. The youngest *A. aragonensis* assemblages show a mixture of M_3 with relatively reduced dental pattern and specimens with a more complete ridge pattern. The M_3 has three roots.

Size (see Tables 10-17, Figs. 28-35) — There is a considerable size difference among the *Armantomys* molars from the numerous localities. This is less true for the premolars, which retain more or less the same size during the Ramblian and Aragonian. It is apparent that the molars of *A. tricristatus* are larger than those of *A. aragonensis*, although the first representatives of the former species may be considered to be of intermediate size. The extremes are formed by the assemblages of *A. aragonensis* from Agreda (zone A) and Retama (zone D1), the former one having the largest teeth and the latter one the smallest. On the other hand, the significance of these observations is uncertain as the major part of our assemblages consists of few teeth only.

Types M^3 Localit.					N	Species
ESC	-	-	-	26	26	A.tricristatus
AC 2	-	-	-	1	1	
VT2C	-	-	-	1	1	
VT2B	-	-	-	2	2	
LP 4B						
RG 2	-	-	-	1	1	
VA 3E	-	2	-	2	4	
VL 4A	2	2	-	-	4	Armantomys aragonensis
CS 1A	-	8	-	-	8	
VA 1A	-	-	-	1	1	
REM	2	17	25	1	55	
MOR 3	-	1	-	-	1	
MOR 2	-	1	2	-	3	
OR 5	-	1	-	-	1	
VR 1A	-	-	-	1	1	
BU	-	1	1	-	2	
COR	3	2	-	-	5	
ART	1	3	1	-	5	
VL 2A	-	2	-	-	2	
SR 1	-	2	-	-	2	
MOR 1	5	6	-	-	11	
BN 2	1	-	-	-	1	
AGR	-	3	-	-	3	
DH	1	1	-	-	2	
RA 5A	4	2	-	-	6	
RA 7	29	20	1	1	51	
RA 4A	10	12	-	1	23	
RA 3B	19	32	-	-	51	
VH 3A	3	2	2	-	7	
VH 1	9	7	1	-	17	
RA 1	1	-	-	-	1	

Fig. 14. Variation of the situation of the metaloph in M^3 of the large-sized *Armantomys* species.

Discussion — We distinguish two large-sized *Armantomys* species: *A. aragonensis* and *A. tricristatus*. Although the size of *A. aragonensis* fluctuates throughout the stratigraphic sequence, it is on the average smaller than that of *A. tricristatus*. Other differences between these two species are:

The ridges of *A. tricristatus* are much more inclined than they are in *A. aragonensis*.

The cheek teeth of *A. tricristatus* are less hypsodont than those of *A. aragonensis*. This is in contrast with the observations of López (in López et al., 1977) and Lacomba & Martínez-Salanova (1988) who state that *A. tricristatus* is the most hypsodont representative of the Gliridae. In fact the height of $M^{1,2}$ of *A. tricristatus* and *A. aragonensis* is more or less the same, while the length and width of the former species are considerably larger.

The P4 of *A. tricristatus* and *A. aragonensis* are of similar size. As the other molars are much larger in *A. tricristatus*, this implicates a strong relative reduction of the premolars.

The P^4 of *A. tricristatus* lacks an anterocone, whereas this cusp is present in *A. aragonensis*.

In the $M^{1,2}$ of *A. tricristatus* the lingual end of the metaloph joins the lingual end of the posteroloph, thus forming an oblique V-pattern. In the $M^{1,2}$ of *A. aragonensis* the lingual end of the metaloph, if not isolated, joins the posteroloph approximately halfway.

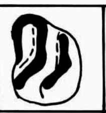
Types M_3 Localit.							N	Species
ESC	-	-	-	-	-	27	27	A. tricristatus
MAN								
VT 2B	-	-	-	-	-	1	1	
LP 4A	-	-	-	-	-	1	1	
RG 2	-	-	-	-	-	1	1	
VA 3E	-	-	-	-	-	1	1	
VL 4B	-	-	1	-	-	-	1	Armantomys aragonensis
VL 4A	-	-	3	-	4	1	8	
VA 3B	-	-	1	-	-	-	1	
CS 1A	-	-	2	1	-	2	5	
REM	-	1	38	-	5	3	47	
MOR 3	-	-	1	-	-	-	1	
MOR 2	-	-	4	-	-	-	4	
OR 5	-	-	3	-	-	-	3	
VR 1A	-	-	1	-	-	-	1	
BU	-	-	1	-	-	1	2	
COR	-	-	9	-	-	-	9	
ART	-	1	2	-	-	-	3	
VL 2A	-	-	2	-	-	-	2	
MOR 1	2	-	3	1	-	-	6	
BN 2	-	-	1	-	-	-	1	
AGR	-	-	4	-	-	-	4	
DH	-	-	2	-	-	-	2	
RA 5A	-	1	2	-	-	-	3	
RA 7	1	1	36	2	-	-	40	
RA 4A	1	-	11	1	-	1	14	
RA 3B	-	4	18	1	-	-	23	
VH 3A	-	-	5	-	-	-	5	
VH 1	-	1	13	-	1	-	15	
RA 1	-	-	2	-	-	-	2	

Fig. 15. Variation of the posterior part of the dental pattern of M_3 of the large-sized *Armantomys* species.

In the upper molars of *A. tricristatus* the posteroloph is always separated from the protocone by a distinct furrow. In *A. aragonensis* this feature is less constant.

The ridges of the M^3 of *A. tricristatus* are more or less semicircular in occlusal view. In *A. aragonensis* the ridges are more transverse.

The anterior part of M_1 of *A. tricristatus* is transversely more compressed than in *A. aragonensis*.

The mesolophid and posterolophid of M_3 of *A. tricristatus* are complete, transverse, and separate ridges. In *A. aragonensis* the posterior part of M_3 is reduced; mesolophid and posterolophid generally form a composite Y-shaped pattern.

The anterolophid of the lower molars of *A. tricristatus* is shorter than in *A. aragonensis*.

The *A. aragonensis* - *tricristatus* lineage is characterized by trends towards: size increase of the molars, more inclination of the ridges, loss of the anterocone in P^4, a connection between metaloph and posteroloph in the upper molars, shortening of the anterolophid in the lower molars, and a more complete ridge pattern of M_3.

Armantomys from localities not studied in this paper

Valdes et al. (1986) mentioned *A. aragonensis* from of Tarazona (zone D, Middle

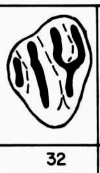
Types P^4 Localit.				N
ART	2	46	32	80
SR 2	-	22	9	31
SR 1	1	28	5	34
OR 1	-	8	9	17
AT 1	-	13	3	16
CAB	5	2	-	7

Fig. 16. Variation of the situation of the metaloph in P^4 of *Praearmantomys crusafonti.*

Types M^1 Local.			N
ART	26	41	67
SR 2	27	20	47
SR 1	13	9	22
OR 3	-	1	1
OR 1	5	5	10
AT 1	7	4	11
CAB	9	-	9

Fig. 17. Variation of the situation of the metaloph in M^1 of *Praearmantomys crusafonti.*

Aragonian, Ebro Basin, Zaragoza). However, the size of the few teeth (2 P^4 and 2 $M^{1,2}$) does not fall within the variation of *A. aragonensis*, but it does coincide with that of *A. jasperi*. Hence, this small assemblage should be assigned to the latter species.

Alberdi et al. (1981) mention 6 teeth from Moratines (zone D, Madrid Basin) as *A. aragonensis*. The size and the reduced dental pattern of M_3 from this locality agree perfectly well with those of *A. aragonensis*. Sesé et al. (1985) also mention the presence at Moratines of large-sized teeth, that have the size of *A. giganteus*. Apparently the latter authors had a larger collection at their disposal, as they mention the presence of 68 teeth in the same locality. However, measurements and descriptions of the additional material is not given in their paper. As *A. giganteus* is now considered to be a junior synonym of *A. aragonensis* (see above), the entire assemblage from Moratines is provisionally assigned to *A. aragonensis*.

Baudelot & Collier (1982) mention an M^2 of *A. aragonensis* in the Upper Aragonian of Liet (S France). As a matter of fact, its size and dental pattern agree with those of the mentioned species. The contemporaneous faunas from Spain contain *A. tricristatus*, which have significantly larger teeth than the one from Liet. Unfortunately, this only tooth does not allow us any further speculation on evolutionary or biogeographical implications.

Praearmantomys de Bruijn, 1966

Emended diagnosis — 'Large Myomiminae with simple dental pattern and concave occlusal surface. The relatively thick ridges are as high as the basis of the crown. Extra ridges are absent. M^1 longer than M^2, but of the same width. Short centrolophs and centrolophids may be present in $M^{1,2}$ and $M_{1,2}$, respectively. Ridges vertical to slightly inclined.'

Description

P^4 — This element has a peculiar subrounded and triangular shape. The anteroloph is reduced to an isolated anterocone. The paracone is reduced and only in Cabeza Rubia it still has a cusp shape. The protoloph is a straight, transverse ridge. The metaloph is either connected to the protoloph, or it is an isolated, short and trans-

Types M^2 Local.			N
ART	79	9	88
SR 2	45	8	53
SR 1	26	2	28
OR 1	15	3	18
AT 1	19	-	19
CAB	8	-	8

Fig. 18. Variation of the situation of the metaloph in M^2 of *Prae-armantomys crusafonti.*

Types M^3 Localit.				N
ART	52	6	-	58
SR 2	37	2	1	40
SR 1	25	1	2	28
OR 3	1	-	-	1
OR 1	4	-	-	4
AT 1	20	-	-	20
CAB	4	1	-	5

Fig. 19. Variation of the situation of the metaloph in M^3 of *Praearmantomys crusafonti.*

verse ridge, or it is connected to the posteroloph. Figure 16 shows that the metaloph is rarely connected to the protoloph, and that the most common type is the one in which the metaloph is an isolated ridge. In stratigraphic younger forms the metaloph tends to become connected to the posteroloph. The posteroloph is well developed. The labial part of this ridge is relatively narrow, and it is generally separated from its lingual part, which generally has a triangular cusp-like shape.

$M^{1,2}$ — Moderately hypsodont teeth. The anteroloph always forms an isolated transverse ridge. The metaloph may either be connected to, or separated from the protoloph (Figs. 17, 18). Centrolophs are generally absent, but in Cabeza Rubia a short anterior τ-shaped centroloph is present in various specimens. The posteroloph forms an isolated ridge. Figure 18 shows that in M^1 the metaloph is more frequently connected to the protoloph, with the exception of the assemblage from Artesilla. M^2 with an isolated metaloph are relatively rare (Fig. 18). The M^1 shows a tendency towards isolation of the metaloph, but in M^2 this tendency is hardly present. Whereas in the same assemblage the M^1 may have a large proportion of specimens with isolated metaloph, in the M^2 the Y-shaped pattern always prevails.

M^3 — The anteroloph is an isolated ridge. The metaloph is either connected to, or separated from the protoloph (Fig. 19). In some specimens the labial part of the protoloph is separated from its lingual part by a deep furrow (third type, Fig. 19). The posteroloph is either separated from, or connected to the protocone. It appears from Fig. 19 that protoloph and metaloph generally form a composite Y-shaped ridge, and that there is only a slight tendency towards isolation of the metaloph.

P_4 — The reduced anterior part consists of a curved composite ridge, formed by the metalophid and the short anterolohpid. The centrolophid is either absent or very short. The posterolophid is well-developed and it may either be separated from the large and isolated entoconid or it may join this cusp. A mesolophid is absent. Figure 20 shows that in the youngest assemblage from Artesilla the entoconid forms part of the posterolophid in the major part of the specimens.

$M_{1,2}$ — These elements are relatively low-crowned compared to the upper molars. The anterolophid is relatively short and it is generally separated from the protoconid. The metalophid may be either connected to, or isolated from the metaconid (Figs. 21, 22). A short, more or less longitudinal centrolophid may be present. The mesolophid is separated from the posterolophid at the entoconid by a

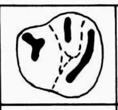
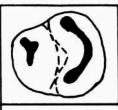
Types P_4 Local.			N
ART	19	33	52
SR 2	22	7	29
SR 1	15	10	25
OR 1	8	5	13
AT 1	5	6	11
CAB	2	-	2

Fig. 20. Variation of the dental pattern in P_4 of *Praearmantomys crusafonti.*

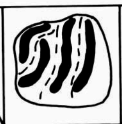
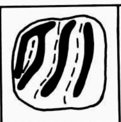
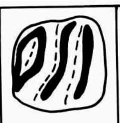
Types M_1 Local.				N
ART	11	6	26	43
SR 2	15	12	18	45
SR 1	4	7	15	26
OR 3	-	-	1	1
OR 1	3	4	6	13
AT 1	7	8	2	17
CAB	5	-	2	7

Fig. 21. Variation of the centrolophid in M_1 of *Praearmantomys crusafonti.*

deep furrow. Figures 21 and 22 show that centrolophids occur more frequently in M_1 than in M_2. In the same assemblage, where in M_1 specimens with centrolophids prevail, the M_2 lacks this ridge practically. Furthermore it is evident that the centrolophid is more frequently present in the older assemblages than in the younger ones.

M_3 — The anterolophid is separated from the protoconid. A centrolophid is absent. As far as the posterior part of this element is concerned, four standard morphotypes are recognized (Fig. 23). The first one has a short and isolated mesolophid. The second one has the mesolophid and posterolophid connected, thus forming an oblique Y-shaped composite ridge. In the third type the posterior arm of this composite Y-shaped ridge, is small and situated more lingually, but still with a small furrow at the posterior wall of the tooth. In the fourth type mesolophid and posterolophid are melted together to form one isolated and transverse ridge. Figure 23 shows that the second type with the composite oblique Y-shaped ridge is the most common in

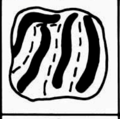
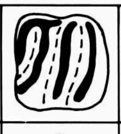
Types M_2 Local.				N
ART	2	-	45	47
SR 2	4	-	49	53
SR 1	5	-	23	28
OR 1	2	-	10	12
AT 1	3	2	15	20
CAB	-	-	7	7

Fig. 22. Variation of the centrolophid in M_2 of *Praearmantomys crusafonti.*

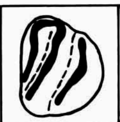
Types M_3 Localit.					N
ART	1	39	17	13	70
SR 2	-	34	1	1	36
SR 1	2	22	2	2	28
OR 1	-	12	2	-	14
AT 1	1	15	4	2	22
CAB	2	1	-	-	3

Fig. 23. Variation of the posterior part of the dental pattern in M_3 of *Praearmantomys crusafonti.*

all assemblages. But in Artesilla specimens with a reduced posterior part are also frequent, implying a trend towards simplification of the dental pattern.

Size (Table 18) — The size of the teeth of *Praearmantomys* is relatively stable. Only the M^1, M^2, and M_2 from Cabeza Rubia appear to be slightly larger than those of the other assemblages.

Discussion — *Praearmantomys* is characterized by moderately hypsodont upper molars and relatively low-crowned lower molars. The ridges of the lower molars are symmetrical to slightly inclined. Its first occurrence is in Cabeza Rubia (zone Y2), and it is absent from the major part of the localities of zone Z and from those of zone A. A recently found fauna from zone Z of the Loranca Basin revealed the presence of this genus. All *Praearmantomys* assemblages studied in this paper are considered to belong to *P. crusafonti*, although various differences are observed among these assemblages. The following evolutionary trends can be observed in *P. crusafonti*: towards connection of the metaloph to the posteroloph in P^4; towards isolation of the metaloph from the protoloph in M^1, and to a very slight extent also in M^2 and M^3; towards connection of posterolophid with entoconid in P_4; towards loss of the centrolophid, which is more evident in M_1 than in M_2; towards reduction of the posterior part of M_3.

Hypsodonty and ridge shape

The lingual view of the upper molars and the labial view of the lower ones show best the differences among the various genera and species.

Hypsodonty can be measured in various ways. In the upper molars the most reliable results are obtained measuring the height of the anterior part of the crown. This may cause problems when the crown base is slightly sinuous. Furthermore, in M^2 the crown base and occlusal surface are not parallel, and the posterior part of the crown is lower than the anterior one.

