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A new eumyarionine cricetid from Pakistan

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Abstract. Miocene deposits in four areas of Pakistan (the Potwar Plateau, Trans-Indus area, Sulaiman foothills, and Baluchistan) have produced a rich and diverse record of cricetid rodents that spans an interval of about 12.5 Ma (20 to 7.5 Ma). This interval apparently spans the "cricetid vacuums" of Europe (about 18-20 Ma) and North America (about 17-19 Ma); the Pakistan record fills a critical gap in the history of Palearctic cricetid rodents and enriches our understanding of their evolution. A new species of Eumyarioninae cricetid, *Eumyarion kowalskii*, n. sp., is described from the Sulaiman foothills of Pakistan. *E. kowalskii* probably gave rise to *Prokanisamys* and the rest of the Rhizomyidae. In addition to *Eumyarion*, the Eucricetodontinae cricetids are represented in Pakistan by two species of *Primus*; the Democricetodontinae are represented by three species of *Spanocricetodon* and eight species of *Democricetodon*. The Megacricetodontinae are represented in Pakistan by four species of *Megacricetodon* and two species of *Punjabemys*. The Myocricetodontinae are represented in Pakistan by two species of *Myocricetodon* and three species of *Dakkamyoides*. The Dendromurinae are represented by one species of *Potwarmus*, one species of *Paradakkamys* and two species of *Dakkamys*. The Miocene record of these six informal taxonomic groups of cricetid rodents in Pakistan represents an important chapter in the history of muroid rodents.

Key words: Miocene, cricetid, Pakistan.

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I. INTRODUCTION

Neogene sediments in Pakistan have produced a diverse and robust record of muroid rodents, including cricetids, rhizomyids, and murids. This record was reviewed, along with the less robust record of ctenodactyloid, sciurid, gerbillid, and glirid rodents, by JACOBS et al. (1989). Subsequent to that review, additional rodents from the Zinda Pir Dome in the Sulaiman foothills of central Pakistan were reported by DOWNING et al. (1993). Sediments in the Zinda Pir Dome overlap and bridge the Siwalik sedimentary sequence of the Potwar Plateau, and the early Miocene sequence in the Bugti Hills of Baluchistan (FRIEDMAN et al. 1992). These sediments also aid in the correlation of fossils from the Murree Formation in the Trans-Indus area and the Manchar Formation in eastern Baluchistan. Baluchimyine rodents similar to those reported from the Bugti area by FLYNN et al. (1986) were reported from locality Z108 in the Chitarwata Formation of the Zinda Pir Dome by FLYNN & CHEEMA (1994). Higher in the Chitarwata Formation, locality Z113 has yielded the cricetid genera *Eumyarion* THALER, 1966 and *Primus* DE BRUIJN et al., 1981, neither of which is known from Siwalik deposits. The overlying Vihowa Formation in the Zinda Pir Dome has yielded cricetid rodents similar to those from the Kamlial Formation in the Potwar Plateau (Fig. 1).

In this contribution the *Eumyarion* material from the Zinda Pir Dome is described, and a brief summary of the cricetid rodent record in Pakistan, as presently interpreted, is presented.

Specimens described below are the property of the Government of Pakistan, assigned to the Pakistan Museum of Natural History (PMNH). Terminology for cricetid teeth follows LINDSAY (1988).

