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# Diversity of Late Neogene–Pleistocene small mammals of the Baikalian region and implications for paleoenvironment and biostratigraphy: An overview

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**Abstract**

Gradual cooling in the Northern latitudes and intensive orogenic processes led to a prominent environmental change in Eurasia during the Pliocene. The climate changed towards arid and cool conditions. This resulted in a significant reorganization of the biogeocenosis of the Baikalian region. Several open landscape dwellers appeared in mammal faunas. The diverse small mammal species are characteristic of the faunas of Transbaikalia and Prebaikalia. However, the Prebaikalian fauna slightly differs from Transbaikalian one as it includes some peculiar species. Further trends of gradual climatic changes led to significant differences in the biota of these two regions that continue to exist at present.


## 1. Introduction

The Baikalian region includes the territories of Prebaikalia and Western Transbaikalia, respectively, located westwards and eastwards of Lake Baikal. These territories stretch from 47°N to 59°N and 102°E to 114°E (Fig. 1). Prebaikalia is situated on the south-eastern borderland of the Siberian platform, one of the stable blocks of the Asiatic continent, while Western Transbaikalia is a part of the Central-Asian fold belt formed during the long geological evolution of the Paleoasian ocean. The Transbaikalian region is characterized by the alternation of low and medium height ranges (300 and 800–1460 m) separated by deep intermontane depression and river valleys (Bazarov, 1986).

There are two geomorphological provinces in the region which are characterized by different types of tectonically determined relief forms (Fig. 2). The result is a great variety of landscapes from lowland through mountain meadow, mountain taiga and mountain tundra, characterized by different environmental conditions. Such variability of environments and climatic conditions determine a high diversity of faunal associations and plant communities.

At present, the vast territory of Prebaikalia is occupied mainly by dense conifer forest, although steppe, meadow and swampy areas are present as well. The most abundant and diverse taxa in Prebaikalian fauna are forest inhabitants some of which are widely distributed in the adjacent areas; steppe, and dry steppe, meadow species inhabit restricted areas (Lyamkin, 1994).

In contrast to Prebaikalia, most of southern and south-eastern Transbaikal area are mountains and its northern and north-eastern part are mountainous areas covered by taiga forest. The Selenginian middle mountains are characterized by a sharply continental climate and are covered by forest-steppe, dry steppe, meadow and in part subdesert landscapes.

Prebaikalia is a part of European–Siberian paleozoogeographical province and Transbaikalia is part of the Central-Asian one. They contain rather different modern small mammal faunas (Appendix).

Since Late Pliocene to Early Pleistocene time, an outstanding biodiversity of mammal faunas were recorded in the Baikalian region. On this basis paleoenvironmental evolution and the correlation of coeval faunas were observed.

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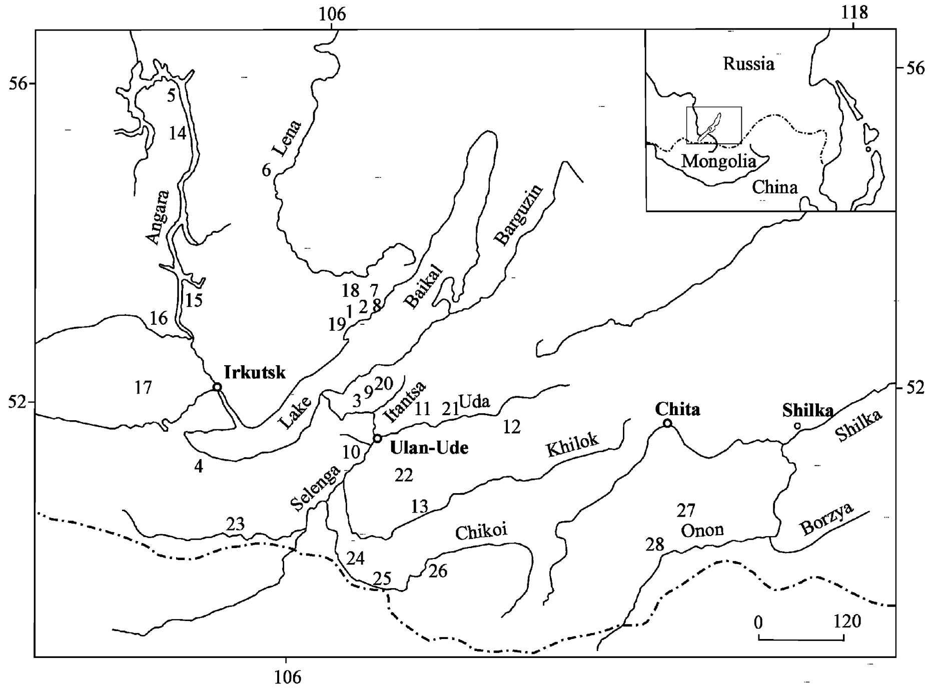