It is convenient to express the hypsodonty as a ratio in order to eliminate absolute size. Length or width of the tooth as measured in occlusal view may serve, but the length has some disadvantages. Firstly, M^1 is longer than M^2, whereas they are of similar width, so that different hypsodonty ratios are obtained from teeth of comparable crown height. Secondly, in the Gliridae studied in this paper, increase of hypsodonty is accompanied by an increase in inclination of the ridges. In occlusal view, the length increases with progressive inclination. For these reasons we have used the width of M^1 and M^2 to calculate the relative hypsodonty. Tables 19 and 20 show the hypsodonty of unworn or slightly worn M^1 and M^2. It appears that the small-sized *Armantomys* species are on the average lower crowned than the large-sized *Armantomys* species, and that *Praearmantomys* has the lowest molars. It is also apparent that *A. tricristatus* is not as high crowned as López (1977) and Lacomba & Martínez Salanova (1988) assumed. As a matter of fact *A. tricristatus* is lower crowned than the Ramblian representatives of *A. aragonensis*. From Fig. 24 it is

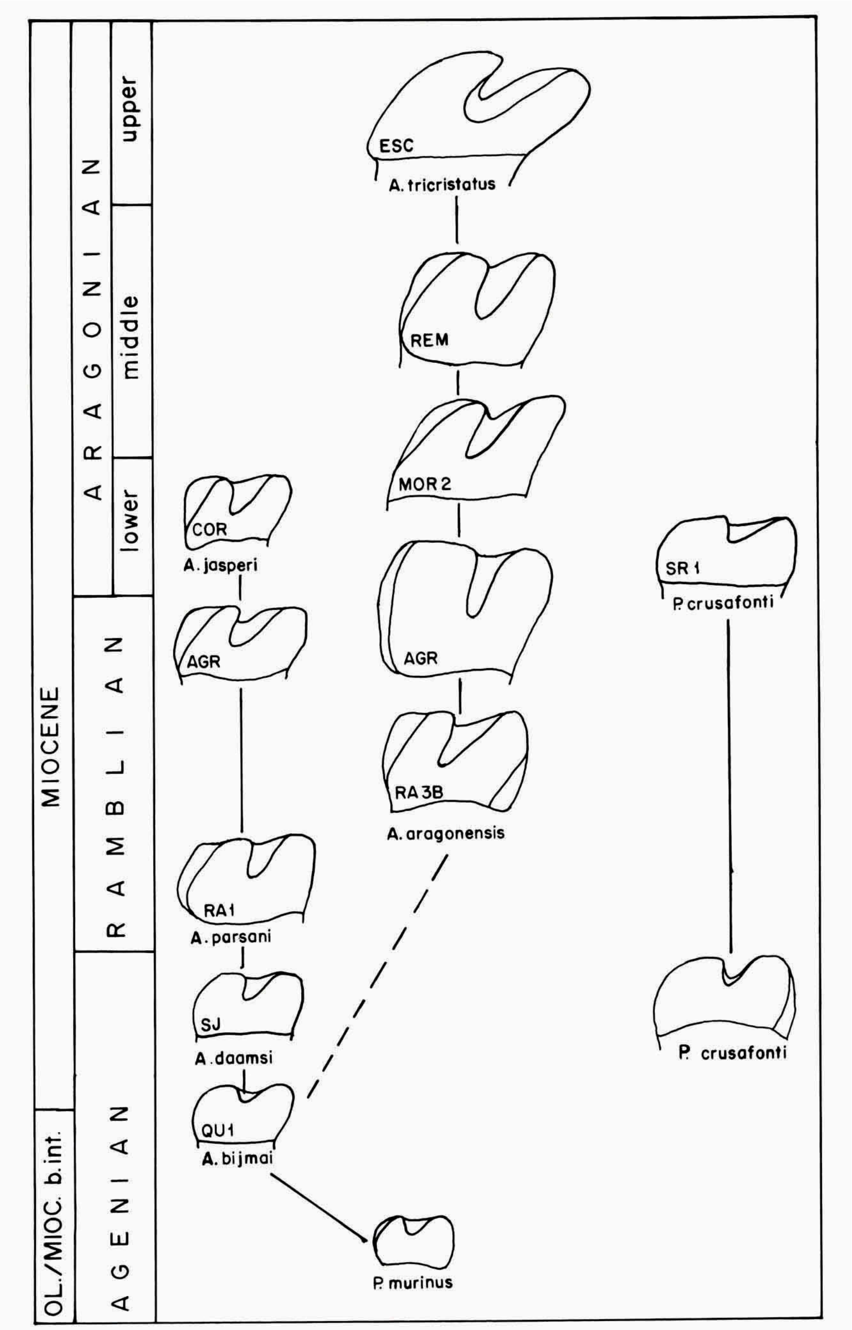


Fig. 24. Development of ridge shape of M^1 in *Praearmantomys* and *Armantomys*.

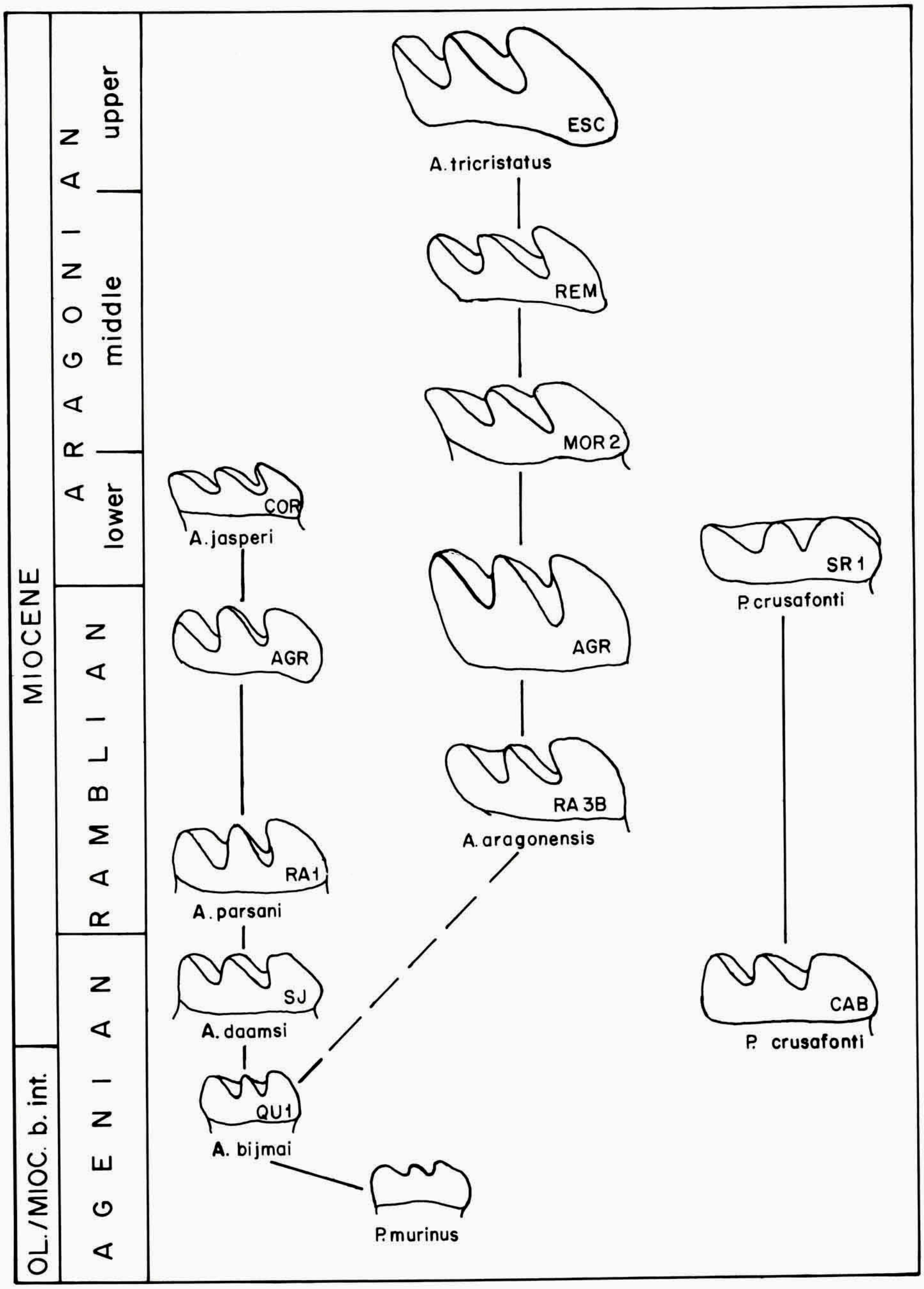


Fig. 25. Development of ridge shape of M_2 in *Praearmantomys* and *Armantomys*.

evident that *Peridyromys murinus* and *Armantomys bijmai* have a high-crowned base compared to the height of the ridges. In *A. daamsi* the ridges are higher with respect to the crown base, and this trend continues towards *A. jasperi*. In *A. daamsi*, *A. parsani* and *A. jasperi* the ridges are overturned. The first representatives of *A. aragonensis* from the Lower Ramblian already have high ridges compared to the crown base. This feature does not change during the entire time range of this species. *A. tricristatus* differs from *A. aragonensis* by its more inclined ridges. The upper molars of *Praearmantomys* have less inclined ridges, which are low with respect to the crown base.

In the lower molars the division of height by crown length or width did not show any differences between the various genera and species. From Fig. 25 it is clear that in the small-sized *Armantomys* species the ridges tend to become higher with respect to the crown base. Reliable measuring of the height of the ridges is difficult as the valleys debouch gradually into the labial tooth border, thus hampering the determination of a fixed measuring point. In *A. bijmai* the ridges of the lower molars are relatively higher than in *P. murinus*, whereas in the upper molars there is no apparent difference between these two species in this respect. In *A. daamsi* the ridges of the lower molars are more inclined than in its ancestor, and in *A. jasperi* they are even more inclined. The lower molars of the first representatives of *A. aragonensis* have already much inclined ridges, which are high with respect to the crown base. They are more inclined than in the contemporaneous *A. parsani*, but *A. jasperi* and *A. aragonensis* from zone D have a similar ridge shape. *A. tricristatus* has a ridge shape resembling that of *A. aragonensis* although it seems that the posterolophid is by far the most voluminous ridge. *Praearmantomys* has a low crown and only slightly inclined ridges.

Comparison between *Armantomys* and *Praearmantomys*

Table 1. Distinctive features of *Armantomys and Praearmantomys*.

	Large-sized *Armantomys*	Small-sized *Armantomys*	*Praearmantomys*
Size	large	small-medium	large
Hypsodonty	moderate-high	moderate	low
Enteroloph bend	absent	prominent	absent
Proto-metaloph	not connected	variable	variable
Protoloph spur	absent	variable	absent
Protoloph	continuous	may be interrupted	continuous
Centrolophs	absent	in older species	rarely
Inclination of ridges in M inf.	strong	moderate	more or less vertical
M1	longer than wide	wider than long	longer than wide
M2	wider than long	wider than long	wider than long
Centrolophid M1 and M2	absent	present in older assemblages	variable

The most important distinguishing characters of these genera are summarized in Table 1. *Armantomys* is the genus with the highest crowns. The ridges are simple, inclined structures. The small-sized *Armantomys* species have the most complicated molar pattern as shown by the presence of centroloph(id)s, anterior spur of the protoloph, and generally more undulating ridges and crenulations on the upper slope of the ridges. *Praearmantomys* is intermediate in complexity. Short centrolophs are only present in the material from Cabeza Rubia, although the M_1 and M_2 of the other, younger assemblages also have centrolophids. Of these three groups, the lowest crowns are found in representatives of *Praearmantomys.*

Phylogeny

Peridyromys murinus is considered by various authors to be the main stock of many other genera and species of the Gliridae. In the Upper Oligocene of western Europe Gliridae are generally little diversified. *Gliravus* is represented by various species, *Peridyromys* by two, and *Bransatoglis* by one or two. On the other hand, Upper Oligocene faunas are poorly represented and consequently poorly known. *Peridyromys murinus* is a relatively hypsodont dormouse with inclined ridges, and we therefore do not think that it gave rise to species with low-crowned teeth such as *'Peridyromys' brailloni* (Thaler, 1966), *Peridyromys prosper* (Thaler, 1966) and *Peridyromys rex* García Moreno, 1986.

However, we do think that *P. murinus* is the ancestral species of *Armantomys bijmai* (Fig. 26). The latter species has larger teeth than the former one, but in Quel 1 various specimens are present, which are intermediate between these two species, but only in size and ridge pattern. The predominant morphotype of $M^{1,2}$ in Spanish *P. murinus* is the one with the anterior centroloph only. The same morphotype prevails in *Armantomys bijmai,* the oldest species of this genus. We suppose that some population of *P. murinus* gave rise to *A. bijmai* in the northern part of Spain during the latest Oligocene or the Oligocene-Miocene transition.

The first appearance of *Praearmantomys* is in zone Y2 (Lower Miocene) of the Loranca Basin. The most peculiar feature of this genus are the high-crowned upper molars compared to the relatively low-crowned lower ones. Moreover, the ridges are not as inclined as they are in *Peridyromys murinus* and *A. bijmai.* Therefore we do not think that either of these species should be considered as its ancestor. The ridge shape and the low-crowned lower molars coincide rather with those of an undescribed *Pseudodryomys* species from zone Y1 from the Loranca Basin. It is therefore more probable that the origin of *Praearmantomys* should be sought in that species. A detailed study on the evolution of *Pseudodryomys* by the present author is planned for the near future. But, in spite of the relatively well-documented (yet unpublished) faunas of zones Y1 and Y2 from the Loranca Basin, intermediate assemblages are not known.

The first appearance of *Armantomys aragonensis* is in the Lower Ramblian of Ramblar 1 in the Calatayud-Teruel Basin, where it is found together with *A. parsani.* Unfortunately, few specimens are known from this locality, but in the immediately

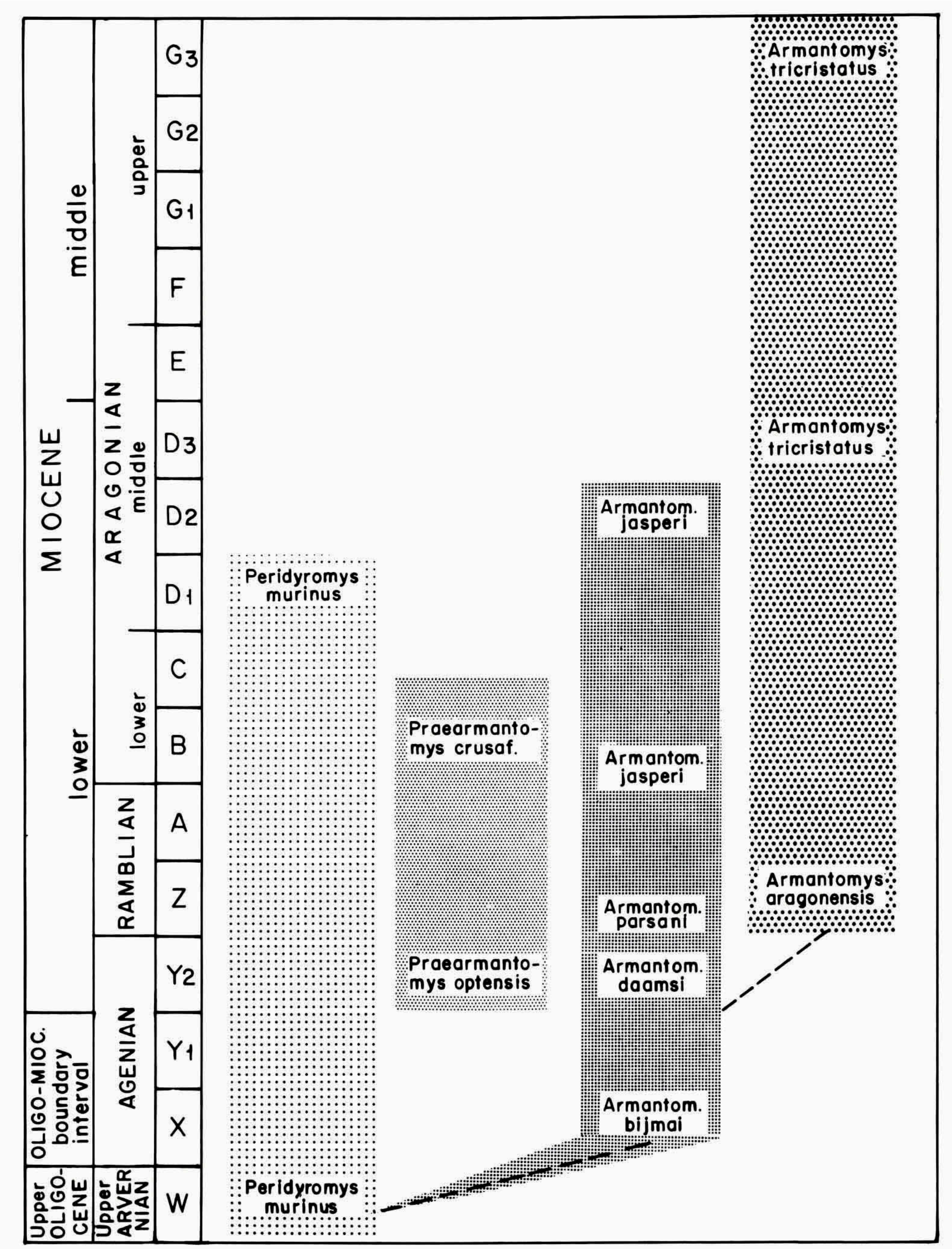


Fig. 26. Phylogenetic tree of the hypsodont Myomiminae studied in this paper.

