Vespertilio 16: 271–278, 2012
ISSN 1213-6123

Myotis cf. *schaubi* and other bats from the Pleistocene of the Central Altai Mts., Russia

Valentina V. Rosina

Borissiak Paleontological Institute RAS, Profsoyuznaya 123, 117997 Moscow, Russia; ros@paleo.ru

Abstract. The bat fauna from the Paleolithic locality of the Ust'-Kanskaya cave includes: *Plecotus auritus*, *P.* aff. *auritus*, *Eptesicus nilssonii*, *E.* cf. *nilssonii*, *Vespertilio murinus*, *Vespertilio* sp., *Murina hilgendorfi*, *Myotis blythii*, *M. petax*, *Myotis* sp. and *M.* cf. *schaubi*. The most abundant and common species are *E. nilssonii*, *E.* cf. *nilssonii*, *P. auritus* and *P.* aff. *auritus*, while *M.* cf. *schaubi*, *M. blythii* and all remaining species are rare and not numerous. Among the fossil bats from the Ust'-Kanskaya cave only *M.* cf. *schaubi* is reported here for the first time as a fossil species that became extinct in the Altai Mts. and remains so to the present day. The scarcity of the fossil bat material and the peculiar aggregation of bat taxa are evidence in favour of the accumulation of bat bones as ae result of natural mortality during hibernation. The unique findings of *M.* cf. *schaubi* and some archaic voles (*Allophaiomys* and *Mimomys*) enable some speculations about the age of certain layers and beds of the Ust'-Kanskaya cave.

Chiroptera, Vespertilionidae, Late Pleistocene, Altai Mts., Ust'-Kanskaya cave

Introduction

The Ust'-Kanskaya cave is situated in the Charysh River basin near the settlement of Ust'-kan in the Central Altai Mts. of Russia. It is a small karstic cavity in a massive of Silurian mountain limestone about 16 m long and 13 m wide with a southwestern orientation of the entrance (Fig. 1; Serdyuk 2010). The Late Quaternary sediments are up to 1–2 m thick and are represented mostly by clay loams of different density (Postnov 2004). They were divided into 12 layers on the basis of their geomorphologic properties and archaeological materials which were found here (for details see Postnov 2004).

The small mammalian fauna from the Ust'-Kanskaya cave is numerous in all layers but very heterogeneous from the biostratigraphical point of view. Apparently, the sediments, originally from deposits of the Pleistocene ages, were mixed.

The Late Pleistocene vole species, such as *Lagurus lagurus* (Pallas, 1773), *Stenocranius gregalis* (Pallas, 1779), *Microtus arvalis* (Pallas, 1778), *M. agrestis* (Linnaeus, 1761), *M. hyperboreus* Vinogradov, 1934, *M. oeconomus* (Pallas, 1776), *Arvicola terrestris* (Linnaeus, 1758), Lemmini, *Alticola macrotis* (Radde, 1862), *A. strelzowi* (Kastschenko, 1899), *Clethrionomys rutilus* (Pallas, 1779), and *C. rufocanus* (Sundevall, 1846,) were found in all layers of the stratum of the Ust'-Kanskaya cave (Serdyuk 2010). However, the mammalian fauna from the lower layers (layers 12–8) includes also the vole species typical for the earlier intervals of Pleistocene; *Allophaiomys pliocaenicus* Kormos, 1932, *Microtus hintoni* (Kretzoi, 1941), *Prolagurus pannonicus* (Kormos, 1930), *P. ternopolitanus* (Topachevsky, 1973), *Mimomys intermedius* (Newton, 1881), *Allophaiomys deucalion* Kretzoi, 1969, and *Altaiomys ustkanicus* Serdyuk et Tesakov, 2006 (Serdyuk 2010). These species are absent from the upper layers (layers 7–1, see Serdyuk 2010). Thus the overall faunal composition of the strata of the Ust'-Kanskaya cave indicates their Late Pleistocene age and only the lowermost beds of the stratum include fossil material which is probably older.

