Journal of
Bat Research & Conservation

OPEN ACCESS
www.secemu.org
DOI: 10.14709/BarbJ.18.1.2025.03

ORIGINAL ARTICLE

First records of bats near Multa lakes, Altai (Russia): diet and ectoparasites

Viskontene Alex [1,2,*], Baeva Irina[3,*], Solntseva Svetlana[4]

[1] Zoological Institute Russian Academy of Science (RAS), Universitetskaya Embankment 1, Saint Petersburg, Russia.

[2] Central Research Institute of Epidemiology of Rospotrebnadzor, Novogireevskaya str., 3a, Moscow, Russia

[3] Tigirek State Nature Reserve, Nikitina Street, 111, Barnaul, Altai Krai, Russia.

[4] Cherepovets State University, Lunacharsky Avenue, 5, Cherepovets, Vologda Region, Russia.

*Corresponding author:
alex.viskontene@gmail.com
kentavr_ira@mail.ru

DOI: https://doi.org/10.14709/BarbJ.18.1.2025.03

ABSTRACT

In the Altai Republic Red List almost all bats have 'Data Deficient'-status, and knowledge of their ecology in the region is still fragmented. The aim of this study was to illuminate one blind spot in bat research in this territory and compare it with known data. Bats were trapped for the first time near the Multa lakes, Altai, Russia, in July 2023. We captured six bats of three species: the eastern water bat (*Myotis petax*), David's myotis (*Myotis davidii*), and the Ikonnikov's bat (*Myotis ikonnikovi*). In the bats` faeces, six orders of arthropods were found: Coleoptera, Diptera, Trichoptera, Neuroptera, Lepidoptera and Mesostigmata. The ectoparasites inhabiting the trapped *Myotis* were *Macronyssus charusnurensis, Spinturnix bregetovae, Nycteribia quasiocellata* and one *Cimex cf. lectularius*. No fleas were captured. Our results suggest that the bats near Multa Lakes are similar to those studied in Altai-Sayan Region of Southern Siberia.

Keywords: Altai, bats, dietary analysis, ectoparasites, gamasid, mites, *Myotis*

received: September, 13th 2024
accepted: February, 3rd 2025

INTRODUCTION

The history of bat studies in Altai and adjacent territory extends more than 200 years (Pallas 1811). However, for most of the territory, the data remains fragmented (Zhigalin & Khritankov 2014). According to the Altai Republic Red List, all bat species have 'Data Deficient'-status (Malkov 2017). That can be explained by the inaccessibility of potential bat habitats on the one hand and a great variety of habitat conditions in this region on the other hand (Zhigalin et al. 2019).

Besides, after the revision of the taxonomic status of the eastern group of bats, a lot of scientific names have been changed. In papers before 2005, the eastern water bat *Myotis petax* Hollister, 1912 was called Daubenton's bat *Myotis daubentonii* (Kuhl, 1817) (Matveev et al. 2005); similarly, *Myotis sibiricus* was earlier mistakenly called *Myotis brandtii* (Kruskop et al. 2012); David's myotis *Myotis davidii* (Peters, 1869) was formerly identified as *Myotis mystacinus* (Kuhl, 1819) (Benda & Tsytsulina 2000) and *Myotis longicaudatus* Ognev, 1927 as *Myotis frater* G. Allen, 1823 (Kazakov et al., 2025, Ruedi et al., 2015). In some papers, *M. davidii* is mentioned as *Myotis aurascens* Kuzyakin, 1935, which is its junior synonym (Benda et al. 2012). Another *Myotis* bat, Ikonnikov's bat *Myotis ikonnikovi* Ognev, 1911, was previously considered a subspecies of *Myotis muricola* (Gray, 1864) (Tsytsulina 2001). Other changes have been made to the genus *Plecotus*. After morphological and molecular studies, *Plecotus auritus* was divided into different species, where the *Plecotus ognevi* Kishida, 1927 is the one that can be found in the Asian part of its natural habitat (Spitzenberger et al. 2006). Thus far, the revision of Altai bats is incomplete for some species distribution and the area's borders remain unknown (Zhigalin et al. 2019).

To date, 11 bat species have been registered in the Altai Republic (Malkov 2017). Six bats belong to genus *Myotis*: long-tailed myotis (*Myotis longicaudatus* Ognev, 1927), David's myotis (*Myotis davidii* Peters, 1869), Siberian whiskered myotis (*Myotis sibiricus* [Kasatschenko, 1845]), Ikonnikov's bat (*Myotis ikonnikovi* Ognev, 1912), eastern water bat (*Myotis petax* Hollister, 1912) and pond bat (*Myotis dasycneme* Boie, 1825). A single species represent other genera: Ognev's long-eared bat (*Plecotus ognevi* Kishida, 1927), common noctule (*Nyctalus noctula* [von Schreber, 1774]), northern bat (*Eptesicus [Cnephaeus] nilssonii* [Keyserling, Blasius, 1839]), parti-coloured bat (*Vespertilio murinus* Linnaeus, 1758), and Hilgendorf's tube-nosed bat (*Murina hilgendorfi* [Peters, 1880]).