Series	Continental Stages		Local Zones	Localities	Armantomys						Praearmantomys crusafonti
					bijmai	daamsi	parsani	jasperi	aragonensis	tricristatus	
MIOCENE	ARAGONIAN	upper	G3	ESC						o	
				AC2						o	
			G2	MAN						o	
			F	VT2C						o	
				VT2B						4	
		middle	E	LP4B						1	
				LP4A						1	
			D3	RG2						o	
				VA3E						2	
			D2	VA3D					2		
				VL4B					6		
				VL4A				o	5		
				VA3B					2		
			D1	CS1A				o	4		
				VA1A					4		
				REM				o	7		
				MOR3				o	2		
				MOR2					o		
				MUE					o		
		lower	C	OR5					o		
				VR1A					o		
				BU					o		
				COR				3	4		
				ART				o	o		25
			B	VL2A				1	7		
				SR2				2			25
				SR1				2	o		17
				OR3							5
				OR2				3			
				OR1				2			37
	RAMBLIAN		A	AT1				o			56
				CAM				5	2		
				MOR1			o		3		
				AGR			4		2		
				BN2			6		1		
				DH					9		
			Z	RA5A					25		
				RA7			o		25		
				RA4A			2		22		
				RA3B			1		19		
				VH3A			7		26		
				VH1					27		
				RA1			24		o		
				NAL			35				
				GAL5			22				
	"AGENIAN"		Y2	CAB			1				12
				SJ		14					
OLIGOC. MIOCEN. transit.			Y1	FU2	40						
				CET	o						
				QU1	36						
			X	STC	2						

Fig. 27. Distribution chart of the Myomiminae species studied in this paper. The numbers refer to the relative abundance of each species with respect to the entire rodent fauna.

following ones this species is well represented. It is then already characterized by hypsodont molars with inclined ridges, and morphologically it can be derived directly from *A. bijmai*, as suggested in Figs. 24 and 25. *A. aragonensis* is, however, considerably larger than the representatives of the *A. bijmai* - *A. jasperi* lineage and intermediate assemblages are again not known.

Palaeoecology and palaeoclimatology

Armantomys is poorly represented in Santa Cilia and Cetina de Aragón (Fig. 27), which are traditionally considered to represent humid biotopes. In the Ebro Basin this genus is frequent in younger localities of relatively dry biotopes, but in the Loranca Basin it is absent in localities of comparable age. During the time interval covered by zone Z *Armantomys parsani* is abundantly present in Navalón (Loranca Basin) and Ramblar 1 (Calatayud-Teruel Basin). The relative temperature curve constructed by Daams & van der Meulen (1984) reflects a temperature decrease from zone Y2 to zones Z-A. It is therefore possible that this decrease favoured the migration of *Armantomys* from the north towards the south. Afterwards the relative abundance of the small-sized *Armantomys* species decreases and its last occurrence is in zone D2, when temperatures have risen again considerably. At the time of its appearance in the Calatayud-Teruel Basin, the small-sized *A. parsani* is accompanied by the large-sized *A. aragonensis*. Afterwards, *A. aragonensis* becomes abundant in zone Z and the small-sized *Armantomys* species are relegated to a modest position. We don't know why *A. aragonensis* and the small-sized *Armantomys* species are practically incompatible, but it may be due to competition. *Armantomys* is much less frequent in zone A, and it is practically absent in zone B, when *Praearmantomys* is abundant. This incompatibility may be due to competition or a difference in biotope. But *Praearmantomys* was probably more susceptible to temperature changes, and when temperatures increased again, *Praearmantomys* disappeared and *Armantomys* could take over again. Representatives of the *A. aragonensis A. tricristatus* lineage are the only hypsodont Myomiminae which continue to the end of the Aragonian, and they consequently are interpreted as being less affected by temperature fluctuations.

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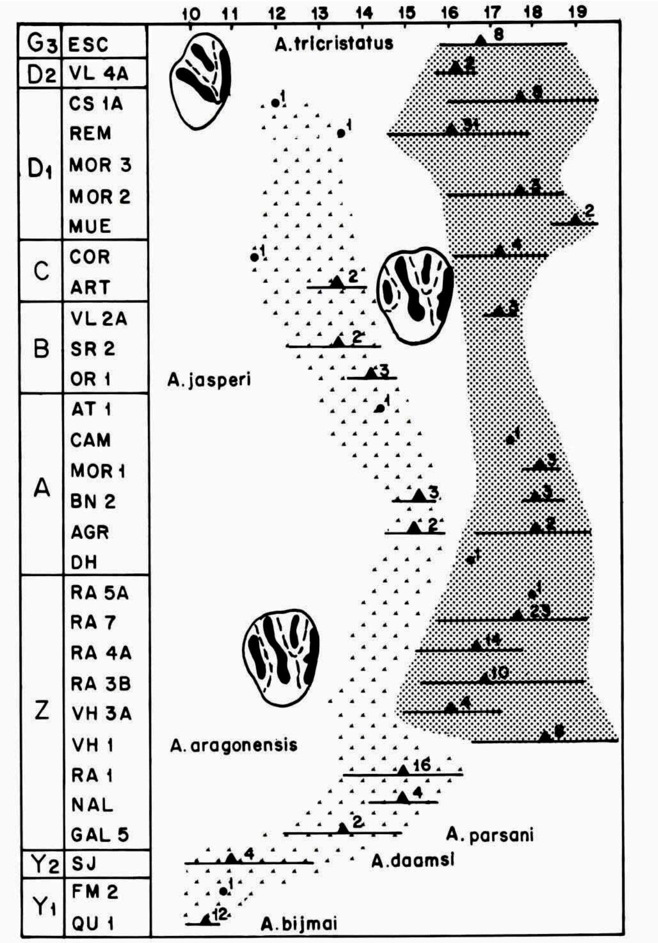

Fig. 28. Width ranges of P4 of *Armantomys*.

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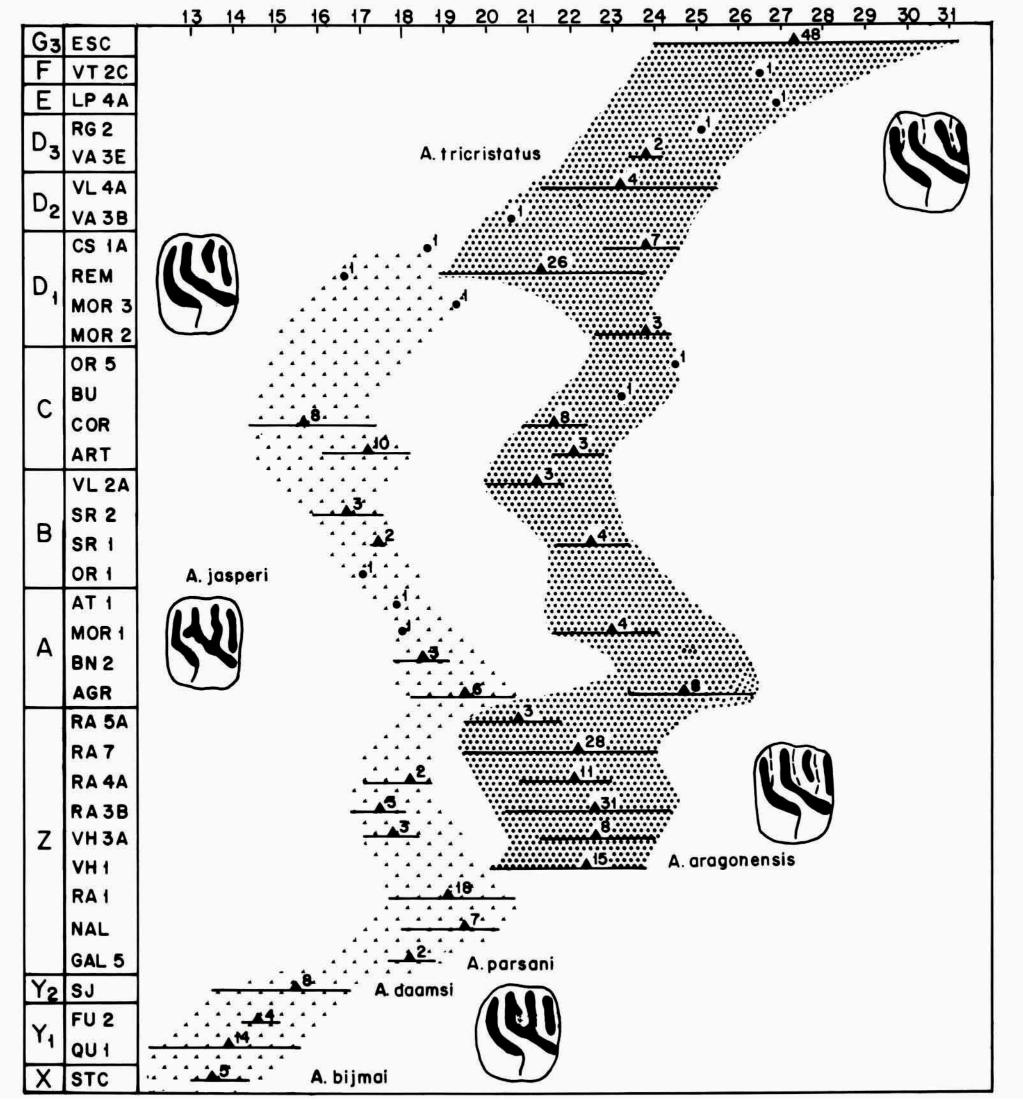

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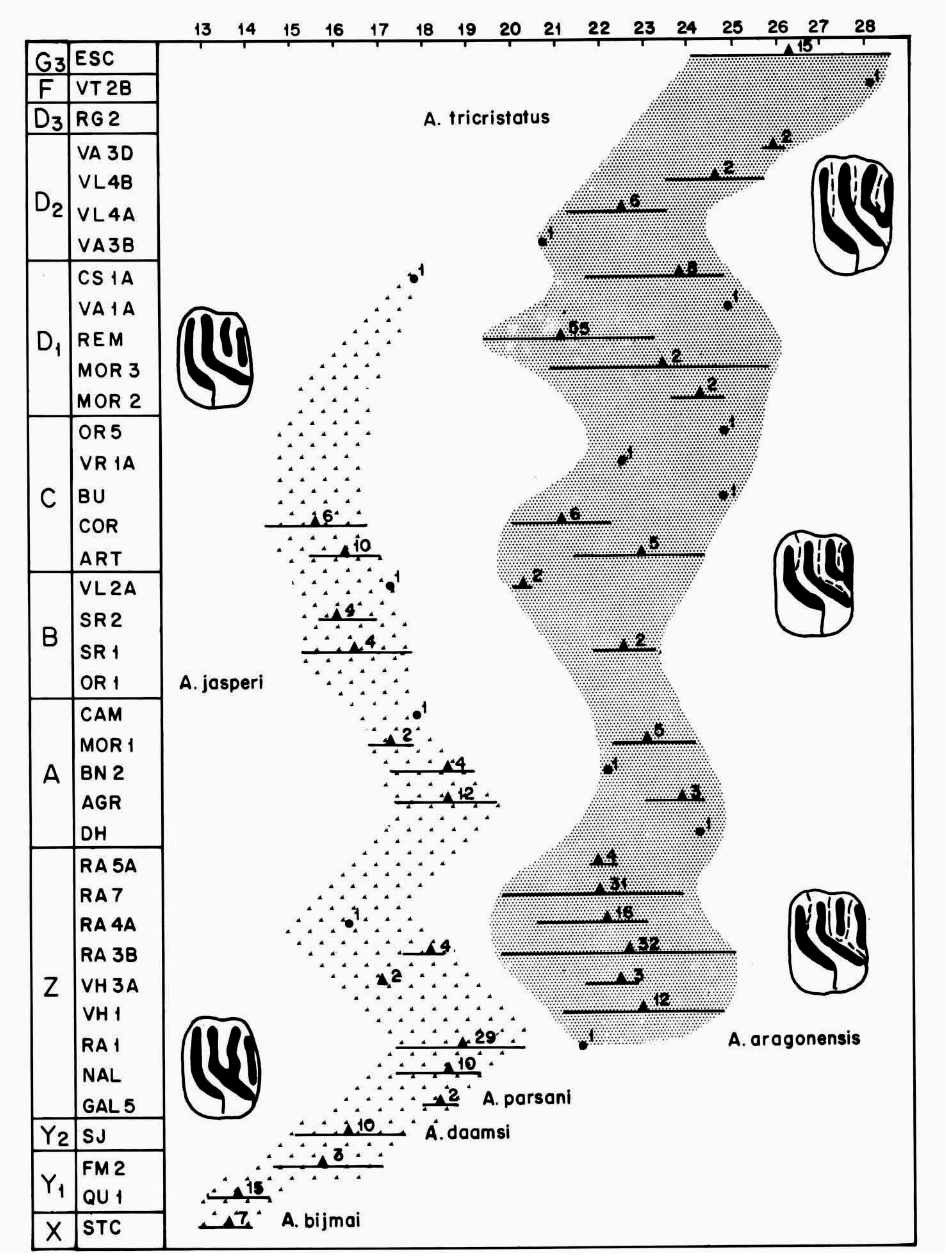

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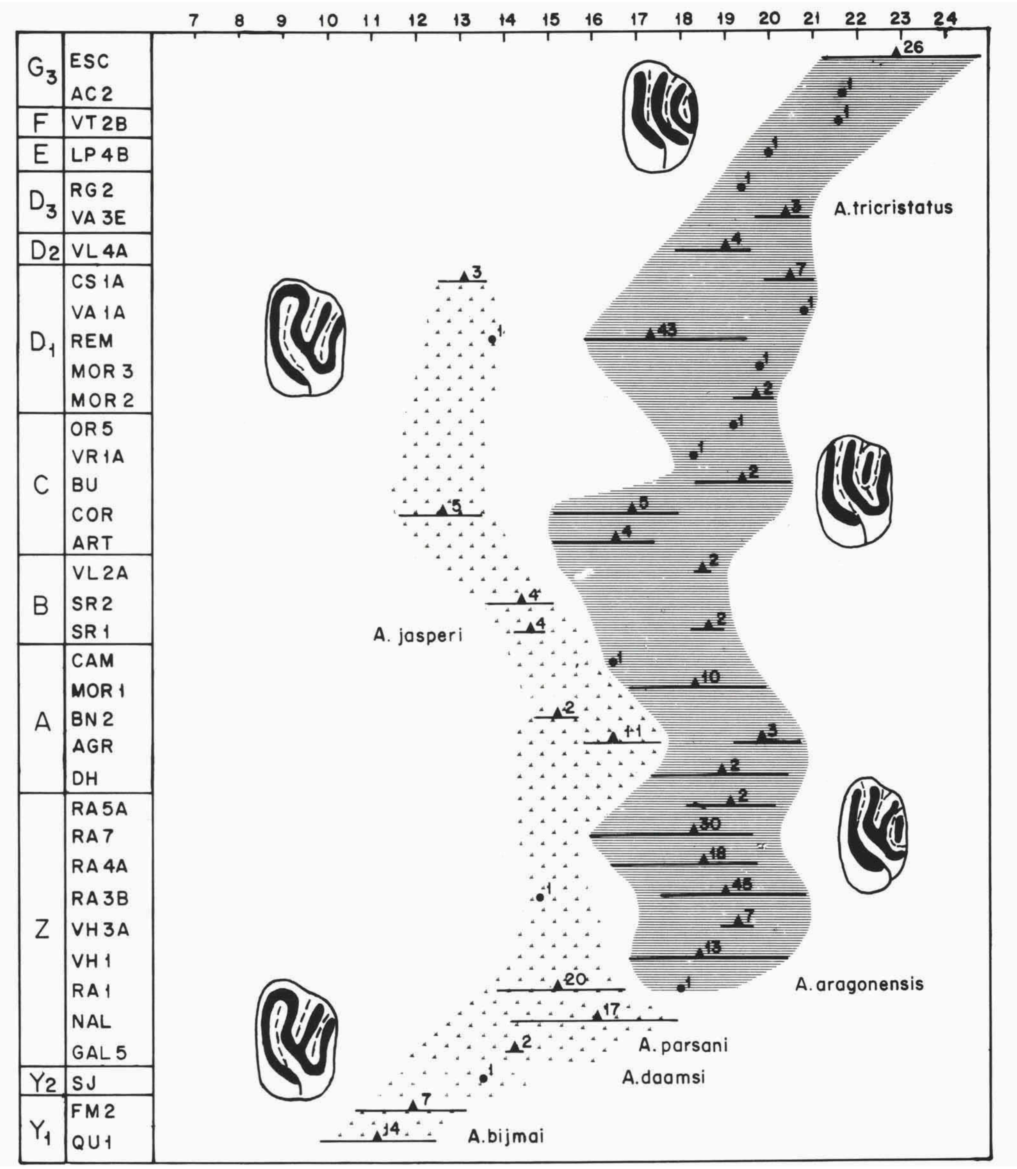

