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Gliridae (Mammalia: Rodentia) from the Miocene of the Zaisan Depression (Eastern Kazakhstan)

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Abstract. Three species of Gliridae belonging to the genera *Microdyromys*, *Miodyromys* and *Prodryomys* have been identified from the Miocene layers of the Zaisan Depression in Eastern Kazachstan. This is the first locality of Miocene dormice known from Kazakhstan and one of few such localities in Asia. All species were probably associated with the open, semi-arid environment.

Key-words: fossil mammals, rodents, *Gliridae*, Miocene, Kazakhstan.

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I. INTRODUCTION

The dormice (Gliridae), numerous and diversified in the fossil and recent faunas of Europe, are rare in Asia (HARTENBERGER 1994). To-day six genera of this family of rodents are present on the Asian continent: *Glirulus* THOMAS, 1896 inhabits Japan, *Dryomys* THOMAS, 1906 ranges across western and central Asia, *Eliomys* WAGNER, 1840 is distributed, besides most of Europe and North Africa, also in western Asia, *Glis* BRISSON, 1762 is present in the Caucasus, Iran and Turkmenistan, whereas *Myomimus* OGNEV, 1924 populates the Middle East and parts of Central Asia (WILSON, REEDER 1992). The systematic position of the genus *Chaetocauda* WANG, 1985, discovered in China is uncertain (DAAMS, DE BRUIJN 1995).

The fossil remains of dormice are very scarce in Asian paleontological localities with the exception of Anatolia, where Early Miocene localities provided a rich fauna of Gliridae, similar to the European one in generic composition but represented by different species. The composition of the fauna suggests the humid environment (FLYNN & JACOBS 1990, BRUIJN et all. 1992, ÜNAY 1994).

Since the Middle Miocene dormice have been represented in the Middle East only by the genus *Myomimus* (SEN 1991). It survived until the Holocene in continental Anatolia (CORBET & MORRIS 1967), was present in the Pliocene of Rhodes (BRUIJN et al. 1970) and in the Quaternary of the islands Kalymnos (KUSS & STORCH 1978) and Chios (STORCH 1975). *Myomimus* is also present in the Pleistocene and Holocene of Israel (BATE 1937, HAAS 1973, TCHERNOV 1968, 1986).

In Southern Georgia GABUNIA & BENDUKIDZE (1990) listed *Peridyromys* aff. *murinus* (POMEL, 1853) from the Oligocene of Benara.

In Southern Asia *Myomimus* was identified from the Miocene of Pakistan (MUNTHE 1980, WESSELS et al. 1982), being represented there by *M. sumbalenwalicus* MUNTHE, 1980.

Fossil remains belonging to the recent species *Glirulus japonicus* (SCHINZ, 1845) inhabiting Honshu, Shikoku and Kyushu have been found in the Pleistocene and Holocene sediments of Japan (KOWALSKI & HASEGAWA 1976, KAWAMURA 1989).

In 1985 WU published the discovery of the new species *Myomimus sinensis* from the latest Miocene or early Pliocene localities Ertemte and Harr Obo in Inner Mongolia, China. In the next year WU (1986) described some other fossil dormice, which she named *Microdyromys orientalis* WU, 1986 from the Middle Miocene fauna of Shuanggou (Sihong, Jiangsu, China). It was the first Asian record of the genus so far known from the Miocene of Europe.

In the Lower Eocene Obayla svita of the Zaisan Depression SHEVYREVA (1992) discovered a single tooth, which, according to her, represents a new genus and species of primitive glirids, *Chaibulakomys angos*.

The teeth of dormice collected by N. S. SHEVYREVA in the Miocene layers of the Zaisan Depression during her personal investigation and described in the present paper therefore substantially enrich the knowledge of the history of that family of rodents in Asia.

The material described below is deposited in the collection of the Paleontological Institute of the Russian Academy of Sciences in Moscow (PIN).

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II. THE ZAISAN DEPRESSION

The Zaisan Depression is relatively well known from the geological point of view (see RUSSEL & ZHAI 1987 for bibliography). In the years 1961-1991 N. S. SHEVYREVA conducted a field-study of small mammals in this region which led to the discovery of numerous fossil localities containing material concerning this group as well as other groups of vertebrates, invertebrates and plants in layers spanning the periods from the Lower Eocene to the Upper Pliocene. So far, descriptions of selected elements of the rodent fauna have been published in numerous papers by SHEVYREVA in the years 1968-1996 (e. g. SHEVYREVA 1984, 1994).