Material and methods

The material of fossil bats under study (in total 142 items) was found in the layers 4, 5–7, 8, 9 and 10 of deposits of the Ust'-Kanskaya cave and is represented mostly by isolated teeth, fragments of humerus and lower jaws in various degrees of preservation. All fossil material is housed in the Borissiak Paleontological Institute of the Russian Academy of Sciences (PIN, Moscow, Russia). Dental terminology follows Miller (1907). Photographs were taken by a scanning electron microscope located at the PIN. The specimens were measured with a binocular microscope (MBS-10) with an ocular micrometer. All measurements are given in millimeters with 0.01 mm precision.

Lengths of individual teeth and tooth-rows were taken as the maximum distance between posterior and anterior crown edges of the respective teeth. The widths of the upper molars were taken as the maximum distance between the lingual and buccal crown edges, and were measured parallel to the mesial side (see Sigé 1968: 72, Fig. 4). The following measurements were taken: the length of the p4 (Lp4); length (Lm) × width of the trigonid (Wtr) × width of the talonid (Wtl) of m1, 2; width of M1, 2 (WM1, 2); the height of a mandibular corpus measured at the lingual side below m1 (Hmdm1). The following abbreviations and abridgements are used in the text: mnd – mandibular bone; sin. – sinister (= left); dex. – dexter (= right).

The holotypes of *Myotis baranensis* Kormos, 1934 (V.61.1403), *M. wusti* Kormos, 1934 (V.61.1412) and *M. schaubi* Kormos, 1934 (V.61.1416), deposited at the Hungarian Natural History Museum (HNHM, Budapest, Hungary) were examined. We used the osteological collections of Recent *Myotis emarginatus* (Geoffroy, 1806), *M. bechsteinii* (Kuhl, 1817), *M. nattereri* (Kuhl, 1817) and *M. schaubi* Kormos, 1934 from the Zoological Museum of the Moscow State University (ZMMU, Moscow, Russia) and the Zoological Institute of the Russian Academy of Sciences (ZIN, St. Petersburg, Russia) for comparison.

Results

Only Vespertilionidae bats were found in the locality of the Ust'-Kanskaya cave (Table 1): *Plecotus auritus* (Linnaeus, 1758); *P.* aff. *auritus*; *Eptesicus nilssonii* (Keyserling et Blasius, 1839); *E.* cf. *nilssonii*; *Vespertilio murinus* Linnaeus, 1758; *Vespertilio* sp.; *Murina hilgendorfi* Peters, 1880; *Myotis blythii* (Tomes, 1857); *M. petax* Hollister, 1912; *Myotis* sp. and *M.* cf. *schaubi* Kormos, 1934.

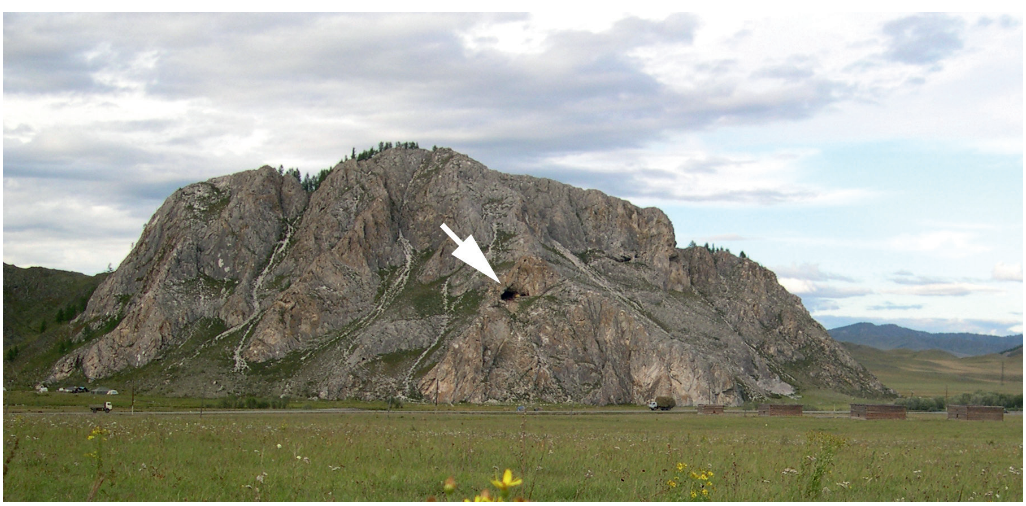

Fig. 1. Location of the Ust'-Kanskaya cave (see the white arrow sign), a karstic cavity in the Silurian limestone deposits in the Čaryš river basin near the settlement of Ust'-kan, Central Altai Mts., Russia (photo by A. K. Agadjanian).