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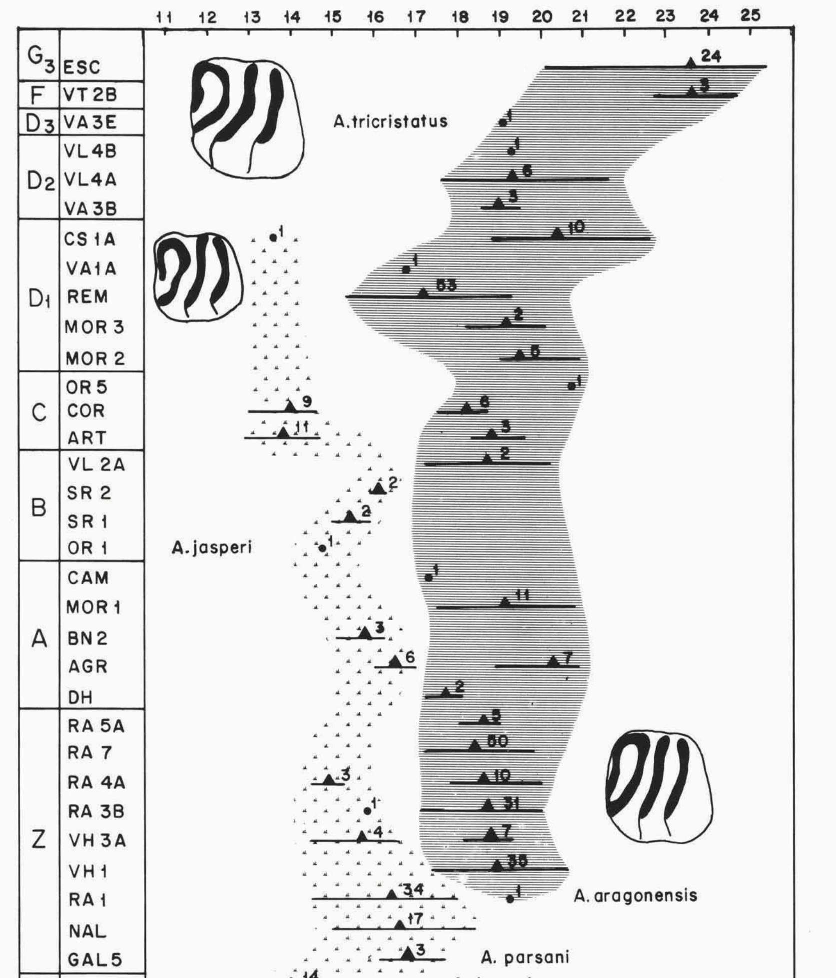

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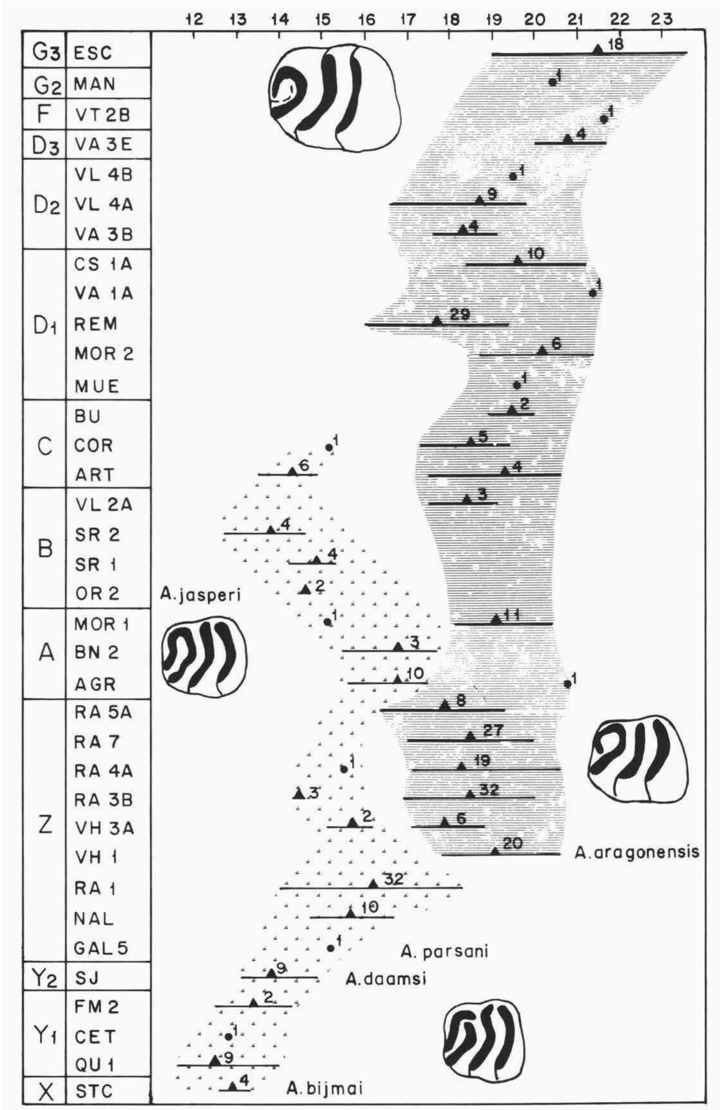

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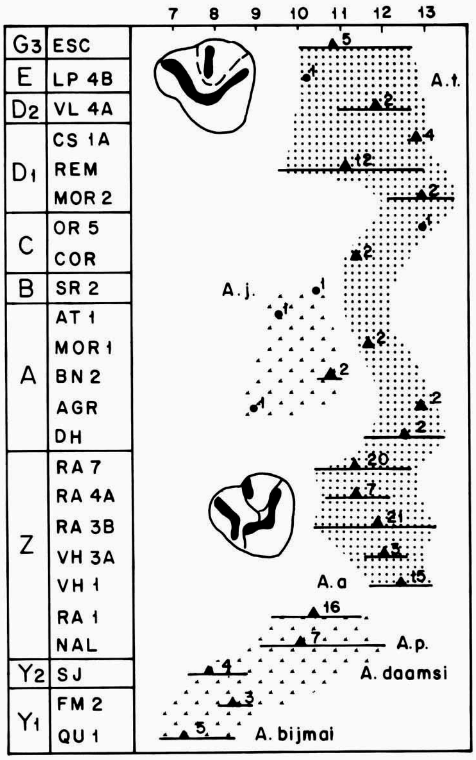

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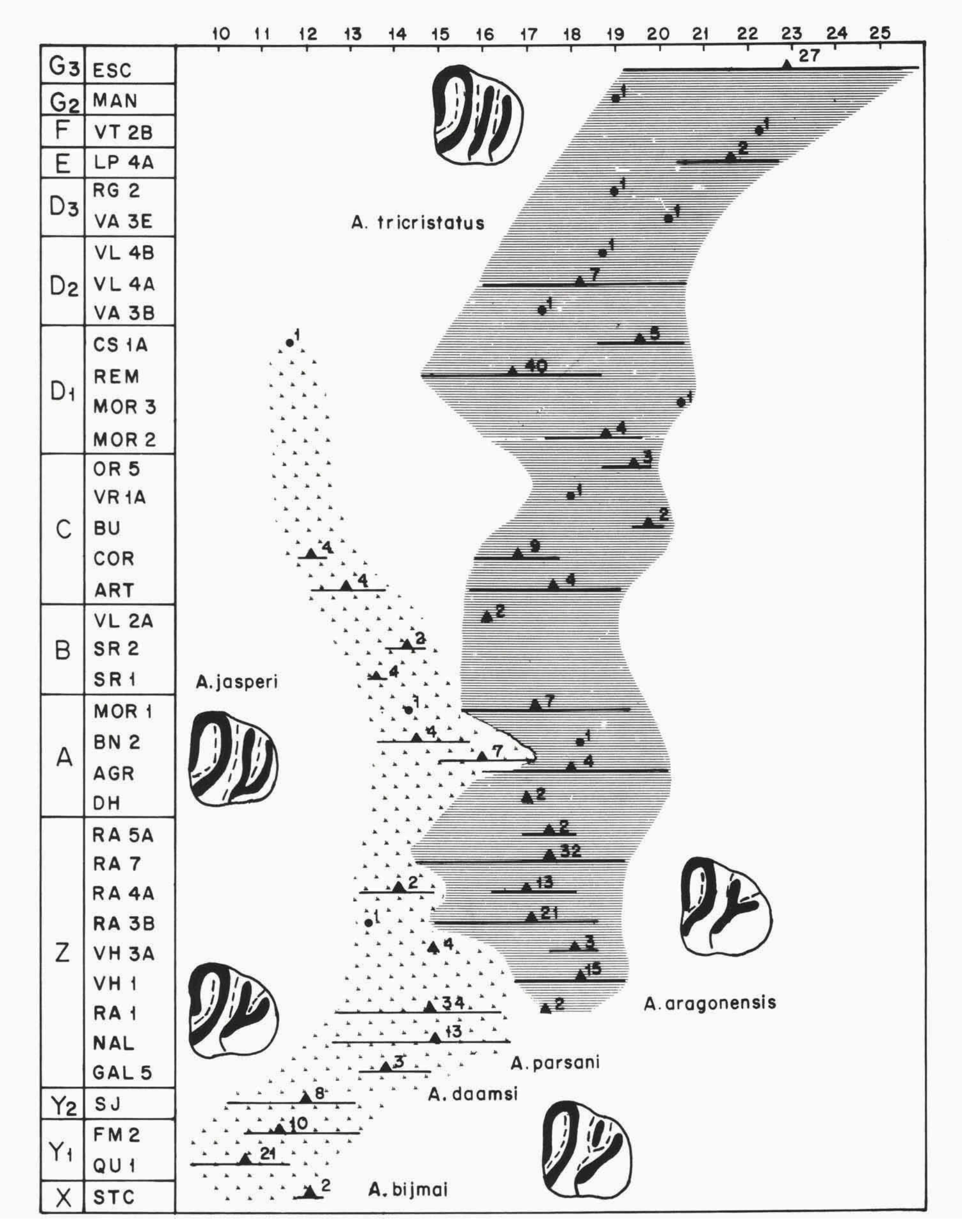

Fig. 35. Width ranges of M_3 of *Armantomys*.

Table 2. Measurements of P^4 of the *Armantomys bijmai - A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Caseton 1A	1	—	8.4	—	1	—	12.0	—	*A. jasperi*
Retama	1	—	10.6	—	1	—	13.5	—	*A. jasperi*
Corcoles *	1	—	8.4	—	1	—	11.5	—	*A. jasperi*
Artesilla	2	9.5	9.9	10.2	2	12.7	13.4	14.1	*A. jasperi*
San Roque2	2	9.3	10.2	11.0	2	12.3	13.4	14.4	*A. jasperi*
Olmo Red. 1	2	11.2	11.4	11.6	3	13.6	14.2	14.8	*A. jasperi*
Ateca 1	1	—	11.1	—	1	—	14.4	—	*A. parsani*
Bañon 2	3	9.8	11.0	11.7	3	14.7	15.3	15.7	*A. parsani*
Agreda	3	10.0	11.2	12.2	2	14.5	15.2	15.9	*A. parsani*
Ramblar 1 *	23	10.8	11.8	13.3	16	13.5	14.9	16.3	*A. parsani*
Navalon	5	10.6	11.1	11.7	4	14.1	14.9	15.7	*A. parsani*
La Galocha 5	2	10.6	11.5	12.4	2	12.1	13.5	14.8	*A. parsani*
San Juan *	4	8.2	9.2	10.1	4	9.8	10.9	12.8	*A. daamsi*
Fuenmayor 2	2	8.4	8.5	8.6	1	—	10.7	—	*A. bijmai*
Quel 1 *	11	7.6	8.0	8.8	12	9.8	10.3	10.6	*A. bijmai*

Table 3. Measurements of M^1 of the *Armantomys bijmai - A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Retama	1	—	13.6	—	1	—	16.6	—	*A. jasperi*
Caseton 1A	1	—	15.7	—	1	—	18.6	—	*A. jasperi*
Retama	1	—	13.6	—	1	—	16.6	—	*A. jasperi*
Moratilla 3	2	14.7	15.2	15.6	1	—	19.3	—	*A. jasperi*
Corcoles *	6	12.7	13.3	13.7	8	14.4	15.7	17.4	*A. jasperi*
Artesilla	10	13.1	14.1	14.8	10	16.1	17.2	18.2	*A. jasperi*
San Roque 2	3	13.6	13.9	14.3	3	15.9	16.7	17.6	*A. jasperi*
San Roque 1	3	13.7	14.4	14.9	2	17.3	17.5	17.6	*A. jasperi*
Olmo Red. 1	1	—	15.4	—	1	—	17.1	—	*A. jasperi*
Ateca 1	1	—	13.6	—	1	—	17.9	—	*A. jasperi*
Moratilla 1	1	—	14.7	—	1	—	18.0	—	*A. parsani*
Bañon 2	4	14.4	15.5	16.4	3	17.8	18.5	19.1	*A. parsani*
Agreda	7	14.1	15.2	16.4	6	18.2	19.5	20.7	*A. parsani*
Ramblar 4A	3	13.0	14.6	15.7	2	17.1	18.2	18.7	*A. parsani*
Ramblar 3B	2	14.0	14.4	14.8	3	16.8	17.5	18.1	*A. parsani*
Valhondo 3A	3	13.8	14.6	15.2	3	17.1	17.8	18.4	*A. parsani*
Ramblar 1 *	26	14.4	16.1	17.4	18	17.7	19.1	20.7	*A. parsani*
Navalon	7	14.8	16.3	18.1	7	18.0	19.5	20.3	*A. parsani*
La Galocha 5	2	—	15.5	—	2	17.7	18.3	18.8	*A. parsani*
Cabeza Rubia	1	—	14.9	—	1	—	17.8	—	*A. parsani*
San Juan *	9	11.9	13.2	14.3	8	13.5	15.5	16.8	*A. daamsi*
Fuenmayor 2	6	10.8	11.9	12.7	4	14.2	14.6	15.1	*A. bijmai*
Quel 1 *	16	10.8	11.4	12.2	14	12.0	13.9	15.6	*A. bijmai*
Santa Cilia	6	10.2	11.0	11.8	5	13.0	13.5	14.4	*A. bijmai*

* Type locality of the species concerned.