Fig. 1. Sketch map of the main Late Pliocene–Pleistocene localities with mammal faunas of the Baikalian region. Late Pliocene: 1—Podtok, Cherem Khaem, Malye Goly 1, Malye Goly 2; 2—Karantsy; 3—Klochnevo 1, Klochnevo 2, Zasukhino 1; 4—Shankhaikha. Early Pleistocene: 5—Zayarsk; 6—Podymakhino; 7—Nikiley, Rykovo, Malye Goly 3; 8—Yelga, Zagli, Nyurgan; 9—Zasukhino 2, Zasukhino 3; 10—Tologoi 1.2; 11—Dodogol 1, Dodogol 2; 12—Kudun; 13—Ust'-Obor. Middle-Late Pleistocene: 14—Ozernaya Balya; 15—Igetei; 16—Mal'ta; 17—Rzadolinskaya 7; 18—Kachug, Mys; 19—Kurtun; 20—Zasukhino 4, Zasukhino 5, Zasukhino 6; 21—Dodogol 3, Dodogol 4, Dodogol 5; 22—Khar'yaska 1, Khar'yaska 2; 23—Botsi; 24—Beregovaya 2; 25—Sharagol; 26—Studenoe; 27—Nozhyi; 28—Nizhnyi Tsasuchei.

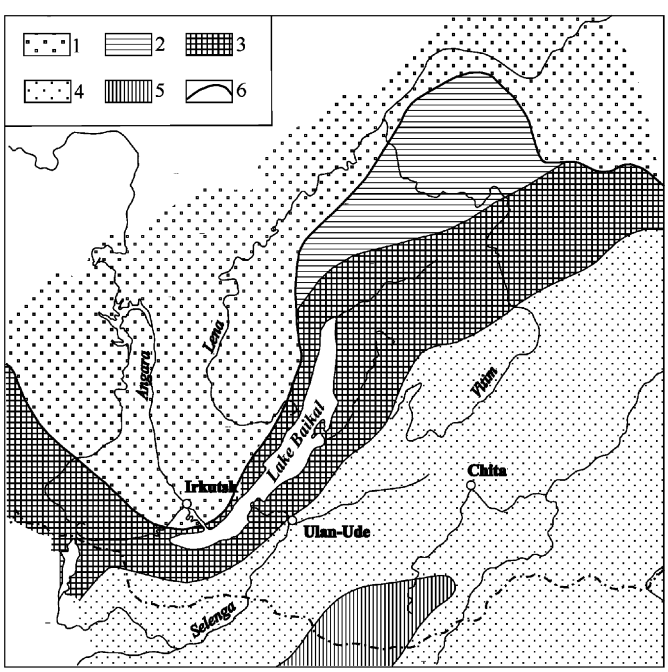


Fig. 2. Scheme of the geomorphological zonation of Prebaikalia and Transbaikalia (after Logatchev, 1974, Fig. 2). Legends: 1—Geomorphological province "plateau and lowland of the Siberian platform". The areas of geomorphological province "mountains of the South Siberia": 2—Baikal-Patom upland; 3—Sayan-Baikalian mountain land; 4—Transbaikalian middle mountains; 5—Khentei-Daurian upland; 6—borderline between geomorphological provinces.

