2021

Biodiversity of Small Mammals and Paleoenvironment of Transbaikalia and North Mongolia in the Late Pliocene

N. V. Alexeeva
Siberian Branch, Russian Academy of Sciences, ochotona@mail.ru

M. A. Erbajeva
Siberian Branch, Russian Academy of Sciences, erbajeva@ginst.ru

Erforsch. biol. Ress. Mongolei (Halle/Saale) 2021 (**14**): 59-70

Biodiversity of small mammals and paleoenvironment of Transbaikalia and North Mongolia in the Late Pliocene

N.V. Alexeeva & M.A. Erbajeva

Abstract

This paper reports the results of analysis on small mammal faunas dwelling during the Late Pliocene the Transbaikal and Northern Mongolia regions. They were found to share many common species, even though some differences linked with local and regional specifics of the environment are the case. High diversity of small mammal taxa, species richness and their prominent quantity specify the localities of Udunga, Beregovaya and Tologoi in Transbaikal region and in Shamar of Northern Mongolia. The compositions of all faunas point to the existence of the savanna-like landscapes and warm semiarid climate in that period.

Key words: small mammals, species diversity, Transbaikalia, North Mongolia, Late Pliocene, paleoenvironment

1. Introduction

The Transbaikal and North Mongolia regions are enclosed within the continental interior of North Asia. Since early Neogene time through the Pliocene and Early Pleistocene these two regions were unified. They were referred to the Central-Asian paleozoogeographical province of the Palearctic region based on the mammal fauna analysis (VANGENGEIM 1977). The abundant fossil data on the vertebrates, mostly mammals, were collected at several sites located along the Selenga River and its tributaries: Uda, Temnik, Chikoi Rivers in Transbaikalia and Orkhon River in Mongolia. Some localities are multilayered, e.g. Tologoi, Udunga, Beregovaya in the Transbaikal area and Shamar, Orkhon-1 and Orkhon-2, Bural-Obo in Mongolia (fig. 1, 2, 3).

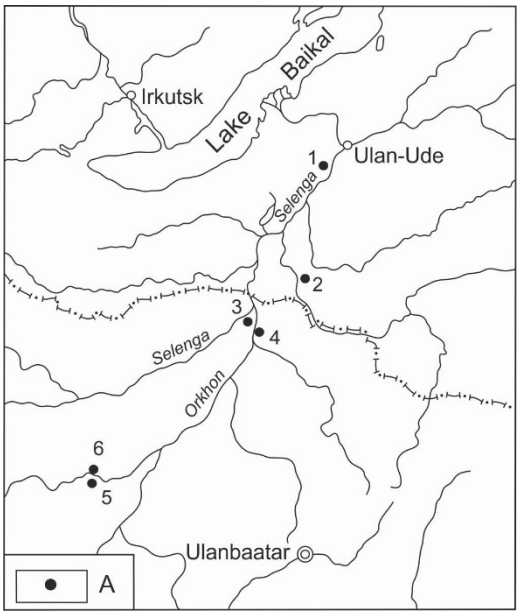

Fig. 1: Sketch-map of the location of studied Late Pliocene sites in Transbaikalia and North Mongolia (modified after DEVJATKIN & ZAZHIGIN 1974, fig. 1). A – sites:1 - Tologoi; 2 – Beregovaya; 3 - Shamar; 4 - Bural-Obo; 5 – Orkhon-1; 6 – Orkhon-2.

Fig. 2: View of the Orkhon valley with location of Bural-Obo site (photo: A. AGADJANIAN).

The faunas of large and small mammals were examined at these localities by many paleontologists (VANGENGEIM et al. 1966; VISLOBOKOVA et al. 1993; BAZAROV et al. 1976; ZAZHIGIN 1989; ERBAJEVA et al. 2003; ALEXEEVA 2005; AGADJANIAN 2014 a.o.). In addition, comprehensive investigations were performed on morphology and systematics of different groups of large mammals. Altogether, they proved that many common taxa had existed in the faunas of both Transbaikalia and Mongolia: e.g. carnivora (SOTNIKOVA 1979, 1980), deer (VISLOBOKOVA 1983), antelopes (DMITRIEVA 1977), *Paleotragus* (GODINA 1981), *Hipparion* (ZHEGALLO 1978). The data recently obtained on small mammals in the Tologoi Key section of Transbaikalia have revealed two faunas collected from different horizons. Previously, the mammal fossils were discovered from the sediments above the calcareous concretion horizon and fauna was referred to the Late Pliocene Chikoi faunistic complex similar to that in the Beregovaya site. More recently scarce fossil remains were found in the horizon of dark red sediments lying below the calcareous concretion horizon (Fig. 4). New paleontological materials have been recently collected in the latter horizon, which is recognized as fossil soil. The study showed that the Tologoi section (T.1.1) contains two faunistic horizons sharing some common species. The detailed analysis suggest that the faunas of these horizons slightly differ in the species composition and by evolutionary stages of some taxa. This evidence points to two successive evolutionary stages of the Late Pliocene mammal associations in Tologoi locality and in common in the Transbaikal area. These data demonstrate some evidence on the stratigraphic division.