Table 4. Measurements of M^2 of the *Armantomys bijmai* - *A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Caseton 1A	1	—	12.7	—	1	—	17.8	—	*A. jasperi*
Corcoles *	6	11.2	11.9	12.5	6	14.4	15.5	16.7	*A. jasperi*
Artesilla	10	11.8	12.5	13.2	10	15.4	16.2	17.0	*A. jasperi*
Villaf. 2A	2	13.0	13.3	13.6	2	—	17.2	—	*A. jasperi*
San Roque 2	6	12.1	12.5	13.0	4	15.6	16.0	16.9	*A. jasperi*
San Roque 1	6	12.1	12.6	13.8	5	15.2	16.4	17.7	*A. jasperi*
Olmo Red. 1	1	—	12.2	—	0	—	—	—	*A. jasperi*
Calomarde	2	14.2	14.7	15.2	1	—	17.8	—	*A. jasperi*
Moratilla 1	2	14.0	14.4	14.7	2	16.7	17.2	17.7	*A. jasperi*
Bañon 2	4	13.2	13.9	14.5	4	17.2	18.5	19.1	*A. parsani*
Agreda	12	13.0	14.0	14.7	12	17.3	18.5	19.6	*A. parsani*
Ramblar 4A	1	—	13.2	—	1	—	16.2	—	*A. parsani*
Ramblar 3B	4	12.6	13.3	13.8	4	17.5	18.1	18.4	*A. parsani*
Valhondo 3A	2	12.7	12.9	13.0	2	16.9	17.0	17.1	*A. parsani*
Ramblar 1 *	37	12.1	14.3	15.6	29	17.3	18.8	20.2	*A. parsani*
Navalon	13	13.4	14.2	15.8	10	17.3	18.5	19.2	*A. parsani*
La Galocha 5	3	13.7	14.1	14.4	2	17.9	18.3	18.7	*A. parsani*
Cabeza Rubia	1	—	14.5	—	1	—	19.3	—	*A. parsani*
San Juan *	14	11.2	12.1	13.0	10	15.0	16.2	17.5	*A. daamsi*
Fuenmayor 2	6	9.9	11.5	12.6	3	14.5	15.6	17.0	*A. bijmai*
Quel 1 *	16	10.4	11.3	12.0	15	13.0	13.7	14.4	*A. bijmai*
Santa Cilia	8	10.0	10.4	11.2	7	12.8	13.5	14.0	*A. bijmai*

Table 5. Measurements of M^3 of the *Armantomys bijmai* - *A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Caseton 1A	3	8.3	8.7	9.0	3	12.5	13.1	13.6	*A. jasperi*
Retama	1	—	9.4	—	1	—	13.7	—	*A. jasperi*
Corcoles *	5	8.9	9.3	9.9	5	11.6	12.6	13.5	*A. jasperi*
San Roque 2	4	7.9	9.4	10.0	4	13.6	14.4	15.1	*A. jasperi*
San Roque 1	4	9.5	10.1	10.5	4	14.2	14.6	14.9	*A. jasperi*
Bañon 2	2	8.9	9.2	9.4	2	14.7	15.2	15.6	*A. parsani*
Agreda	10	10.1	10.8	11.7	11	5.7	16.4	17.5	*A. parsani*
Ramblar 7	1	—	10.4	—	1	—	15.9	—	*A. parsani*
Ramblar 3B	1	—	9.7	—	1	—	14.8	—	*A. parsani*
Ramblar 1 *	27	9.4	10.2	11.8	20	13.8	15.2	16.7	*A. parsani*
Navalon	17	9.4	10.6	12.0	17	14.1	16.1	17.9	*A. parsani*
La Galocha 5	3	9.0	10.0	11.4	2	14.0	14.2	14.4	*A. parsani*
San Juan *	3	8.7	9.1	9.6	1	—	13.5	—	*A. daamsi*
Fuenmayor 2	8	7.0	7.7	8.7	7	10.6	11.9	13.1	*A. bijmai*
Quel 1 *	13	6.8	7.6	8.6	14	9.8	11.1	12.4	*A. bijmai*

* Type locality of the species concerned.

Table 6. Measurements of P_4 of the *Armantomys bijmai* - *A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
SanRoque 2	1	—	10.4	—	1	—	9.3	—	*A. jasperi*
Ateca 1	1	—	9.5	—	1	—	9.4	—	*A. parsani*
Bañon 2	2	10.4	10.7	11.0	2	10.1	10.3	10.5	*A. parsani*
Agreda	1	—	8.9	—	1	—	8.9	—	*A. parsani*
Ramblar 1 *	16	9.3	10.3	11.4	15	9.2	10.4	11.3	*A. parsani*
Navalon	7	9.0	10.0	12.0	9	9.2	10.1	11.5	*A. parsani*
San Juan *	4	7.3	7.8	8.7	5	6.3	7.7	8.5	*A. daamsi*
Fuenmayor 2	3	8.0	8.4	8.8	2	7.9	8.3	8.6	*A. bijmai*
Quel 1 *	5	6.6	7.2	8.4	5	7.0	7.7	8.6	*A. bijmai*

Table 7. Measurements of M_1 of the *Armantomys bijmai* - *A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Corcoles *	1	—	15.0	—	1	—	15.2	—	*A. jasperi*
Artesilla	6	13.1	13.9	14.6	6	13.5	14.3	14.9	*A. jasperi*
San Roque 2	3	13.2	13.8	14.3	4	12.7	13.8	14.6	*A. jasperi*
San Roque 1	4	14.2	14.5	14.8	4	14.2	14.9	15.3	*A. jasperi*
Olmo Red. 2	2	14.3	14.4	14.5	2	14.5	14.6	14.7	*A. jasperi*
Moratilla 1	1	—	15.7	—	1	—	15.1	—	*A. parsani*
Bañon 2	3	14.7	15.6	16.2	3	15.5	16.8	17.7	*A. parsani*
Agreda	8	14.7	15.6	16.1	10	15.6	16.8	17.5	*A. parsani*
Ramblar 4A	1	—	14.6	—	1	—	15.5	—	*A. parsani*
Ramblar 3B	3	13.7	14.3	15.1	3	14.3	14.4	14.6	*A. parsani*
Valhondo 3A	2	15.7	16.5	17.2	2	15.1	15.7	16.2	*A. parsani*
Ramblar 1 *	30	14.0	15.8	17.2	32	14.0	16.2	18.3	*A. parsani*
Navalon	12	13.5	15.6	17.0	10	14.7	15.7	16.7	*A. parsani*
La Galocha 5	1	—	15.7	—	1	—	15.2	—	*A. parsani*
Cabeza Rubia	1	—	15.2	—	1	—	15.3	—	*A. daamsi*
San Juan *	11	12.5	13.4	14.5	9	13.1	13.8	14.9	*A. daamsi*
Fuenmayor 2	3	11.7	12.3	12.7	2	12.5	13.4	14.3	*A. bijmai*
Cetina	1	—	12.3	—	1	—	12.8	—	*A. bijmai*
Quel 1 *	11	10.8	11.6	12.8	9	11.6	12.5	14.0	*A. bijmai*
Santa Cilia	4	11.6	11.7	11.8	4	12.6	12.9	13.3	*A. bijmai*

* Type locality of the species concerned.

Table 8. Measurements of M_2 of the *Armantomys bijmai - A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Caseton 1A	1	—	13.6	—	1	—	15.2	—	*A. jasperi*
Corcoles *	9	13.0	14.0	14.6	8	13.3	13.8	15.0	*A. jasperi*
Artesilla	11	12.9	13.8	14.7	12	13.7	15.1	16.2	*A. jasperi*
San Roque 2	2	15.9	16.1	16.3	3	14.6	15.2	15.9	*A. jasperi*
San Roque 1	2	15.0	15.5	15.9	2	15.2	15.3	15.4	*A. jasperi*
Olmo Red. 1	1	—	14.7	—	0	—	—	—	*A. jasperi*
Bañon 2	3	15.1	15.8	16.2	3	16.8	17.5	18.2	*A. parsani*
Agreda	6	16.0	16.5	17.0	11	16.1	17.5	18.6	*A. parsani*
Ramblar 4A	3	14.5	14.9	15.3	3	14.6	15.7	16.4	*A. parsani*
Ramblar 3B	1	—	15.8	—	2	16.1	16.5	16.9	*A. parsani*
Valhondo 3A	4	14.5	15.7	16.5	4	16.5	17.0	17.3	*A. parsani*
Ramblar 1 *	34	14.5	16.4	17.9	38	15.2	17.2	19.2	*A. parsani*
Navalon	17	15.0	16.6	18.4	14	15.7	17.3	19.1	*A. parsani*
La Galocha 5	3	16.1	16.8	17.7	4	15.1	16.1	16.7	*A. parsani*
San Juan *	14	12.9	14.0	15.3	15	13.0	14.8	16.6	*A. daamsi*
Fuenmayor 2	7	11.9	12.8	13.9	5	13.3	13.9	14.5	*A. bijmai*
Cetina	1	—	13.7	—	1	—	13.6	—	*A. bijmai*
Quel 1 *	15	11.0	11.6	12.4	16	11.4	12.6	13.6	*A. bijmai*
Santa Cilia	3	11.4	11.5	11.6	3	11.8	12.1	12.6	*A. bijmai*

Table 9. Measurements of M_3 of the *Armantomys bijmai - A. jasperi* lineage.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Caseton 1A	1	—	11.2	—	1	—	11.6	—	*A. jasperi*
Corcoles *	4	10.8	11.9	12.4	4	11.8	12.1	12.4	*A. jasperi*
Artesilla	4	12.0	12.3	12.9	4	12.1	12.9	13.8	*A. jasperi*
San Roque 2	2	12.9	13.2	13.5	2	13.8	14.3	14.7	*A. jasperi*
San Roque 1	5	12.2	12.8	13.3	4	13.4	13.6	13.8	*A. jasperi*
Moratilla 1	1	—	13.5	—	1	—	14.3	—	*A. parsani*
Bañon 2	4	12.6	13.2	14.5	4	13.6	14.5	15.7	*A. parsani*
Agreda	7	14.0	14.6	15.1	7	15.0	16.0	17.1	*A. parsani*
Ramblar 4A	2	12.7	13.3	13.8	2	13.2	14.1	14.9	*A. parsani*
Ramblar 3B	1	—	13.3	—	1	—	13.4	—	*A. parsani*
Valhondo 3A	4	12.5	13.1	13.6	4	14.8	14.9	14.9	*A. parsani*
Ramblar 1 *	36	11.2	13.9	16.4	34	12.7	14.8	16.4	*A. parsani*
Navalon	14	11.6	13.6	15.8	13	12.6	14.9	16.6	*A. parsani*
La Galocha 5	3	11.4	13.4	15.3	3	13.2	13.8	14.8	*A. parsani*
San Juan *	8	10.1	11.1	12.3	8	10.2	12.0	13.1	*A. daamsi*
Fuenmayor 2	10	9.5	10.2	11.5	10	10.6	11.4	13.2	*A. bijmai*
Quel 1 *	20	8.6	9.7	10.6	21	9.4	10.6	11.6	*A. bijmai*
Santa Cilia	1	—	10.4	—	2	11.8	12.1	12.4	*A. bijmai*

* Type locality of the species concerned.

Table 10. Measurements of P^4 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa*	7	11.1	12.2	13.7	8	15.8	16.8	18.8	*A. tricristatus*
Villaf. 4B	1	—	13.3	—	0	—	—	—	*A. aragonensis*
Villaf. 4A	2	10.8	11.2	11.6	2	15.7	16.2	16.7	*A. aragonensis*
Caseton 1A	6	13.1	13.6	14.2	8	16.0	17.7	19.5	*A. aragonensis*
Retama	33	10.2	11.3	12.6	31	14.6	16.1	17.9	*A. aragonensis*
Moratilla 3	1	—	12.1	—	0	—	—	—	*A. aragonensis*
Moratilla 2	2	11.2	12.4	13.5	3	16.0	17.7	18.7	*A. aragonensis*
Muela Alta	2	12.6	13.1	13.6	2	18.4	19.0	19.5	*A. aragonensis*
Corcoles	5	11.2	12.5	14.2	4	16.1	17.2	18.3	*A. aragonensis*
Villaf. 2A *	3	11.3	11.9	12.8	3	16.8	17.2	17.6	*A. aragonensis*
Calomarde	1	11.1	11.6	12.1	2	16.4	16.9	17.4	*A. aragonensis*
Moratilla 1	3	12.1	12.9	13.9	3	17.7	18.1	18.6	*A. aragonensis*
Bañon 2	3	12.8	13.5	14.7	3	17.7	18.0	18.7	*A. aragonensis*
Agreda	2	12.0	12.8	13.6	2	16.6	18.0	19.3	*A. aragonensis*
La Dehesa	1	—	12.6	—	1	—	16.5	—	*A. aragonensis*
Ramblar 5A	1	—	13.2	—	1	—	17.9	—	*A. aragonensis*
Ramblar 7	27	11.2	13.4	14.8	23	15.7	17.6	19.2	*A. aragonensis*
Ramblar 4A	14	11.5	12.6	13.9	14	15.2	16.6	17.6	*A. aragonensis*
Ramblar 3B	14	11.2	12.3	13.6	10	15.3	16.8	19.1	*A. aragonensis*
Valhondo 3A	3	11.9	12.7	13.6	4	14.9	16.0	17.2	*A. aragonensis*
Valhondo 1	10	12.9	13.8	14.7	8	16.5	18.2	19.9	*A. aragonensis*

Table 11. Measurements of M^1 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	47	20.0	22.7	26.8	48	24.0	27.3	31.2	*A. tricristatus*
Valalto 2C	1	—	20.2	—	1	—	26.5	—	*A. tricristatus*
Las Planas 4A	1	—	22.2	—	1	—	26.9	—	*A. tricristatus*
Regajo 2	1	—	20.5	—	1	—	25.1	—	*A. tricristatus*
Valdem. 3E	3	19.6	20.7	22.0	2	23.4	23.8	24.2	*A. tricristatus*
Villaf. 4B	2	17.9	18.6	19.2	2	22.9	23.9	24.9	*A. aragonensis*
Villaf. 4A	6	17.0	18.4	19.6	4	21.3	23.2	25.5	*A. aragonensis*
Valdem. 3B	1	—	18.6	—	1	—	20.6	—	*A. aragonensis*
Caseton 1A	7	18.8	20.1	21.2	7	22.8	23.8	24.6	*A. aragonensis*
Retama	32	16.3	17.7	19.6	26	18.9	21.3	23.8	*A. aragonensis*
Moratilla 2	3	18.3	20.0	21.2	3	22.6	23.8	24.4	*A. aragonensis*
Olmo Red. 5	1	—	19.4	—	1	—	24.5	—	*A. aragonensis*
Buñol	1	—	18.1	—	1	—	23.2	—	*A. aragonensis*
Corcoles	9	16.5	17.9	19.0	8	20.9	21.6	22.4	*A. aragonensis*
Artesilla	4	17.0	17.2	17.4	3	21.6	22.1	22.8	*A. aragonensis*
Villaf. 2A *	4	14.6	16.6	18.5	3	20.0	21.2	21.8	*A. aragonensis*
San Roque 1	4	16.1	16.9	17.6	4	21.7	22.5	23.4	*A. aragonensis*
Moratilla 1	4	17.0	18.0	18.4	4	21.6	23.0	24.1	*A. aragonensis*
Agreda	7	18.3	19.4	21.7	8	23.4	24.7	26.3	*A. aragonensis*
Ramblar 5A	5	16.0	17.1	17.7	3	19.5	20.8	21.7	*A. aragonensis*
Ramblar 7	36	15.3	17.4	19.7	28	19.5	22.2	24.1	*A. aragonensis*
Ramblar 4A	13	16.2	17.5	19.5	11	20.8	22.1	23.0	*A. aragonensis*
Ramblar 3B	35	15.9	17.7	19.7	31	20.5	22.6	24.4	*A. aragonensis*
Valhondo 3A	8	16.8	17.8	19.3	8	21.3	22.6	24.0	*A. aragonensis*
Valhondo 1	22	16.3	18.1	19.6	15	20.1	22.4	23.8	*A. aragonensis*

* Type locality of the species concerned.

Table 12. Measurements of M^2 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	13	18.8	20.7	22.3	15	24.1	26.3	28.6	*A. tricristatus*
Valalto 2B	0	—	—	—	1	—	28.1	—	*A. tricristatus*
Regajo 2	1	—	17.9	—	0	—	—	—	*A. tricristatus*
Valdem. 3D	2	16.2	16.6	16.9	2	25.7	26.0	26.2	*A. aragonensis*
Villaf. 4B	2	18.5	18.7	18.8	2	23.5	24.6	25.7	*A. aragonensis*
Villaf. 4A	6	14.4	15.2	16.5	6	21.3	22.5	23.5	*A. aragonensis*
Valdem. 3B	1	—	16.1	—	1	—	20.7	—	*A. aragonensis*
Caseton 1A	9	15.7	17.2	18.4	8	21.7	23.8	24.8	*A. aragonensis*
Valdem. 1A	1	—	21.3	—	1	—	24.9	—	*A. aragonensis*
Retama	61	13.7	15.6	16.8	55	19.4	21.1	23.2	*A. aragonensis*
Moratilla 3	2	15.5	16.9	18.3	2	20.9	23.4	25.8	*A. aragonensis*
Moratilla 2	2	16.5	16.8	17.1	2	23.6	24.3	24.8	*A. aragonensis*
Olmo Red. 5	1	—	18.4	—	1	—	24.8	—	*A. aragonensis*
Vargas 1A	1	—	16.3	—	1	—	22.5	—	*A. aragonensis*
Buñol	1	—	17.0	—	1	—	24.8	—	*A. aragonensis*
Corcoles	6	14.2	15.3	16.4	6	20.0	21.1	22.2	*A. aragonensis*
Artesilla	7	14.6	16.2	17.2	5	21.4	22.9	24.3	*A. aragonensis*
Villaf. 2A *	2	14.7	14.9	15.1	2	20.0	20.2	20.4	*A. aragonensis*
San Roque 1	2	15.1	15.3	15.4	2	21.8	22.5	23.2	*A. aragonensis*
Moratilla 1	6	14.3	15.7	16.6	5	22.2	23.0	24.1	*A. aragonensis*
Bañon 2	1	—	15.1	—	1	—	22.1	—	*A. aragonensis*
Agreda	4	16.3	16.7	17.2	3	23.0	23.8	24.3	*A. aragonensis*
La Dehesa	1	—	17.6	—	1	—	24.2	—	*A. aragonensis*
Ramblar 5A	5	15.2	16.0	16.7	4	21.7	21.9	22.3	*A. aragonensis*
Ramblar 7	44	14.0	15.8	17.2	31	19.7	21.9	23.8	*A. aragonensis*
Ramblar 4A	23	14.7	15.8	18.0	16	20.5	22.1	23.0	*A. aragonensis*
Ramblar 3B	41	13.7	15.9	17.6	32	19.7	22.6	25.0	*A. aragonensis*
Valhondo 3A	4	14.9	16.2	17.0	3	21.6	22.4	22.8	*A. aragonensis*
Valhondo 1	17	16.2	17.1	18.5	12	21.1	22.9	24.7	*A. aragonensis*
Ramblar 1	1	—	16.5	—	1	—	21.5	—	*A. aragonensis*

* Type locality of the species concerned.