Table 1. Distribution of numbers of bat records in the Late Pleistocene deposits of the Ust'-Kanskaya cave

layer	species	number of specimens
4	*Myotis blythii*	2
	Eptesicus cf. *nilssonii*	1
5	*Eptesicus nilssonii*	1
5–7	*Myotis petax*	1
	Eptesicus cf. *nilssonii*	2
	Plecotus auritus	1
	Vespertilionidae indet.	1
7	*Eptesicus nilssonii*	1
	Eptesicus cf. *nilssonii*	1
8	*Vespertilio* sp.	1
	Eptesicus nilssonii	5
	Eptesicus cf. *nilssonii*	9
	Plecotus aff. *auritus*	1
	Vespertilionidae indet.	5
9	*Myotis* sp.	1
	Eptesicus nilssonii	1
	Eptesicus cf. *nilssonii*	6
	Plecotus aff. *auritus*	3
	Vespertilionidae indet.	8
10	*Myotis blythii*	1
	Myotis cf. *schaubi*	4
	Myotis sp.	1
	Vespertilio murinus	1
	Eptesicus nilssonii	32
	Eptesicus cf. *nilssonii*	13
	Plecotus auritus	2
	Plecotus aff. *auritus*	12
	Murina hilgendorfi	1
	Vespertilionidae indet.	24
total		142

The Holocene bats are morphologically identical with the Recent bats from the Altai Mts. In the Pleistocene taphocoenosis there are both forms which are identical with Recent Altai bats and forms which are somewhat larger than the Recent bats (the difference between the mean body size data is not more than 15%). The latter ones are assigned to *E*. cf. *nilssonii* and *P* aff. *auritus*.

The most abundant and common species of the taphocenosis are *E. nilssonii* and *E*. cf. *nilssonii* (39.6% and 31.7% of all identifiable remains, respectively). *Plecotus auritus* and *P*. aff. *auritus* (3% and 15.8%, respectively) are principal elements, while *M*. cf. *schaubi* (4%), *M. blythii* (3%) and all remaining species (together less than 3%) represent the complementary elements of the sample.

With the exception of *M*. cf. *schaubi*, all fossil bats from the Ust'-Kanskaya cave have analogous Recent bat species that inhabit the Altai region today. Only *M*. cf. *schaubi* is for the first time reported here as a fossil species that became extinct in the Altai Mts.. *Myotis schaubi* was described as a new fossil species by Kormos (1934) from the Early Pleistocene locality Villany-3 (MN 17/ MQ 1, Hungary). Today this species inhabits arid mountain regions of the Palearctic from Transcaucasia to Iran (Horáček & Hanák 1984).

***Myotis* cf. *schaubi* Kormos, 1934** (Fig. 2)

Material. PIN 4837/59 M1 dex., PIN 4837/60 M2 dex., PIN 4837/61 M2 sin., PIN 4837/62 mnd sin. with p4–m2. All material was found in the layer 10 of the strata of the Ust'-Kanskaya cave.

Measurements. See Tables 2, 3.

Description. The isolated right upper M1, M2 and left M2 are represented. The M1–2 have no para- or metaconules but have distinct paralophs and metalophs. The postprotocrista extends to the lingual base of the metacone and forms a distinct hypocone by a hypoconal undulation. Thus, the trigon basins of the molars are closed. The teeth have a well-developed undulating buccal cingulum which is very thin at the protocone side. The M1 is more compact than the M2, the latter having a more regular W-shaped ectoloph and more prolate crown.

The dentary is a proximal part of the horizontal ramus with p4, m1 and m2 and is broken in front of the alveoli of m3. The alveoli of the incisors are similar in size, not compressed and stand one after the other. The preserved alveoli of p2–3 are also similar in size and both are situated very spaciously in the midline of the row of teeth. The p4 is rectangular and elongate in occlusal view. The m1 and m2 are myotodont with a well-defined hypoconulid. All teeth have a well-developed undulating cingulum.