The remains of dormice described below originate from the Zaisan Depression and were collected in several localities situated at the foot of the Saykan Range. One locality, Batpaksunde, is situated in the outcrops of the Akzhar Svita located between the rivers Bittybulakh and Terekt. The localities "Point Y" and "Point I" belong to two horizons of the Sarybulak Svita outcrops ocurring on the right bank of the Sarybulak River. Locality Tarbagan is in the stratotype of the Sarybulak Svita situated on the right bank of the Kalmakpay River.

According to the stratigraphical scheme presented by BORISOV (1963), the Akzhar Svita belongs to Lower Miocene and the Sarybulak Svita to the Upper Miocene. This correlation is made mainly on the basis of the stratigraphic position of these two svitas in the section. Their paleontological dates were based on unfrequent discoveries of large mammals (identified by L. K. GABUNIA), molluscs (G. G. MARTINSON & N. W. TOLSTIKOVA), plant macrofossils (J. A. ILJINSKAYA) and pollen (L. A. PANOVA).

One tooth of dormice described below from the locality Batpaksunde originates from the upper part of the Akzhar Svita. It is equivalent of layer 248 in BORISOV's section (1963, p. 62).

The locality Tarbagan is connected with sediments of the lower subsvita of the Sarybulak Svita which evidently are equivalents of layer 279 or 280 (BORISOV 1963, p. 64).

The localities on the bank of the Sarybulak River are also connected with the lower part of the Sarybulak Svita. The stratigraphic position of the locality "Point I" corresponds with layer 279 (BORISOV 1963, p. 64). The locality "Point Y" is situated below the "Point I" (2.5 - 3 m); its stratigraphic position corresponds, in all probability, with the layer 278 (BORISOV 1963, p.63).

III. SYSTEMATIC PART

Family Gliridae THOMAS, 1897

Genus *Microdyromys* DE BRUIJN, 1966)

Microdyromys cf. *orientalis* WU 1986

(Fig. 1)

M a t e r i a l: Right M^2 (PIN, No 2978 - 8; L = 1.12, W = 1.27 mm, Fig. 1: A) from the locality Tarbagan). Another specimen, right M^1 (PIN, No 2977-3955, L = 1.02, W = 1.25 mm, Fig. 1: B), originates from the locality "Point I" on the bank of the Sarybulak, and is so heavily worn that its membership in this species cannot be established for a certainty.

D e s c r i p t i o n. M^2 (Fig. 1: A) has three roots. Its occlusal surface is distinctly concave. The protocone and paracone are prominent. The anterior centroloph is much better developed than the posterior one. The centrolophs do not join at the centre of the tooth and do not reach the endoloph. The tooth represents morphotype H of DAAMS (1981). The anterior extra ridge is low, the posterior extra ridge is absent. The lingual wall of the crown is ornamented.

M^1 (Fig. 1: B) has also three roots. The pattern of the occlusal surface of the crown is nearly completely obliterated.

R e m a r k s. M^2 has all the characteristics of the genus *Microdyromys*. So far seven species of this genus have been described from the fossil sites of Europe, ranging from the Late Oligocene to the Middle Miocene. Another species, *M. orientalis*, has been described from the Aragonian of Xiacaowan in China.

In *M. koenigswaldi* DE BRUIJN, 1966 the molars are larger than the tooth from the Zaisan Depression. In *M. praemurinus* (FREUDENBERG, 1941), *M. legidensis* DAAMS, 1981 and *M. monspeliensis* AGUILAR, 1977 they are smaller. In *M. sinuosus* (ALVAREZ SIERRA, 1986) the ridges

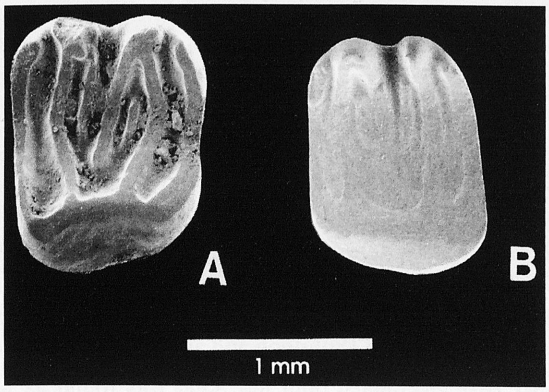

Fig. 1. *Microdyromys* cf. *orientalis*, Zaisan Depression. A – right M^2 (PIN, No 2978-8), Tarbagan. B – left M^1 (PIN, No 2977-3955), Sarybulak River, "Point I".

are sinuous, whereas in the Zaisan Depression specimen they are not. The first of the authors has directly compared the specimens from Zaisan with a sample of *M. complicatus* DE BRUIJN, 1966 from Sansan. The Zaisan specimens are similar to the specimens from Sansan in size, but differ from them in their less well developed additional ridges. The teeth from Zaisan resemble the specimens of *M. orientalis*, but compared directly with the cast of them are visibly larger.