Some bat research were conducted in 1970-1980 (Kazakov & Yarmysh 1974, Stukanova 1976, Stukanova & Pupina 1976, Marin 1980, Marinin & Malkov 1989). The region was quite forgotten until 1999 when the number of publications increased again (Malkov & Veryaskina 1999, Malkov 2006, Gorbunova 2006, 2015). Besides the information on several aspects of the biology of the species, such as their distribution among the region, data on sex-age composition of the population, migration activity, and others is still incomplete.

It is known that *Myotis* bats always prey on insects in hovering flight (aerial hawking), but they can also glean them from leaves' surface, ground (gleaning) or water (trawling) (Liu et al. 2000). *M. petax* forage 5-20 cm from the water surface, hunting for Plecoptera, mayflies and caddisflies (Tiunov et al. 2021). On Lake Baikal, eastern water bats have been detected to prey on pelagic Amphipoda (Didorenko et al. 2022). *M. ikonnikovi* forages on emerging aquatic insects by aerial hawking (Fukui et al. 2006). These bats can prey on the border of forest vegetation and open space, in floodplain thickets (Tiunov et al. 2021). In Japan Ikonnikov's bats were found to prey on 16 insect orders, mainly on the orders of Coleoptera, Lepidoptera and Diptera, to a lesser degree on Neuroptera and others (Sato & Katsuta 2018, Heim et al. 2021). Some bats of the genus *Myotis* are known to eat fish (Aizpurua & Alberdi 2018). From a perspective of bats' taxonomy changes and unstudied territory, it become interesting to investigate if bats' food preferences near Multa lakes differ from those in previously studied places.

Typical bat ectoparasites are ticks, mites, fleas, bat flies and bugs. Gamasid mites are permanent parasites representing two families: Macronyssidae and Spinturnicidae. Macronyssidae feeds on mammals, birds and reptiles. On bats, they can be found on the flying membrane, near ears, and on genitals. Spinturnicidae are highly specialised parasites of the wing or tail membrane of bats. Adult bat fleas and bat flies can be found on bats fur, especially in the armpit and the scruff of the neck. Bat bugs do not live permanently on their hosts, but often remain at roost sites. There is a lot of data about bat ectoparasites in nearby Mongolia (Scheffler et al. 2010, 2012, Scheffler 2016, Scheffler et al. 2016) and some scattered information about Kazakhstan (Orlova et al. 2023). Bat and ectoparasite species are well-studied in Russian Far East (Orlova & Kazakov 2016, Zakharov et al. 2016, Tiunov et al. 2021), and some data is presented for Southern Siberia (Orlova et al. 2014a, 2015a, 2015c).

The Katunsky Nature Reserve is located almost in the centre of the Eurasian continent, at a considerable distance from all seas and oceans. The climate is continental. On the border of the reserve lies the Multinsky cascade of lakes. The Multa River, originating under the watershed of the Katunsky ridge, forms three lakes in the upper reaches called Verkhneye, Sredneye and Nizhneye Multinskoye lakes. Verkhneye Multinskoye Lake is located at an altitude of 1920 m above sea level. On the northern side, the lake is dammed by a moraine composed of coarse material and overgrown with cedars; its surface area is 13.3 hectares, up to 50 m deep. The Sredneye Multinskoye Lake is located 6 km from Verkhniy, at an altitude of 1740 m. The area of the lake is 106 hectares, the length is almost two km, the average width is about 600 m, the depth is about 20 m. The Nizhneye Multinskoye Lake is separated from the Sredneye Lake by a moraine ridge 30 m high and 150 m long. There is a gentle waterfall on the moraine called Shumy, where the Multa River connects Sredneye and Nizhneye Multinskoye lakes (Fig. 3). The area of the lake is 155.7 hectares, length 2.4 km, width 700 m, depth about 20 m. The water in the lakes is clear, level fluctuations are insignificant (Yashina et al. 2006).

The Chiroptera fauna of Multa Lakes and their parasites were examined in our reseach for the first time. The aim of this study was to sample a blind spot in bat research in this region and to compare it with the known data. The result represents an important step to understanding Altai's bat ecology and parasitology.