## 2. Materials and methods

The study is based on the complex analysis of both published and unpublished paleontological and geological data obtained using multidisciplinary approaches. Abundant fossils of insectivores, lagomorphs and rodents were analyzed. These groups of mammals have been chosen as indicators of environmental changes due to their high evolutionary rate and their high sensitivity to environment resulting from their short lifespan. The study used Transbaikalian and Prebaikalian small mammalian fossil collection kept at the Geological Institute, Ulan-Ude as well as published data on Prebaikalian faunas in order to perform a comparison of different faunas from these two regions.

## 3. Discussion

The analysis of the faunal evolution and geological data of the Baikalian region in the Late Neogene clearly indicates the influence of global and regional climatic changes in the paleoenvironmental development. Tectonic evolution of the Northern Hemisphere, especially the progressive uplift of the Himalaya and Tibetan plateau during the Late Cenozoic induced climatic changes in Central Asia (Prokopenko et al., 2001). Moreover, the formation in the Baikal Rift Zone of a series of south

Siberian ranges of Sayan and Khangai systems during the Late Neogene influenced regional climatic changes (Kuzmin and Yarmolyuk, 2006).

As a result, there were considerable changes in the paleoenvironment and in the biogeocenosis of the Baikalian region. The Late Miocene–Early Pliocene warm and rather humid climate became cooler and arid to the end of the Early Pliocene with a further shift towards cooling and aridification during Middle Pliocene. Broadleaved-coniferous forests gradually reduced, replaced by coniferous and savanna-like forest-steppe, dumetum, steppe and meadow became widely distributed at the end of Middle Pliocene (Belova, 1985). The mammal faunal assemblages and plant communities, as well as birds and amphibian assemblages suggest a warm and moderately arid climate at that time (Alexeeva, 2005).

At the beginning of the Late Pliocene, global cooling is registered in several regions of Nothern Hemisphere. This feature was recognized also in the Baikalian region, where the cold intervals are recorded at 2.82–2.5 Ma (Prokopenko et al., 2001). The climatic shift towards cooler and more arid conditions, caused the spreading of steppes and grassland. A significant re-organization in the biogeocenosis of the region occurred at that time, as suggested by the composition and the structure of mammal faunas and vegetation (Erbajeva, 1998; Bezrukova et al., 2002). The most thermophilic elements of the flora already disappeared and mammal faunas changed.

The Late Pliocene is characterized by the disappearance of the Neogene genus *Hipparion*, and by the first appearance of the genus *Equus*. The reduction of the abundance of rooted voles of the genera *Mimomys* and *Villanyia*, and of zokors (*Prosiphneus*) was recorded. Moreover, other significant changes in the diversity of rodents took place. In the region the genera *Cromeromys*, *Spermophilus*, *Clethrionomys* and *Allactaga* appeared for the first time. Ochotonids were reduced in diversity and abundance. The cementless rooted vole *Villanyia* and the genus *Prosiphneus* are represented by species which are evolutionarily more advanced than in the preceding faunas of the region. Landscapes became mosaic. Plant communities reveal the presence of mixed forests along foothills, river valleys and northern mountain slopes (Bazarov, 1986; Alexeeva, 2005).

In the Baikalian region, coeval Late Cenozoic faunas have been correlated. In the Transbaikal area, the Late Pliocene mammalian faunas are known as Itantsinian Faunal Complex and in Prebaikalia as Kharantsinian and Malogolian faunas (Table 1) (Vangengeim, 1977; Adamenko and Adamenko, 1986; Pokatilov, 1994; Alexeeva, 2005). These faunas indicate a new stage in the faunal succession of the Baikalian region.