The existing material is not sufficient for an unquestionable identification at species level, but evidently belongs to the group of *Microdyromys orientalis.*

Genus *Miodyromys* KRETZOI, 1943

Miodyromys cf. *biradiculus* MAYR, 1979

(Fig 2)

M a t e r i a l. 12 isolated teeth (1 dP_4, 1 P_4, 2 M_1, 3 M_2, 1 M_3, 2 M^1, 1 M^2, 1 M^3) from the "Point I" locality and 1 M^2 from the "Point Y" locality.

D e s c r i p t i o n. Occlusal surface of the crown moderately concave, crowns low.

Left dP_4 (PIN No 2977-2299, Fig. 2: A) has an elongated crown, distinctly narrowed in its anterior part. The roots are not preserved but probably there were two. The anterior part of the crown is composed of a semicircular anterolophid and of two irregular ridges, one of them connected with the labial part of the anterolophid. Between the mesolophid and posterolophid is a well- developed accessory ridge.

Right P_4 (PIN, No 2977-2304, Fig. 2: B) has one long root marked both lingually and labialy with a groove, and divided near its end. The crown, heavily worn, is nearly round, with an oval ridge on its anterior part. The posterior part of the crown is composed of the mesolophid and posterolophid. There is no accessory ridge between them.

M_1 is represented by 2 specimens. Both are two-rooted. Their crown is slighty narrower in its anterior part. Right M_1 (PIN, No 2977-2294, Fig. 2: C) is nearly unworn. Its crown is composed of 5 main ridges, the centrolophid is lingually connected with the metaconid. There is only one, moderately well-developed extra ridge, situated between the posterolophid and mesolophid. Left M_1 (PIN, No 2977-2293, Fig. 2: D) is much more worn. It has two extra ridges, one moderately well-developed between mesolophid and posterolophid, the other very short between the endolophid and centrolophid.

There are 3 specimens of M_2, all left. They are all two-rooted, the crown is similar in width in its anterior and posterior parts. In one specimen (PIN, No 2977-2297, Fig. 2 E) there is only one extra ridge between the mesolophid and posterolophid. This extra ridge is present in all specimens, but in the remaining two (Figs 2: F-G) there is also another ridge, situated between the centrolophid and metalophid. In the specimen PIN, No 2977-2296, Fig. 2: G the centrolophid is interrupted in the middle of its length and in another the structure of the antero-labial part of the crown is particularly complicated.

M_3 represented by one left specimen (PIN, No 2977-2298, Fig. 2: H) is two-rooted with a subtriangular crown. It has two extra ridges, one between the mesolophid and posterolophid and the other rudimentary, situated anteriorly to the centrolophid.

Two M^1 (left, PIN, No 2977-2305, Fig. 2: I, and right, PIN, No 2977-2300, Fig 2: J) are very similar. They are three-rooted. The crown is composed of four main ridges and two centrolophs. There are no extra ridges. The anterior centroloph is longer; the centrolophs do not fuse together but end free in the middle of the crown. Protoloph and anteroloph join separately the endoloph.

M^2 is represented by two specimens, both left. One was found as were all the specimens described above, in the "Point I" locality (PIN, No 2977-2306, Fig. 2: K), the other in the locality "Point Y" (PIN, No 2977-2952, Fig. 2: M). They are three-rooted and resemble M^1, but their crowns