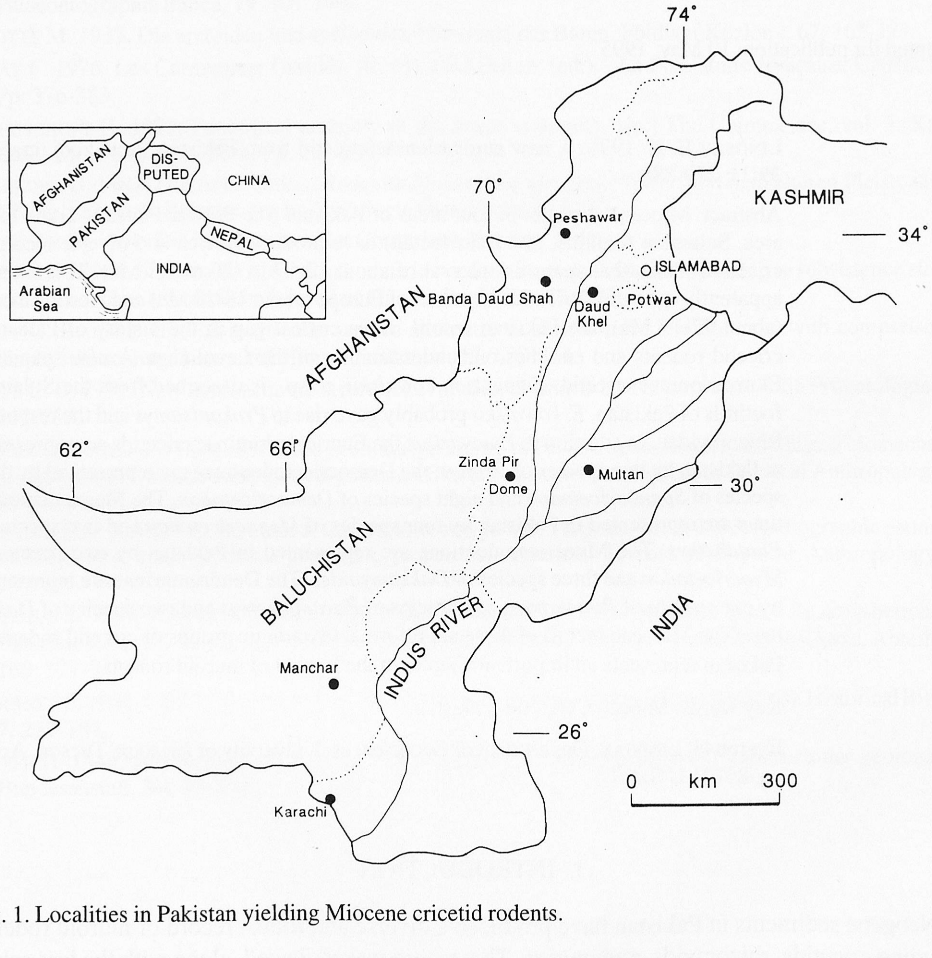

Fig. 1. Localities in Pakistan yielding Miocene cricetid rodents.

A c k n o w l e d g m e n t s. My sincere thanks are extended to the organizers of the Conference on Neogene and Quaternary Mammals of the Palearctic for providing a very informative, well-organized, and stimulating conference in an historic and charming setting. It is fitting that a conference on the history and evolution of Palearctic mammals should be held in honor of Professor Kazimierz KOWALSKI, who has made numerous contributions to knowledge of these mammals. I join the other participants and contributors to that conference in dedicating this contribution to Professor KOWALSKI, in recognition of his expertise and enduring contributions to this area of knowledge.

I also extend my gratitude to fellow workers who have provided specimens and/or casts used in this study. These individuals include Louis JACOBS, Lawrence FLYNN, Hans DE BRUIJN, Wilma WESSELS, and Jens MUNTHE. Special thanks are also extended to Will DOWNS, John BARRY, Lawrence FLYNN, Kevin DOWNING, Jessica HARRISON, and Muhammid ANWAR for assistance and labor in the collection of these specimens, and to Lawrence FLYNN for critiquing and improving this manuscript. This work was supported by the Geological Survey of Pakistan, with work coordinated by Dr. Mahmood RAZA, and the Pakistan Museum of Natural History, with work coordinated by Mr. Iqbal Umer CHEEMA. Support for the field work and study was provided by the Smithsonian Foreign Currency Program and the National Science Foundation.

II. SYSTEMATIC PALEONTOLOGY

Cricetidae ROCHEBRUNE, 1883

Eumyarioninae UNAY, 1989

Eumyarion kowalskii new species

(Fig. 2)

T y p e. PMNH Z113/679, right M1/ from locality Z113 in the Chitarwata Formation, Zinda Pir Dome, Pakistan.

