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THE *ALLOPHAIOMYS* POPULATIONS OF BETFIA IX (ROMANIA, BIHOR COUNTY)

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ABSTRACT

Betfia is located 9 km from the city of Oradea in Romania. The fissure-fill system of the local limestone quarry has produced remarkable vertebrate faunas for nearly 100 years. The study of the localities was initiated by Tivadar Kormos and later the field activity was continued by Miklos Kretzoi, Elena Terzea and Tibor Jurcsak. The well- known Betfia II locality produced the original type-fauna of the biochronological Biharian unit. In 1994-1995 Merton Venczel re-excavated Betfia locality no. IX and collected two rich faunas. The *Allophaiomys* material from these new collections is described here.

INTRODUCTION

The complex of Betfia localities was studied from 1904 on. The excavations were primary conducted by Hungarian paleontologists (Kormos, 1914, Kretzoi 1941a). The classical localities Betfia II and Betfia IV produced a number of new species (Méhely, 1914; Kormos 1930, 1932; Schaub 1930) and this fauna was described as the type-locality of the Biharian biochronological unit (Kretzoi, 1941b). From the 1960s the sampling and description were continued by Terzea (1973, 1984, 1991, 1992, 1995) and Terzea and Jurcsak (1967, 1968, 1976). They described a new series of localities (Betfia V - Betfia XIII). Locality IX was first published by Terzea (1988) as well, with rich *Allophaiomys* material (946 m1) determined as *Allophaiomys pliocaenicus pliocaenicus*. Ruiz Bustos (1993) identified *Allophaiomys deucalion* in the fauna . the basis of his special enamel unit analysis that he applied to Terzea's figures. In 1994 Venczel re-excavated the locality and found a rich microvertebrate fauna (Betfia IX/B) with an abundant series of *Allophaiomys* molars. In 1995 he found a terra rossa layer (Betfia IX/C) under the brecciatic sediment of IX/B. This lower layer produced a special fauna dominated by *Apodemus* and *Pliomys*, indicating a forested paleoenvironment (Table 1, Figure 1). The geographical names connected to the locality were described in three languages in different publications and this situation sometimes gave rise to misunderstanding. For this reason we give a small dictionary for the correlation of these names.

GERMAN	HUNGARIAN	ROMANIAN
-	Bihar	Bihor
Grosswardein	Nagyvárad	Oradea
-	Püspökfürdõ	Baile 1 Mai
Somlyoberg	Somlyo-hegy	Dealul Somleu
-	Betfia	Betfia

MATERIALS AND METHODS

Betfia IX/B produced 1219 intact m1s and 359 M3s. We also have 389 m1s and 248 M3s from Betfia IX/C. (In Table 1 we indicated the sum of the intact m1s and the anteroconids of incomplete molars.)

The metrical study of the m1 molars is based on the generally applied measurements and ratios of van der Meulen (1973:Figure 22). The measurements and ratios of the M3s is after Nadachowski (1990:Figure 1).The determination of the morphotypes of m1s and M3s is after Rabeder (1981, 1986). The enamel thickness was measured on 200 m1s from the IX/b and IX/c samples after the methodology of Heinrich (1982, 1987). The SDQ1 ratio of an m1 molar was computed on the basis of 14 basic measurements (seven ratios) including the posterior lobe. The SDQ2 ratio was computed on 10 basic data points (five ratios) without the posterior lobe (Figure 7). On the basis of the extremely rich material we could study the parameters and ratios of the m1 molars not only in the total materials of B IX/B and B IX/C, but in five morphotype-groups as well (Figures 2-5), as follows:

-A group: morphotypes *mimomys*, *deucalion*, *latilaguroides*
-B group: morphotypes *laguroides*, *superlaguroides*
-C group: morphotypes *pliocaenicus*, *superpliocaenicus*
-D group: morphotypes *collolaguroides*, *protonivalis*, *eonivalis*, *nivalinus*
-E group: morphotypes *praehintoni*, *eoratticeps*, *ratticepoides*, *eomalei*, *protarvalidens*.

RESULTS AND DISCUSSION

The results of the morphometric investigations are given in Figsures 1-13 and in the Tables 1-8.

Terzea (1988) determined the *Microtus* assemblage of Betfia IX as *Allophaiomys pliocaenicus pliocaenicus*. The material of the new collection cannot be unambiguously referred to this subspecies . The evidence for this statement is the following:

1. All three types of the enamel differentiation were found, dominated by an undifferentiated enamel pattern. (Tables 4-5, Figures 8, 9) The SDQ values are higher than the same parameters for the *A. pliocaenicus* material from Betfia II (Hír, this volume).

2. The frequency of the m1 morphotypes is bimodal, dominated by *deucalion* and *pliocaenicus* types (Table7, Figure 12).

3. In the distribution of the M3 morphotypes of Betfia IX/b the "para"-types are dominant with confluent T2 and T3 (Table 8, Figure 13).

The ranges of the A/L values are unusually large relative to other Middle European *Allophaiomys* materials, especially of Betfia IX/B (Figure 6) but the difference may be related to the abundant sample size of the new material. Among the distribution of the A/L values of the five morphotype-groups the A and C groups produced two normal curves (Figure 5). The curves of B, D, E groups are fit better to the distribution of the C group. For this reason we give the parameters of the A group and of the B-C-D-E groups separately in Tables 2 and 3.

On the basis of the separated A/L histograms of the A and C morphotype- groups the possibility of two taxa was recognized in an earlier investigation (Hír and Venczel, 1997). But now this idea can be rejected, and the phenomenon can be regarded as a result of normal intraspecific variation. Results of enamel thickness analysis showed no correlation between morphotype and the SDQ value (Figures 8, 9).

We can characterize the *Allophaiomys* populations of Betfia IX as early forms of *Allophaiomys pliocaenicus*, which are more advanced than *A. deucalion* materials from Villany 5, Mokra and Kolinany, but definitely more primitive than the assemblages from D. altenburg 2C1, Monte Peglia and Betfia II (Figures 6, 11).

The most important evolutionary processes from Betfia IX/C time to Betfia IX/B are: 1) decrease of the L parameter, 2) decrease of the SDQ values (referring to the process of enamel differentiation), and 3) decrease of the frequency of primitive morphotypes (group A).

In the evolution of European *Allophaiomys* the most important trend is the more lengthened and more complicated ACC of the m1 (van der Meulen, 1973; Agustí 1991), mirrored by higher A/L values and higher frequencies of the more complicated morphotypes. From Betfia IX/C to Betfia IX/B only moderate increase of the A/L ratio is visible in the complete materials and in the morphotype-groups (Figure 9). The decrease of L was more pronounced than the increase of the A/L ratio (Figure 10).