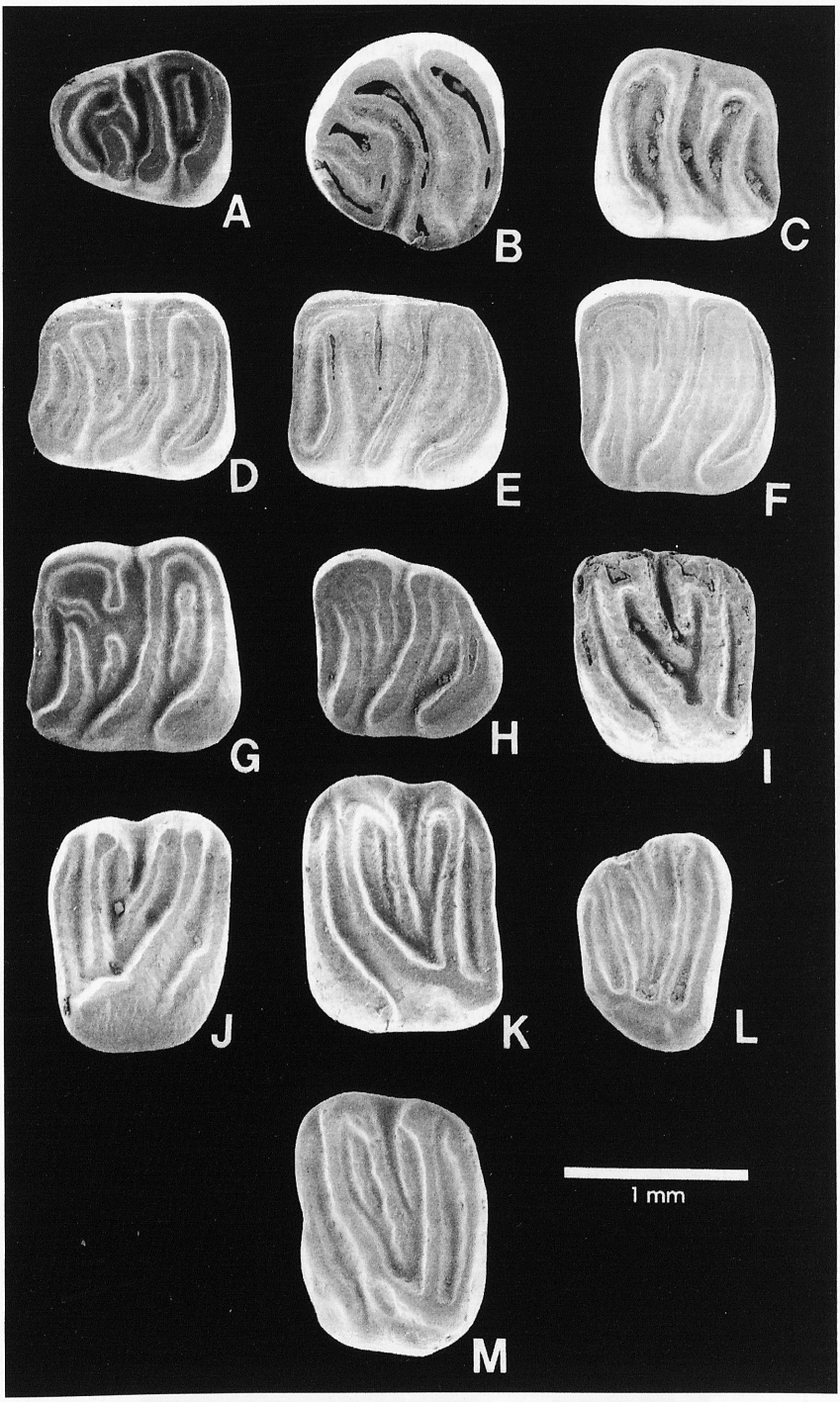

Fig. 2. *Miodyromys* cf. *biradiculus*, Zaisan Depression. A-L – Sarybulak River, "Point I", M – Sarybulak River, "Point Y". A – left dP_4 (PIN, No 2977-2299), B – right P_4 (PIN, No 2977-2304), C – right M_1 (PIN, No 2977-2294), D – left M_1 (PIN, No 2977-2293), E – left M_2 (PIN, No 2977-2297), F – left M_2 (PIN, No 2977-2295, G – left M_2 (PIN, No 2977-2296), H – left M_3 (PIN, No 2977-2298), I – left M^1 (PIN, No 2977-2305), J – right M^1 (PIN, No 2977-2300), K – left M^2 (PIN, No 2977-2306), L – right M^3 (PIN, No 2977-2302), M – right M^2 (PIN, No 2977-3952).

are broader and more rectangular. In both there are two centrolophs, the anterior longer than the posterior one. They end free without fusing together or joining the endoloph. There is one accessory ridge between the protoloph and the anterior centroloph.

M^3 is represented by one right specimen, (PIN, No 2977-2302, Fig. 2: L), three-rooted. The occlusal surface of the crown has 6 main ridges. The anteroloph is lingually separated from the endoloph. The anterior centroloph is shorter than the posterior one. An extra ridge between the posterior centroloph and the metaloph is present.