D i a g n o s i s. A relatively large and robust member of the Eumyarioninae with proportionally wider and shorter cheek teeth (especially in lower molars) than most other species of *Eumyarion*. Accessory lophs (e. g., paraloph, posteriorspur of paracone, entoloph, and freely terminating posterior arm of hypoconid) are absent in *E. kowalskii*, in contrast to most other species of *Eumyarion*. M1/ with weakly bicuspid anterocone joining paracone labially by narrow anteroloph and protocone lingually by long anterior arm of protocone; M3/ with metacone indistinct or absent and central mure continuous, formed by union of protocone, protoloph, mesoloph, metaloph and hypocone; M/1 with relatively small anteroconid, joining metaconid on lingual margin and long anterior arm of protoconid labial to midline; metalophid prominent, joining protoconid centrally or posteriorly; posterior arm of protoconid directed posteriorly as mure; posterior arm of hypoconid never terminating freely; M/3 with entoconid minute or indistinct, with prominent hypolophid and posterior cingulum that continue anterior to the metaconid on the lingual side of tooth as a lingual cingulum.

D i f f e r e n t i a l d i a g n o s i s. *Eumyarion kowalskii*, new species, is larger and more robust than most other known species of *Eumyarion* (e. g., *E. microps* DE BRUIJN & SARAC, 1991, *E. intercentralis* DE BRUIJN & SARAC, 1991, *E. leemani* HARTENBERGER, 1966, *E. medium* LARTET, 1851, *E. bifidus* FAHLBUSCH, 1964, *E. weinfurteri* SCHAUB &ZAPFE, 1953, and *E. carbonicus* DE BRUIJN & SARAC, 1991); it is closest in size and inflation of cusps to *E. montanus* DE BRUIJN & SARAC, 1991, the largest previously known species of this genus. *E. kowalskii* is similar to *E. montanus* in having reduced or lost the posterior spur of the paracone in the upper molars, and the mesoloph (and mesolophid) are usually short. *E. kowalskii* differs from *E. montanus* in having a more distinctly bicuspid (and possibly less inflated and narrower) anterocone, plus absence of paraloph (=anterior arm of protocone *fide* DE BRUIJN & SARAC 1991) on M1/; the protoloph of M/2 always joins the posterior arm of the protocone; metalophid I is never present on M/1; ectolophid absent on M/2.

E t y m o l o g y. Named for Professor Kazimierz KOWALSKI, in recognition of his numerous contributions to our knowledge of small mammal evolution and biogeography.

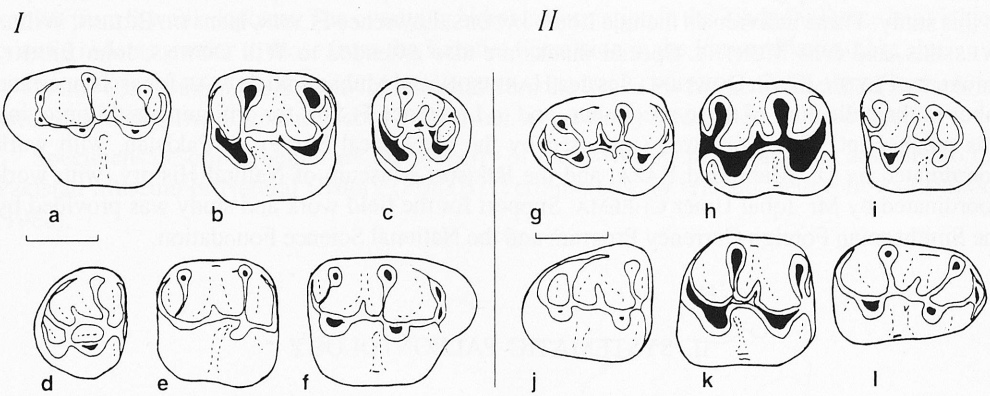

Fig. 2. *Eumyarion kowalskii*, new species. a, Z113/680, left M1/; b, Z113/697, left M2/; c, Z113/713 (reversed), right M3/; d, Z113/712, right M3/; e, Z113/698, right M2/; f, Z113/679 (type), right M1/; g, Z113/737, left M/1; h, Z113/736 (reversed), right M/2; i, Z113/721, left M/3; j, Z113/726 (reversed), left M/3; k, Z113/729, right M/2; l, Z113/739, right M/1. Bar length equals 1 mm.

H y p o d i g m. Locality Z113, type plus 16 M1/, 16 M2/, 6 M3/, 8 M/1, 8 M/2, 6 M/3; locality Z135, 1 M3/, 1 M/2.