Table 13. Measurements of M^3 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	23	16.0	17.7	19.9	26	21.2	22.9	24.8	*A. tricristatus*
Alcocer 2	1	—	16.0	—	1	—	21.7	—	*A. tricristatus*
Valalto 2B	1	—	17.8	—	1	—	21.6	—	*A. tricristatus*
Las Planas 4B	1	—	15.2	—	1	—	20.0	—	*A. tricristatus*
Regajo 2	1	—	13.1	—	1	—	19.4	—	*A. tricristatus*
Valdem.3E	3	14.6	14.9	15.3	3	19.7	20.4	20.9	*A. tricristatus*
Villaf. 4A	4	11.6	12.8	14.3	4	17.9	19.0	19.6	*A. aragonensis*
Caseton 1A	7	13.4	14.3	16.0	7	19.9	20.5	21.0	*A. aragonensis*
Valdem. 1A	1	—	15.0	—	1	—	20.8	—	*A. aragonensis*
Retama	45	10.5	12.0	14.2	43	15.8	17.3	19.5	*A. aragonensis*
Moratilla 3	1	—	13.1	—	1	—	19.8	—	*A. aragonensis*
Moratilla 2	3	12.1	13.0	13.6	2	19.2	19.7	20.1	*A. aragonensis*
Olmo Red. 5	1	—	13.8	—	1	—	19.2	—	*A. aragonensis*
Vargas 1A	1	—	11.4	—	1	—	18.3	—	*A. aragonensis*
Buñol	2	12.4	12.8	13.1	2	18.3	19.4	20.5	*A. aragonensis*
Corcoles	5	11.0	11.4	11.8	5	15.1	16.9	17.9	*A. aragonensis*
Artesilla	4	10.3	11.0	12.0	4	15.1	16.5	17.4	*A. aragonensis*
Villaf. 2A *	2	11.6	11.8	11.9	2	18.3	18.5	18.6	*A. aragonensis*
San Roque 1	2	11.8	11.9	11.9	2	18.2	18.6	18.9	*A. aragonensis*
Moratilla 1	11	10.6	11.7	13.9	10	16.8	18.3	19.9	*A. aragonensis*
Agreda	3	10.2	12.5	14.2	3	19.2	19.8	20.7	*A. aragonensis*
La Dehesa	2	12.8	13.0	13.2	2	17.3	18.9	20.4	*A. aragonensis*
Ramblar 5A	2	12.6	13.1	13.5	2	18.1	19.1	20.1	*A. aragonensis*
Ramblar 7	52	9.9	12.0	14.0	30	15.9	18.3	19.6	*A. aragonensis*
Ramblar 4A	18	10.5	12.1	13.3	18	16.4	18.5	19.7	*A. aragonensis*
Ramblar 3B	52	10.2	12.0	14.3	45	17.5	19.0	20.8	*A. aragonensis*
Valhondo 3A	7	12.2	12.7	13.3	7	18.9	19.3	19.6	*A. aragonensis*
Valhondo 1	16	9.8	12.2	13.8	13	16.8	18.4	20.4	*A. aragonensis*
Ramblar 1	1	—	11.7	—	1	—	18.0	—	*A. aragonensis*

* Type locality of the species concerned.

Table 14. Measurements of P_4 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	5	10.0	10.8	12.7	5	10.3	10.8	11.3	*A. tricristatus*
Las Pl. 4B	1	—	10.2	—	1	—	10.5	—	*A. tricristatus*
Villaf. 4B	1	—	12.6	—	1	—	11.7	—	*A. aragonensis*
Villaf. 4A	2	10.9	11.8	12.7	2	10.0	10.7	11.3	*A. aragonensis*
Caseton 1A	4	12.6	12.8	12.9	4	11.7	12.2	12.6	*A. aragonensis*
Retama	12	9.5	11.1	13.0	12	9.2	10.7	11.5	*A. aragonensis*
Moratilla 2	2	12.1	12.9	13.7	2	10.9	12.3	13.6	*A. aragonensis*
Olmo Red. 5	1	—	12.9	—	1	—	12.9	—	*A. aragonensis*
Corcoles	2	11.2	11.3	11.4	1	—	10.9	—	*A. aragonensis*
Moratilla 1	2	11.5	11.6	11.7	2	11.6	11.7	11.8	*A. aragonensis*
Agreda	2	12.7	12.9	13.0	3	12.7	13.6	14.2	*A. aragonensis*
La Dehesa	2	11.5	12.5	13.4	2	11.3	12.2	13.0	*A. aragonensis*
Ramblar 7	20	10.3	11.3	12.6	21	10.3	11.2	12.4	*A. aragonensis*
Ramblar 4A	7	10.6	11.3	12.1	7	10.5	11.7	12.7	*A. aragonensis*
Ramblar 3B	21	10.3	11.8	13.2	22	10.2	11.4	12.9	*A. aragonensis*
Valhondo 3A	3	11.5	12.0	12.5	3	10.9	11.8	12.9	*A. aragonensis*
Valhondo 1	15	11.6	12.4	13.1	13	12.3	12.7	13.3	*A. aragonensis*

Table 15. Measurements of M_1 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	17	20.8	24.8	28.3	18	19.0	21.5	23.6	*A. tricristatus*
Manchones 1	1	—	19.0	—	1	—	20.4	—	*A. tricristatus*
Valalto 2B	1	—	21.8	—	1	—	21.6	—	*A. tricristatus*
Valdem. 3E	4	20.3	22.2	24.2	4	20.0	20.8	21.7	*A. tricristatus*
Villaf. 4B	1	—	19.4	—	1	—	19.5	—	*A. aragonensis*
Villaf. 4A	5	16.9	19.0	21.4	9	16.6	18.7	19.8	*A. aragonensis*
Valdem. 3B	3	17.3	18.3	19.1	4	17.6	18.3	19.1	*A. aragonensis*
Caseton 1A	10	18.4	20.4	22.3	10	18.4	19.6	21.2	*A. aragonensis*
Valdem. 1A	1	—	23.5	—	1	—	21.4	—	*A. aragonensis*
Retama	31	16.4	17.9	19.3	29	16.0	17.7	19.4	*A. aragonensis*
Moratilla 2	6	18.6	19.6	20.1	6	18.7	20.2	21.4	*A. aragonensis*
Muela Alta	1	—	20.7	—	1	—	19.6	—	*A. aragonensis*
Buñol	2	17.6	18.1	18.6	2	18.9	19.5	20.0	*A. aragonensis*
Corcoles	6	16.4	17.9	19.5	5	17.3	18.5	19.4	*A. aragonensis*
Artesilla	4	17.5	19.2	20.8	4	17.5	19.3	20.6	*A. aragonensis*
Villaf. 2A *	4	16.4	17.5	18.8	3	17.5	18.4	19.1	*A. aragonensis*
Moratilla 1	11	18.5	19.1	19.6	11	18.1	19.1	20.4	*A. aragonensis*
Agreda	0	—	—	—	1	—	20.8	—	*A. aragonensis*
Ramblar 5A	7	15.5	17.2	18.7	8	16.4	17.9	19.3	*A. aragonensis*
Ramblar 7	31	16.3	18.5	20.1	27	17.0	18.5	20.0	*A. aragonensis*
Ramblar 4A	18	16.5	18.3	20.2	19	17.1	18.3	20.6	*A. aragonensis*
Ramblar 3B	31	15.8	18.3	20.1	32	16.9	18.5	20.0	*A. aragonensis*
Valhondo 3A	5	17.1	18.1	19.4	6	17.1	17.9	18.8	*A. aragonensis*
Valhondo 1	15	17.7	18.5	20.5	20	17.8	19.1	20.6	*A. aragonensis*

* Type locality of the species concerned.

Table 16. Measurements of M_2 of *Armantomys aragonensis* and *A. tricristatus*

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	24	20.1	23.6	25.4	25	22.5	24.7	26.8	*A. tricristatus*
Valalto 2B	3	22.7	23.6	24.7	3	24.5	25.0	25.7	*A. tricristatus*
Valdem. 3E	1	—	19.1	—	1	—	22.2	—	*A. tricristatus*
Villaf. 4B	1	—	19.3	—	1	—	20.9	—	*A. aragonensis*
Villaf. 4A	6	17.6	19.3	21.6	5	17.9	19.4	20.6	*A. aragonensis*
Valdem. 3B	3	18.6	19.0	19.5	3	19.5	20.3	20.8	*A. aragonensis*
Caseton 1A	10	18.8	20.4	22.6	10	19.8	21.2	22.3	*A. aragonensis*
Valdem. 1A	1	—	16.8	—	1	—	18.3	—	*A. aragonensis*
Retama	53	15.3	17.2	19.3	47	17.2	19.2	21.2	*A. aragonensis*
Moratilla 3	2	18.2	19.2	20.1	2	21.7	22.2	22.7	*A. aragonensis*
Moratilla 2	5	19.0	19.5	20.9	5	21.2	21.8	22.0	*A. aragonensis*
Olmo Red. 5	1	—	20.7	—	1	—	22.3	—	*A. aragonensis*
Corcoles	6	17.5	18.2	18.7	6	17.1	17.9	19.2	*A. aragonensis*
Artesilla	3	18.3	18.8	19.6	4	17.3	19.9	21.7	*A. aragonensis*
Villaf. 2A *	2	17.2	18.7	20.2	2	18.8	19.6	20.3	*A. aragonensis*
Calomarde	1	—	17.3	—	1	—	18.2	—	*A. aragonensis*
Moratilla 1	10	17.5	19.1	20.8	11	16.7	20.0	21.5	*A. aragonensis*
Agreda	7	18.9	20.3	20.9	8	18.8	21.5	23.1	*A. aragonensis*
La Dehesa	2	17.2	17.7	18.1	3	19.4	20.1	20.7	*A. aragonensis*
Ramblar 5A	5	18.0	18.6	19.0	5	18.5	19.4	20.4	*A. aragonensis*
Ramblar 7	50	17.2	18.4	19.8	47	18.7	20.1	21.4	*A. aragonensis*
Ramblar 4A	10	17.8	18.6	20.0	9	19.0	19.9	20.9	*A. aragonensis*
Ramblar 3B	31	17.1	18.7	20.0	37	17.8	19.7	21.5	*A. aragonensis*
Valhondo 3A	7	18.1	18.8	19.3	6	17.2	20.0	21.7	*A. aragonensis*
Valhondo 1	35	17.4	18.9	20.6	33	18.2	20.3	23.3	*A. aragonensis*
Ramblar 1	1	—	19.2	—	1	—	19.5	—	*A. aragonensis*

* Type locality of the species concerned.

Table 17. Measurements of M_3 of *Armantomys aragonensis* and *A. tricristatus*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	26	20.6	21.8	24.5	27	19.2	23.0	25.9	*A. tricristatus*
Manchones	1	—	18.6	—	1	—	19.0	—	*A. tricristatus*
Valalto 2B	1	—	23.5	—	1	—	22.3	—	*A. tricristatus*
Las Pl. 4A	1	—	19.3	—	2	20.4	21.6	22.7	*A. tricristatus*
Regajo 2	1	—	17.7	—	1	—	19.0	—	*A. tricristatus*
Valdem. 3E	1	—	21.0	—	1	—	20.2	—	*A. tricristatus*
Villaf. 4B	1	—	18.3	—	1	—	18.7	—	*A. aragonensis*
Villaf. 4A	7	13.3	16.7	18.0	7	16.0	18.2	20.6	*A. aragonensis*
Valdem. 3B	1	—	17.8	—	1	—	17.3	—	*A. aragonensis*
Caseton 1A	4	16.7	18.3	20.3	5	18.6	19.6	20.5	*A. aragonensis*
Retama	45	13.6	15.2	17.0	40	14.6	16.7	18.7	*A. aragonensis*
Moratilla 3	1	—	18.1	—	1	—	20.5	—	*A. aragonensis*
Moratilla 2	4	16.7	17.8	19.1	4	17.4	18.8	19.6	*A. aragonensis*
Olmo Red. 5	3	17.8	18.5	19.0	3	18.7	19.4	19.8	*A. aragonensis*
Vargas 1A	1	—	15.4	—	1	—	18.0	—	*A. aragonensis*
Buñol	2	16.8	16.9	16.9	2	19.4	19.8	20.1	*A. aragonensis*
Corcoles	9	14.3	15.2	16.0	9	15.8	16.8	17.7	*A. aragonensis*
Artesilla	3	15.4	15.6	15.8	4	15.7	17.6	19.1	*A. aragonensis*
Villaf. 2A *	2	14.7	15.0	15.3	2	16.0	16.1	16.1	*A. aragonensis*
Moratilla 1	7	14.3	15.4	16.8	7	15.5	17.2	19.3	*A. aragonensis*
Bañon 2	1	—	15.2	—	1	—	18.2	—	*A. aragonensis*
Agreda	6	13.1	15.6	17.9	4	16.0	18.0	20.2	*A. aragonensis*
La Dehesa	3	15.0	16.1	16.8	2	16.9	17.0	17.1	*A. aragonensis*
Ramblar 5A	3	14.7	15.6	17.1	2	16.9	17.5	18.1	*A. aragonensis*
Ramblar 7	36	12.9	16.2	17.8	32	14.5	17.5	19.2	*A. aragonensis*
Ramblar 4A	13	14.9	15.8	16.6	13	16.2	17.0	18.1	*A. aragonensis*
Ramblar 3B	21	14.5	15.8	17.8	21	14.9	17.1	18.6	*A. aragonensis*
Valhondo 3A	3	15.0	16.5	17.2	3	17.5	18.1	18.6	*A. aragonensis*
Valhondo 1	15	15.3	16.4	18.3	15	16.7	18.2	19.2	*A. aragonensis*
Ramblar 1	2	16.1	16.3	16.4	2	17.3	17.4	17.5	*A. aragonensis*

* Type locality of the species concerned.

Table 18. Measurements of the cheek teeth of *Praearmantomys crusafonti*.