Betfia-IX has produced the most abundant *Allophaiomys* material in Europe. The new collections need further investigations, especially a higher level statistical analysis. Another important task is the geochronological correlation of the Betfia IX/C fauna, because it represents a mild and wet climatic event during the Early Pleistocene. This rodent association is unique among the Middle European *Allophaiomys* faunas (Table 1).

LITERATURE CITED

Agustí, J. 1991. The *Allophaiomys* complex in Southern Europe. Geobios 25:133-144.

Fejfar, O. and I. Horácek. 1983. Zur Entwicklung der Kleinsäugerfaunen im Villányium und Alt-Biharium auf dem Gebiet der CSSR. Pp.111-207 in W. D. Heinrich (ed) Wirbeltier-Evolution und Faunenwandel im Kanozoikum. Akademie Verlag, Berlin.

Heinrich, W. 1982. Zur evolution und Biostratigraphie von Arvicola (Rodentia, Mammalia) im Pleistozän Europas. Zeitschrift fur Geologische Wissenschaften 10:683-735.

Heinrich, W., 1987: Neue Ergebnisse zur Evolution und Biostratigraphie von *Arvicola* (Rodentia, Mammalia) im Quartar Europas. Zeitschrift fur Geologische Wissenschaften 16:389-406.

Hír, J. and M. Venczel.1997. New excavation at the locality Betfia IX (Romania, Bihor County). Folia Naturae Bihariae (Nymphaea), 23-25:93-116.

Kormos, T. 1914. Évben végzett ásatásaim eredményei. Földtani Intézet, Évi Jelentése 1913-rol, pp. 498-540.

Kormos, T. 1930. Diagnosen neuer Säugetiere aus der oberpliozänen Fauna des Somlyóberges bei Püspökfürdö. Annales Historico-Naturales Musei Nationalis Hungarici 27:237-246.

Kormos, T. 1932. Neue Wühlmause aus dem Oberpliozän von Püspökfürdö. Neues Jahrbusch für Mineralogie, Beilgeband series B, 69:323-346.

Kretzoi, M.1941 a. Die unterpleistozäne Säugetierfauna von Betfia bei Nagyvárad. Földtani Közlöny 71:308-355.

Kretzoi, M. 1941 b. Weitere beiträge zur kenntnis der fauna von Gombaszög. Annales Historico-Naturales Musei Nationalis Hungarici 34:105-139.

Méhely, L. 1914. Fibrinae Hungariae. Magyarország harmad- es negyedkori Gyökeresfogú poczkai. Magyar Tudományos Akadémia, Matematikai és Természetudomány Bizottág kiad., Budapest, 102 pp.

Meulen , A. J. van der.1973. Middle Pleistocene smaller mammals from the Monte Peglia, (Orvieto, Italy) with special reference to the phylogeny of *Microtus* (Arvicolidae, Rodentia). Quaternaria17:1-144.

Meulen, A. J. van der. 1974. On *Microtus* (*Allophaiomys*) *deucalion* (Kretzoi, 1969), Arvicolidae, Rodentia), from the Upper Villanyian (Lower Pleistocene) of Villany-5, S. Hungary. Proceedings Koninkl. Nederlanden van Weetenschappen, Series B 77:259-266.

Nadachowski, A. 1990. On the taxonomic status of *Chionomys* Miller, 1908 (Rodentia: Mammalia) from Southern Anatolia (Turkey). Acta Zoologia Cracoviensia 33:79-89.

Rabeder, G. 1981. Die Arvicoliden (Rodentia, Mammalia) aus dem Pliozän und dem alteren Pleistozän von Niederösterreich. Beiträge zur Paläontologie und Geologie von Österreich 8:1-343.

Rabeder, G. 1986. Herkunft und frühe evolution der gattung *Microtus* (Arvicolidae, Rodentia). Zeitschrift für Säugetierkunde 51:350-367.

Rekovets, L., and A. Nadachowski. 1995. Pleistocene Voles (Arvicolidae) of the Ukraine. Paleontologia I Evolucio 28-29:145-245.

Ruiz Bustos, A. 1993. New data on Lower Pleistocene Arvicolids . The Venta Micena, Betfia IX and Villany-5 sites. Communicaciones de las IX Jornadas de Paleontologia 60-64.

Schaub, S. 1930. Quartäre und Jungtertiäre hamster. Abhandlungen der Schweizerischen Palaeontologischen Gesellschaft 49:1-49.

Terzea, E. 1973. A propos d'une faune villafranchienne finale de Betfia (Bihor, Roumanie). Travaux de l'Institut de Spéologie Emile Racovitza 12:229-242.

Terzea, E. 1984. Mammiferes rares du Pleistocene inferieur de Betfia XIII (Bihor, Roumanie). Travaux de l'Institut de Spéologie Emile Racovitza 23:49-56.

Terzea, E. 1988. La faune de vertebres du pleistocene inferieur de Betfia -IX (Depart. de Bihor, Roumanie). Travaux de l'Institut de Spéologie Emile Racovitza 27:79 -85.

Terzea, E. 1991. Le genre *Villanyia* Kretzoi dans le pleistocene inferieur de Betfia-XIII (Dep. de Bihor, Roumanie). Travaux de l'Institut de Spéologie Emile Racovitza 30:89-105.

Terzea, E. 1992. *Apodemus mystacinus* (Danford and Alston) (Rodentia, Mammalia) dans le Pleistocene inferieur final de Betfia -VII (Bihor, Roumanie). Travaux de l'Institut de Spéologie Emile Racovitza 31:83-94.

Terzea, E. 1995. Mammalian events in the Quaternary of Romania and correlations with the climatic chronology of Western Europe. Acta Zoologia Cracoviensia 38:109-120.

Terzea, E., and T. Jurcsák. 1967. Asupra unui nou punct fosilifer descoperit la Betfia. Travaux de l'Institut de Spéologie Emile Racovita 7:193-209.

Terzea, E., and T. Jurcsák. 1968. Bemerkungen uber die mittelpleistozänen faunen von Betfia. Bericht der Deutschen Gesellschaft fur Geologische Wissenschaften, Reihe A, Geololie und Paläontologie 13:381-391.

Terzea, E., and T. Jurcsák. 1976. Faune de mammiferes de Betfia-XIII et son age geologique. Travaux de l'Institut de Spéologie Emile Racovitza 15:195-205.

TABLE 1. The list of the leporid and rodent material from Betfia IX (with numbers of individuals).