Comparison of the Late Pliocene Transbaikalian and Prebaikalian faunas (Table 2) shows their close relationship. They have in common several taxa on both genus and species level; however, they differ slightly by the species composition and ratio of some taxa, a feature that reflects the peculiarity of the regional paleoenvironmental conditions of each area.

Table 1
Biostratigraphy and correlation of faunas and faunal complexes of Prebaikalia and Western Transbaikalia

| Geologic period | Prebaikalia (Adamenko and Adamenko, 1986; Pokatilov, 1994) | Western Transbaikalia (Alexeeva, 2005) |
|---|---|---|
| Pleistocene | | |
| Late | Faunas from numerous sites | Faunas from numerous sites |
| Middle | Begulian fauna | Ivolginian fauna |
| | Nyurganian fauna | Tologoi faunal complex |
| Early | Zaglinian fauna | Zasukhinian fauna |
| | | Kudunian fauna |
| | Yelginian fauna | Ust'Oborian fauna |
| | Nikileyian fauna | Dodogolian fauna |
| Pliocene | | |
| Late | Malogolian fauna | Itantsinian faunal complex |
| | Kharantsinian fauna | |
| Middle | Khuzirian faunal complex | Chikoian faunal complex |
| | | Udunginian faunal complex |

In comparison with the preceding Middle Pliocene fauna, the Late Pliocene fauna of Transbaikal area shows the reduction of quantity of ochotonid number, as well as of hamsters, siphneids, the cemented vole *Mimomys*, and the cementless vole *Villanyia*. This latter genus is represented in Itantsinian fauna by *Villanyia klochnevi* morphologically a more progressive form than *Villanyia eleonorae* from preceding faunas. Another significant peculiarity of the Itantsinian fauna is the extreme abundance of the remains of ground squirrels represented by species of both subgenera *Spermophilus* and *Urocitellus*. They are both inhabitants of open landscapes mostly steppes and grasslands.

In contrast to the Transbaikal faunas, in the Prebaikalian ones *Mimomys*, *Villanyia* and *Prosiphneus* are still rather abundant (respectively 25%, 20% and 23% of the total number of individuals) (Pokatilov, 1994). The fauna reflects as well open landscapes with predominance of meadow, different steppes and grasslands. The Late Pliocene climate of the Baikalian region was warm and semiarid.

A further significant reorganization of the Baikal region biota is indicated by the Early Pleistocene faunas (the next stage in Baikal region faunal succession). The most significant peculiarity of the Early Pleistocene faunas is the first appearance of the genus *Borsodia,* which replaced *Villanyia* and *Allophaiomys.* Later, other genera such as *Lagurodon*, *Prolagurus*, *Eolagurus*, *Terricola*, *Lasiopodomys*, *Lemmus* and *Microtus* appeared in the faunas. Comparative analyses of the faunas show that they have in