Mammal faunas from Mongolian localities Shamar, Orkhon - 1, Orkhon - 2, Bural Obo were studied and analysed by DEVJATKIN & ZAZHIGIN (1974), DEVJATKIN (1981), ZAZHIGIN (1989) and AGADJANIAN (2014). In Shamar section, the late Pliocene mammal faunas are known from two horizons (2 and 3) (DEVJATKIN 1981, ZAZHIGIN 1989). However, the authors noted some kind of variation in the faunas from different successive faunistic horizons in this site, though they contain mostly common species of the Chikoi complex.

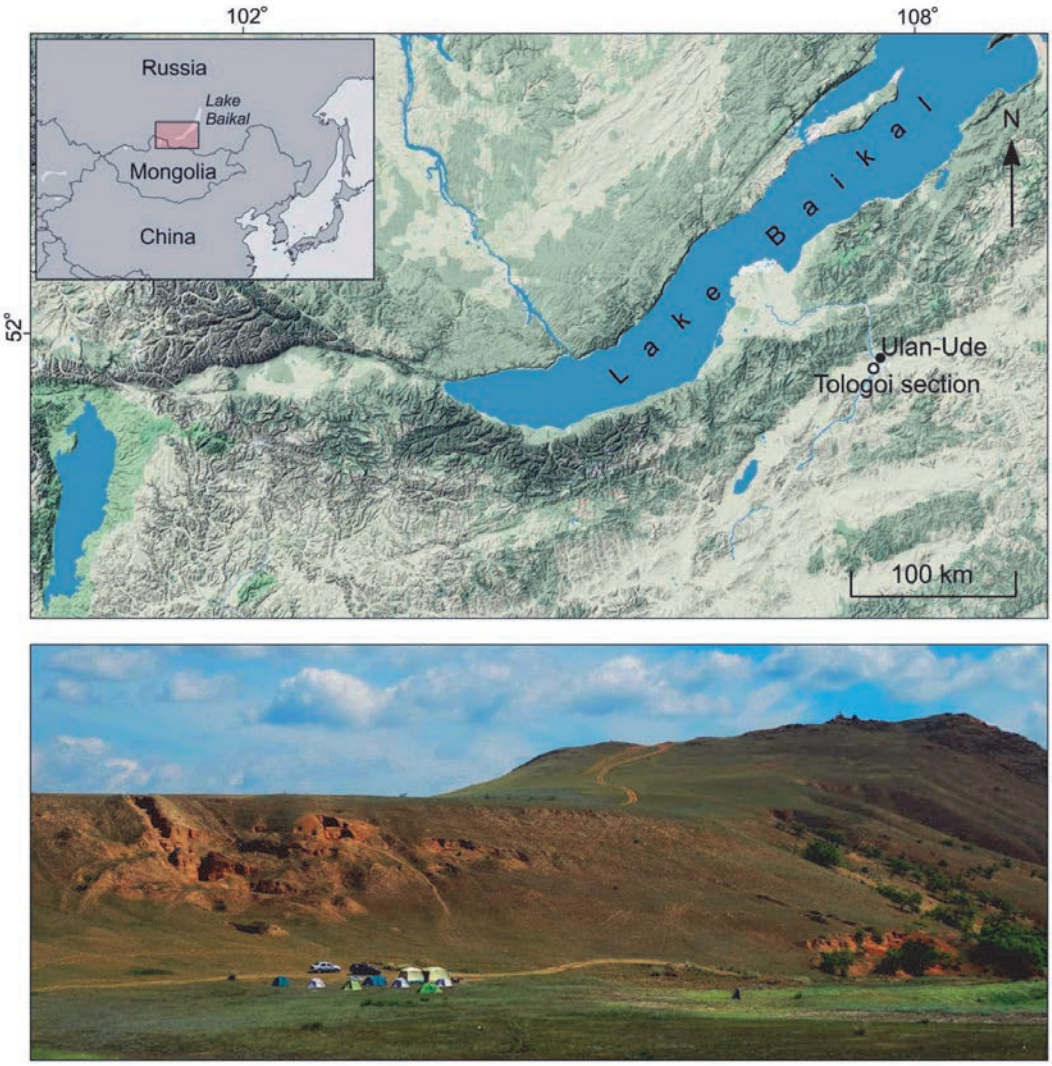

Fig. 3: Location map of the Tologoi site (above) and view of sections (below) (photo: I. FILINOV).