Excavations	Terzea (1988)	New IX/B	New IX/C
Muscardinus sp.	+	5	174
Eliomys sp.	-	-	14
Dryomys sp.	-	2	-
Glis sackdillingensis	-	4	47
Spalax sp.	+	2	-
Citellus primigenius	+	3	-
Sicista sp.	+	69	1
Apodemus sp.	+	77	429
Allocricetus hiki	-	1	-
Cricetus nanus	+	63	2
Cricetus praeglacialis	+	-	-
Ungaromys nanus	-	1	19
Mimomys pusillus	+	675	548
Mimomys tornensis	+	3	2
Mimomys coelodus	-	2	2
Mimomys sp.	+	-	-
Pliomys episcopalis	+	22	345
Clethrionomys sp.	+	25	1
Lemmus sp.	-	1	1
Allophaiomys pliocaenicus	939	-	-
Allophaiomys cf. *A. pliocaenicus*	-	1750	398
Lagurus prepannonicus	735	-	-
Lagurus pannonicus	-	1399	57
Lagurus arankae	-	448	36
Ochotona sp.	+	1	-
Hypolagus brachygnathus	+	1	-
Totals	-	4549	1402

TABLE 2. Measurements (in mm) and ratio data of *Allophaiomys* m1s from Betfia IX/B.

All Morphotypes

	L	A	W	B	C	A/L	B/W	C/W
N	1219	1220	1207	1217	1217	1219	1206	1207
Min.	1.92	0.77	0.59	0.01	0.01	33.5	1.40	1.70
Max.	3.03	1.32	1.92	0.84	0.28	49.4	44.8	34.5
Mean	2.51	1.07	0.86	0.20	0.17	42.6	22.8	19.6
SD	0.18	0.09	0.09	0.07	0.04	2.51	6.85	4.75

Morphotype-group A

	L	A	W	B	C	A/L	B/W	C/W
N	322	323	323	324	324	322	321	326
Min.	1.96	0.77	0.14	0.11	0.03	33.5	14.1	2.90
Max.	3.0	1.27	1.92	0.84	0.28	47.1	44.8	34.5
Mean	2.54	1.03	0.90	0.25	0.18	40.6	29.9	19.6
SD	0.18	0.08	0.09	0.07	0.05	2.25	6.19	5.24

Morphotype-groups B-C-D-E

	L	A	W	B	C	A/L	B/W	C/W
N	896	897	885	894	894	896	884	885
Min.	1.92	0.84	0.59	0.01	0.01	34.8	1.40	1.70
Max.	3.03	1.32	1.88	0.38	0.28	49.4	42.7	32.7
Mean	2.50	1.08	0.85	0.18	0.16	43.4	21.2	19.4
SD	0.17	0.09	0.08	0.06	0.04	2.19	6.30	4.57

TABLE 3. Measurements and ratio data of *Allophaiomys* m1 molars from Betfia IX/C

total material

	L	A	W	B	C	A/L	B/W	C/W
N	389	398	396	398	398	389	396	394
Min.	2.1	0.85	0.70	0.07	0.04	35.1	8.90	4.40
Max.	3.13	1.39	1.08	0.85	1.18	47.5	104.9	120.6
Mean	2.67	1.12	0.91	0.24	0.18	41.8	26.2	20.0
SD	0.19	0.09	0.07	0.07	0.06	2.26	7.70	6.74

morphotype-group A

	L	A	W	B	C	A/L	B/W	C/W
N	158	159	158	159	158	158	158	158
Min.	2.21	0.85	0.77	0.17	0.04	35.1	17.3	4.40
Max.	3.08	1.29	1.08	0.85	1.18	46.7	104.9	120.6
Mean	2.67	1.08	0.92	0.28	0.19	40.5	29.7	20.8
SD	0.18	0.09	0.06	0.08	0.09	2.04	8.19	9.50

morphotype-groups B-C-D-E

	L	A	W	B	C	A/L	B/W	C/W
N	231	239	238	239	240	231	238	238
Min.	2.10	0.91	0.70	0.07	0.04	38.0	8.90	10.2
Max.	3.13	1.39	1.05	0.35	0.25	47.6	40.3	28.8
Mean	2.68	1.14	0.90	0.21	0.17	42.7	23.8	19.4
SD	0.20	0.08	0.07	0.06	0.03	1.99	6.34	3.86

TABLE 4. Data of *Allophaiomys* m1 enamel differentiation from Betfia IX/b.

	SDQ1 total	SDQ1 morphotype-group A	SDQ1 morphotype-groups BCDE
N	200	65	136
Min.	68.57	79.13	68.57
Max.	150.60	150.60	130.95
Mean	107.19	110.30	105.65
SD	23.90	12.95	18.37

	SDQ2 total	SDQ2 morphotype group A	SDQ2 morphotype groups BCDE
N	200	65	134
Min.	62.50	73.81	62.50
Max.	130.00	128.33	130.00
Mean	100.30	105.18	98.79
SD	12.91	12.80	12.78

TABLE 5. Data of *Allophaiomys* m1 enamel differentiation form Betfia IX/C

	SDQ1 total	SDQ1 morphotype-group A	SDQ1 morphotype-groups BCDE
N	200	84	116
Min.	85.12	94.01	85.12
Max.	147.62	147.62	136.19
Mean	111.49	111.81	111.26
SD	10.00	10.17	11.15

	SDQ2 total	SDQ2 morphotype-group A	SDQ2 morphotype-groups BCDE
N	200	84	116
Min.	79.17	82.50	79.17
Max.	146.67	146.67	136.67
Mean	105.01	105.28	104.82
SD	11.70	11.60	11.82

TABLE 6. Measurements and ratio data of *Allophaiomys* M3 molars from Betfia IX/B and IX/C

	Betfia IX/B			Betfia IX/C		
	L	p	p/L	L	p	p/L
N	359	359	359	248	248	248
Min.	1.34	0.53	32.65	1.37	0.52	33.95
Max.	2.06	1.01	59.83	2.06	1.02	51.71
Mean	1.69	0.73	43.45	1.75	0.74	42.43
SD	0.11	0.07	3.22	0.13	0.08	2.97

TABLE 7. Morphotypical composition of the *Allophaiomys* m1s from Betfia IX. N = number of specimens. % = percent composition.

	B IX/B		B IX/C	
	N	%	N	%
mimomys	4	0.3	1	0.25
deucalion	264	22	137	34.3
latilaguroides	46	3.8	21	5.3
laguroides	138	11.5	48	12.0
superlaguroides	26	2.2	9	2.25
collolaguroides	58	4.8	23	5.8
pliocaenicus	477	40	131	32.8
superpliocaenicus	14	1.2	3	0.75
eonivalis	77	6.4	2	0.5
protonivalis	38	3.2	7	1.75
mesonivalis	-	-	2	0.5
praehintoni	29	2.4	12	3.0
eoratticeps	13	1.1	-	-
eomalei	1	0.1	-	-
protarvalidens	11	1.0	1	0.25
praehenseli	-	-	1	0.25
special type	-	-	1	0.25
Totals	1196	100	399	100

TABLE 8. Morphotypical composition of the *Allophaiomys* M3 populations of Betfia IX.