A g e a n d d i s t r i b u t i o n. Early Miocene; Chitarwata Fm. (upper member), Zinda Pir Dome, Pakistan.

D e s c r i p t i o n. Medium sized cricetid rodent with cheek teeth having moderate height of crown and slightly inflated cusps; unilateral hypsodonty not developed.

M1/ – occlusal outline oval, longer than wide, with anterocone occupying labial 2/3 of anterior width, joining paracone labially by short anteroloph, joining protocone lingual to midline by long anterior arm of protocone; anterocone weakly bifurcated (in early to moderate wear), lacking an anterior groove or anterobasal cingulum; protocone and hypocone subequal, with long anterior arms directed obliquely toward the anterior midline, forming the mure; posterior arms of protocone and hypocone short, joining the protoloph and posterior cingulum, respectively; paracone with prominent, relatively long and straight protoloph that joins posterior mure and posterior arm of protocone; metacone with relatively short and curved metaloph that joins the posterior cingulum labial to the midline; posteriorly-directed spur of paracone indistinct or absent; mesoloph short (15 specimens) or long (one specimen); enterostyle absent (10 specimens) or minute (three specimens); lingual anterior cingulum absent; labial and lingual cingula absent (11 specimens) or very short (five specimens); posterior cingulum short and straight, joining posterior base of metacone; lingual sinus narrow and steep-walled, weakly flexed anteriorly near midline; lingual root wide, thinning in middle (five of eight specimens), becoming bifurcated (one specimen).

M2/ – occlusal outline subrectangular with rounded corners, longer than wide; labial cusps placed opposite center of lingual cusps; anterior arm of protocone relatively short, joining anterior cingulum lingual to midline; posterior arm of protocone very short, joining protoloph and posterior mure near midline; anterior arm of hypocone prominent, relatively long, directed obliquely toward midline and continuing anteriorly on midline as posterior mure; posterior arm of hypocone directed transversely and continuing as curved posterior cingulum; protoloph long and relatively straight, joining posterior arm of protocone and mure near midline; metaloph relatively long and straight, weakly joining hypocone (seven specimens) or short, curved, and joining posterior cingulum (six specimens); posterior spur of paracone indistinct or absent; mesoloph short (nine specimens) or of medium length (seven specimens); entoloph absent; anterior cingulum relatively long and straight (seven specimens) or short, not extending lingual to midline (three specimens); lingual cingulum absent (11 specimens) or minute (four specimens); labial cingulum short and low; posterior cingulum narrow, slightly curved to join posterior base of metacone; lingual sinus narrow and steep-walled, flexed anteriorly near midline; lingual root, preserved in four specimens, thin medially.

M3/ – occlusal outline suboval to subcircular, with flattened anterior margin; paracone and protocone prominent, hypocone small or minute, metacone indistinct; protoloph long and straight, joining mure near midline and protocone lingual to midline; metaloph short and distinct in seven of eight specimens; mesoloph short, terminating near (three specimens) or at (four specimens) the labial cingulum; anterior cingulum long, joining protocone and anterior side of paracone; posterior cingulum prominent, curved to join labial cingulum that continues to posterior base of paracone; deep central lake separates mure from protocone, incompletely closed between protocone and hypocone in two of seven specimens; lingual root relatively small and thin.

M/1 – occlusal outline long and narrow, more narrow anteriorly; lingual cusps placed slightly anterior relative to labial cusps; anteroconid smaller and lower than other cusps, joining metaconid by lingual posteriorly-directed anterolophid, weakly joining anterior arm of protoconid labial to midline; posterior arm of protoconid short, directed posteriorly and continuing as the posterior mure; anterior arm of hypoconid short, joining posterior mure near midline; posterior arm of hypoconid short, directed transversely and continuing as posterior cingulum; metalophid prominent, directed transversely and posteriorly to join center (five specimens) or posterior (two specimens) side of protoconid; hypolophid short, directed transversely to weakly join posterior mure; mesolophid length medium (five specimens) or short (two specimens), never reaching lingual margin; ectolophid absent (five specimens) or short (three specimens); labial anterior cingulum short, weakly joining base of protoconid; labial and lingual cingula low and short, with the exception of PMNH Z113/739, which has a prominent lingual cingulum; posterior cingulum high near midline, descending labially and curving to join the posterior base of metaconid; labial sinusid relatively wide near tooth margin, narrow and steep-walled medially and weakly flexed posteriorly; roots are prominent, lacking accessory rootlets.