The Orkhon section containing as well three faunistic horizons (4, 6 and 8) (ZAZHIGIN 1989) slightly differs from Shamar. Fauna of lower horizon 8 of Orkhon – 1 section consists of the Early Pliocene taxa, and the authors consider that it is fauna of the Ruscinian stage. In contrast, the small mammals from upper horizon 6 belong to the Chikoi faunistic complex (DEVJATKIN & ZAZHIGIN 1974).

Later in faunas of Bural-Obo ZAZHIGIN (1989) and AGADJANIAN (2014) pointed out the variety of taxa from different stratigraphic horizons (fig. 5, 6).

The comparative analysis the composition of mammal associations from the localities of Tranbaikalia and Northern Mongolia undoubtedly help us to trace the evolutionary development of the Late Pliocene mammal faunas.

The aim of this work is to show the biodiversity of small mammalian assemblages and their history in the context of paleoenvironment and climate change through the Late Pliocene time.

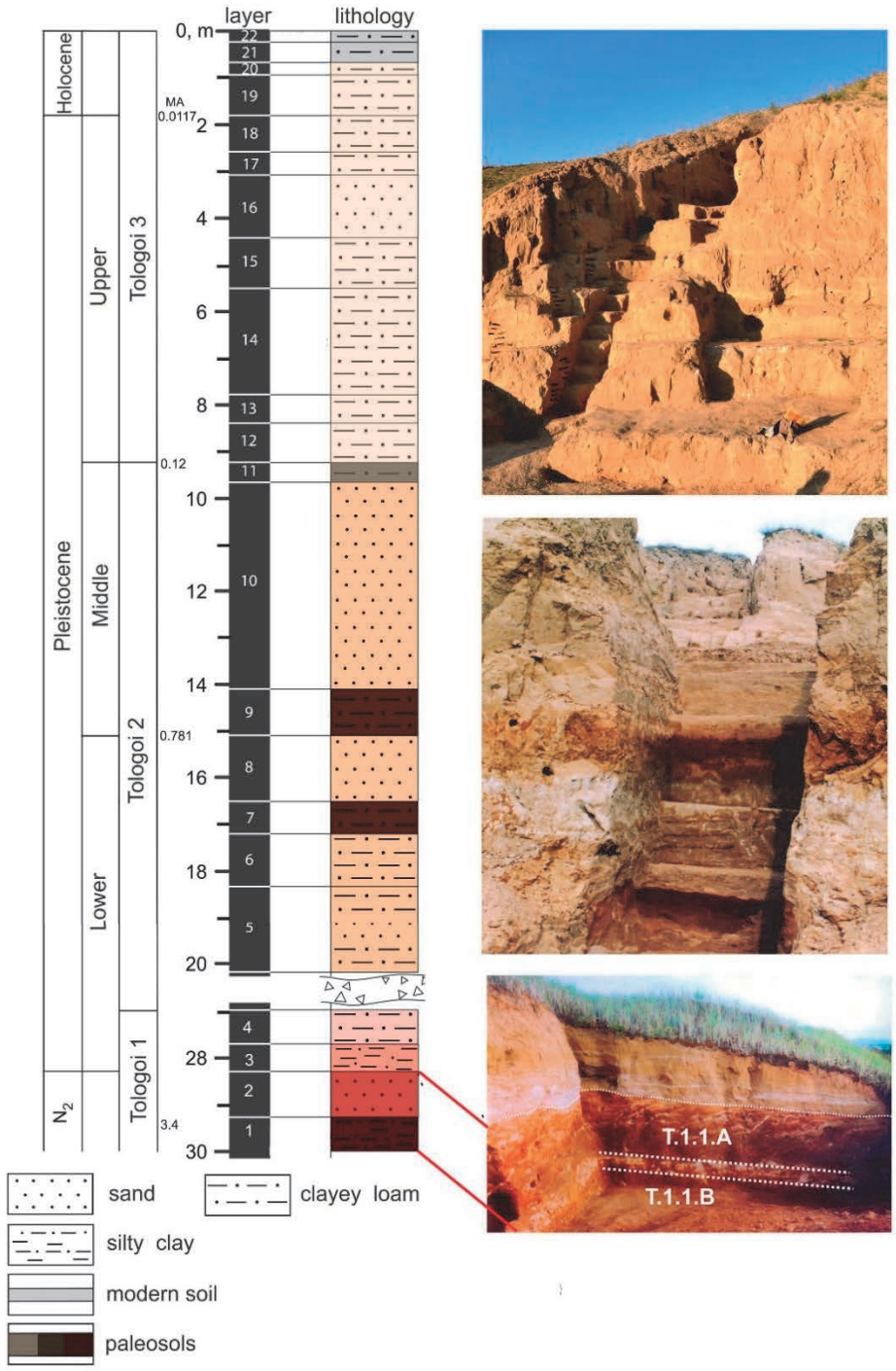

Fig. 4: Chronostratigraphy and lithology of the Tologoi Key section, showing the Late Pliocene red deposits with faunas of Tologoi 1.1. A and Tologoi 1.1. B. (scheme: I. FILINOV & A. SHCHETNIKOV).