MATERIALS AND METHODS

Animal sample collection and body condition index counting

From the 9th to the 20th of July 2023, for the first time, bats were studied in Katun Nature Reserve on Multa site and adjacent territory, Altai (Russia) (Fig. 1, Table 2)**.** Bats were captured with mist nets (5 x 12 m, with 8 pockets), and one or two nets were installed each night (Table 1). Places for net installation were chosen focusing on previous knowledge of bat biotopic preferences and using a bat detector LunaBat DFD-1. Sex, weight and the length of the forearm of each specimen were recorded. Identification of bats was based on morphological traits according to the taxonomic key (Dietz & von Helversen 2004, Nikulkin et al. 2018). After the examination, bats were banded with bird rings. The edges of these rings were knowingly smoothed with a file by hand to prevent wing membrane damage (Masing 1996). All the animals were released into the wild after sample collection.

Body condition index (BCI) was calculated based on Vasenkov and Potapov (2007). BCI = W/W0, where W is the weight of the bat in the field (observed body weight), measured 9-11 hours after the trapping; W0 is a special coefficient multiplied by forearm length in cm (expected weight). The coefficient for *Myotis petax* is 0.14, for *M. ikonnikovi* 0.15 (Vasenkov & Potapov 2007).

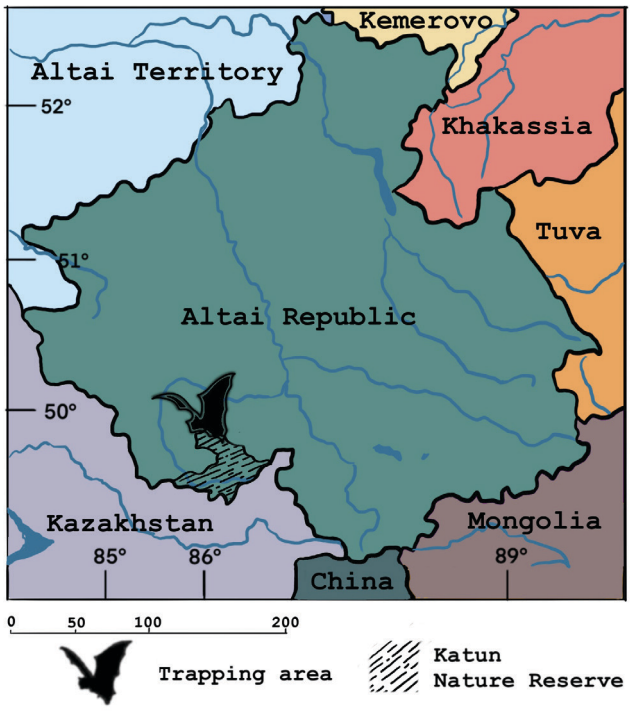

Fig. 1 - Map showing trapping area

Table 1 - Trapping sites and sampling effort

Place	Number and area of nets	Duration of trapping	Number of bats	Bat species
49°59’36.5”N 85°49’46.3”E	2 / 120m	5h 25min	2	*Myotis petax*, *Myotis davidii*
49°59’30.0”N 85°49’45.5”E	1 / 60m	6h 30min	1	*Myotis petax*
49°58’43.6”N 85°50’07.0”E	2 / 120m	10h 25min	0	—
49°58’43.1”N 85°50’08.6”E	1 / 60m	6h 15min	0	—
49°56’44.9”N 85°51’13.1”E	1 / 120m	8h 13min	0	—
49°56’45.3”N 85°51’12.3”E	2 / 120m	12h 20min	3	*Myotis ikonnikovi*
49°55’25.0”N 85°50’44.6”E	1 / 60m	3h 30min	0	—
49°55’25.3”N 85°50’43.9”E	1 / 60m	3h 30min	0	—

Table 2 - Characteristic of captured bats and their food preferences

Species	Ring number	Sex	Date of capture	Coordinates	Length of forearm, mm	Weight of a bat, g	Body condition index according to Vasenkov and Potapov	Arthropod remains orders in faeces
Myotis petax	MOSKVA XB 415257	♀	11.07.2023	49°59’36.5”N 85°49’46.3”E	38	7	1,06	Coleoptera, Lepidoptera, Diptera
	MOSKVA XB 415249	♂	20.07.2023	49°59’30.0”N 85°49’45.5”E	38	9	1,37	Coleoptera, Lepidoptera, Diptera, Neuruptera, mites
Myotis davidii	MOSKVA XB 415253	♂	11.07.2023	49°59’36.5”N 85°49’46.3”E	32,5	6	—	Coleoptera, Lepidoptera, Diptera, Trichoptera
Myotis ikonnikovi	MOSKVA XB 415259	♂	14.07.2023	49°56’45.3”N 85°51’12.3”E	33	5	0,93	Coleoptera, Lepidoptera, Diptera
	MOSKVA XB 415254	♂	15.07.2023	49°56’45.3”N 85°51’12.3”E	33	5	0,93	Coleoptera, Lepidoptera, Diptera
	MOSKVA XB 415268	♂	17.07.2023	49°56’45.3”N 85°51’12.3”E	32	5	1,02	Coleoptera, Lepidoptera, Diptera