	B IX/B		B IX/C	
	indiv.	%	indiv.	%
prosimplex	88	24.4	104	42.0
simplex	102	28.3	74	29.9
iberoprosimplex	-	-	2	0.8
protosimplex	6	1.7	8	3.2
protooeconmus	6	1.7	4	1.6
praeoeconomus	3	0.8	4	1.6
parapraesimplex	1	0.3	-	-
paraprosimplex	13	3.6	14	5.6
parasimplex	116	32.2	28	11.3
artisimplex	-	-	1	0.4
multiplex	3	0.8	5	2.0
paracomplex	19	5.3	3	1.2
iberosimplex	-	-	1	0.4
articomplex	1	0.3	-	-
ibericus	2	0.6	-	-
Totals	360	100	248	100

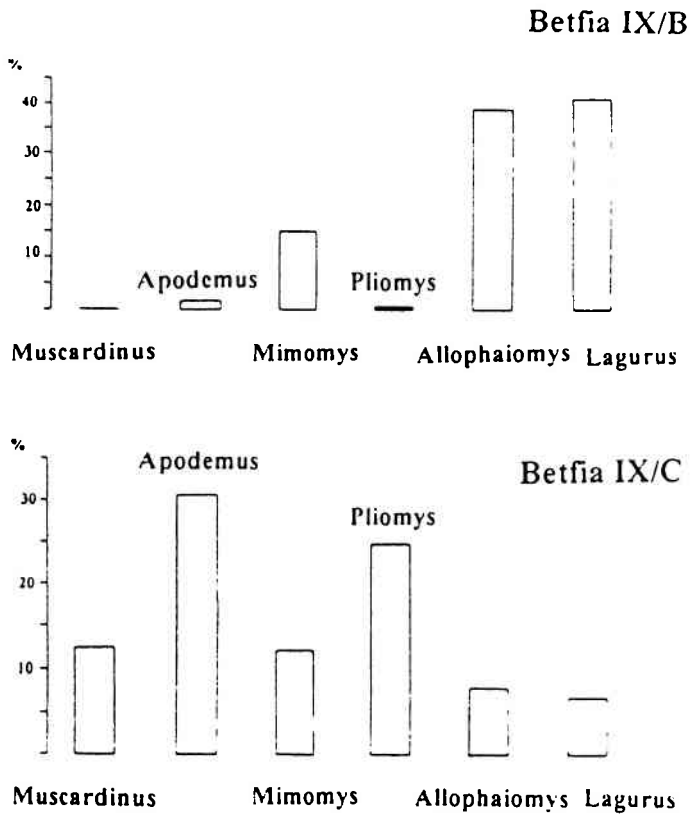

Figure 1 The frequency of six rodent genera in the materials of Betfia IX/C and IX/B materials

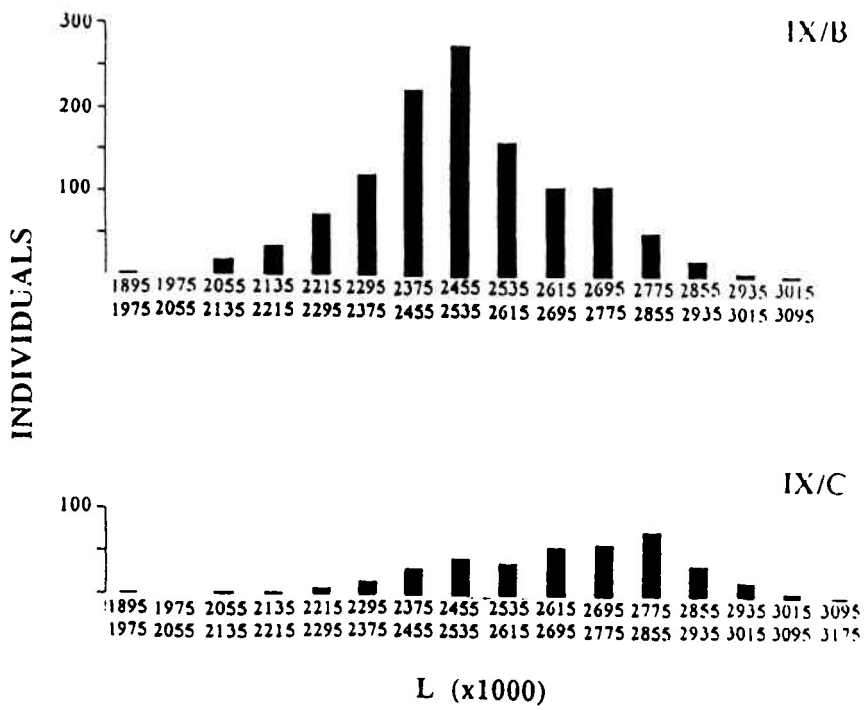

Figure 2 Simple histograms for the *Allophaiomys* m1 L values of Betfia IX/C and IX/B materials

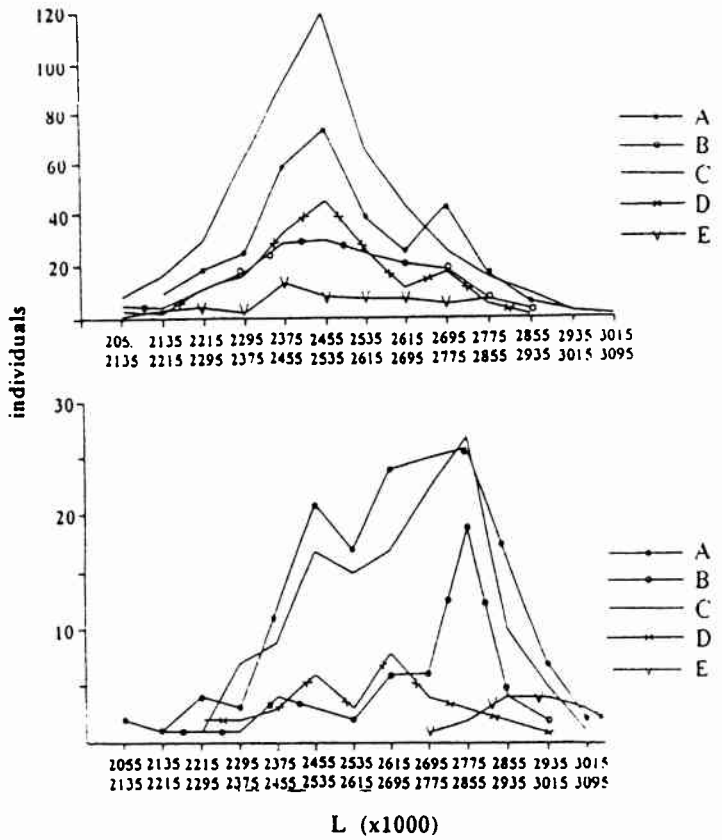

Figure 3 Differentiated histograms for the *Allophaiomys* m1 L values of Betfia IX/C and IX/B materials (refers to the five morphotype-groups).