Fig. 5: General view of the Bural-Obo section (photo: A. AGADJANIAN).

2. Material and methods

Abundant fossils of the Late Cenozoic, in particular of the Pliocene, small mammals of the Transbaikal area and Northern Mongolia were approximately collected during 50 years and analyzed by paleontologists and geologists (VANGENGEIM et al., 1966; DEVJATKIN & ZAZHIGIN 1974; BAZAROV et al. 1976; DEVJATKIN 1981; AGADJANIAN & ERBAJEVA 1983; ZAZHIGIN 1989; ALEXEEVA 2005; AGADJANIAN 2014). The data on the extinct small mammals are important for paleoenvironment and climatic reconstructions, as well as for biostratigraphy of the regions. The materials investigated at the Shamar, Orkhon and Bural-Obo sites are kept at the Geological Institute and Paleontological Institute RAS, Moscow, and those from Transbaikalian sites at the Geological Institute of the Siberian Branch RAS, Ulan-Ude.

3. Short review on main Late Pliocene localities and faunas of Transbaikal and Mongolian regions

During the Neogene the Transbaikal area, as a part of the Baikal rift zone experienced a complicated geological history. The activity of the tectonic processes in Asia, especially uplift of Himalaya and Tibet resulted in the significant climatic alteration and considerable changes in the biogeocenosis in Asia. It influenced as well the sedimentation and paleoenvironmental diversification. In Transbaikalia, as well as in Northern Mongolia the Pliocene climate has changed towards cool and more arid in contrast to preceding Miocene time (LOGACHEV et al., 1964; DEVJATKIN, 1981; BELOVA, 1985; MALAEVA, 1989; DEMSKE et al., 2002). In the biota of the region many thermophilic elements of vegetation became reduced and in the fauna some open landscape inhabitants appeared. The climate was still rather humid and woodland predominated (BELOVA, 1985; MALAEVA, 1989; BEZRUKOVA et al., 1999). Such kind of paleoenvironment continued to exist in the Transbaikal area at the beginning of the Late Pliocene. So, the Udunginian faunal

complex recognized as the oldest mammal fauna presents the earliest stage in the mammal sequences (ERBAJEVA, 1996). The species composition both of large and small mammals shows that in the Udunga fauna forest inhabitants (*Zyglophodon, Parameles, Ursus, Gulo, Nyctereutes, Lynx, Axis, Capreolus, Castor, Orientalomys, Micromys, Hypolagus*) were predominant, though open landscape dwellers (*Gazella, Antilospira, Hipparion, Ovis, Mesosiphneus, Cricetulus, Ochotonoides, Ochotona, Sicista*) were significant elements (SOTNIKOVA & KALMYKOV, 1991; VISLOBOKOVA et al., 1993; ERBAJEVA, 1996). The most peculiar taxa of this fauna are the genera *Gromovia* (hamster), *Ferinestrix, Parailurus,* (carnivora), *Parapresbytis* (monkey) and *Promimomys* (arvicolid) for the first time discovered in the region (MASHCHENKO, 1994; ERBAJEVA et all., 2003; SOTNIKOVA, 2008; WOLSAN, SOTNIKOVA, 2013). The data on the mammal fauna and paleo-vegetation demonstrate that woodlands were widespread and warm and humid climate existed. The analysis of the small mammal composition (Table 1) show the tendency towards arid and slightly cool condition. The progressive cooling resulted in formation of savanna-like landscapes with warm and semiarid climate that was confirmed by the species composition of the following Chikoian fauna. The faunas of this complex are known in Transbaikalian localities Beregovaya and Tologoi and in Mongolian – Shamar, Orkhon and Bural-Obo.

