ISSN 0031-0301, Paleontological Journal, 2006, Vol. 40, Suppl. 4, pp. S494–S500. © Pleiades Publishing, Inc., 2006.

Bats As an Indicator of Human Activity in the Paleolithic, Using the Example of Denisova Cave, Northwestern Altai

V. V. Rossina

Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya ul. 123, Moscow, 117997 Russia
e-mail: ros@paleo.ru

Received February 20, 2006

Abstract—Landscape and climatic changes in northwestern Altai at the end of the Middle Pleistocene were accompanied by a transformation in the taxonomic composition of the bat community and abundance of some species. The dynamics of the bat community is very important for the study of the activity of Paleolithic man. The high sensitivity of bats to human disturbance allowed the time of colonization and nature of usage of Denisova cave by humans to be recognized. In this respect, bats are a very important indicator of events in the surrounding ecosystem.

DOI: 10.1134/S0031030106100091

Key words: Bats, Paleolithic, human activity, northwestern Altai.

INTRODUCTION

Landscape and climatic changes in northwestern Altai at the end of the Middle Pleistocene were accompanied by transformations in the mammal community (Agadjanian, 1998; Barishnikov, 1998; Dupal, 2003) and in the bat fauna in particular.

During the archeological excavation of Altai Paleolithic sites, numerous chiropteran specimens were collected. In our research, the bat community of the Anui River basin was used as a model for studying the chiropteran population and the dynamics of the taxonomic structure of the bat fauna from the Middle Pleistocene to the present.

Fig. 1. Working area in the Anui River basin.

Fig. 2. Hibernating *Myotis dasycneme* and *Murina leucogaster* at the roof of Muzeinaya cave.

MATERIAL AND METHODS

We investigated seven caves of the Anui River Basin (Fig. 1): Denisova, Muzeinaya, Starokarakolskaya, Badannaya, Kaminnaya, Razboinaya, and Titunikha.

The recent population of cave-dwelling bats was studied in summer and winter annually from 2001 to 2005. In summer, the animals were captured with nets during their flight inside and outside the caves, as well as at their feeding sites. In winter, the bat hibernation sites were examined inside the caves (Fig. 2).

Table 1. Holocene bat species records from caves of the Anui River basin

No.	Caves / Species	Muzeinaya	Razboinaya	Titunikha	Denisova	Total
		n	*n*	*n*	*n*	
1	*Myotis dasycneme*	42	5	11	1	59
2	*M. daubentonii*	75	11	24	6	116
3	*M. brandtii*	48	9	6	–	63
4	*M. frater*	–	–	4	–	4
5	*M. ikonnikovi*	13	6	15	3	37
6	*M. blythii*	8	–	8	2	18
7	*Plecotus auritus*	25	14	9	–	48
8	*Eptesicus nilssonii*	15	11	3	2	31
9	*Murina leucogaster*	–	–	1	1	2
	Total	226	56	81	15	378

Fig. 3. Subfossil bat records on the surface of deposits of Muzeinaya cave.

A total of 866 specimens of nine species, *Myotis daubentonii, M. brandtii, M. dasycneme, M. frater, M. ikonnikovi, Plecotus auritus, Vespertilio murinus, Eptesicus nilssonii*, and *Murina leucogaster*, were examined.

Table 2. The population dynamics and taxonomic structure of the cave-dwelling bat community from the end of the Middle Pleistocene to the present

Bat species	Recent community	Early Holocene community	Late Pleistocene community
Myotis daubentonii	+++	+++	+
M. brandtii	+++	+++	+
M. dasycneme	++	++	++
M. ikonnikovii	+	+	+
M. frater	+	+	–
M. blythii	–	+	++
Plecotus auritus	+++	+++	++
Eptesicus nilssonii	+	++	++
Murina leucogaster	+	+	+
Vespertilio murinus	++	+	–

Note: Designations: (+++) abundant, (++) common, (+) solitary, and (–) not recorded.