M/2 – occlusal outline subrectangular with rounded corners, longer than wide; lingual cusps placed slightly anterior relative to labial cusps; anterior arms of protoconid and hypoconid short, joining anterior cingulum and posterior mure, respectively; posterior arms of protoconid and hypoconid prominent, directed obliquely, continuous with the posterior mure and posterior cingulum, respectively; metalophid and hypolophid relatively long, directed transversely and slightly curved anteriorly, joining anterior cingulum and posterior mure, respectively; mesolophid short, directed transversely from short posterior mure; ectolophid absent; anterior cingulum long and narrow, closely appressed to metaconid lingual to midline, descending labial to midline and flexed to join labial base of protoconid; labial cingulum short and low; lingual cingulum absent or very short; posterior cingulum prominent, curved, joining posterior entoconid to enclose long posterolabial lake; labial sinusid narrow and steep-walled, weakly flexed posteriorly near midline; roots well developed, with no accessory rootlets.

M/3 – occlusal outline oval, slightly wider anteriorly with a straight anterior margin; lingual cusps placed slightly anterior relative to labial cusps; protoconid and metaconid prominent, hypoconid slightly smaller, entoconid minute (nine specimens) or indistinct (one specimen); anterior arms of protoconid and hypoconid very short, joining anterior cingulum and posterior mure, respectively; posterior arms of protoconid and hypoconid short, directed transversely and continuing as posterior mure and posterior cingulum, respectively; metalophid slightly curved, joining anterior cingulum; hypolophid low and relatively straight, directed transversely to join mure and anterior hypoconid; mesolophid short to medium length, never reaching lingual margin;

ectolophid absent; anterior cingulum long and narrow, closely appressed to metaconid and protoconid; labial cingulum short and low; lingual cingulum high and narrow, continuous from metaconid to entoconid; posterior cingulum prominent, strongly curved and continuing lingually to join metaconid; labial sinusid narrow and steep walled, especially near midline; roots well developed, accessory rootlets not seen.

Measurements of this material are given in Table I.

Table I

Dental measurements (in millimeters) of *Eumyarion kowalskii*

	Length				Width			
	N	X	S	O.R.	N	X	S	O.R.
M1/	9	2.29	0.13	2.14-2.52	12	1.64	0.09	1.52-1.86
M2/	10	1.69	0.07	1.57-1.82	12	1.67	0.08	1.60-1.87
M3/	5	1.35	0.03	1.32-1.40	6	1.44	0.08	1.33-1.52
M/1	5	1.97	0.05	1.88-2.01	6	1.41	0.06	1.32-1.48
M/2	5	1.78	0.07	1.68-1.86	4	1.61	0.10	1.52-1.72
M/3	9	1.71	0.07	1.59-1.80	8	1.50	0.07	1.38-1.60