Analysis of faeces

Bat faeces were collected in test tubes with 96% alcohol. Each pellet containing insect samples was soaked and softened in a Petri dish with soap solution for not less than 24 hours. Then samples were put on microscope slides in a drop of glycerin and examined with a dissecting microscope 'Lomo' MSP-1 and a binocular microscope 'Altami' Bio-6. Arthropod remains were sorted with a dissecting needle and identified to the lowest possible taxonomic level (usually order, sometimes family) following Chinery 2007, Plavilshchikov 1994 and Shiel et al. 1997.

Collection and identification of ectoparasites

Ectoparasites were collected with forceps from the bat`s flying membrane and fur and transported in the laboratory in 96% alcohol. Gamasid mites were fixed in Fora-Berlese solution. Microscope slides are stored in the Zoological Institute Russian Academy of Science collection. Bat flies were preserved in 96% ethanol. Slides were studied using the optical microscope 'Lomo' NEXCOPE NE620. Ectoparasites were identified using the following keys (Stanyukovich 1997, Farafonova 2001, Orlova et al. 2015b).

Abundance shows a number of parasites per one host specimen. It was counted as the sum of all collected parasites of a species divided by the number of examined hosts (n=6).

Parasite load was calculated according to Scheffler et al. (2016) as Σ number of parasites of a particular species multiplied by the parasitization-factor. The parasitization-factor was for *Cimex cf. lectularius* 23,04, *Nycteribia quasiocellata* 4,41, Macronyssidae (all species) 0,42, Spinturnicidae (all species) 0,81 (to learn more about the index calculation see Scheffler et al. 2016).

RESULTS AND DISCUSSION

Bat captures

In total six vesper bats of three species were captured. *Myotis ikonnikovi* (Ognev, 1912) represented half of all captured bats (Fig. 2, Table 2). Three males were caught in the taiga at the crossroads near the border of the reserve. Specimens were trapped in the interim from 21:55 to 22:10 (GMT+7), at sunset (21:52 GMT+7). On Shumy, — a gentle waterfall on the Multa river connecting Sredneye and Nizhneye Multinskoye lakes (Fig. 3), — a female of eastern water bat (*Myotis petax* Hollister, 1912) and male of David's myotis (*Myotis davidii* Peters, 1869) (Fig. 4) got caught in the net few minutes after sunset. The latest bat capture was made at 00:20 (GMT+7). It was a male eastern water bat found on Sredneye Multinskoye Lake (Fig. 5). About five more bats were registered with a bat detector at other points near Multa lakes, but they were not caught in the nets.

Measurements of the body index demonstrate that all bats were at their normal summer weight +/- 11,8% (Table 2).

Fig. 2 - *Myotis ikonnikovi*, trapped in taiga (photo: Baeva I.)

Fig. 3 - Shumy and Nizhneye Multinskoye Lake, where eastern water bat (*Myotis petax)* female and David's myotis (*Myotis davidii)* male were captured (photo: Baeva I.)

Fig. 4 - *Myotis davidii* trapped on Shumy (photo: Baeva I.)

Fig. 5 - Sredneye Multinskoye Lake, where an eastern water bat (*Myotis petax)* male was captured (photo: Baeva I.)

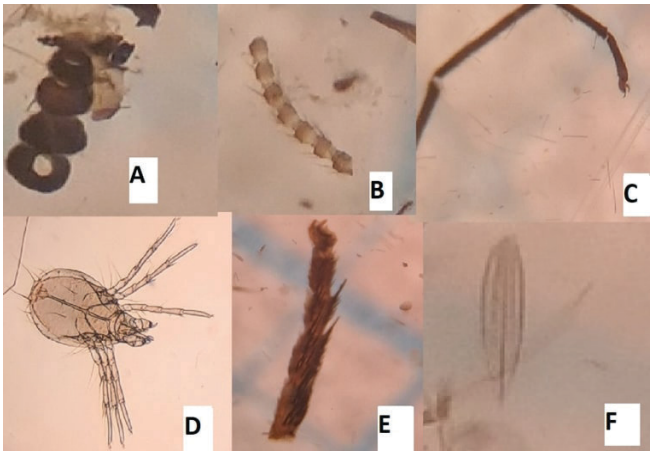

Fig. 6 - Arthropod remains in bats' faeces. A - Coleoptera, fragment of antenna; B - Neuroptera, fragment of antenna; C - Diptera, leg; D - Mesostigmata, larva; E - Trichoptera, leg; F - Lepidoptera, scale from the wing). (photo: Solntseva S.)