Element	Locality	Length				Width			
		n	min	mean	max	n	min	mean	max
P^4	Artesilla	84	11.7	13.4	15.4	84	14.3	16.5	19.0
	San Roque 2	25	12.0	13.2	14.0	26	13.3	15.3	16.6
	San Roque 1	32	11.6	13.2	14.9	27	13.6	15.9	17.9
	Olmo Red. 1	14	12.8	13.4	14.4	11	14.9	15.9	17.0
	Ateca 1 *	15	12.2	13.4	15.0	14	15.1	16.7	18.9
	Cabeza Rubia	5	11.3	12.0	12.5	3	15.2	15.6	16.2
M^1	Artesilla	66	15.4	17.4	19.4	67	18.2	20.4	22.8
	San Roque 2	49	15.4	17.2	19.0	36	18.0	20.2	22.2
	San Roque 1	23	15.3	17.3	19.3	21	17.4	19.9	21.0
	Olmo Red. 3	1	—	17.4	—	1	—	19.2	—
	Olmo Red. 1	10	16.0	17.5	18.8	7	19.0	20.3	22.3
	Ateca 1 *	11	16.3	17.3	18.4	11	19.0	19.7	21.6
	Cabeza Rubia	8	16.0	17.0	17.9	3	21.4	21.6	21.7
M^2	Artesilla	88	13.6	15.3	16.9	87	17.1	19.2	21.6
	San Roque 2	48	13.5	15.1	16.6	40	17.6	20.0	21.4
	San Roque 1	27	13.3	15.1	16.4	22	18.3	19.8	21.1
	Olmo Red. 1	15	14.1	15.5	17.0	15	18.3	20.1	22.0
	Ateca 1 *	20	13.5	15.0	16.0	19	17.9	19.1	20.5
	Cabeza Rubia	7	14.5	16.1	17.1	4	19.3	21.4	23.0
M^3	Artesilla	57	10.0	11.6	13.0	57	14.6	16.3	18.1
	San Roque 2	39	9.1	11.0	12.8	33	14.7	16.6	19.2
	San Roque 1	28	9.2	10.8	12.0	24	13.4	16.1	18.5
	Olmo Red. 3	1	—	10.9	—	1	—	15.4	—
	Olmo Red. 1	3	10.8	11.8	12.6	3	16.1	17.2	18.2
	Ateca 1 *	20	9.3	10.8	12.3	19	14.6	16.6	19.2
	Cabeza Rubia	5	11.0	11.9	12.8	3	17.2	17.3	17.5
P_4	Artesilla	53	10.2	11.2	13.1	53	10.4	11.7	14.0
	San Roque 2	25	9.7	11.0	12.7	28	9.5	11.3	13.4
	San Roque 1	25	9.5	10.4	11.8	24	9.0	10.8	12.4
	Olmo Red. 1	12	10.3	11.1	11.9	12	10.6	11.6	12.3
	Ateca 1 *	14	9.8	10.9	12.2	14	9.1	10.5	11.2
	Cabeza Rubia	1	—	11.4	—	1	—	10.7	—
M_1	Artesilla	45	16.2	17.7	20.6	45	15.1	16.9	19.7
	San Roque 2	43	16.1	17.7	19.3	42	15.3	17.5	19.5
	San Roque 1	23	16.0	17.3	19.3	26	13.8	17.1	19.2
	Olmo Red. 3	1	—	17.7	—	1	—	17.6	—
	Olmo Red. 1	10	16.4	17.7	19.3	11	15.1	17.1	18.9
	Ateca 1 *	19	15.2	16.9	18.3	20	15.2	16.8	18.0
	Cabeza Rubia	4	16.3	17.1	17.6	4	18.0	18.3	18.7
M_2	Artesilla	47	15.1	17.1	20.6	47	16.3	18.4	21.9
	San Roque 2	51	15.3	17.1	18.8	47	16.5	18.8	20.9
	San Roque 1	39	14.9	16.8	19.2	38	15.7	18.2	20.3
	Olmo Red. 1	10	15.4	16.9	18.3	11	16.2	18.0	19.8
	Ateca 1 *	17	14.8	16.9	18.5	17	16.5	18.5	20.0
	Cabeza Rubia	6	17.8	18.5	19.7	5	17.6	19.5	20.6
M_3	Artesilla	69	11.8	13.7	15.8	69	14.0	16.0	17.8
	San Roque 2	34	12.1	14.1	15.8	35	14.6	16.4	18.5
	San Roque 1	25	11.4	14.1	15.7	24	14.0	15.6	17.5
	Olmo Red. 1	12	13.0	14.2	15.9	13	14.1	15.8	18.4
	Ateca 1 *	23	11.3	14.0	16.1	22	14.3	16.4	18.7
	Cabeza Rubia	4	14.0	15.4	16.3	4	15.9	16.8	17.3

* Type locality of the species concerned.

Table 19. Hypsodonty (H/L×100) of $M^{1,2}$ of *Armantomys*, and *Praearmantomys*.

Locality	Length				Width				Species
	n	min	mean	max	n	min	mean	max	
Escobosa *	22	46	56	67	9	52	60	69	*A. tricristatus*
Las Planas 4A	1	—	64	—	0	—	—	—	*A. tricristatus*
Regajo 2	1	—	62	—	1	—	55	—	*A. tricristatus*
Valdemoros 3B	1	—	78	—	1	—	62	—	*A. aragonensis*
Caseton 1A	5	55	62	67	7	56	65	74	*A. aragonensis*
Valdemoros 1A	0	—	—	—	1	—	61	—	*A. aragonensis*
Retama	15	48	59	71	24	55	64	77	*A. aragonensis*
Olmo Red. 5	0	—	—	—	1	—	74	—	*A. aragonensis*
Corcoles	6	55	60	68	0	—	—	—	*A. aragonensis*
Corcoles *	1	—	52	—	4	58	63	71	*A. jasperi*
Artesilla	38	37	52	68	31	47	56	65	*P. crusafonti*
Artesilla	3	76	79	82	2	82	87	92	*A. aragonensis*
Artesilla	6	54	61	65	2	58	58	58	*A. jasperi*
Villaf. 2A *	1	—	79	—	0	—	—	—	*A. aragonensis*
San Roque 2	13	44	51	57	13	46	54	61	*P. crusfonti*
SanRoque1	8	42	48	56	12	43	50	56	*P. crusafonti*
Olmo Redondo 3	1	—	44	—	0	—	—	—	*P. crusafonti*
Olmo Redondo 1	6	48	51	53	7	46	52	58	*P. crusafonti*
Ateca 1	1	—	60	—	0	—	—	—	*A. jasperi*
Ateca1	3	42	45	48	13	46	52	58	*P. crusafonti*
Calomarde	0	—	—	—	1	—	70	—	*A. jasperi*
Moratilla 1	3	66	70	73	4	72	78	81	*A. aragonensis*
Moratilla 1	1	—	59	—	2	59	60	61	*A. parsani*
Bañon 2	0	—	—	—	1	—	79	—	*A. aragonensis*
Bañon 2	1	—	58	—	3	56	60	64	*A. parsani*
Agreda	2	64	68	71	2	82	84	85	*A. aragonensis*
Agreda	1	—	64	—	5	64	67	71	*A. parsani*
Ramblar 5A	1	—	86	—	1	—	78	—	*A. aragonensis*
Ramblar 7	6	59	69	79	10	60	69	80	*A. aragonensis*
Ramblar 4A	2	58	62	65	4	65	72	75	*A. aragonensis*
Ramblar 4A	1	—	66	—	1	—	64	—	*A. parsani*
Ramblar 3B	16	59	68	75	20	66	81	95	*A. aragonensis*
Ramblar 3B	2	54	62	69	0	—	—	—	*A. parsani*
Valhondo 3A	3	56	58	62	1	—	63	—	*A. aragonensis*
Valhondo 3A	3	56	58	60	1	—	60	—	*A. parsani*
Valhondo 1	6	43	54	57	4	57	61	64	*A. aragonensis*
La Galocha 5	2	47	55	62	0	—	—	—	*A. parsani*
Ramblar 1 *	7	53	61	70	10	53	66	74	*A. parsani*
Navalon	4	41	51	64	7	49	57	59	*A. parsani*
La Galocha 5	2	59	61	63	0	—	—	—	*A. parsani*
CabezaRubia	3	48	53	58	0	—	—	—	*P. crusafonti*
Cabeza Rubia	1	—	72	—	1	—	67	—	*A. parsani*
San Juan *	2	52	54	55	4	57	63	71	*A. daamsi*
Fuenmayor	2	53	56	59	2	58	61	63	*A. bijmai*
Quel 1	8	42	58	73	10	46	51	59	*A. bijmai*

* Type locality of the species concerned.

Table 20. Hypsodonty (H/W×100) of *Armantomys* and *Praearmantomys*.

Locality	Hypsodonty M^1				Hypsodonty M^2				Species
	n	min	mean	max	n	min	mean	max	
Escobosa	22	38	47	60	9	41	47	54	*A. tricristatus*
Regajo 2	1	—	51	—	0	—	—	—	*A. tricristatus*
Valdemoros 3B	1	—	64	—	1	—	48	—	*A. aragonensis*
Caseton 1A	5	46	52	59	7	42	48	56	*A. aragonensis*
Valdemoros 1A	0	—	—	—	1	—	53	—	*A. aragonensis*
Moratilla 3	0	—	—	—	1	—	56	—	*A. aragonensis*
Retama	15	37	49	62	24	38	48	59	*A. aragonensis*
Moratilla 2	1	—	55	—	1	—	55	—	*A. aragonensis*
Olmo Redondo 5	0	—	—	—	1	—	55	—	*A. aragonensis*
Córcoles	6	43	49	58	0	—	—	—	*A. aragonensis*
Córcoles	1	—	43	—	4	43	48	57	*A. jasperi*
Artesilla	38	32	45	56	31	38	44	51	*P. crusafonti*
Artesilla	2	61	61	61	2	62	62	62	*A. aragonensis*
Artesilla	6	44	50	54	2	47	52	57	*A. jasperi*
Villafeliche 2A	1	—	58	—	0	—	—	—	*A. aragonensis*
San Roque 2	0	—	—	—	2	49	52	54	*A. jasperi*
San Roque 2	12	38	43	48	13	37	41	46	*P. crusafonti*
San Roque 1	1	—	54	—	0	—	—	—	*A. aragonensis*
San Roque 1	1	—	48	—	3	51	51	51	*A. jasperi*
San Roque 1	9	37	41	45	12	33	38	44	*P. crusafonti*
Olmo Redondo 3	1	—	41	—	0	—	—	—	*P. crusafonti*
Olmo Redondo 1	5	40	43	46	7	35	40	44	*P. crusafonti*
Ateca 1	1	—	46	—	0	—	—	—	*A. jasperi*
Ateca 1	3	38	41	43	13	37	41	46	*P. crusafonti*
Calomarde	0	—	—	—	1	—	56	—	*A. jasperi*
Moratilla 1	3	52	56	58	4	50	54	59	*A. aragonensis*
Moratilla 1	1	—	48	—	1	—	51	—	*A. parsani*
Bañon 2	0	—	—	—	1	—	54	—	*A. aragonensis*
Bañon 2	1	—	46	—	3	43	45	49	*A. parsani*
Ramblar 5	0	—	—	—	1	—	56	—	*A. aragonensis*
Ramblar 7	5	48	54	60	8	46	51	56	*A. aragonensis*
Ramblar 3B	15	48	55	61	17	48	59	72	*A. aragonensis*
Ramblar 3B	2	43	50	56	0	—	—	—	*A. parsani*
Ramblar 4A	2	46	50	53	4	47	51	53	*A. aragonensis*
Ramblar 4A	1	—	49	—	1	—	52	—	*A. parsani*
Valhondo 3A	2	47	48	49	0	—	—	—	*A. aragonensis*
Valhondo 3A	3	46	48	49	1	—	46	—	*A. parsani*
Valhondo 1	6	34	43	47	3	42	46	48	*A. aragonensis*
La Galocha 5	2	47	55	62	0	—	—	—	*A. parsani*
Navalón	4	35	43	52	6	42	45	46	*A. parsani*
Ramblar 1	7	47	52	61	10	43	52	57	*A. parsani*
Ramblar 1	0	—	—	—	1	—	47	—	*A. aragonensis*
Cabeza Rubia	1	—	39	—	0	—	—	—	*P. crusafonti*
Cabeza Rubia	1	—	61	—	1	—	50	—	*A. parsani*
San Juan	2	43	44	44	4	39	46	50	*A. daamsi*
Fuenmayor	2	45	45	45	2	44	45	45	*A. bijmai*
Quel 1	8	34	48	57	10	39	42	48	*A. bijmai*

Plate 1

Armantomys parsani sp. nov. from Ramblar 1

1. P^4 sin., RGM 337 647.
2. P^4 sin., RGM 337 645.
3. P^4 dext., RGM 337 712.
4. M^1 sin., RGM 337 724, holotype.
5. M^2 dext., RGM 337 804.
6. M^1 sin., RGM 337 735.
7. M^1 sin., RGM 337 730.
8. M^1 dext., RGM 337 766.
9. M^2 sin., RGM 337 779.
10. M^3 dext., RGM 337 823.
11. M^3 sin., RGM 337 655.
12. M^3 sin., RGM 337 657.
13. P_4 sin., RGM 337 830.
14. M_1 dext., RGM 337 741.
15. M_1 sin., RGM 337 679.
16. M_1 sin., RGM 337 680.
17. M_2 sin., RGM 337 853.
18. M_3 sin., RGM 337 878.
19. M_3 sin., RGM 337 669.
20. M_3 sin., RGM 337 871.
21. M_3 sin., RGM 337 669.
22. M_3 dext., RGM 337 894.

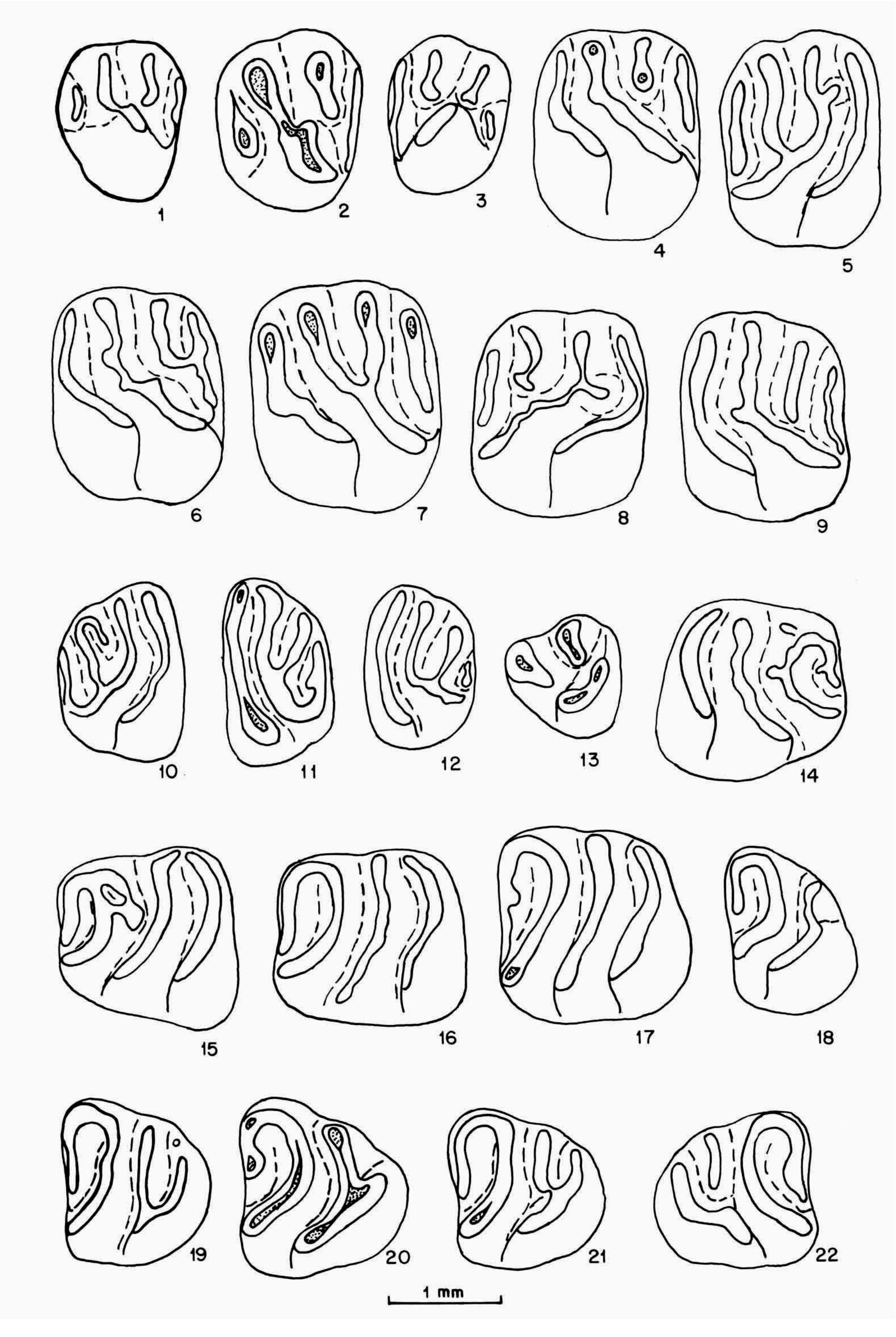
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Plate 2

Armantomys parsani sp. nov.