III. DISCUSSION

Eumyarion kowalskii, new species, is considered a derived member of the Eumyarioninae, most similar in size, and probably closest phyletically, to *Eumyarion montanus* among species of *Eumyarion*. Note that DE BRUIJN et al.(1993) abandoned the Eumyarioninae, including these taxa (along with *Cricetodon* LARTET, 1851, *Hispanomys* MEIN & FREUDENTHAL, 1971, *Ruscinomys* DEPERET, 1890, *Byzantinia* DE BRUIJN, 1976, *Zramys* JAEGER, MICHAUX & DAVID, 1973, *Deperetomys* MEIN & FREUDENTHAL, 1971 and *Meteamys* DE BRUIJN et al., 1992) in a broader taxonomic framework they called the Cricetodontinae. I see merit in the separation of Eumyarioninae (initially proposed by ÜNAY 1989) as a distinct lineage among the Cricetidae, probably ancestral to *Anomalomys* GAILLARD, 1900 (as proposed by DE BRUIJN & SARAC 1991) and the Rhizomyidae, and shall continue to recognize this lineage. *E. kowalskii* has a special place in that lineage as a possible ancestor of the Rhizomyidae. To be more direct, *E. kowalskii* is lower crowned, less lophate, and slightly larger than *Prokanisamys arifi*, described from the Murree Formation (along with *Primus* DE BRUIJN et al., 1981 and *Spanocricetodon* LI, 1977), by DE BRUIJN et al. (1981). In both *E. kowalskii* and *P. arifi* the M/1 and M/3 are about equal in size, with M/3 slightly smaller. In describing *P. arifi*, DE BRUIJN et al. (1981) noted that the height of the lophs was almost as great as the cusps (i. e., lophate), and that the M/3 was shorter and usually narrower than the M/1. In *E. kowalskii* the lophs are lower than the cusps (i. e., cuspate), and the M/3 is shorter and usually wider than the M/1. DE BRUIJN et al. (1981) noted that the hypolophulid (=hypolophid in the above descriptions) of the lower molars in *P. arifi* is directed posterolabially. Casts, illustrations, and specimens of *P. arifi* available to me suggest that this is not a consistent character; the hypolophids in the lower molars of *P. arifi* appear directed transversely, with possibly a slight flexure anteriorly near the midline, virtually identical to the hypolophid seen in *E. kowalskii* and Turkish species of *Eumyarion* (e. g., *E. microps, E. intercentralis, E. carbonicus*, and *E. montanus*) illustrated by DE BRUIJN et al. (1993).

These similarities suggest that *E. kowalskii* is closely related to *P. arifi*. I consider that *E. kowalskii* can be confidently separated from *P. arifi* on the basis of lower crown height, more cuspate cheek teeth, and shorter M/3 that is usually wider than M/1. As interpreted here, the biochrons of these two species do not overlap in the Zinda Pir Dome. The record of *E. kowalskii* (locs. Z113 and Z135) is stratigraphically lower than the earliest record of *P. arifi* (Z126), suggesting that *E. kowalskii* may have given rise to *P. arifi*.

IV. THE RECORD OF CRICETID RODENTS IN PAKISTAN

The stratigraphic record of cricetids from Pakistan, as presently interpreted, is illustrated in Fig. 3. Locality Z113 in the Zinda Pir Dome, with both *Eumyarion* and *Primus*, is interpreted the oldest site yielding cricetids in Pakistan. Locality Z113 was correlated with the base of magnetic chron C6N, at about 20 Ma, by FRIEDMAN et al. (1992) and DOWNING et al. (1993). Locality H-GSP116, from the Murree Formation near Banda Daud Shah, with *Primus*, *Spanocricetodon*, and *Prokanisamys* (DE BRUIJN et al. 1981), is interpreted slightly younger (about 19.5 Ma) than locality Z113. This interpretation is based primarily on the appearance of *P. arifi* at locality H-GSP 116 (and at locality Z126, at the top of the Chitarwata Fm. in the Zinda Pir Dome), interpreted as being derived relative to *E. kowalskii* from loc. Z113 (as discussed above).

The base of the Siwalik sequence in the Potwar Plateau is considered about 18.3 Ma (JOHNSON et al. 1985) and cricetids are well represented in the lower part of that sequence. The youngest known record of cricetids in Siwalik deposits of the Potwar Plateau is from locality Y387 in the Dhok Pathan Fm., interpreted about 7.5 Ma by JOHNSON et al. (1985).

In reviewing published accounts of cricetids to prepare Fig. 3 I have revised some of the identifications of cricetids from Pakistan, as published. These revised identifications include specimens from the Potwar Plateau and Zinda Pir Dome that I have studied plus specimens from sites that I have not studied. Revised identifications of specimens that I have not studied are in most instances based on casts of the published specimens. Revised identifications are discussed briefly below.

Eumyarion kowalskii, new species

In previous reports on cricetids from Pakistan (e. g., DOWNING et al. 1993; LINDSAY 1994) this taxon was reported as *Eucricetodon.* I thank Dr. Remmert DAAMS for suggesting at the conference in Kraków, that I should compare this taxon to species of *Eumyarion* described from Turkey by DE BRUIJN & SARAC (1991).