D i m e n s i o n s. See Table I.

R e m a r k s. All the isolated teeth described above belong to one species, showing only little variability. They were collected in two localities, both belonging to the Sarybulak Svita of the Zaisan Depression.

The teeth belonged to a medium-sized glirid with low crowns, having moderately concave occlusal surface. M^{1-2} have four main ridges and two centrolophs. The anterior centroloph is longer than the posterior one. The centrolophs do not fuse with the middle part of the metaloph. In lower molars the accessory ridge between mesolophid and posterolophid is either a single accessory ridge or is better developed than the extra ridge between the endolophid and centrolophid. The characters enumerated above conform to the generic diagnosis of *Miodyromys* (MAYR 1979). A direct comparison of the specimens from the Zaisan Depression with the European *Miodyromys* also points to the membership of this Asian specimens in this genus.

Seven species of the genus *Miodyromys* have been described so far. Of them, *M. hamadryas* (MAJOR, 1899) is larger than our specimens and its M_{2-3} are three-rooted, whereas all the lower molars from Zaisan are two-rooted. *M. hugueneyae* AGUSTI & ARBIOL, 1989, known only from the Oligocene of Spain, was larger than the form from the Zaisan Depression and its lower molars have anterior extra ridge lacking in our specimens. *M. aegercii* BAUDELOT, 1972 and *M. vagus* MAYR, 1979 have three roots in lower molars and are also larger than the teeth from Zaysan. *M. praecox* WU, 1993 from Stubersheim 3 in Germany (MN 3) has most characters (two-rooted lower molars, dimensions) identical with those of *M. biradiculus* MAYR, 1979, differs however from the latter and from the Zaisan specimens in well developed accessory ridges in lower molars.

Table I

Dimensions of molars of *Miodyromys* cf. *biradiculus* (in mm)

Tooth	Coll. No (PIN)	L	W
Sarybulak River, "Point J"			
dP_4 sin.	2977-2299	0.76	0.63
P_4 dex.	2977-2304	0.83	0.80
M_1 dex.	2977-2294	1.01	0.96
M_1 sin.	2977-2293	1.09	1.02
M_2 sin.	2977-2297	1.17	0.98
M_2 sin.	2977-2295	1.16	1.08
M_2 sin.	2977-2296	1.15	1.16
M_3 sin.	2977-2298	1.12	0.94
M^1 sin.	2977-2305	1.09	1.12
M^1 sin.	2977-2300	1.05	1.22
M^2 sin.	2977-2306	1.12	1.30
M^3 dex.	2977-2302	0.80	1.14
Sarybulak River, "Point Y"			
M^2 sin.	2977-2952	1.18	1.40

All the characters of the specimens from Zaisan agree with those of the species *Miodyromys biradiculus* MAYR, 1979. The scarcity of material and the great geographical distance of the sites from the range of all the other species of the genus demand caution in specific identification.

So far the genus *Miodyromys* has been known from Western Europe (Spain, Portugal, France, Switzerland, Germany), extending in time from the Upper Oligocene to the Upper Miocene (MN 9). *M. biradiculus*, first described from Wintershof – West in Germany (MN-3) was later identified also from other German localities as well as from France occurring from MN 3 to MN 4.

Prodryomys MAYR, 1979

Prodryomys sp.

(Fig. 3)

M a t e r i a l. One right M_2 (PIN, No 4059-829: L = 1.30, W = 1.33 mm, Fig. 3: A) was collected at the locality Batpaksunde in the upper part of the Akzher Svita. Another, slightly damaged right M^1 (PIN, No 2978-8, L = 1.23, W = 1.32 mm, Fig. 3: B) was discovered at the locality Tarbagan, in the sediments of the Sarybulak Svita.

D e s c r i p t i o n. Right M_2 (PIN No 4059 - 829, Fig 3: A) is three-rooted. The crown is moderately concave, the ridges are low and the valleys shallow and broad. The tooth is nearly as broad as long, it is broader in its anterior part. The anterolophid is labially separated from the metalophid. There is a well-developed centrolophid ending free in 3/4 of the width of the tooth. One accessory ridge is situated between the mesolopid and posterolophid and one between the anterolophid and metalophid, posterior one being better developed than the anterior.