No new species for the Altai were discovered (Zhigalin et al. 2019). David's myotis was previously found near the Katun Nature Reserve (Malkov & Veryaskina 1999). *M. petax* and *M. ikonnikovi* were detected in Katun Nature Reserve for the first time (Malkov 2017) and were previously trapped only in Altai Nature Reserve (Gorbunova 2015). *M. petax* is considered to be one of the most widespread bat species in Altai-Sayan Mountain country (Zhigalin & Khritankov 2014); in Tigireksky Reserve (the Altai Territory), this bat was the most numerous (Vasenkov & Tomilenko 2005). *M. ikonnikovi* is also a widespread bat, registered for Altai Territory and other adjacent areas (Malkov & Veryaskina 1999, Rosina 2004, Vasenkov & Tomilenko 2005, Malkov 2006, Vasekov et al. 2008, Zhigalin & Khritankov 2014).

We expect there could be at least nine species in Katun Nature Reserve: in addition to ones we found *Myotis sibiricus, M. dasycneme, Plecotus ognevi, Nyctalus noctula, Eptesicus (Cnephaeus) nilssonii, Murina hilgendorfi* (Gorbunova 2015). Consequently, the territory requires further studies.

Bats' dietary analysis

In total, 16 pellets were examined. Five orders of insects were found: Coleoptera, Diptera, Trichoptera, Neuroptera, Lepidoptera; and one order of mites: Mesostigmata (Table 2). The small number of samples did not allow us to identify all the insects to the family. Most samples consisted of fragments of antenna of beetles and net-winged insects. Insects of the order Diptera were detected based on antennae and legs fragments of family Chironomidae. From caddisflies, only one leg was found. Fragments (legs and scales from the wing) were found for the order Lepidoptera (Fig. 6). Furthermore, fragments and complete specimens of gamasid mites were detected. These mites are typical bat ectoparasites (Orlova et al. 2015b) so they can get into the digestive tract as a result of grooming. Thus, Gamasina cannot be considered as a true part of bats' diet.

All detected insect orders are common in the bats diets (Sato & Katsuta 2018, Heim et al. 2021).

Ectoparasites identification

From six captured bats, one male of *Myotis ikonnikovi* had no ectoparasites. The other bats were infected with parasitic mites and insects. In total 43 arthropods were collected. The detected mites belonged to one order: Mesostigmata, Gamasina family Spinturnicidae and Macronyssidae. The insects were dominated by bat flies (Diptera, family Nycteribiidae). Single bed bug (Hemiptera, genus *Cimex*) was captured on *Myotis davidii* (Table 3). Despite the fact that fleas family Ischnopsyllidae are common bat ectoparasites (Scheffler et al. 2010, 2012), these insects were not detected on trapped bats.

Acari

Order Mesostigmata Canestrini, 1891

Family Spinturnicidae Oudemans, 1902
Spinturnix bregetovae Stanyukovich, 1995

Material: 2♂, 1♀ from *Myotis ikonnikovi*, 1 protonymph from *Myotis petax,* 1 protonymph and 1 deutonymph from *Myotis davidii.*

Abundance of *Spinturnix bregetovae* for all *Myotis* bats was 1,00.

Its distribution is Central and Eastern Palaearctic (Orlova et al. 2015b). Oligoxenous mite, parasiting on small bats of the genus *Myotis* (Tiunov et al. 2021). On *Myotis ikonnikovi* it was previously found in the Republic of Buryatia (Orlova & Kazakov 2016), on *Myotis petax* in Tuva (Orlova et al. 2015b).

Family Macronyssidae Oudemans, 1936
Macronyssus charusnurensis Dusbábek, 1966

Material: 5♂, 10♀, 2 protonymph from *Myotis petax,* 3♂from *Myotis davidii.* 3 females were with internal eggs.

Abundance of *Macronyssus charusnurensis* for all *Myotis* bats was 3,33.

Distributed in Central and Eastern Palaearctic, and the Urals (Orlova et al. 2015b). Its type host is *Myotis mystacinus* (Dusbábek 1966), furthermore, *Myotis petax* is considered to be its main host (Orlova et al. 2015b). The mite was occasionally noticed on other vesper bats genus *Myotis, Plecotus, Murina, Eptesicus* (Stanyukovich 1997, Orlova et al. 2015b, Orlova 2014), *Vespertilio* (Scheffler et al. 2012).

Insecta

Order Diptera Linnaeus, 1758

Family Nycteribiidae Samouelle, 1819
Nycteribia quasiocellata (Theodor, 1966)

Material: 4♂, 9♀, from *Myotis petax,* 1♂, 2♀ from *Myotis davidii*

Abundance of *Nycteribia quasiocellata* for all *Myotis* bats was 2,67.