Comparison. The structure of the upper molars, dental formula, shape of p4, the non-reduced lower incisors and premolar areas of the specimens are evidence of its membership in *Myotis*.

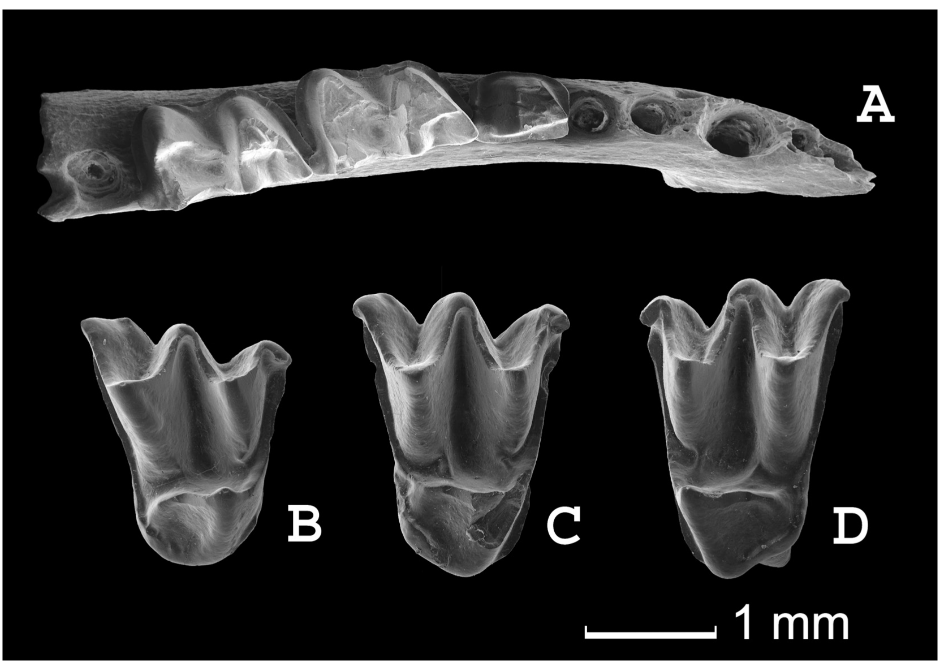

Fig. 2. *Myotis* cf. *schaubi* from the Ust'-Kanskaya cave, occlusal view: A – dentary fragment sin. with p4–m2, PIN 4837/62; B – M1 dex, PIN 4837/59; C – M2 dex, PIN 4837/60; D – M2 sin, PIN 4837/61.

Table 2. Selected dentary measurements of some Recent and fossil *Myotis* species (in mm); min value – max value, (mean); n – number of specimens

species	origin	n	LP_4	LM_1	$WtrM_1$	$WtlM_1$	LM_2	$WtrM_2$	$WtlM_2$	Hmndm1
Myotis cf. *schaubi* PIN 4837/62	Ust'-Kanskaya cave	1	1.00	1.60	1.05	1.12	1.70	1.10	1.12	2.05
M. schaubi holotype	Villany-3, Hungary	1	0.94	1.56	0.97	1.04	1.56	0.92	1.00	1.73
M. schaubi	Armenia, Iran	2	0.86–1.00 (0.93)	1.35–1.50 (1.43)	0.9	1.05–1.15 (1.10)	1.55–1.60 (1.58)	0.95–1.06 (1.00)	1.08–1.18 (1.13)	1.47–1.77 (1.62)
M. baranensis holotype	Villany-3, Hungary	1	1.20	1.90	1.26	1.33	1.87	1.38	1.38	2.32
M. wusti holotype	Villany-3, Hungary	1	1.11	1.53	0.92	1.10	1.61	0.99	1.14	1.92
M. steiningeri holotype*	Villany-3, Hungary	1	–	–	–	–	–	–	–	1.70
M. bechsteinii	Russia	1	1.00	1.60	0.85	1.00	1.60	0.98	1.03	1.75
M. emarginatus	Serbia, Russia	3	0.93–1.00 (0.96)	1.40–1.43 (1.40)	0.75–0.85 (0.80)	0.80–0.90 (0.86)	1.35–1.40 (1.38)	0.80–0.90 (0.87)	0.85–0.95 (0.89)	1.65–1.80 (1.73)
M. nattereri	Czech Rep., Russia	4	0.75–0.95 (0.84)	1.25–1.35 (1.30)	0.73–0.85 (0.78)	0.85–1.00 (0.92)	1.25–1.45 (1.35)	0.85–0.95 (0.90)	0.90–1.05 (0.95)	1.40–1.60 (1.47)