Table 2
Pliocene and Pleistocene small mammal succession of the Baikalian region

| Geologic period | Age (Ma) | MN/MQ Zones | Small mammal associations | |
|---|---|---|---|---|
| | | | Prebaikalia[a] | Transbaikalia |
| Holocene | 0.01 | | Recent faunas | |
| Pleistocene | | | | |
| Late | 0.125 | MQ 25–26 | *Sorex* sp., *Lepus timidus*, *Ochotona hyperborea*, *Ochotona pusilla*, *Tamias sibiricus*, *Spermphilus undulatus*, *Spermophilus* cf. *parryi*, *Clethrionomys rutilus*, *Clethrion. rufocanus*, *Lagurus lagurus*, *Dicrostonyx* cf. *henseli*, *Dicrostonyx* sp., *Myopus schisticolor*, *Lemmus amurensis*, *Arvicola terrestris*, *Microtus gregalis*, *Microtus oeconomus*, *Microtus middendorfii*, *Castor* sp. | *Sorex erbajevae*, *Sorex* sp., *Lepus timidus*, *Lepus tolai*, *Ochotona daurica*, *O. hyperborea*, *Tamias sibiricus*, *Marmota sibirica*, *Allactaga sibirica*, *Spermophilus undulatus*, *Cricetulus barabensis*, *Meriones unguiculatus*, *Ellobius tancrei*, *Lagurus lagurus*, *Lasiopodomys brandti*, *Microtus gregalis*, *Microtus oeconomus*, *Microtus fortis*, *Microtus maximoviczi* |
| Middle | 0.78 | MQ 21–24 | *Lepus* sp., *Ochotona* sp., *Spermophilus* cf. *undulatus*, *Alticola* sp., *Dicrostonyx* cf. *simplicior*, *Dicrostonyx* cf. *henseli*, *Eolagurus simplicidens*, *Lagurus* sp., *Cricetulus* sp., *Pitymys* ex gr. *arvaloides*, *Microtus gregalis*, *Microtus oeconomus*, *Microtus* sp. | *Ochotona dodogolica*, *Ochotona gureevi*, *Marmota sibirica*, *Spermophilus gromovi*, *Allactaga sibirica transbaikalica*, *Ellobius tancrei*, *Eolagurus simplicidens*, *Lagurus transiens*, *Meriones unguiculatus*, *Lasiopodomys brandti*, *Microtus gregalis*, *Microtus oeconomus*, *Microtus mongolicus*, *Cricetulus barabensis*, *Myospalax wongi* |
| Early | 1.8 | MQ 19–20 MN18 | *Sorex* sp., Leporinae gen., *Ochotona* cf. *whartoni*, *Ochotona filippovi*, *Sicista* sp., *Spermophilus* cf. *tologoicus*, *Alactagulus* sp., *Plioscirtopoda* sp., *Cricetus* sp., *Cricetulus* sp., *Villanyia* cf. *hungarica*, *Mimomys* cf. *intermedius*, *Mimomys* cf. *pusillus*, *Clethrionomys* ex. gr. *rutilus*, *Lagurodon* sp., *Prolagurus* sp., *Lemmus* aff. *kowalskii*, *Allophaiomys pliocaenicus*, *Prosiphneus* sp. | *Crocidura* sp., *Ochotona tologoica*, *Ochotona zasuchini*, *Ochotona bazarovi*, *Spermophilus tologoicus*,*Spermophilus itancinicus*, *Prolagurus pannonicus*, *Prolagurus ternopolitanus*, *Lagurodon arankae*, *Terricola hintoni*, *Allophaiomys pliocaenicus*, *Mimomys* cf. *pusillus*, *Borsodia laguriformes*, *Myospalax omegodon*, *Prosiphneus* cf. *youngi* |
| Pliocene | | | | |
| Late | 2.6 | MN 17 | *Sorex* cf. *paleosibiriensis*, *Sorex* sp., *Hypolagus* sp., *Ochotona* sp., *Ochotonoides complicidens Spermophilus* sp., *Allactaga* sp., *Clethrionomys* sp., *Villanyia lenensis*, *Villanyia angensis*, *Mimomys parapolonicus*, *Cromeromys sibiricus*, *Cromeromys praeintermedius*, *Clethrionomys* sp., *Prosiphneus* sp. | *Ochotona* cf. *nihewanica*, *Ochotona* cf. *intermedia*, *Spermophilus itancinicus*, *Spermophilus tologoicus*, *Marmota* sp., *Castor* sp., *Allactaga* sp., *Cricetulus* cf. *barabensis*, *Cricetinus* cf. *varians*, *Clethrionomys* cf. *kretzoii*, *Villanyia klochnevi*, *Mimomys* cf. *reidi*, *Mimomys* cf. *pusillus Cromeromys* sp., *Prosiphneus youngi* |
| Middle | 3.4 | MN 16 | *Sicista* cf. *pliocaenica*, *Promimomys* cf. *gracilis*, *Promimomys* sp., *Prosiphneus chuzhirica* | *Sorex mirabilis*, *Sorex* sp., *Petenyia hungarica*, *Beremendia fissidens*, *Hypolagus multiplicatus*, *Hypolagus transbaikalicus*, *Ochotonoides complicidens*, *Ochotona gromovi*, *Ochotona intermedia*, *Ochotona sibirica*, *Marmota tologoica*, *Castor* sp., *Sicista pliocaenica*, *Orientalomys sibiricus*, *Micromys minutus*, *Cricetinus varians*, *Cricetulus* cf. *barabensis*, *Kowalskia* sp., *Gromovia daamsi*, *Villanyia eleonorae*, *Mimomys minor*, *Mimomys pseudintermedius*, *Mimomys* cf. *reidi*, *Promimomys gracilis*, *Promimomys* cf. *stehlini*, *Pitymimomys koenigswaldi*, *Prosiphneus praetingi*, *Prosiphneus aff. lyratus* |