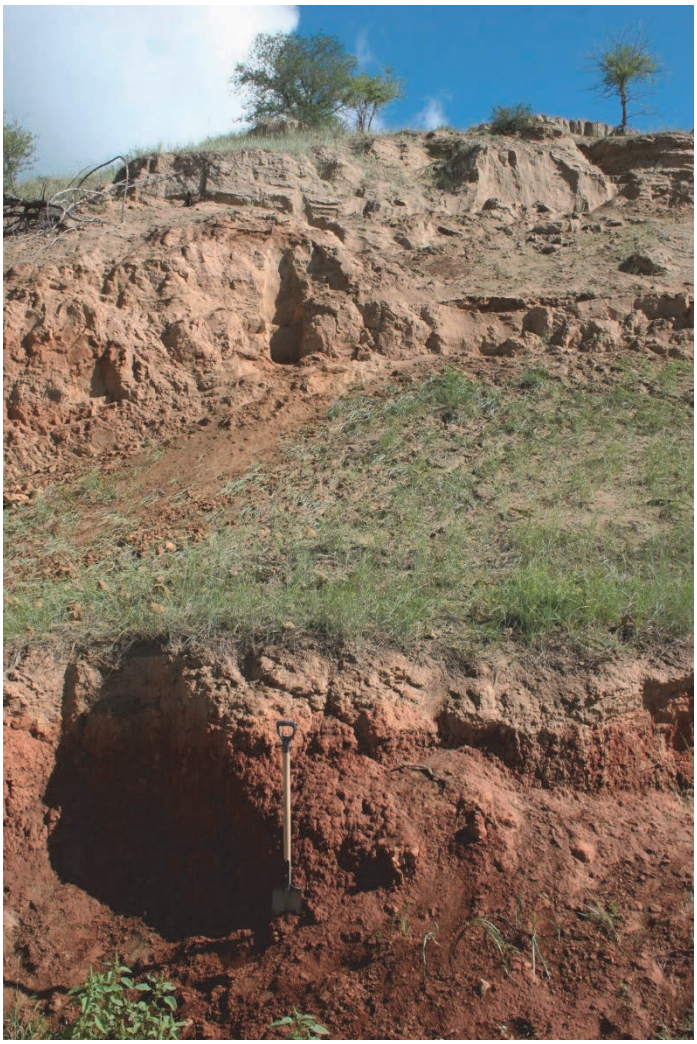

Fig. 6: The exposure of the Late Pliocene red sediments on the lowermost part of the Bural-Obo section (photo: A. AGADJANIAN).

New faunal data obtained in Tologoi and the analysis of the currently available materials have revealed two evolutionary stages in the development of faunas of the Chikoi complex. The fauna of the earliest stage has been discovered from the lowermost horizon of Tologoi section (below the calcareous concretion horizon) (Fig. 4), it was named as fauna Tologoi 1.1, B. The more advanced mammal fauna of typical Chikoi complex are known from the upper faunistic horizon (above calcareous concretion horizon); it is fauna of Tologoi 1.1, A (fig. 4).

The Tologoi 1.1, B fauna slightly differs from the preceding fauna Tologoi 1.1, A by the species composition, evolutionary level of some taxa and their ratio of species. The fauna of the early stage includes archaic arvicolids of the genera *Promimomy*s and *Cseria* known in the Udunga site. It must be emphasized that the rooted voles of the genera *Villanyia* and *Mimomys* represent the taxa with more primitive features of cheek teeth than the species from the type fauna of Chikoi complex. These data suggest that the fauna of Tologoi 1.1 B are close to that of Udunginian complex not only by the archaic evolutionary levels of arvicolid species, but by the presence of hamster (*Kowalskia*) and containing of scarce ochotonid remains. It is noteworthy, that the Shamar fauna of horizon 3 resembles the Udunginian fauna by the predominance of woodland taxa, namely murids (*Orientalomys*) and containing extremely scarce advanced arvicolids of the genera *Villanyia* and *Mimomys* (ZAZHIGIN, 1989). Moreover, both Udunginian and Shamar faunas commonly include unusual species *Parapresbytis eohanuman* BORISSOGLEBSKAYA (BORISSOGLEBSKAYA, 1981). On the base of the faunal composition, we suppose that the faunas of the Udunga, Tologoi 1.1 B and Shamar sites (horizon 3) originated at the earliest stage of the fauna development in Late Pliocene. At that time, the climate of the region was still rather humid, and the woodland was widespread. This is confirmed by the evidence on pollen flora and mammal association, including peculiar high crowned hamster *Gromovia daamsi* ERBAJEVA, ALEXEEVA, KHENZYKHENOVA and the other enigmatic species *Ferinestrix rapax* WOLSAN, SOTNIKOVA , 2013, DEMSKE et al. 2002, ERBAJEVA et al. 2003. The Chikoi faunal complex (Beregovaya site), containing rather abundant and diverse taxa, represents the younger stage in the fauna succession of the Late Pliocene (table 1). The fauna of this stage was present in all mentioned above localities of the Transbaikal area and North Mongolia. The faunas of studied region, the same as all Eurasian Pliocene mammal associations, display the abundance of lagomorphs, both leporids (*Hypolagus*) and ochotonids (*Ochotonoides* and *Ochotona*), high diversity and number of arvicolids of the genera *Mimomys* and *Villanyia*, presence of harvest mice (*Micromys*), and birch mice (*Sicista*). The entire Chikoi mammal fauna is featured by the presence of North American genus *Synaptomys,* and the genus *Marmota* invaded from the New World to Asia in Pliocene time (ERBAJEVA 2009). The faunas contain some European genera, such as *Beremendia, Petenyia, Kowalskia, Mimomys* and *Pitymimomys*. However, the dominant elements in the mammal assemblages are taxa of the Central-Asian origin, namely the genera *Allactaga, Cricetinus*, *Cricetulus*, zokors of the genera *Mesosiphneus* and *Pliosiphneus*.