Inhabits Far East and Siberia (Farafonova 2001). Oligoxenous bat ectoparasite that mainly feeds on *Myotis*, especially on *Myotis petax* (Medvedev et al. 1991, Scheffler et al. 2010, Farafonova & Gornostaev 2018). It can also feed on *Eptesicus (Cnephaeus) nilssonii* (Farafonova & Gornostaev 2018).

Order Hemiptera Linnaeus, 1758

Family *Cimicidae* Latreille, 1802
Cimex cf. lectularius

Material: 1 from *Myotis davidii*

All found ectoparasites are typical for the Altai Region and examined bat species (Scheffler et al. 2010, 2012, Orlova et al. 2014a, 2014b, 2015a). Fleas were not found in our study, but infection with *Myodopsylla trisellis* and *Ischnopsyllus comans* might be expected on *Myotis petax* according to other authors (Scheffler et al. 2010, Scheffler 2016, Zakharov et al. 2016).

Abundance of *Macronyssus charusnurensis* was low. It is known that infestation of this mite usually increases in autumn (Orlova et al. 2014b), while our study was conducted in the middle of summer. On the contrary, in Mongolia, the number of ectoparasites declined from summer to autumn (Scheffler et al. 2016) because of the high parasite infestation of breeding bats. Even for *Myotis daubentonii*, a European species that is similar to *Myotis petax*, the highest level of male's parasite infestation was observed during spermatogenesis (Encarnação 2011). In order to make any conclusions, we would need to collect different bat sexes throughout the summer period.

Table 3 - Ectoparasites collected from *Myotis* bats near Multa lakes, Altai

Host	Host sex	Host ring number	N of parasites/ parasite load	Parasite	Parasite sex	Parasite age
Myotis petax	♀	MOSKVA XB 415257	Sum:7 / 11,31	—	—	—
			1	*Spinturnix bregetovae*	—	protonymph
			2	*Macronyssus charusnurensis*	♂	imago
			1	*Macronyssus charusnurensis*	♀	imago
			1	*Macronyssus charusnurensis*	—	protonymph
			1	*Nycteribia quasiocellata*	♀	imago
			1	*Nycteribia quasiocellata*	♂	imago
	♂	MOSKVA XB 415249	Sum:24 / 53,97	—	—	—
			3	*Macronyssus charusnurensis*	♂	imago
			9	*Macronyssus charusnurensis*	♀	imago
			1	*Macronyssus charusnurensis*	—	protonymph
			8	*Nycteribia quasiocellata*	♀	imago
			3	*Nycteribia quasiocellata*	♂	imago
Myotis davidii	♂	MOSKVA XB 415253	Sum:9 / 34,74	—	—	—
			1	*Spinturnix bregetovae*	—	protonymph
			1	*Spinturnix bregetovae*	—	deutonymph
			3	*Macronyssus charusnurensis*	♂	imago
			2	*Nycteribia quasiocellata*	♀	imago
			1	*Nycteribia quasiocellata*	♂	imago
			1	*Cimex cf. lectularius*		imago
Myotis ikonnikovi	♂	MOSKVA XB 415259	Sum:2 / 1,62	—	—	—
			1	*Spinturnix bregetovae*	♂	imago
			1	*Spinturnix bregetovae*	♀	imago
	♂	MOSKVA XB 415254	Sum:0 / 0	—	—	—
			0	no parasites	no	no
	♂	MOSKVA XB 415268	Sum:1 / 0,81	—	—	—
			1	*Spinturnix bregetovae*	♂	imago

Nycteribia quasiocellata abundance was also not very high. A preference for host females by this fly was observed by Orlova and co-authors (Orlova et al. 2015d).

Parasite load is higher for *Myotis petax* and *Myotis davidii* than *Myotis ikonnikovi.* The same was observed by Scheffler and co-authors (2016). In our work *Myotis ikonnikovi* has a little lover parasite load (0, 0,81, and 1,62 to 4,66 ± 6,47), while *Myotis petax* — two times lover or higher depending on the specimen (11,31 and 53,97 to 22,42 ± 30,91).

During samples collection, the age of trapped animals was not recorded: However, the bat banded with ring MOSKVA XB 415249 was assumed to be a subadult, as the parasite load was much higher than on other bats, which is typical for young Chiroptera.

CONCLUSIONS

We provide some new data for bats of north Altai. However, the territory remains particularly unknown. In the future, it would be necessary to capture more bats to be able to draw any statistically significant conclusions and compare trapped bats in this natural reserve to other protected areas in this region.