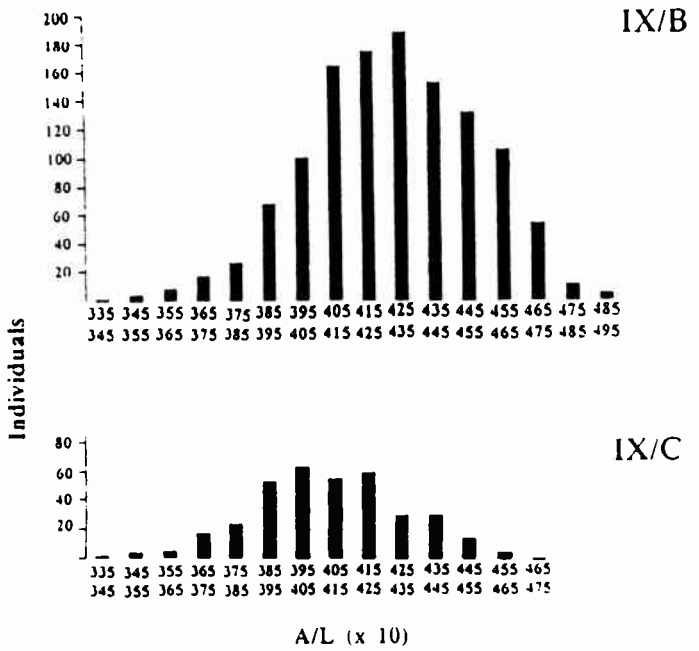

Figure 4 Simple histograms for the *Allophaiomys* m1 A/L values of Betfia IX/C and IX/B materials

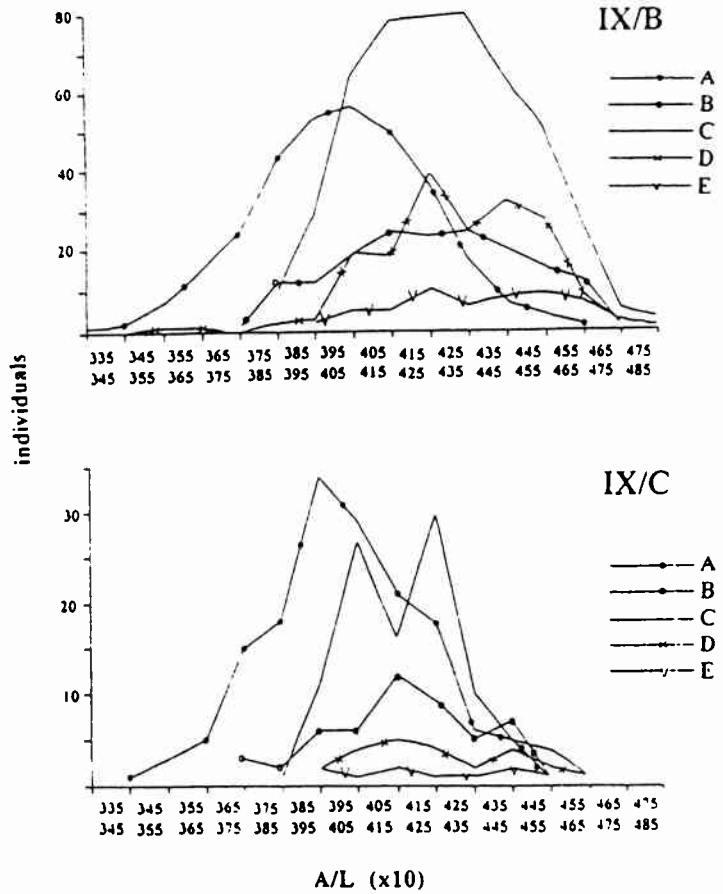

Figure 5 Differentiated histograms for the *Allophaiomys* m1 a/L values of Betfia IX/C and IX/B materials (refers to the five morphotype-groups)

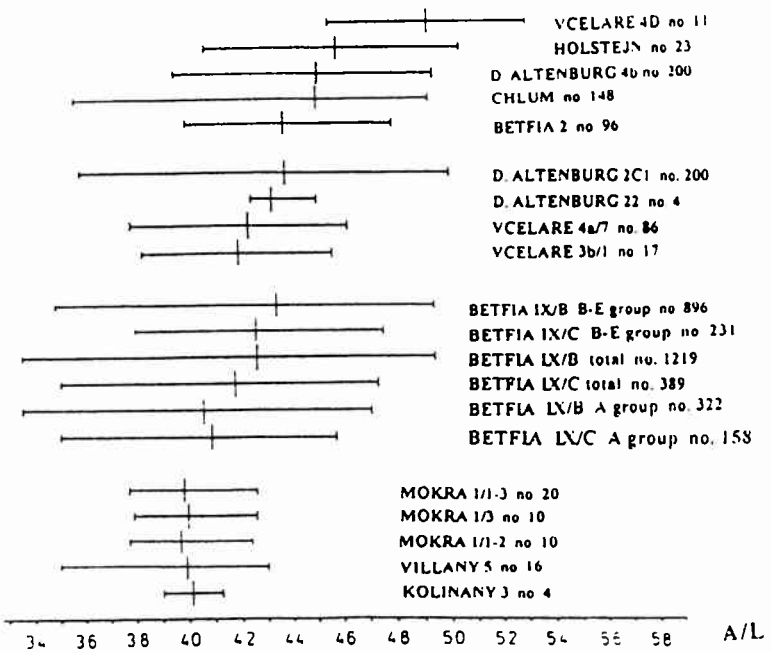

Figure 6 Comparision of the means and the ranges of the A/L values of some Middle European *Allophaiomys* populations The data are after Fejfar and Horacek (1983), van der Meulen (1973), Rabeder (1981)

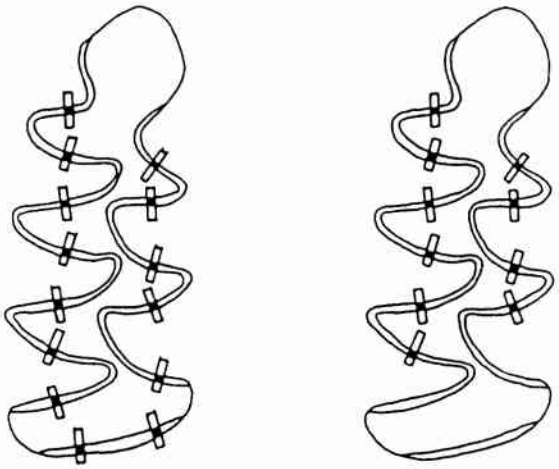

Figure 7 Sketch for measuring practice applied by the author for computing enamel differenciacion ratios SDQ1 and SDQ 2