The species composition of faunas and paleo-vegetation pointed to the fact that the climate during the second half of the Late Pliocene had changed towards arid and cool, in contrast to that in the beginning of Late Pliocene. The woodland areas gradually decreased and savanna-like landscape occupied the territory. One might assume that forests mainly spread along the rivers, and possibly mountainous slopes. The landscapes looked mosaic-type: these were forest-steppe, steppes and meadows, in places shrub thickets. The territories with well-developed river system and close to lakes hosted the habitat of *Castor*, *Neomys* and *Cricetinus*, meadows, meadow-steppes, and the herbaceous biotopes in the lowland could be favorable sites for *Scaptochirus, Mesosiphneus*, *Beremendia, Petenyia* and cemented voles of the genus *Mimomys*. The open landscape inhabitants being the ochotonids (variety *Ochotona)*, hamsters (*Cricetulus*) and cementless vole of the genus *Villanyia* became more abundant and diverse. For instance, in the Beregovaya locality the proportion of the latter reached nearly 80 % of the entire number of small mammals. It seems that these forms, especially *Villanyia eleonorae,* occurred in the most suitable life conditions, its amount was approximately measured as 70 % (ERBAJEVA 1974). This species was steppe herbivorous dweller characterized by cementless teeth, narrow masticatory teeth occlusal surface with sharp cutting edge, resembling teeth structure of the modern *Lagurus* feeding on harsh vegetation.

Table 1: List of the Late Pliocene small mammals of the Transbaikal area and the Northern Mongolia *

Taxa	Udunga	Tologoi 1.1.B	Tologoi 1.1.A	Berego-vaya	Shamar horiz.2	Shamar horiz.3	Orkhon1, horiz.4,6	Orkhon1, horiz.8	Bural-Obo **
Lypotyphla									
Sorex sp.			+	+	+		+	+	+
Erinacaeus sp.					+				
Beremendia fissidens Petenyi				+	sp.				sp.
Petenyia hungarica Kormos			+	+					
Neomys sp					+				
Scaptochirus cf. *primaevus* Schloss.									+
Lagomorpha									
Hypolagus transbaicalicus (Erba-jeva)	+	+	+	+	sp.		sp.		sp.
H. multiplicatus (Erbajeva)	+			+					
Ochotona gromovi Erbajeva	aff.			+					cf.
Ochotona intermedia Erbajeva			+	+					
Ochotona sibirica (Erbajeva)	aff.			+					
Ochotona zazhigini Erbajeva									+
Ochotona sp.	+	+			sp.		+	+	+
Ochotonoides complicidens Boule et Teilhard de Chardin	+	+	+	+	+			+	
Rodentia									
Marmota tologoica Ivanijev		+							
Castor sp.	+			+					
Sicista pliocaenica Erbajeva			+	+	sp.	sp.	sp.	sp.	+
Allactaga sp.					+				+
Orientalomys sibirica (Erbjeva)	+	+		+		+	+		+

Taxa	Udunga	Tologoi 1.1.B	Tologoi 1.1.A	Berego-vaya	Shamar horiz.2	Shamar horiz.3	Orkhon1, horiz.4,6	Orkhon1, horiz.8	Bural-Obo **
Orientalomys sibirica (Erbajeva)	+	+		+		+	+		+
Micromys minutus Pallas				+		sp.			+
Cricetinus varians Zdansky	+	+	+	+		+		aff.	
Gromovia daamsi Erbajeva, Alexeeva, Khenzykhenova	+								
Cricetulus sp.			+	+	+			+	+
Kowalskia sp.	+	+							
Promimomys cf. *stehlini* Kormos	+	+							
Cseria gracilis Kretzoi	+	+							
Mimomys minor Feifar	cf.	cf.	+	+	+				
M. pseudintermedius Erbajeva				+					
Mimomys reidi Hinton				+					
Mimomys cf. *hintoni coelodus*						+	+		
Pitymimomys koenigswaldi Erbajeva, Alexeeva, Khenzykhenova			+						
Villanyia eleonorae Erbajeva	cf.	cf.	+	+	+	sp.	+	sp.	+
Synaptomys sp.						+			aff.
Mesosiphneus praetingi Teilhard de Chardin	+	+	+	+	+	+	+		+
Pliosiphneus cf. *lyratus* Teilhard de Chardin			+						
Prosiphneus cf. *ericksoni* (Schloss.)								+	

* - List of species from Transbaikalia is given after ERBAJEVA (1974, 1996), ERBAJEVA et al. (2003), BAZAROV et al. (1976) and list from Mongolian sites is given after DEVJATKIN, ZAZHIGIN (1974); DEVJATKIN (1981); ZAZHIGIN (1989).