Holocene bat remains were collected in the caves listed above in the upper layers of cave deposits (Fig. 3). We collected more than 1000 chiropteran specimens, including skulls, teeth, and postcranial bones.

At the Paleolithic site (Denisova cave), a rich Pleistocene fauna of mammals was collected; however, until our research, the numerous bat specimens from the cave sediments remained unidentified (Fig. 4).

The Pleistocene deposits are about 4.5 m thick and include 14 layers (from 9 to 22). The oldest layer (22) is dated 120 ka, i.e., the end of the Middle Pleistocene (Agadjanian, 2003). Fossil material of bats is mostly represented by isolated teeth.

For isolated bat teeth, we compiled a key to bat teeth (predominantly upper molars). A total of 2234 isolated bat teeth were identified.

RESULTS

Our investigation shows that, in the Upper Pleistocene, the bat community of Denisova cave consisted of *Myotis blythii, M. daubentonii, M. brandtii, M. dasycneme, M. ikonnikovi, Plecotus* aff. *auritus, Eptesicus* cf. *nilssonii,* and *Murina leucogaster* (Fig. 5).

P. aff. *auritus*, *E.* cf. *nilssonii*, and *M. dasycneme* were the most abundant and common species, while

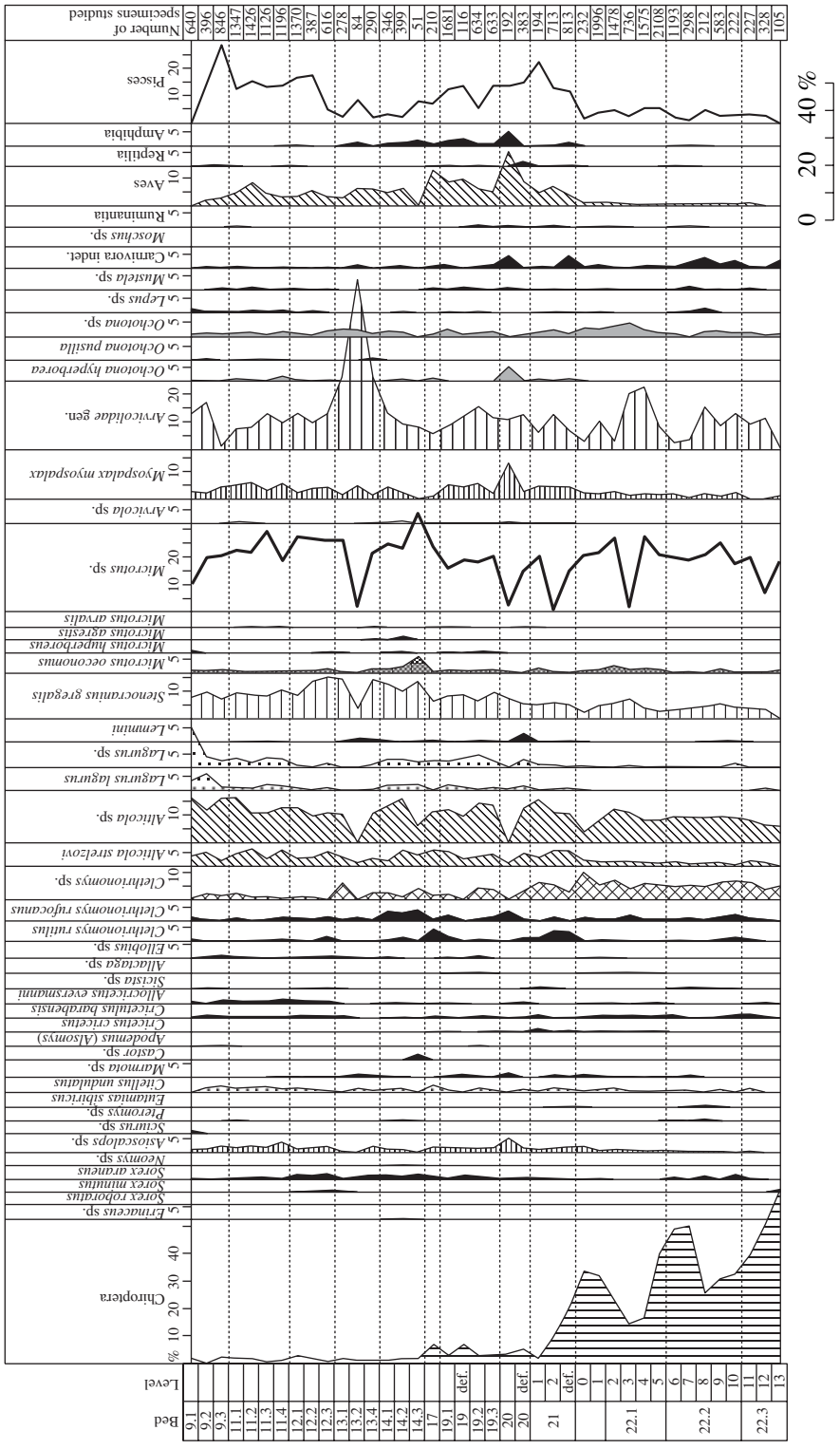

Fig. 4. Rich mammal fauna from the Pleistocene deposits of Denisova cave; note the abundance of bat fossil records.

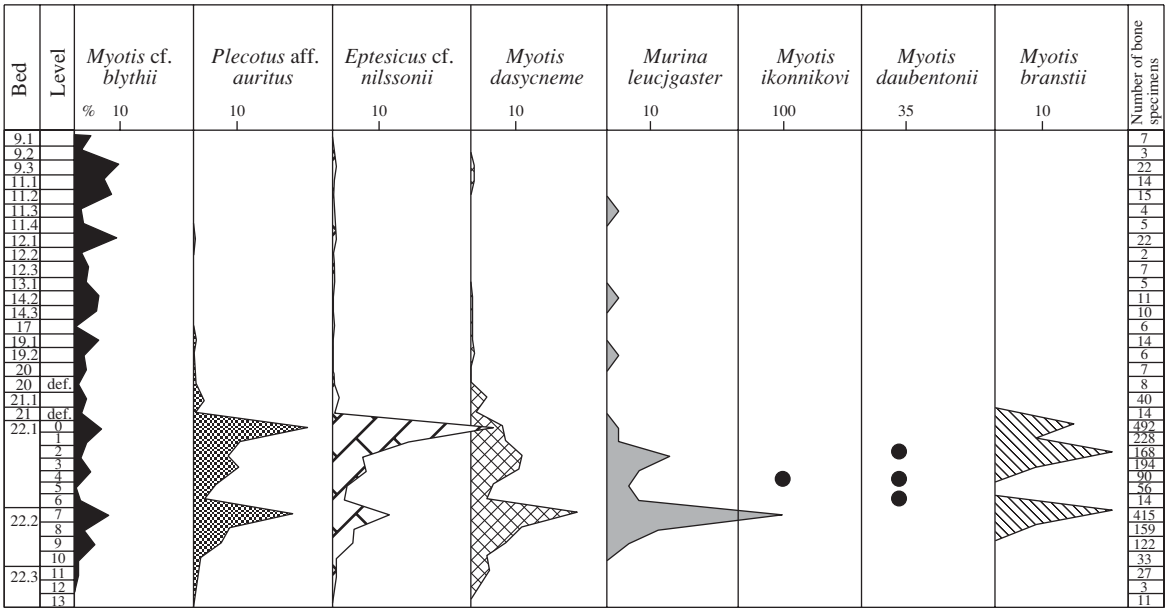

Fig. 5. Dynamics of the number of bat specimens in the Pleistocene deposits of Denisova cave.