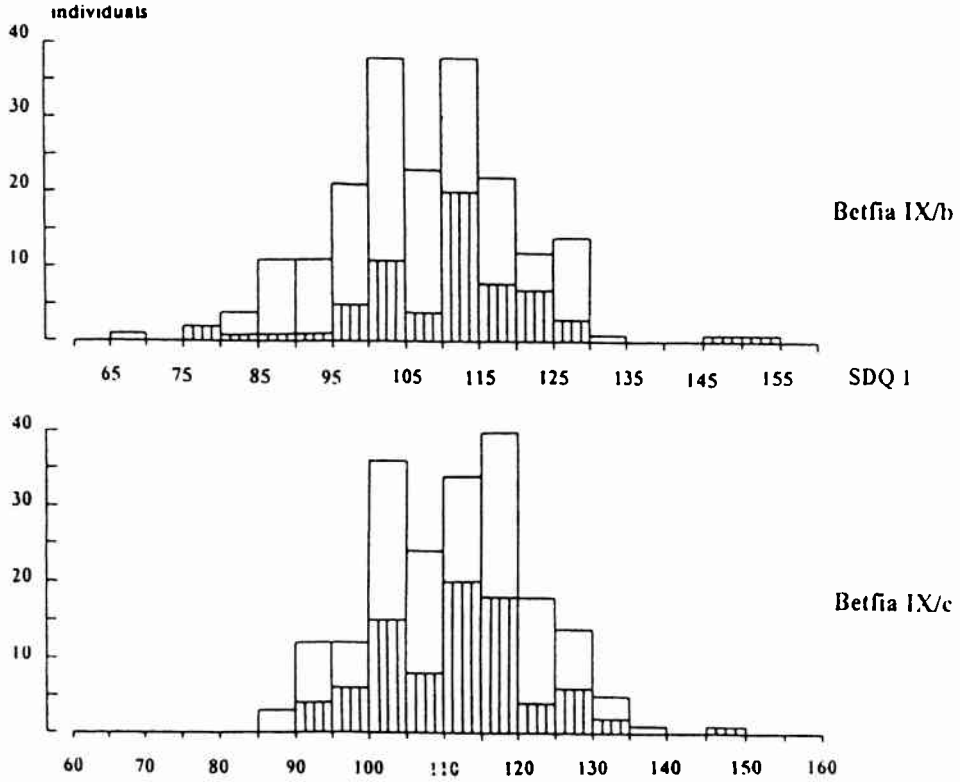

Figure 8. Histograms of 200-200 m1 SDQ 1 values from Betfia IX/C and IX/B. The striped areas refer to the morphotype-group A, the clear areas refer to the morphotype-groups B,C,D,E

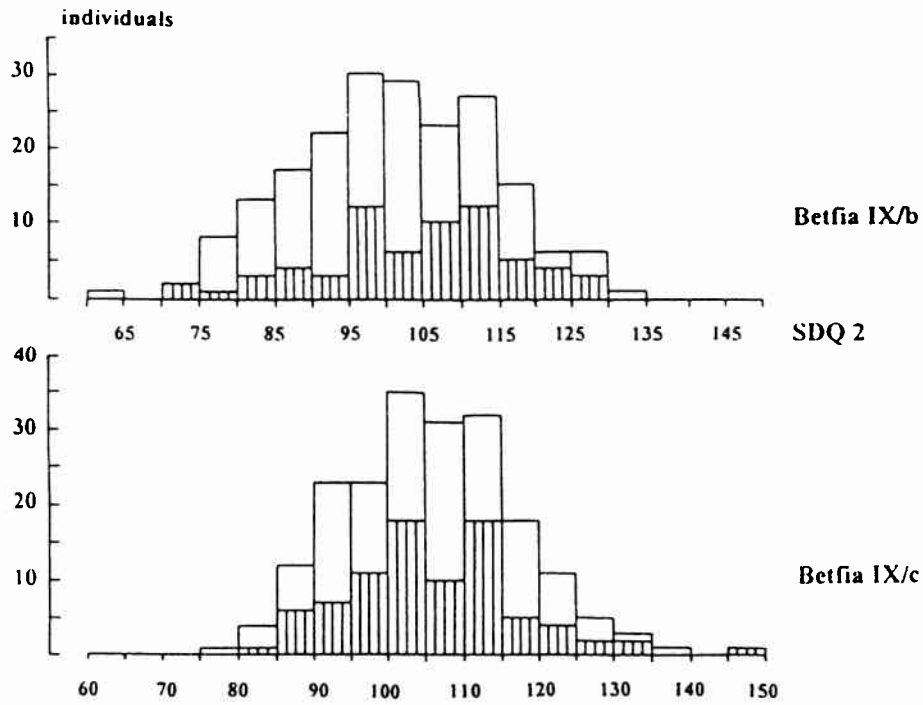

Figure 9 Histograms of 200-200 m1 SDQ 2 values from Betfia IX/C and IX/B. The striped areas refer to the morphotype-group A, the clear areas refer to the morphotype-groups B,C.D,E

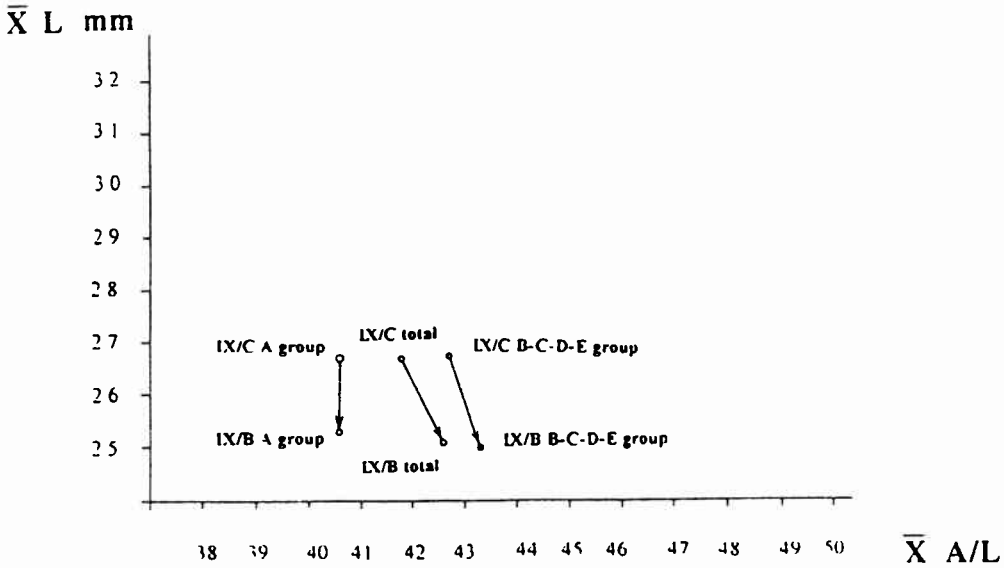

Figure 10 The evolutionary trends of the mean L and mean A/L values of the *Allophaiomys* m1 molars from Betfia IX/C to Betfia IX/B