ACKNOWLEDGMENTS

We would like to thank the staff of Katun Nature Reserve for assistance in fieldwork and Orlova M. V. (Tyumen State Medical University, Tyumen, Russia) and Vinarskaya N. P. (Zoological Institute RAS, Saint Petersburg, Russia) for checking ectoparasite identification. Moreover, authors express their gratitude to Evgenia Yurova (Genius-loci design studio) for map drawing.

CRediT authorship contribution statement

Viskontene: Conceptualization, Formal analysis, Investigation, Resources, Writing - Original Draft, Writing - Review & Editing, Visualization, Supervision

Baeva: Conceptualization, Investigation, Writing - Review & Editing, Visualization, Project administration

Solntseva: Investigation

REFERENCES

AIZPURUA, O. & ALBERDI, A. (2018). Ecology and evolutionary biology of fishing bats. *Mammal Rev,* 48(4): 284-297. https://doi.org/10.1111/mam.12136

BENDA, P. & TSYTSULINA, K. A. (2000). Taxonomic revision of *Myotis mystacinus* group (Mammalia: Chiroptera) in the western Palearctic. *Acta Soc Zool Bohem*, 64: 331-398.

BENDA, P., FAIZOLÂHI K., ANDREAS, M., OBUCH, J., REITER, A., ŠEVČÍK, M., UHRIN, M., VALLO, P. & ASHRAFI, S. (2012). Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 10. Bat fauna of Iran. *Acta Soc Zool Bohem,* 76: 163-582.

CHINERY, M. (2007). Insects of Britain and Western Europe. ed.: A. & C. Black. London, United Kingdom, 320 pp.

DIDORENKO, S. I., BOTVINKIN, A. D. & TAKHTEEV, V. V. (2022). *Myotis petax* (Chiroptera, Vespertilionidae) preys on pelagic Amphipoda (Crustacea, Gammaroidea) of Lake Baikal. *Acta Chiropterol*, 24(1): 187-194. https://doi.org/10.3161/15081109ACC2022.24.1.015

DIETZ, C. & O. VON HELVERSEN (2004): Identification key to the bats of Europe – electronical publication, version 1.0, 72 pp

DUSBÁBEK, F. (1966). A contribution to the knowledge of parasitic mites from Mongolia (Acarina: Gamasides). *Mitt Zool Mus* Berlin, 42(1): 43-59.

ENCARNAÇÃO, J. A. (2011). Mites, males, mates: sex- and age-specific host-parasite relationship between bats and ectoparasites. *104th Annual Conference Of The German Zoological Association*, 104: 82.

FARAFONOVA, G. V. (2001). Fam. Hippoboscidae – louse flies. In: Key to the insects of Russian far east. 6. Diptera and Siphonaptera. Pt 2. ed.: P.A. Lehr. Dalnauka. Vladivostok, Russia, p.252-258.

FARAFONOVA, G. V. & GORNOSTAEV, N. G. (2018). Review of nycteribiid flies (Diptera: Nycteribiidae) of Russia. *Russian Entomological J*, 27(4): 435-438. https://doi.org/10.15298/rusentj.27.4.11

FUKUI, D., MURAKAMI, M., NAKANO, S. & AOI, T. (2006). Effect of emergent aquatic insects on bat foraging in a riparian forest. *J Anim Ecol*, 75(6): 1252-1258.https://doi.org/10.1111/j.1365-2656.2006.01146.x

GORBUNOVA, Y. E. (2006). Bats of the Altai Nature Reserve. Rare animals of the Altai Republic. In: The materials for preparation of the second edition of the Red Book of the Republic Altai. ed.: Gorno-Altaisk State University. Gorno-Altaisk, Russia, 213 pp.

GORBUNOVA, Y. E. (2015). A rare species of the groups of chiroptera, insectivora and rodentia in the natural complexes of the altai nature reserve: distribution, abundance, biotopical location, Gorno-Altaisk, Russia. ed.: Gorno-Altai State University. Gorno-Altaisk, Russia, p.98-99.

HEIM, O., PUISTO, A. I. E., SÄÄKSJÄRVI, I., FUKUI, D. & VESTERINEN, E. J. (2021). Dietary analysis reveals differences in the prey use of two sympatric bat species. *Ecol Evol*, 11(24): 18651-18661. https://doi.org/10.1002/ece3.8472

KAZAKOV, B. A. & YARMYSH, N. N. (1974). On the morpho-physiological adaptations of the common noctule to starvation. *Proceedings of the 1st All-Union Conference on Bats,* 105-108

KAZAKOV, D.V., KRUSKOP, S.V., KAWAI, K., GORBAN, A. A., & GOROBEYKO, U. V. (2025) Phylogeography, morphometry and the species distribution modelling in Myotis longicaudatus (Chiroptera, Vespertilionidae) in the Eastern Palaearctic. *Mamm Res* 70, 127–140. https://doi.org/10.1007/s13364-025-00782-5

KRUSKOP, S. V., BORISENKO, A. V., IVANOVA, N. V., LIM, B. K. & EGER, J. L. (2012). Genetic diversity of northeastern Palaearctic bats as revealed by DNA barcodes. *Acta Chiropterol*, 14(1): 1-14. https://doi.org/10.3161/150811012X654222

LIU, M. Y., XIE, Y. H. & JI, D. M. (2000). The list of China vertebrate. ed.: Liaoning University Press. Shenyang, China.