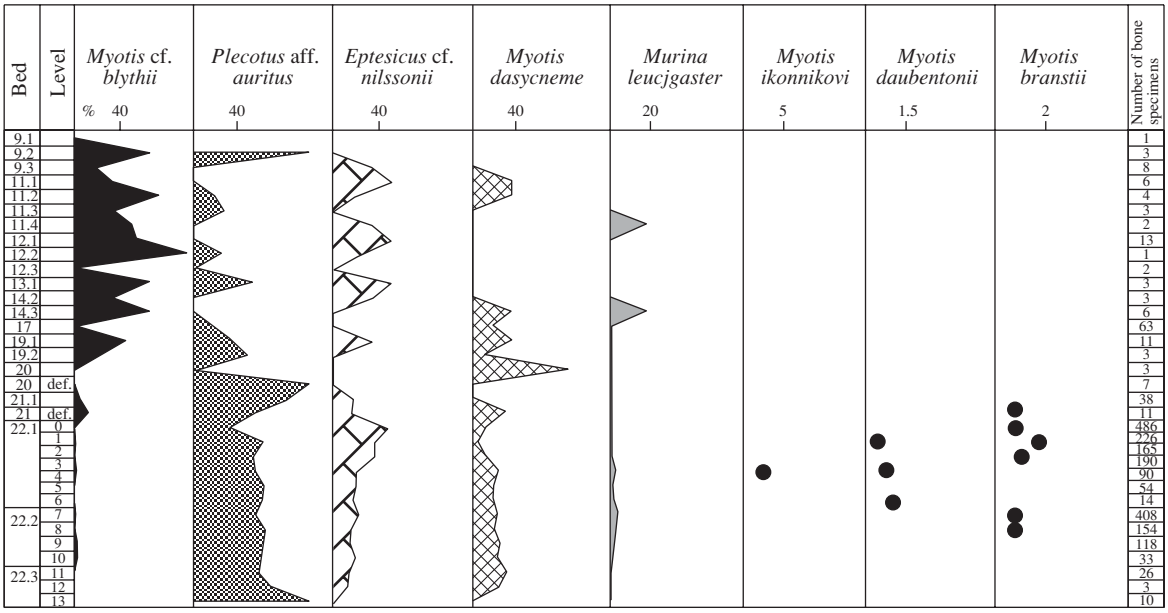

Fig. 6. Dynamics of the percentage of bat specimens in the Pleistocene deposits of Denisova cave.

small-sized species of the genus *Myotis* were infrequent.

According to our data, the proportion of *Myotis blythii* in the bat community increased constantly from the Upper Pleistocene to the Holocene (Fig. 6).

It is well-known that this species is associated with open landscapes (Arlettaz et al., 1993). Palynological data have corroborated that, during that period, the area of open landscapes increased, while the forested area decreased (Malaeva, 1999).

The high sensitivity of bats to human disturbance allowed the time of colonization and nature of usage of Denisova cave by humans to be recognized. From the time that humans began to exploit Denisova cave (Upper Pleistocene), most of the bat species gradually decreased in number (Fig. 5) apparently because of the smoke the human fires produced.

Fig. 7. The colony of *Myotis blythii* inhabiting Letuchikh Mishei cave on the right bank of the Charysh River.

Our data strongly suggest that Paleolithic man occupied the cave only in the winter period, because *M. blythii* continued to increase in number, which can be attributed to an increase in abundance during the summer season, when it produced summer nesting colonies.

The present-day cave bat community established in the Anui River basin (northwestern Altai) consists of *Myotis daubentonii, M. brandtii, M. dasycneme, M. frater, M. ikonnikovi, P. auritus, E. nilssonii*, and *Murina leucogaster.* Our data show that it doesn't include *Myotis blythii*, although, in the Lower Holocene, *M. blythii* was also represented there and gradually decreased in number (Table 1). Apparently, the scenario described was due to a decrease in the area of open landscapes during that period. At present, *M. blythii* only occurs south of the Charysh River basin (Fig. 7).

Throughout the Holocene, small-sized species of *Myotis*, such as *M. daubentonii* and *M. brandtii*, were the most numerous and common species (Table 2). Thus, the present-day cave-dwelling bat community of the Anui River basin is of the taiga type.