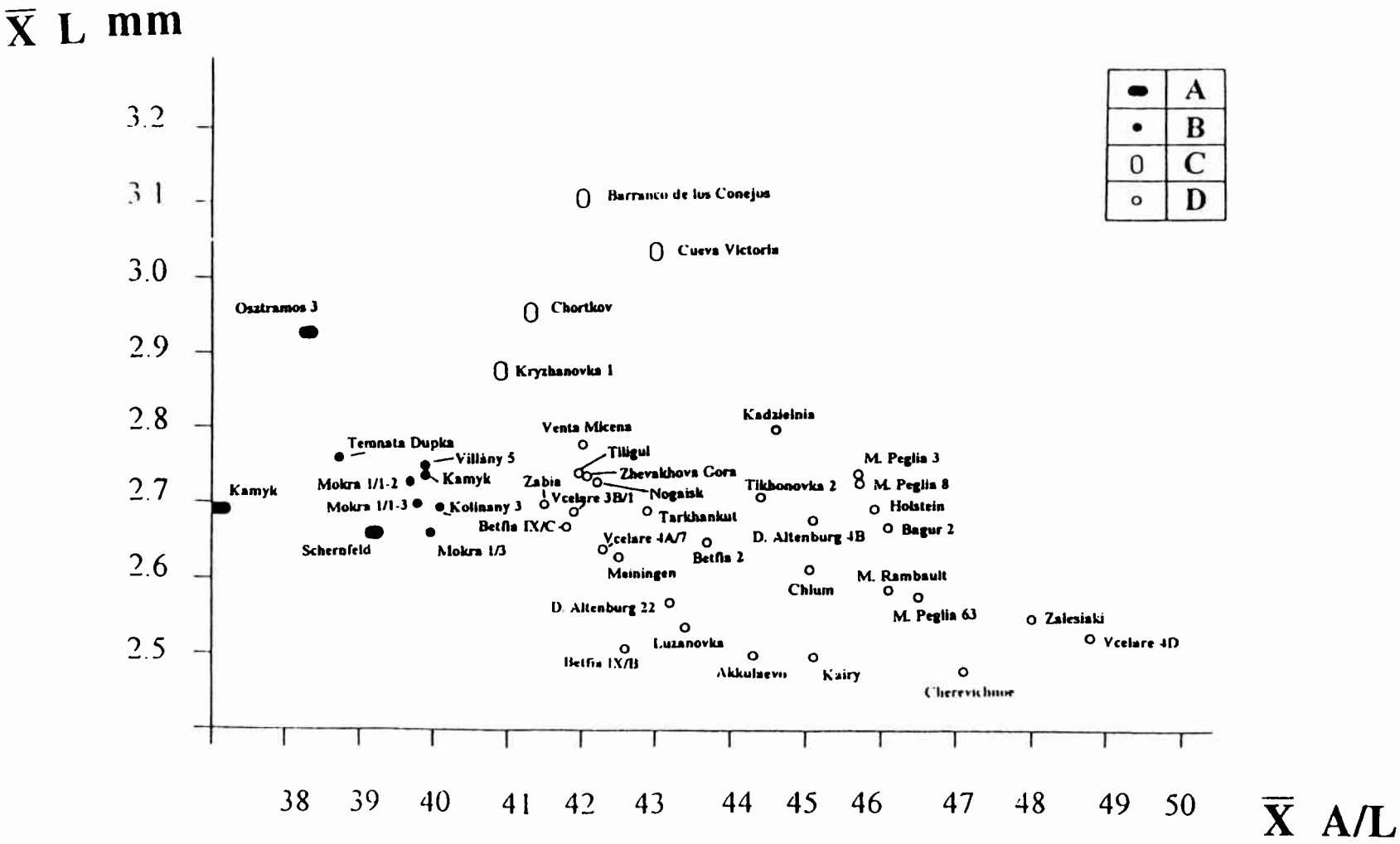

Figure11 Comparision of the mean L and the mean A/L values of some European *Allophaiomys* populations The data are after Agusti (1991), Fejfar and Horacek (1983), van der Meulen (1973, 1974), Rabeder (1981), Rekovets and Nadachowski (1995) A, *Mimomys tornensis* B, *Allophaiomys deucalion* C, *A vandermeuleni -A chalinei* D, *A phocaenicus -A nutiensis -A praehintoni*