** - List of species from Bural-Obo has been compiled after ZAZHIGIN (1989) and AGADJANIAN (2014).

The analysis of the Late Pliocene faunal record allows to trace the gradual evolutionary development in the species composition in the context of the paleo-environment and climate change. The woodland realm with rather humid and temperate climate at the beginning of the Late Pliocene was progressively replaced by the savanna-like territories to the end of this period. The climate became semiarid and warm, but it was not too hot.

Conclusion

1. During the Pliocene time, the regions of Transbaikalia and North Mongolia made up the united area, and they belonged to the Central-Asian paleo-zoogeographical province of the Palearctic region.
2. The Late Pliocene faunas available in studied localities of these regions show quite high taxonomic diversity.
3. The two evolutionary stages are known in the Late Pliocene faunas developing in context of the environment and climate changes.

Acknowledgements

We are greatful to our colleagues Agadjanian A.K., Sotnikova M.V., Vislobokova I.A., Zazhigin V.S. and Zhegallo V.I. for the professional assistance and fruitful field works in the Transbaikalian localities. Special gratitude to Agadjanian A.K. for Bural-Obo fotos and to Filinov I.A. and Shchetnikov A.A. for foto and scheme of the Tologoi locality section.

Funding for this study came from the Fundamental basic project IX.127.1.5., the registration No. AAAA-A16-116121550056-9 and RFBR, grant Nr 20-05-00163.

References

AGADJANIAN, A.K. (2014): Study of Late Cenozoic small mammals of Mongolia. – Paleontology of Central Asia and adjacent regions. International conference to 45 anniversary of the joint Russian-Mongolian palaeontological expeditions (JRMPE) 1969-2014, 12-13 November 2014, PIN, Moscow. - Abstracts: 8-10. (In Russian).

AGADJANIAN, A.K.; ERBAJEVA, M.A. (1983): Late Cenozoic rodents and lagomorphs of the USSR territories. - Nauka (Moscow): 189. (In Russian).

ALEXEEVA, N.V. (2005): Late Cenozoic Environmental evolution of West Transbaikalia based on small mammal faunas). - GEOS Press (Moscow): 141. (In Russian).

BAZAROV, D.B.; ERBAJEVA, M.A.; REZANOV, I.N. (1976): Geology and fauna of the Anthropogene Key sections of the Western Transbaikalia. – Nauka (Moscow): 148. (In Russian).

BELOVA, V.A. (1985): Vegetation and climate of the late Cenozoic in southern West Siberia. – Nauka (Novosibirsk): 128. (in Russian)

BEZRUKOVA, E.V.; KULAGINA, N.V.; LETUNOVA, P.P.; SHESTAKOVA, O.N. (1999): Climatic and vegetation changes in the Baikal region for the last 5 Ma according to palynological data on the Baikal sediments. - Geol. Geofiz. **40**: 735-745. (In Russian).

BORISSOGLEBSKAYA, M.B. (1981): New species of monkey (Mammalia, Primates) from the Pliocene of North Mongolia. - Fossil Vertebrates of Mongolia. The joint Soviet-Mongolian Paleontological Expedition, Transaction, vol. **15**. – Nauka (Moscow): 95-108. (In Russian).

DEMSKE, D.; MOHR, B.; OBERHAENSLI, H. (2002): Late Pliocene vegetation and climate of the Lake Baikal region, southern East Siberia, reconstructed from palinological data. - Palaeogeography, Palaeoclimatology, Palaeoecology **184**: 107-129.

DEVJATKIN, E.V. (1981). The Cenozoic of Inner Asia. (Stratigraphy, geochronology and correlation). - Nauka (Moscow): 196. (In Russian).

DEVJATKIN, E.V.; ZAZHIGIN, V.S. (1974): Eopleistocene deposits and new mammalian localities in Northern Mongolia // Mesozoic and Cenozoic faunas and biostratigraphy of Mongolia. The joint Soviet-Mongolian Paleontological Expedition, Transaction, vol.**1**. - Nauka (Moscow): 357-363. (In Russian).

DMITRIEVA, E.L. (1977). Neogene antelopes of Mongolia and adjacent territories. The joint Soviet-Mongolian Paleontological Expedition, Transaction, vol. **6**. - Nauka (Moscow): 120. (In Russian).

ERBAJEVA, M.A. (1974). Villafranchian fauna of small mammals of the Western Transbaikalia. Memoires B.R.G.M. Nr. **78**. T.1. Lyon: 137-139.

ERBAJEVA, M.A. (1996). Pliocene lagomorphs and Rodentia of Udunga locality (Western Trans-Baikal). In: SOKOLOV, V.E. (ed.): The state of Therio faunas of Russia and adjacent territories. Proc. Int. Conf., Moscow: 133-136. (In Russian).