Right M^1 (PIN No 2978-8, Fig 3: B) is three-rooted. Its crown is moderately concave. The anteroloph and protoloph run parallel and obliquely in a postero-lingual direction. The centrolophs are of similar size. They fuse together in the middle of the tooth and continue forming an Y. The trigone is V-shaped. There are two accessory ridges of similar size, one anteriorly, the other posteriorly to the centrolophs.

R e m a r k s. The M_2 described above differs from M_2 of *Miodyromys* from Zaisan in different shape of the crown which in *Miodyromys* is generally narrower and does not broaden anteriorly, in wider and shallower valleys, and the presence of three roots. It is also larger.

The M^1 differs from both specimens of M^1 of *Miodyromys* from Zaisan in having fused centrolophs, the presence of accessory ridges and larger dimensions.

The characters of the teeth described above well fit the definition of *Prodryomys*. According to WU (1993), there are four species of this genus: *P. satus* MAYR, 1979, *P. brailloni* (THALER,

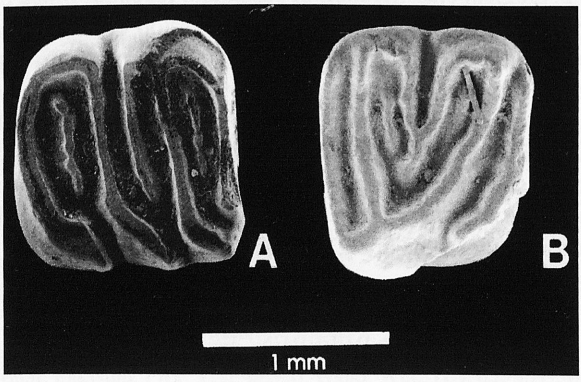

Fig. 3. *Prodryomys* sp., Zaisan Depression. A – Batpaksunde, right M_2 (PIN, No 4059-829), B – Tarbagan, right M^2 (PIN, No 2978-8).

1966), *P. prosper* (THALER, 1966) and *P. gregarius* (DEHM, 1950). *P. satus* and *P. brailloni* have two roots in lower molars whereas our specimen is three-rooted. *P. prosper* resembles very much *P. brailloni*. I was unable to find any data about the number of roots in *P. prosper*, but according to AGUILAR's (1974) description the morphology of the crown differs from that in M_2 from Zaisan. In *P. gregarius* from MN 3 to MN 4 of Western Europe there are three roots in M_2, as in our specimen from Zaisan, but our form is much smaller.

The material of *Prodryomys* from Zaisan is too scarce for specific identification.

The genus *Prodryomys* is known from Western Europe (Spain, France, Germany). Its range extended in time from the Lower (MN 2) to Upper Miocene (MN 6). It is possible that it is a direct ancestor of the recent genus *Dryomys*.

IV. DISCUSSION

The fauna of glirids of the Zaisan Depression with its three species distributed in three different layers (Table II) is so far the richest fauna of this group of rodents in Asia outside Anatolia. The presence of *Microdyromys* cf. *orientalis* and *Miodyromys* cf. *biradiculus* may suggest Early Middle Miocene age for the Sarybulak Svita in the Zaisan Depression. *Microdyromys orientalis* was found in the fauna dated, according to WU (1986), at "Middle Aragonian" or "Early Middle Miocene". *Miodyromys biradiculus* is present in Europe in the faunal assemblages belonging to the mammalian zones MN 3 and MN 4. Of course, the presence of these forms in Kazakhstan was not necessarily contemporaneous with their appearance in Europe or in distant parts of China.

Table II

Number of molar specimens of Gliridae from the of Zaisan Depression localities

Locality	*Microdyromys* cf. *orientalis*	Miodyromys cf. *biradiculus*	Prodryomys sp.
Sarybulak River "Point I"	1	14	–
Sarybulak River "Point Y"	–	1	–
Tarbagan	1	–	1
Batpaksunde	–	–	1

According to the ecological classification of fossil and recent dormice proposed by MEULEN & BRUIJN (1982), the forms present in the Zaisan Depression belong to three different groups. *Prodryomys* is a member of the "basined molar group" containing omnivorous species living "in open country and forests with rocky substrate, largely ground-dwellers". *Microdyromys* belongs to "simple intermediate group" with omnivorous species, inhabiting "mainly forests, but also open country". The "asymmetrical group" with *Miodyromys* as its member is probably mainly vegetarian, but contains forms of "open country, ground-dwelling". Groups containing typical forest species are not present in the Zaisan Depression. The composition of dormice in the Miocene layers of the Zaisan Depression suggests the open, semi-arid paleoenvironment.

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