Spanocricetodon LI, 1977

Two species of *Spanocricetodon* (*S. lii* and *S. khani*) were described by DE BRUIJN et al. (1981) from the Murree Formation near Banda Daud Shah; *S. lii* was also listed from locality Gaj 81-06 in the Manchar Formation by DE BRUIJN & HUSSAIN (1984). Both *S. lii* and *S. khani* have been identified from locality Z135 in the Chitarwata Fm., Zinda Pir Dome.

Democricetodon FAHLBUSCH, 1964

The only species of *Democricetodon* rigorously described from Neogene sediments in Pakistan is *Democricetodon kohatensis* WESSELS et al. (1982). Seven additional species of *Democricetodon* (species X, A, B-C, E, F, G, and H) have been reported but not formally described by LINDSAY (1994). In addition, *Democricetodon* sp. X is probably similar (if not identical) to the species referred questionably to *Democricetodon* cf. *franconicus* from the Manchar Formation (localities Gaj 81-06, Sehwan 81-14 and 82-27 by DE BRUIJN & HUSSAIN (1984). *Democricetodon* sp. A is probably recorded from localities Sehwan 81-14 and 82-27 in the Manchar Formation (listed as *Democricetodon* aff. *kohatensis*) by DE BRUIJN & HUSSAIN (1984). The species reported as

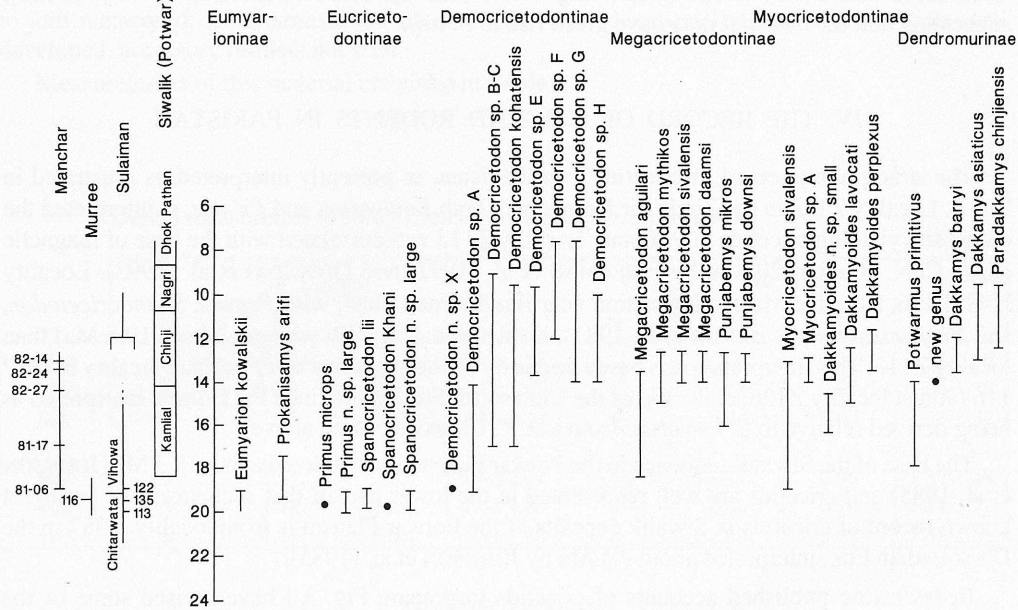

Fig. 3. Chronologic ranges of Miocene cricetid rodents in Pakistan.

Democricetodon cf. *kohatensis* from locality Jal 101 by CHEEMA et al. (1983) probably includes both *Democricetodon* sp. B-C and *D. kohatensis*. The species described as *Copemys* (*Democricetodon*) sp. from the Chinji Formation near Daud Kehl by HUSSAIN et al. (1977) and HUSSAIN et al. (1979) probably includes *Democricetodon* sp. B-C, *D. kohatensis*, *Democricetodon* sp. E, and *Democricetodon* sp. G. The species described as *Democricetodon* cf. *gaillardi* (a European species) from locality Jal 101 by CHEEMA et al. (1983) probably includes *Democricetodon* sp. E and *Democricetodon* sp. F.

Megacricetodon FAHLBUSCH, 1964

The species described as *Megacricetodon* sp. from locality H-GSP 107 by WESSELS et al., (1982) probably includes *Megacricetodon mythikos*, which is known from the Kamlial and Chinji Formations in the Potwar Plateau.