* after Kormos (1934)

Table 3. Widths of the upper molars of some Recent *Myotis* species and *Myotis* cf. *schaubi* from the Ust'-Kanskaya cave (in mm); min value – max value, (mean); n – number of specimens

species / specimen	origin	n	WM1	WM2
M. cf. *schaubi* PIN 4837/59	Ust'-kanskaya cave	1	1.95	–
M. cf. *schaubi* PIN 4837/60	Ust'-kanskaya cave	1	–	2.30
M. cf. *schaubi* PIN 4837/61	Ust'-kanskaya cave	1	–	2.45
M. schaubi	Armenia	1	2.00	2.30
M. bechsteinii	Russia	5	1.70–1.95 (1.78)	1.85–2.10 (1.97)
M. emarginatus	Russia, Serbia	19	1.55–1.83 (1.67)	1.65–2.05 (1.88)
M. nattereri	Russia, Czech Rep.	17	1.50–1.93 (1.74)	1.73–2.18 (1.99)

However, the material under study is very fragile and it is difficult to make an accurate species determination.

For stratigraphic reasons and because of the difference in morphology we will not compare Miocene and Pliocene *Myotis* species, such as *Myotis boyeri* Mein, 1964 from Lissieu (MN 13, France) or *M. podlesicensis* Kowalski, 1956 from Podlesice (MN 13/14, Poland), with our material. There are four Early Pleistocene *Myotis* species which are well-suited for comparison with specimens from the Ust'-Kanskaya cave: *M. baranensis* Kormos, 1934, *M. wusti* Kormos, 1934, *M. steiningeri* Kormos, 1934 and *M. schaubi* Kormos, 1934 from Villany-3 (MN 17 / MQ 1, Hungary).

Based on the dental morphology, the fossil specimens are somewhat similar to the Recent *M. emarginatus*, *M. bechsteini* and *M. nattereri*. However the latter three species are significantly smaller than the Pleistocene *Myotis* from the Ust'-Kanskaya cave (Tables 2, 3). Moreover, *M. bechsteini* differs from the Altai fossils in having a very weak paraloph and paraconule and having no metaloph on the crowns of the upper molars. In contrast to the Altai fossil specimens, the paraloph paraconule and hypocone of *M. emarginatus* are very weak (Rosina 2002). As opposed to *M. nattereri*, the upper molars of the specimens from the Ust'-Kanskaya cave have a well-developed para- and metaloph (Fig. 2).

The Early Pleistocene *M. baranensis* is considerably larger than the Altai fossil specimens (Table 2) and also differs in having a more reduced p3.

Only *M. steiningeri*, *M. wusti* and *M. schaubi* are similar in size to the specimens from the Ust'-Kanskaya cave (Tables 2, 3). The p4 of *M. wusti* is longer and has a more developed anterobuccal cingulum than that of the Altai specimens. On the contrary, the p4 of *M. steiningeri* is more quadrate in form with well-developed anterobuccal and posterobuccal cingular cuspules (Kormos 1934: Fig. 40, pp. 13–14).

The *Myotis* specimens from the Pleistocene sediments of the Ust'-Kanskaya cave are very similar to *M. schaubi*. The M1–2 of both the fossils and the Recent species have distinct paralophs and metalophs. The trigon basins of the molars are closed; the postprotocrista forms a distinct hypocone by a hypoconal undulation. The buccal undulating cingulum is well-developed but it is very thin at the area of the protocone (Fig. 2). The morphology of the dentary is also very similar (Table 2). However, the direct comparison of the specimens from the Ust'-Kanskaya cave with *M. schaubi* is difficult because of the poor preservation of the fossils. Moreover, the Recent *M. schaubi* has a small but distinct paraconule on the upper molars which is not visible on the fossil molars from the Ust'-Kanskaya cave (Fig. 2). Thus, the fossil specimens are assigned to *M*. cf. *schaubi*.