[a]After Pokatilov (1994), Filippov et al. (1995), and Khenzykhenova (2003).

common several species during Early Pleistocene and some taxa demonstrate a rather high evolutionary development (Table 3).

In spite of the high resemblance of the mammal associations, the Transbaikalian and Prebaikalian faunas show some differences. The faunas of the first region are characterized by the predominance of Central-Asian elements, such as *Borsodia*, *Lasiopodomys*, *Myospalax*, *Prosiphneus* and *Ochotona*, while the Prebaikalian faunas are characterized by a higher diversity of species (Table 2). In faunas of both areas taxa widely distributed at that time in Eurasia, as *Allophaiomys*, *Lagurodon*, *Prolagurus*,

Table 3
Chronological distribution of some lineages of Transbaikalian small mammals

| Pliocene | | Pleistocene | | |
|---|---|---|---|---|
| Middle | Late | Early | Middle | Late |
| *Villanyia eleonorae---------V. klochnevi-----Borsodia laguriformes----Prolagurus ternopolitanus - Pr. pannonicus- - - -----------------Lagurus transiens------------Lagurus lagurus------* | | | | |
| *Borsodia laguriformes ---Lagurodon arankae----Eolagurus simplicidens sibiricus ----E. simplicidens simplicidens ---Eolagurus cf. luteus* | | | | |
| *Prosiphneus .praetingi------- ? ----- ? ----- ? --------------Myospalax omegodon----------???? - - - - - - - - - - Myospalax wongi--* | | | | |
| *Prosiphneus cf. lyratus------Pr. young i ----------- Prosiphneus cf. youngi - - - - - ? ? ? - - - - - - - - - - - - - - - - - - Myospalax aspalax----* | | | | |
| *Ochotona gromovi------------------------Ochotona tologoica-----------O. zasuchini* | | | | |
| *Ochotona intermedia--- O. cf intermedia -------------- O. bazarovi-----------------------------------------------------------------Ochotona gureevi------------------------- Ochotona daurica------* | | | | |
| *------O. nihewanica ---------------------- ?????? -------------------Ochotona dodogolica------------?????-----------------Ochotona pallasi* | | | | |
| *Spermophilus (Urocitellus) itancinicus-------------------------------------------S. (Urocitellus) itancinicus bazarovi------------------------------ ----S. (Urocitellus) undulatus gromovi ----------------S. (U.) undulates------* | | | | |
| *Spermophilus (Spermophilus) tologoicus---------------------S. (Spermophilus) tologoicus ??? ----------------------------------------------------S. (Spermophilus) dauricus----* | | | | |

*Eolagurus* and *Terricola* are present. Prebaikalian faunas include taxa which are characteristic of the arid biotopes of the Middle Asia and Kazakhstan (*Alactagulus*, *Plioscirtopoda*) (Adamenko and Adamenko, 1986). The faunas evidenced that open landscapes continued to exist in the region. Moreover, in the Early Pleistocene, Prebaikalian fauna *Lemmus* aff. *kowalskii* was discovered for the first time as well as of *Ochotona* cf. *whartoni*, known from Kolyma lowland and Alaska (Filippov et al., 1995).