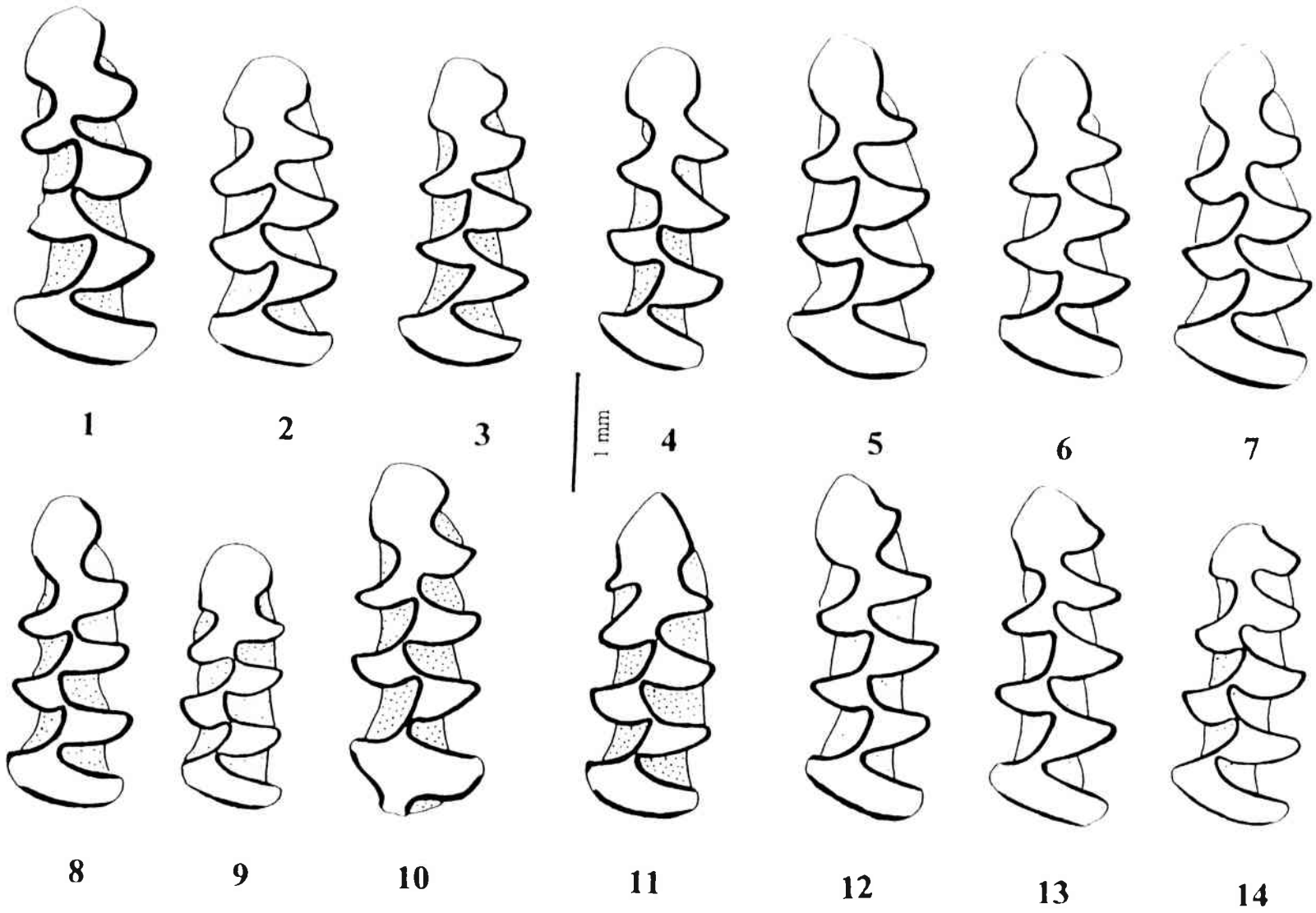

Figure 12 Occlusal surfaces of *Allophaiomys* m1 molars from Betfia IX/C and Betfia IX/B 1, B IX/B no 414 *deucalion* 2, B IX/C/4 no 3 *deucalion* 3, B IX/C/1-2 no 6 *pliocaenicus* 4, B IX/C no 15 spec morphotype 5, B IX/C/4 no 15 *latilaguroides* 6, B IX/C/4 no 48 *laguroides* 7, B IX/C/4 no 8 *superlaguroides* 8, B IX/B no 449 *pliocaenicus* 9, B IX/C/3 no 10 *pliocaenicus* 10, B IX/B no 1019 *pliocaenicus* 11, B IX/B no 1024 *protonivalis* 12, B IX/C/4 no 80 *praehintoni* 13, B IX/C/4 no 62 *protarvalidens* 14, B IX/B no 736 *praehintoni*

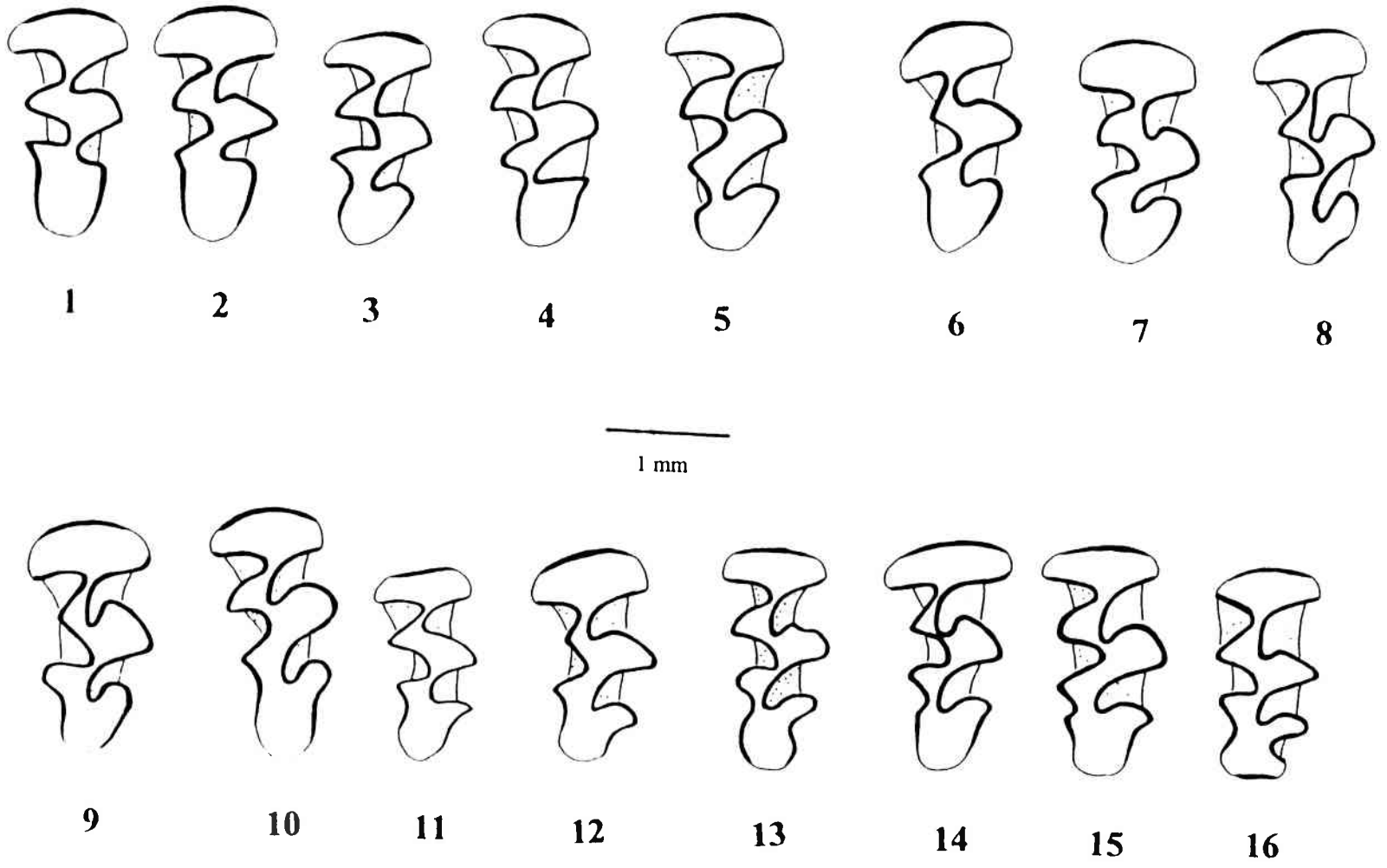

Figure 13 Occlusal surfaces of *Allophaiomys* M3 molars from Betfia IX/C and Betfia IX/B 1, B IX/B no 62 *parapraesimplex*. 2, B IX/C no. 84 *protosimplex*. 3, B IX/B no 5 *prosimplex* 4, B IX/C no 36 *prosimplex* 5, B IX/C no 48 *prosimplex*. 6, B IX/B no 44 *paraprosimplex*. 7, B IX/B no 49 *parasimplex*. 8, B IX/C/96 no 98 *iberoprosimplex* 9, B IX/C no 99 *iberoprosimplex*. 10, B IX/C no 49 *simplex* 11, B IX/C no. 72 *parasimplex* 12, B IX/C/96 no 143 *iberosimplex*. 13, B IX/C/96 no 122 *multiplex*. 14, B IX/B no. 130 *ibericus*. 15, B IX/B no. 61 *protoeconomus* 16 B IX/B no 94 *paracomplex*