Discussion

Most fossil bats from the Ust'-Kanskaya cave are cave-dwelling species. They use caves year-round as a shelter and especially during hibernation when these bats can form quite large aggregations. Moreover, *Myotis blythii* can form large nursery colonies in caves in the summer time. At present, one such colony of *M. blythii* inhabits the caves in the Charish River basin of the northwestern Altai Mts. (Strelkov 1968, own data). Among the bats of the Ust'-Kanskaya cave only *Vespertilio murinus* is not a typical cave-dweller but rather a dendrophilous species. However, as shown by our observations in the Altai Mts., small groups of *V. murinus* often visit karstic cavities in the autumn (Rosina 2004a). Apparently the bat community in the Ust'-Kanskaya cave never was numerous, judging from the small number of fossils in the cave sediments. It is quite possible that the remains of the bats at the Ust'-Kanskaya cave have accumulated as a result of natural mortality occurring in animals during hibernation. This conclusion is also confirmed by the peculiar aggregation of bat taxa in the Ust'-Kanskaya cave: *Plecotus* and *Eptesicus* predominate and *Myotis* are very rare. Moreover, *M. dasycneme* (Boie, 1825) and *M. ikonnikovii* Ognev, 1912 which are very common in the Holocene deposits in Altai caves (Rossina 2004b), at present abundant there in the hibernation aggregations of bats (Rossina 2008), were not found in the deposits of the Ust'-Kanskaya cave. However, these species are common and abundant during hibernation only, inhabiting large and deep caves with mild winter temperatures. In small caves and rock shelters which freeze in the winter, these thermophilic *Myotis* are rare, but psychrophilic *Eptesicus* and *Plecotus* are very common. Such a situation is observed today in the Denisova cave and also in the Kaminnaya cave (Rossina 2008). Thus the dominance of *Eptesicus* and *Plecotus* records in the Ust'-Kanskaya cave is evidence in favour of accumulation of bat bones as a result of natural mortality during hibernation. However, a pellet origin of some material cannot be excluded.

The scarcity of the fossil bat material and evidence of mixing of the sediments from the Ust'-Kanskaya cave make it impossible to use our findings for paleoecological reconstruction or for biostratigraphical conclusions. Such investigations have been done on the basis of the rich fossil bat material from the Denisova cave – one of the famous paleolithic localities of the Altai Mts. (Rossina 2006). However, the unique findings of some bat species, first of all *M*. cf. *schaubi*, permit some speculations about the age of certain layers and beds of the Ust'-Kanskaya cave. All records of *M*. cf. *schaubi* were made from the lowermost bed of the stratum (layer 10). Some archaic voles *Allophaiomys* and *Mimomys* which are typical for the early intervals of Pleistocene (Serdyuk 2010), were also found there. These mammal species are not known from the other multi-layered Paleolithic site of the Denisova cave (Agadjanian 1998, 2003, Rossina 2006). Thus the fossil material of the lower layers of the Ust'-Kanskaya cave include some elements of mammal faunas which are probably older than the Late Pleistocene. The *M*. cf. *schaubi* is one of such faunal elements among the bats of the Altai Mts.

Acknowledgements

We are very grateful to Prof. Dr. Alexander K. Agadjanian (Borissiak Paleontological Institute RAS, Moscow, Russia) for all-around support of our research. We give our appreciation to Dr. N.V. Serdyuk for the kind assistance in our work with the fossil collections from the Ust'-Kanskaya cave. The study was supported by the Russian Foundation for Basic Research (Project 11-04-00933-a and 11-06-12030-офи-м-2011).

References

Agadjanian A. K., 2004: Mlekopitaûŝie pozdnego plejstocena severo-zapadnogo Altaâ v usloviâh aktivnosti drevnego čeloveka [The Late Pleistocene mammals of northwestern Altai in conditions of the Paleolithic man activity]. Pp.: 81–115. In: Antipina E. E. & Černyh E. N. (eds.): *Novejšie arheozoologičeskie issledovaniâ v Rossii* [*New Archeozoological Investigations in Russia*]. Âziki slavianskih kultur, Moskva, 224 pp (in Russian).