During the Middle Pleistocene the paleoenvironment of the Baikalian region changed significantly towards cooler conditions. In the faunas, the genera *Allophaiomys*, *Borsodia*, *Lagurodon*, *Prolagurus* and *Terricola* completely disappeared. Due to the continuation of orogenic processes, the mountains surrounding Lake Baikal uplifted, in particular in western border, becoming a major barrier for the influence of westerly Humid Atlantic Cyclones in the Transbaikal area. Thus, marked aridification became substantial in this region (Bazarov, 1986; Alexeeva, 2005). From the Middle Pleistocene to Late Pleistocene, the environment of Transbaikal and Prebaikal areas differ significantly. In Transbaikalian faunas, the Central-Asian species were dominant. They mostly consisted of dry steppes, subdesert and desert inhabitants. In contrast, the Prebaikalian faunas framework was more complicated, as they included the representatives of non-analogue faunas, or tundra-steppe, or mammoth faunas such as *Dicrostonyx gulielmi*, *Dicrostonyx henseli*, *Lemmus sibiricus*, *Myopus schisticolor*, *Microtus middendorfii*, *Microtus hyperboreus* (Khenzykhenova, 2003). Moreover, they include several species of Central-Asian origin, which completely disappear in the Late Pleistocene faunas except for *Lagurus lagurus* (Table 2). Most of the species are typical Siberian forms, inhabited different biotopes from meadow-steppe and variable mixed forests with meadows to cold periglacial landscapes. This environment is favorable for lemmings and northern voles and arctic ground squirrels.

## 4. Conclusions

An overview of the Baikal region small mammal diversity from the Late Pliocene to Pleistocene shows that during the Late Pliocene and Early Pleistocene several common species were distinctive for both Transbaikalian and Prebaikalian faunas due to their similar paleoenvironmental and climatic conditions. Because of the marked shift towards cooler conditions occurred since the end of Early Pleistocene to the Late Pleistocene, the environments of the Transbaikal and Prebaikal areas started to show much distinction. Consequently, the faunal associations of the two areas significantly differed, belonging to two different paleozoogeographical provinces. The Transbaikalian fauna is the Central-Asian affinity and Prebaikalian one is referred to the European–Siberian province.

## Acknowledgment

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## Appendix

See Table A1.