ERBAJEVA, M.A. (2009). Pliocene-Recent Holarctic marmots: overview. Ethology, Ecology & Evolution. In: ARMITAGE, K.B.; LENTI BOERO, D. (eds.): Proc. VIth Int. Marmot Conf., Cogne, Valle d'Aosta, Italy, 3-6 September 2008; **21** (N 3-4): 339-348.

ERBAJEVA, M.A.; ALEXEEVA, N.V.; KHENZYKHENOVA, F.I. (2003): Pliocene small mammals from the Udunga site of the Transbaikal area. - Colloquios de Paleontologia, Spec. **1**: 133-145.

GODINA, A.JA. (1981): Palaeotragus from upper Pliocene of Mongolia and Trans-Baikaln region. Fossil Vertebrates of Mongolia. The joint Soviet-Mongolian Paleontological Expedition, Transaction, vol. **15**. - Nauka (Moscow): 109-113. (In Russian).

LOGATCHEV, N.A., LOMONOSOVA, T.K. & KLIMANOVA, V.M. (1964). Cenozoic deposits of the Irkutsk Amphitheater. – Nauka, Moscow: 187. (In Russian).

MALAEVA, E.M. (1989). The history of the Pliocene vegetation in Mongolia and the criteria for its paleofloristic subdivision. In: LOGATCHEV, N.A. (ed.): Late Cenozoic of Mongolia (stratigraphy and paleogeography). The joint Soviet-Mongolian Scientific Research Geological Expedition, Transactions **47**. - Nauka (Moscow): 139-157. (In Russian).

MASHCHENKO, E.N. (1994): The northernmost primate of Asia. - Priroda **1**: 64-70. (in Russian)

SOTNIKOVA, M.V. (1979): On genus *Felis* (*Lynx*) from Pliocene of Mongolia and USSR. Mesosoic and Cenozoic faunas of Mongolia. - The joint Soviet-Mongolian Paleontological Expedition, Transaction **8**. - Nauka (Moscow): 23-30. (In Russian).

SOTNIKOVA, M.V. (1980): Late Pliocene Mustelidae from Shamar locality (MPR). - Bulletin of Commission for study of the Quaternary N **50**:138-145. (In Russian).

SOTNIKOVA, M.V. (2008). A new species of lesser panda *Parailurus* (Mammalia, Carnivora) from the Pliocene of Transbaikalia (Russia) and some aspects of ailurine phylogeny. - Paleontol. J. **42**: 90-99.

SOTNIKOVA, M.V.; KALMYKOV, N.P. (1991): Pliocene association of predatory mammals from Udunga site (Western Transbaikalia). In: VANGENGEIM, E.A. (ed.): Paleogeography and biostratigraphy of Pliocene and anthropogene. - Moscow, Geological Institute, Academy of Sciences of the USSR: 146-160. (In Russian).

VANGENGEIM E.A. (1977): Paleontologic foundation of the Anthropogene stratigraphy of Northern Asia (on mammals). - For Xth Congress of INQUA (Birmingham, 1977). - Nauka (Moscow): 172. (in Russian).

VANGENGEIM E.A.; BELJAEVA, E.I.; GARUTT, V.E.; ZAZHIGIN, V.S. (1966): Eopleistocene mammals of the Western Transbaikalia. – Nauka (Moscow): 164. (in Russian).

VISLOBOKOVA I.A. (1983).The fossil deer of Mongolia. The joint Soviet-Mongolian Paleontological Expedition, Transaction **23**. - Nauka (Moscow): **75**. (in Russian).

VISLOBOKOVA, I.A.; ERBAJEVA, M.A.; SOTNIKOVA, M.V. (1993): Early Villafranchian stage in mammal faunal development of the northern Eurasia. - Stratigraphy & Geological Correlation **1** (5): 87-96. (In Russian).

WOLSAN, M.; SOTNIKOVA, M.V. (2013): Systematics, evolution and biogeography of the Pliocene stem meline badger *Ferinestrix* (Carnivora: Mustelidae). - Zool. J. Linnean Soc. **167**: 208-226.

ZAZHIGIN, V.S. (1989): Upper Pliocene Key sections and their biostratigraphic characteristic (based on mammals). Late Cenozoic of Mongolia (stratigraphy and paleogeography). In: Logatchev, N.A. (ed.): The joint Soviet-Mongolian Scientific Research Geological Expedition, Transactions **47**. – Nauka (Moscow): 10-24. (In Russian).

ZHEGALLO, V.I. (1978): Hipparions of the Central Asia. - Nauka (Moscow): 156 (in Russian).

Addresses:

N.V. Alexeeva
M.A. Erbajeva *
Geological Institute
Siberian Branch RAS
Ulan-Ude
Russia

E-mail: ochotona@mail.ru
erbajeva@ginst.ru

* Corresponding author