1. P_4 sin., no. NAL 51, Navalón.
2. P_4 dext., no. NAL 58, Navalón.
3. M_1 dext., no. NAL 71, Navalón.
4. M_3 dext., no. NAL 108, Navalón.
5. M_3 sin., no. NAL 96, Navalón.
6. M^1 sin., no. VH3A 716, Valhondo 3A.
7. M^1 dext., no. VH3A 718, Valhondo 3A.
8. M_1 dext., no. VH3A 720, Valhondo 3A.
9. M_1 dext., RGM 390 030, Bañon 2.
10. M_2 dext., RGM 390 034, Bañon 2.
11. M_1 sin., RGM 390 033, Bañon 2.
12. M^1 dext., RGM 390 020, Bañon 2.
13. M^2 dext., RGM 390 023, Bañon 2.

Armantomys jasperi sp. nov. from Córcoles

14. P^4 dext., no. COR 56.
15. M^1 sin., no. COR 58.
16. M^1 sin., no. COR 66.
17. M^2 sin., no. COR 70, holotype.
18. M^2 sin., no. COR 73.
19. M^2 sin., no. COR 71.
20. M^3 sin., no. COR 75.
21. M^3 sin., no. COR 74.
22. M^3 sin., no. COR 76.
23. M^3 sin., no. COR 77.
24. M^3 dext., no. COR 78.

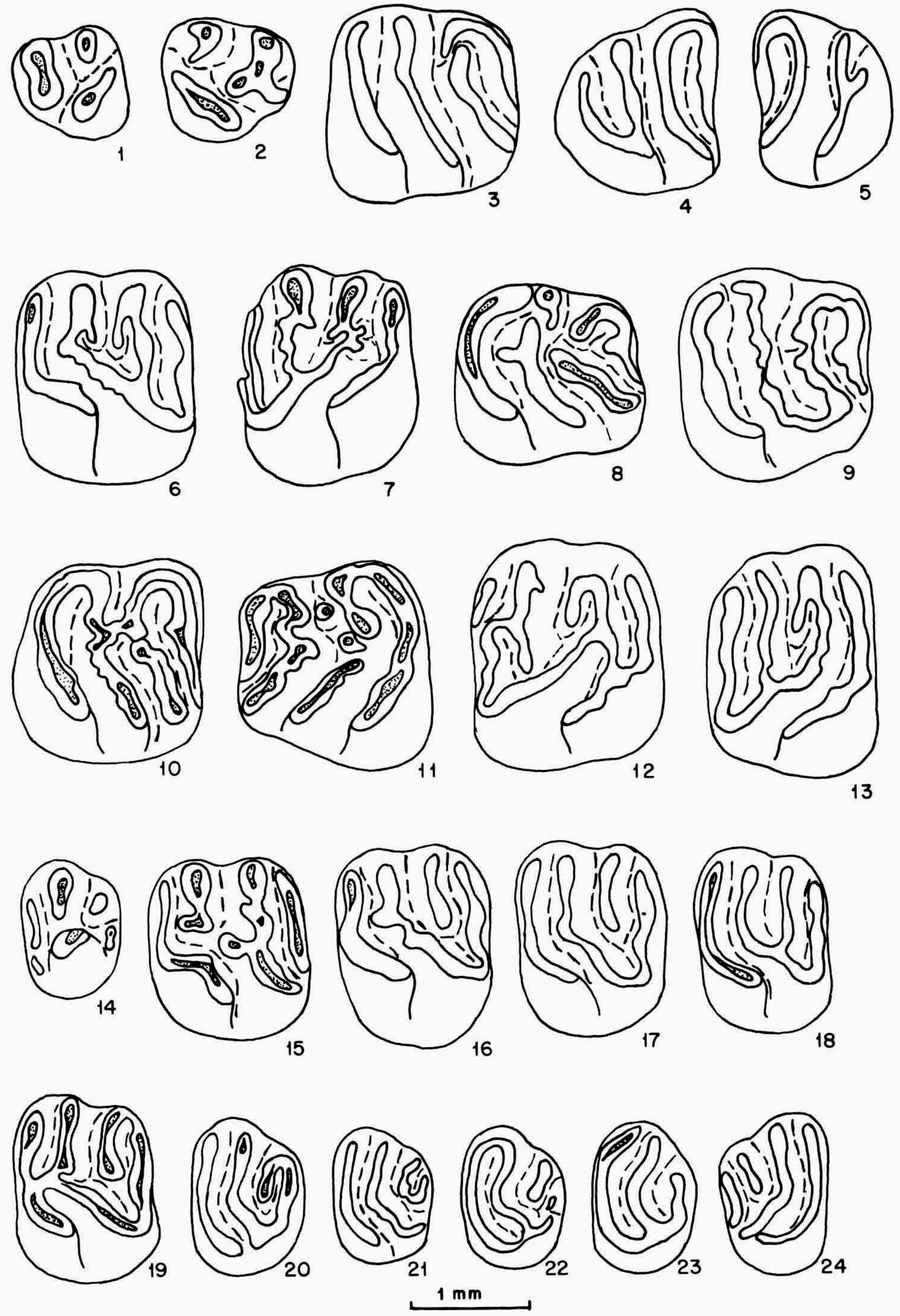
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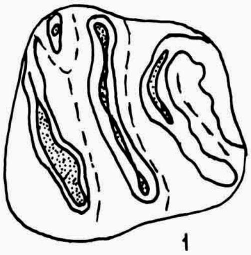
Plate 3

Armantomys jasperi sp. nov.

1. M_1 dext., no. COR 39, Córcoles.
2. M_2 sin., no. COR 79, Córcoles.
3. M_3 sin., no. COR 88, Córcoles.
4. M_3 sin., no. COR 89, Córcoles.
5. M^1 dext., no. ART 238, Artesilla.
6. M^1 dext., no. ART 237, Artesilla.
7. M_2 sin., no. ART 280, Artesilla.
8. M_1 sin., RGM 337 993, Olmo Redondo 2.
9. M^2 dext., no. VL2A 307, Villafeliche 2A.
10. M^3 dext., no. REM 148, Retama.
11. P^4 dext., RGM 391 913, Casetón 1A.
12. M^3 dext., RGM 391 918, Casetón 1A.
13. M_2 dext., RGM 391 919, Casetón 1A.
14. M^1 dext., RGM 391 914, Casetón 1A.
15. M^2 dext., RGM 391 915, Casetón 1A.
16. M^3 sin., RGM 391 916, Casetón 1A.
17. M_3 sin., RGM 391 920, Casetón 1A.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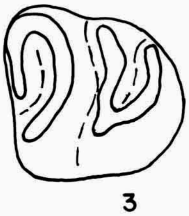
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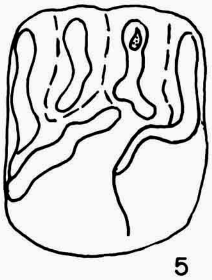
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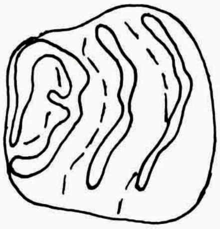
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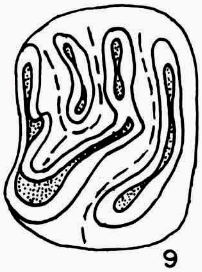
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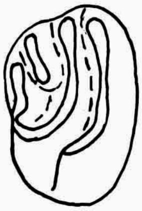
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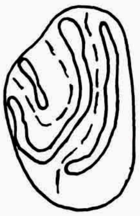
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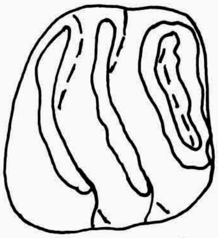
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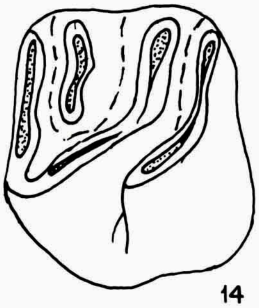
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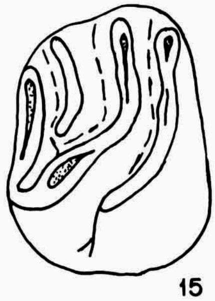
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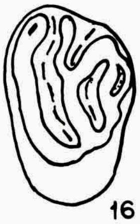
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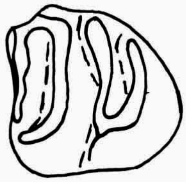
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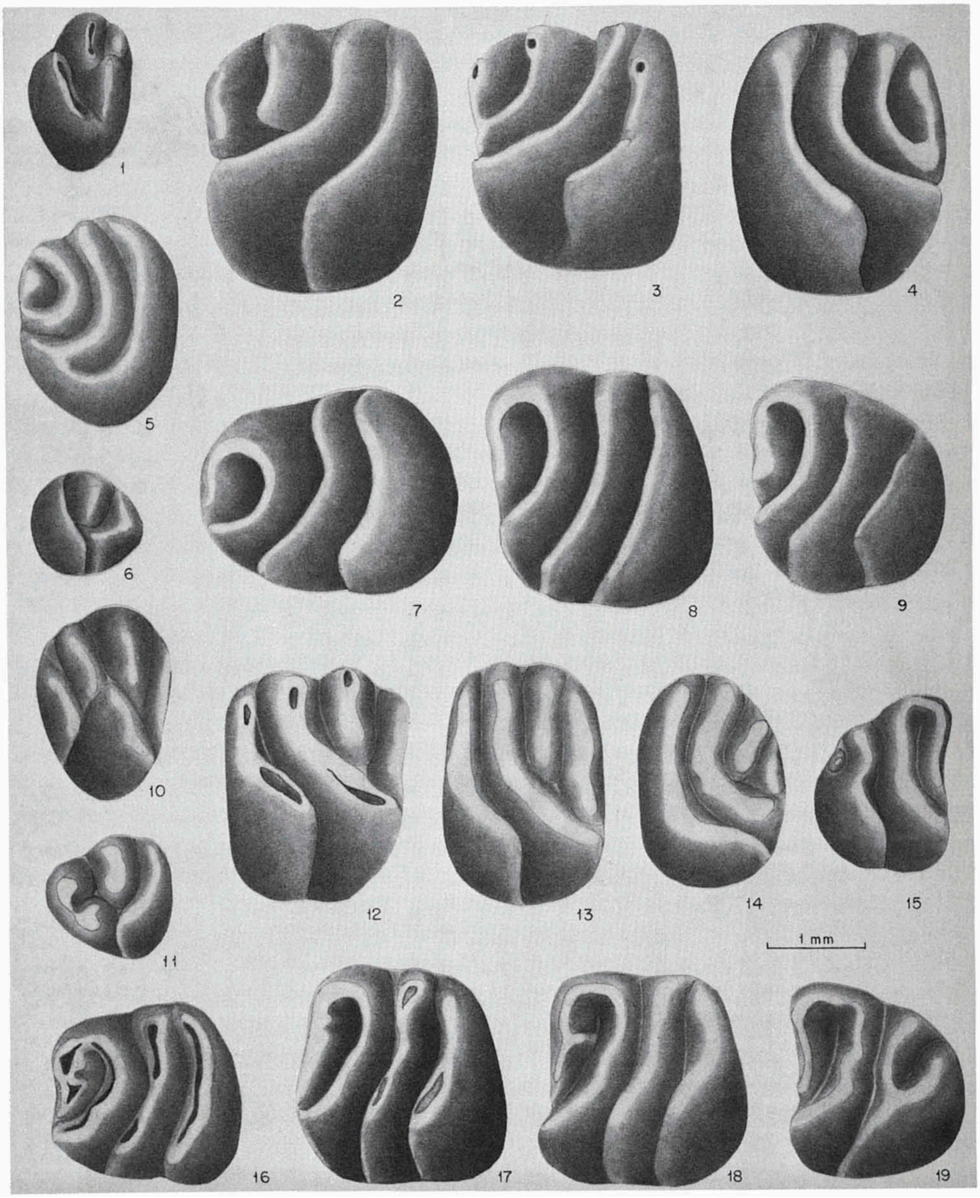
Plate 4

Armantomys tricristatus López Martínez, 1977 from Escobosa

1. P^4 sin., no. G573.
2. M^1 dext., no. G627.
3. M^1 dext., no. G3.
4. M^2 sin., no. G634.
5. M^3 dext., no. G7.
6. P_4 dext., no. G588.
7. M_1 sin., no. G11.
8. M_2 sin., no. G606.
9. M_3 sin., no. G613.

Armantomys aragonensis de Bruijn, 1966

10. P^4 sin., no. AGR 1185, Agreda.
11. P_4 sin., no. AGR 1205, Agreda.
12. M^1 sin., no. AGR 1191, Agreda.
13. M^2 sin., no. AGR 1199, Agreda.
14. M^3 sin., no. AGR 1201, Agreda.
15. M_3 dext., no. AGR 1223, Agreda.
16. M_1 sin., no. MOR2 618, Moratilla 2.
17. M_2 sin., no. MOR2 628, Moratilla 2.
18. M_2 sin., no. AGR 1212, Agreda.
19. M_3 sin., no. AGR 1221, Agreda.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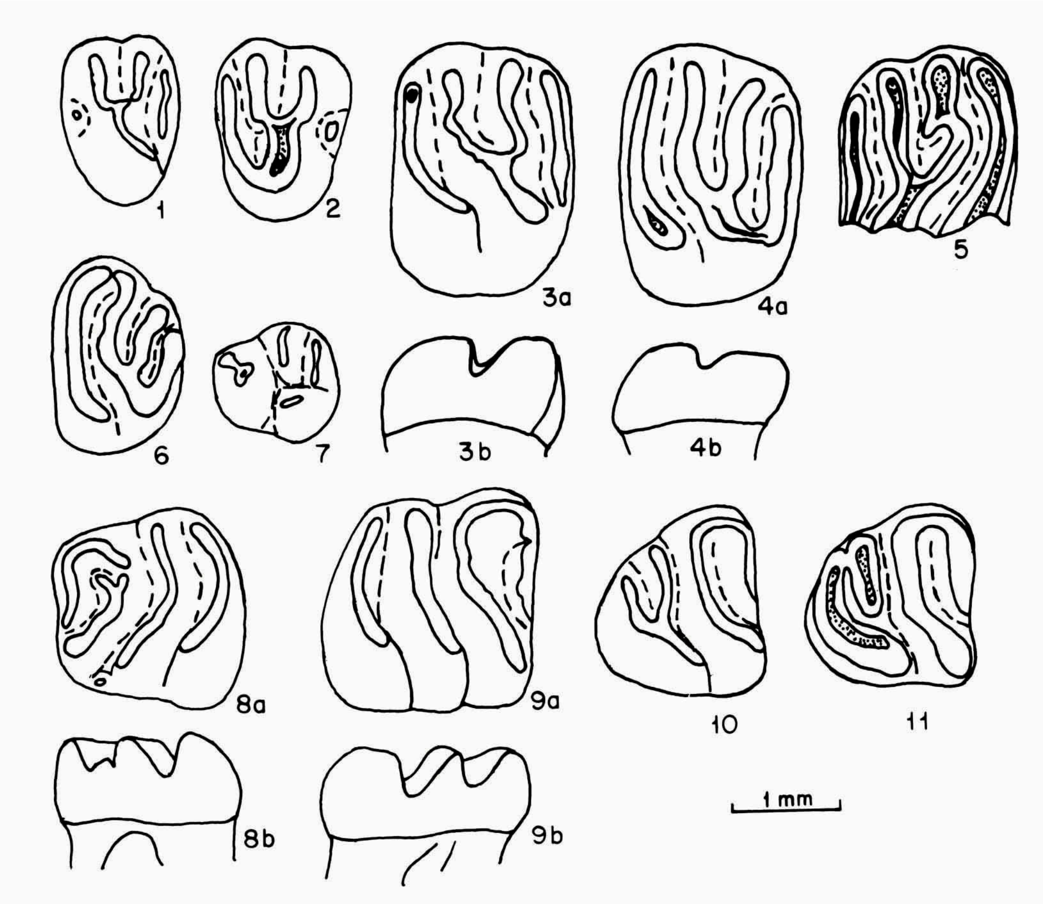

Plate 5

Praearmantomys crusafonti de Bruijn, 1966, from Cabeza Rubia

1. P^4 sin., no. CAB 50.
2. P^4 dext., no. CAB 1.
3. M^1 sin., no. CAB 53; a) occlusal view; b) lingual view.
4. M^2 sin., no. CAB 8; a) occlusal view; b) lingual view.
5. M^2 dext.,(fragment), no. CAB 10.
6. M^3 sin., no. CAB 62.
7. P_4 sin., no. CAB 64.
8. M_1 sin., no. CAB 67; a) occlusal view; b) labial view.
9. M_2 dext., no. CAB 15; a) occlusal view; b) labial view.
10. M_3 dext., no. CAB 19.
11. M_3 dext., no. CAB 18.