Table A1
List of the recent species of the Baikalian region

| | Prebaikalia[a] | Transbaikalia[b] | |
|---|---|---|---|
| | | Western | Eastern |
| 1 | | *Hemiechinus dauricus* | *Hemiechinus dauricus* |
| 2 | *Talpa altaica* | *Talpa altaica* | |
| 3 | *Sorex daphaenodon* | *Sorex daphaenodon* | *Sorex daphaenodon* |
| 4 | *Sorex araneus* | *Sorex araneus* | *Sorex araneus* |
| 5 | *Sorex isodon* | *Sorex isodon* | *Sorex isodon* |
| 6 | | *Sorex tundrensis* | *Sorex tundrensis* |
| 7 | *Sorex caecutiens* | *Sorex caecutiens* | *Sorex caecutiens* |
| 8 | *Sorex roboratus* | *Sorex roboratus* | *Sorex roboratus* |
| 9 | *Sorex minutissimus* | *Sorex minutissimus* | *Sorex minutissimus* |
| 10 | *Sorex minutus* | *Sorex minutus* | *Sorex minutus* |
| 11 | | *Crocidura suaveolens* | *Crocidura suaveolens* |
| 12 | *Neomys fodiens* | *Neomys fodiens* | *Neomys fodiens* |
| 13 | *Lepus timidus* | *Lepus timidus* | *Lepus timidus* |
| 14 | | *Lepus capensis tolai* | *Lepus capensis tolai* |
| 15 | | | *Lepus europaeus*[c] |
| 16 | *Ochotona alpina* | *Ochotona alpina* | *Ochotona alpina* |
| 17 | *Ochotona hyperborea* | *Ochotona hyperborea* | *Ochotona hyperborean* |
| 18 | | *Ochotona daurica* | *Ochotona daurica* |
| 19 | *Pteromys volans* | *Pteromys volans* | *Pteromys volans* |
| 20 | *Sciurus vulgaris* | *Sciurus vulgaris* | *Sciurus vulgaris* |
| 21 | *Tamias sibiricus* | *Tamias sibiricus* | *Tamias sibiricus* |
| 22 | *Spermophilus undulatus* | *Spermophilus undulatus* | *Spermophilus undulates* |
| 23 | | | *Spermophilus dauricus* |
| 24 | | *Marmota sibirica* | *Marmota sibirica* |
| 25 | *Marmota camtschatica* | *Marmota camtschatica* | *Marmota camtschatica* |
| 26 | *Castor fiber* | *Castor fiber* | |
| 27 | *Sicista betulina* | *Sicista betulina* | |
| 28 | *Sicista subtilis* | | |
| 29 | | *Allactaga sibirica* | *Allactaga sibirica* |
| 30 | *Rattus norvegicus* | *Rattus norvegicus* | *Rattus norvegicus* |
| 31 | *Rattus rattus* | | |
| 32 | *Mus musculus* | *Mus musculus* | *Mus musculus* |
| 33 | *Apodemus peninsulae* | *Apodemus peninsulae* | *Apodemus peninsulae* |
| 34 | *Apodemus agrarius* | | |
| 35 | *Micromys minutus* | *Micromys minutus* | *Micromys minutes* |
| 36 | *Cricetulus barabensis* | *Cricetulus barabensis* | *Cricetulus barabensis* |
| 37 | | *Cricetulus pseudogriseus* | *Cricetulus pseudogriseus* |
| 38 | | *Cricetulus longicaudatus* | |
| 39 | | *Phodopus sungorus* | *Phodopus sungorus* |
| 40 | | *Meriones unguiculatus* | *Meriones unguiculatus* |
| 41 | | | *Myospalax aspalax* |
| 42 | | | *Myospalax psilurus* |
| 43 | *Clethrionomys rutilus* | *Clethrionomys rutilus* | *Clethrionomys rutilus* |
| 44 | *Clethrionomys rufocanus* | *Clethrionomys rufocanus* | *Clethrionomys rufocanus* |
| 45 | *Clethrionomys glareolus* | | |
| 46 | *Alticola macrotis* | *Alticola macrotis* | *Alticola macrotis* |
| 47 | *Alticola olchonensis* | | |
| 48 | | *Lemmus amurensis* | *Lemmus amurensis* |
| 49 | *Myopus schisticolor* | *Myopus schisticolor* | *Myopus schisticolor* |
| 50 | | *Lasiopodomys mandarinus* | |
| 51 | | | *Lasiopodomys brandti* |
| 52 | *Arvicola terrestris* | *Arvicola terrestris* | |
| 53 | *Microtus gregalis* | *Microtus gregalis* | *Microtus gregalis* |
| 54 | *Microtus oeconomus* | *Microtus oeconomus* | *Microtus oeconomus* |
| 55 | *Microtus fortis* | *Microtus fortis* | *Microtus fortis* |
| 56 | *Microtus maximoviczi* | *Microtus maximoviczi* | *Microtus maximoviczi* |
| 57 | | *Microtus mujanensis* | |
| 58 | *Microtus mongolicus* | *Microtus mongolicus* | *Microtus mongolicus* |
| 59 | *Microtus agrestis* | | |
| 60 | *Microtus arvalis* | | |
| 61 | *M. rossiameridionalis* | | |
| 62 | *Ondatra zibethicus* | *Ondatra zibethicus* | *Ondatra zibethicus* |

[a]List of species after Litvinov (2000).
[b]List of species after Gromov and Erbajeva (1995).
[c]Oral communication of Kiriluyk (Chita region).

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