Punjabemys LINDSAY, 1988

Punjabemys leptos LINDSAY, 1988 is now included in *Punjabemys downsi* LINDSAY, 1988. *Punjabemys mikros* LINDSAY, 1988 and *P. downsi* are probably present in the material described as *Megacricetodon* sp. from locality H-GSP 107 by WESSELS et al. (1982). *P. mikros* is probably the taxon reported as Genus II sp. from localities Gaj 81-06, Sehwan 81-14, 82-27, 82-24, and Gaj 82-14 in the Manchar Formation by DE BRUIJN & HUSSAIN (1984).

Myocricetodon LAVOCAT, 1952

Myocricetodon sp. A of LINDSAY (1988) is identified as the species reported as *Myocricetodon* sp. from the Chinji Formation by HUSSAIN et al. (1977) and HUSSAIN et al. (1979). This species is probably also the taxon identified as Genus I sp. from the Manchar Formation (localities Gaj 81-06, Sehwan 81-14, and Gaj 82-14) by DE BRUIJN & HUSSAIN (1984).

Dakkamyoides LINDSAY, 1988

Dakkamyoides lavocati LINDSAY, 1988 is identified as the species reported from the Chinji Formation (locality H-GSP 107) as *Dakkamys* sp. by WESSELS et al. (1982). An undescribed small new species of *Dakkamyoides* is probably the taxon described as *Myocricetodon* sp. I from localities Sehwan 81-14 and 82-24 by DE BRUIJN & HUSSAIN (1984), and described as *Myocricetodon* cf. *M. parvus* by WESSELS et al. (1987).

Potwarmus LINDSAY, 1988

Antemus primitivus WESSELS et al. (1982) was named the type of *Potwarmus* LINDSAY, 1988. *P. primitivus* is known from the Manchar Formation, reported as *Antemus* sp. 1 from locality Sehwan 81-14 and as *Antemus primitivus* from localities Sehwan 82-27 and 82-24 by DE BRUIJN & HUSSAIN (1984).

Dakkamys JAEGER, 1977

Dakkamys barryi LINDSAY, 1988 is considered the taxon reported (as *Dakkamys* sp.) from locality H-GSP 107 near Banda Daud Shah by WESSELS et al. (1982). *Dakkamys asiaticus* LINDSAY, 1988 is considered the taxon reported (as *Dakkamys* sp.) from locality Jal-101 by CHEEMA et al. (1983) and from locality Gaj 82-14 in the Manchar Formation by DE BRUIJN & HUSSAIN (1984).

Paradakkamys LINDSAY, 1988

Paradakkamys chinjiensis LINDSAY 1988 is considered the taxon reported (as *Myocricetodon* sp.) from locality Jal-101 by CHEEMA et al. (1983).

Six lineages of cricetids are recognized in the fossil record of Pakistan. These include the Eucricetodontinae of MEIN & FREUDENTHAL (1971), the Eumyarioninae of ÜNAY (1989) and DE BRUIJN & SARAC (1991), plus the Democricetodontinae, Megacricetodontinae, Myocricetodontinae and Dendromurinae of LINDSAY (1988).

Primus (two species) is the only cricetid genus from Pakistan that is assigned to the Eucricetodontinae, and *Eumyarion* (one species) is the only cricetid genus from Pakistan assigned to the Eumyarioninae. *Spanocricetodon* (three species) and *Democricetodon* (eight species) are assigned to the Democricetodontinae. *Megacricetodon* (four species) and *Punjabemys* (two species) are assigned to the Megacricetodontinae. *Myocricetodon* (two species) and *Dakkamyoides* (three species) are assigned to the Myocricetodontinae. *Potwarmus* (one species), *Dakkamys* (two species), and *Paradakkamys* (one species) are assigned to the Dendromurinae. These six cricetid lineages are represented by 29 species whose combined temporal range is about 12.5 Ma (20 to 7.5 Ma). Cricetid rodents were abundant and diverse members of the Early to Middle Miocene mammal fauna of southern Asia; their success can be measured by 1) their diversity and 2) the families of rodents they spawned (e. g., Rhizomyidae from *Eumyarion* and Muridae from *Potwarmus*).

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