Agadjanian A. K., 1998: Fauna melkih mlekopitaûŝih Denisovoj peŝery [Small mammal fauna of the Denisova cave]. Pp.: 34–41. In: Derevânko A. P. & Molodin V. I. (ed.): *Problemy arheologii*, *ètnografii*, *antropologii Sibiri i sopredel'nyh territorij* [*Problems in Archeology*, *Ethnography*, *Anthropology in Siberia and Adjacent Territories*]. Institute of Archaeology and Ethnography SD RAS, Novosibirsk, 528 pp (in Russian).

Horáček I. & Hanák V., 1984: Comments on the systematics and phylogeny of *Myotis nattereri* (Kuhl, 1818). *Myotis*, **21–22**: 20–29.

Kormos T., 1934: Neue Insektenfresser, Fledermäuse und Nager aus dem Oberpliozän der Villányer Gegend. *Földtani Közlöny*, *Budapest*, **64**: 296–321.

Miller G. S., 1907: The families and genera of bats. *Bulletin of the United States National Museum*, **57**: i–xvii+1–282.

Postnov A. V., 2004: *Otčet ob issledovaniâ arheologičeskih pamâtnikov Ust'-Kanskaâ peŝera i Čaryšskij naves v 2003 g*. (*Ust'-Kanskij rajon Respubliki Altaj*) [*Research Report on the Archaeological Sites Ust'-Kanskaâ Cave and Čaryšskij naves in 2003* (*Ust'-Kanskij District of the Republic of Altai*)]. Institute of Archaeology and Ethnography SD RAS, Novosibirsk, 135 pp (in Russian).

Rossina V. V., 2002: Odontologičeskoe raznoobrazie nočnic (*Myotis*) Palearktiki [Odontological diversity of mouse-eared bats (*Myotis*) from the Palaearctic]. *Plecotus et al*., **pars spec**.: 27–29 (in Russian, with a summary in English).

Rossina V. V., 2004a: Letnee naselenie letučih myšej (Chiroptera) peŝer severo-zapadnogo Altaâ [Bat (Chiroptera) summer ihabitation of the caves in the northwestern Altai]. *Plecotus et al*., **7**: 63–71 (in Russian, with a summary in English).

Rossina V. V., 2004b: Golocenovye rukokrylye (Chiroptera; Mammalia) i osobennosti ih tafonomii v usloviâh peŝer severo-zapadnogo Altaâ [The Holocene bats (Chiroptera; Mammalia) and peculiarities of their taphonomy in the conditions of caves of the northwestern Altai]. Pp.: 110–118. In: Barskov I. S., Leonova T. B. & Ponomarenko A. G. (eds.): Èkosistemnye perestrojki i èvoluciâ biosfery [*Ecosystem Reorganizations and Biosphere Evolution*. *Volume 6*]. Institute of Palaeontology RAS, Nedra, Moskva, 140 pp (in Russian, with a summary in English).

Rossina V. V., 2006: Bats as an indicator of human activity in the Paleolithic using. The example of Denisova Cave, Northwestern Altai. *Paleontologičeskij Žurnal*, **40**(Supplement 4): S494–S500.

Rossina V. V., 2008: Bat hibernation in caves of northwestern Altai (Russia). Pp.: 117–128. In: Klys G., Wołoszyn B. W., Jagt-Yazykova E. & Kusnierz A. (eds.): *The Influence of Environmental Conditions on the Bat Hibernaculum Choice*. ZPW Plik, Sucha Góra NP, Bytom, 143 pp.

Serdyuk N. V., 2010: Drevnie polevki (Arvicolinae, Cricetidae, Rodentia, Mammalia) iz plejstocena Central'nogo Altaâ [Ancient voles (Arvicolinae, Cricetidae, Rodentia, Mammalia) from the Pleistocene of the Central Altai]. *Paleontologičeskij Žurnal*, **3**: 88–98 (in Russian, with a summary in English).

Sigé B., 1968: Les chiroptères du Miocène inférieur de Bouzigues. I. Étude systématique. *Palaeovertebrata*, **1**(3): 65–133.

Strelkov P. P., 1968: Ostrouhie nočnicy na Altae [The lesser mouse-eared bats in the Altai]. *Priroda*, *Moskva*, **1968**(2): 59–61 (in Russian).

received on 25 October 2012