CONCLUSIONS

(1) Recent bat fauna of northwestern Altai is of the taiga type and consists of 11 species: *Myotis daubentonii, M. brandtii, M. dasycneme, M. frater, M. ikonnikovi, M. blythii, Plecotus auritus, Vespertilio murinus, Eptesicus nilssonii, Murina leucogaster*, and *Nyctalus noctula.* Among the cave-dwelling bats, the most abundant and common species are *Myotis daubentonii, M. brandtii, M. dasycneme, P. auritus*, and *Murina leucogaster.* Other species are rarer.

(2) Landscape and climatic changes in northwestern Altai at the end of the Middle Pleistocene were accompanied by a transformation in the taxonomic composition of the bat community and influenced the numbers of some species.

(3) As a result of steppification of northwestern Altai landscape from the Upper Pleistocene to the Holocene, the proportion of boreal species in the bat community decreased constantly, while the proportion of steppe species increased. During the Holocene, a reverse trend is revealed for steppe species (e.g., *M. blythii*); their percentage decreased because of the increase of the forest area.

(4) From the Pleistocene to the Recent, the anthropogenic factor had a limiting effect on the cave-dwelling bat community.

ACKNOWLEDGMENTS

I am deeply grateful to Prof. A.K. Agadjanian for all-round support of my investigations. I would also like to thank Dr. M.V. Shun'kov for help in realization of field investigations, A.G. Kononov and A.A. Makivsky for help in collecting the fossil material, M.K. Emel'anova for help in preparation of pictures,

and T.V. Karpova for valuable comments on the manuscript.

The study was supported by the Complex Program for Basic Research of the Presidium of the Russian Academy of Sciences (no. 25 "Biosphere Origin and Evolution"), the Program of the Presidium of the Russian Academy of Sciences "Historical Dynamics of Bioresources As a Prerequisite for Their Conservation and Harmonious Exploitation," and the Russian Foundation for Basic Research (project nos. 04-05-64805 and 05-04-48493).

REFERENCES

1. A. K. Agadjanian, "The Late Pleistocene Mammals of Northwestern Altai in Conditions of Paleolithic Man Activity," in *Modern Archeozoological Investigations in Russia* (Moscow, 2003), pp. 81–115 [in Russian].
2. A. K. Agadjanian, "The Small Mammal Fauna of Denisova cave," in *Problems of Archeology, Ethnography, and Anthropology of Siberia and Adjacent Territories* (Inst. Arkheol. Etnogr. Sib. Otd. Ross. Akad. Nauk, Novosibirsk, 1998), Vol. 1, pp. 34–41 [in Russian].
3. R. Arlettaz, M. Ruedi, and J. Hausser, "Ecologie trophique de deux especes jumelles et sympatriques de chauves-souris: *Myotis myotis* et *Myotis blythi* (Chiroptera: Vespertilionidae), Premiers resultants," Mammalia **57** (4), 519–531 (1993).
4. G. F. Baryshnikov, "Paleoecology of the Most Ancient Inhabitants of the Altai Mountains," in *Problems of Archeology, Ethnography, and Anthropology of Siberia and Adjacent Territories* (Inst. Arkheol. Etnogr. Sib. Otd. Ross. Akad. Nauk, Novosibirsk, 1998), Vol. 1, pp. 42–50 [in Russian].
5. T. A. Dupal, "Changes in Small Mammal Communities of the Northwestern Altai at the Pleistocene–Holocene Boundary," Paleontol. Zh., No. 1, 78–84 (2004) [Paleontol. J. **38** (1), 83–89 (2004)].
6. E. M. Malaeva, "Palinology of Pleistocene Deposits of nearby Entrance of Denisova Cave," in *Problems of Archeology, Ethnography, and Anthropology of Siberia and Adjacent Territories* (Inst. Arkheol. Etnogr. Sib. Otd. Ross. Akad. Nauk, Novosibirsk, 1998), Vol. 5, pp. 163–168 [in Russian].