MALKOV, P. U. & VERYASKINA, U. Y. U. (1999). Mesta nakhodok rukokrylykh Respubliki Altay. In: Zhivotnyy mir Altaye-Sayanskoy gornoy strany. ed: Sbornik nauchnykh trudov GAGU. Gorno-Altaisk, Russia, p.83-100.

MALKOV, P. U. (2006). Distribution and abundance of some rare mammals of Altai Rare animals of the Altai Republic. In: The materials for preparation of the second edition of the Red Book of the Republic Altai. ed.: Gorno-Altaisk State University. Gorno-Altaisk, Russia, p.217-223.

MALKOV, P. U. (2017). Отряд Chiroptera. In: Krasnaya kniga Respubliki Altay (zhivotnyye, 3-ye izdaniye) [Red List of the Altai Republic (animals, 3rd edition)]. ed.: Gorno-Altaisk State University. Gorno-Altaisk, Russia, p.281-296.

MARIN, Y. F. (1980). Records of bats in the Altai Nature Reserve. In: Bats. ed.: Nauka. Moscow, Russia, p.95-97.

MARININ, A. M. & MALKOV, P. U. (1989). Mammals - inhabitants of Altai caves. All-Union conference on problems of cadastre and registration of animal world. Part 2. Ufa, Russia, p.67-68.

MASING, M. (1996). The safe use of bird rings - the continuing saga!. *Eurobat Chat*, 6: 9.

MATVEEV, V. A., KRUSKOP, S. V. & KRAMEROV, D. A. (2005). Revalidation of *Myotis petax* Hollister, 1912 and its new status in connection with *M. daubentonii* (Kuhl, 1817) (Vespertilionidae, Chiroptera). *Acta Chiropterol*, 7(1): 23-37. https://doi.org/10.3161/1733-5329(2005)7[23:ROMPHA]2.0.CO;2

MEDVEDEV, S. G., STANYUKOVICH, M. K., TIUNOV, M. P. & FARAFONOVA, G. V. (1991). Bat ectoparasites of Far East. *Parasitologia*, 25(1): 27-37.

NIKULKIN, V. N., KOSACHEV, P. A., FILIPPOVA, N. V., VAZHOV, S. V., IRISOVA, N. L., PETROV, V. Y., EBEL, A. L., ZHIGALIN, A. V. & TOMILENKO, A. A. (2018). Polevoy opredelitel' redkikh rasteniy i zhivotnykh Altayskogo kraya. ed.: Tipografiya upravleniya delami administratsii Altayskogo kraya. Barnaul, Russia, 404 pp.

ORLOVA, M.V., (2014) Invasion of Specific Ectoparasites of Siberian-Far Eastern Bat Species to the Urals, *Rus. J. Biol. Invasions* 5 (1), 29–31. https://doi.org/10.1134/S207511171401007X

ORLOVA, M. V., ORLOV, O. L. & GOLOVANOVA, A. P. (2014a). The first records of the Far Eastern species of gamasid mites-bat ectoparasites in Altai. *Euroasian Entomol J,* 13(5): 419-422.

ORLOVA, M. V., ORLOV, O. L. & ZHIGALIN, A. V. (2014b). New records of ectoparasites of the eastern water bat *Myotis petax* Hollister, 1912 (Vespertilionidae, Chiroptera) and the revision of the material previously collected from *Myotis daubentonii* s. lato in the eastern Palaearctic. *Entmol Rev*, 94: 1306-1312. https://doi.org/10.1134/S0013873814090115

ORLOVA, M. V., ZHIGALIN, A. V., ORLOV, O. L., KRUSKOP, S. V. & BOGDANOV, I. I. (2015a). Contribution to the ectoparasite fauna of rare and poor studied bat species of Southern Siberia. *Biol Bull Russ Acad Sci*, 42: 254-259. https://doi.org/10.1134/S1062359015030085

ORLOVA, M. V., STANYUKOVICH., M. K. & ORLOV, O. L. (2015b). Gamasid mites (mesostigmata: gamasina) parasitizing bats (chiroptera: rhinolophidae, vespertilionidae, molossidae) of palaearctic boreal zone (Russia and adjacent countries). ed.: publishing House of Tomsk State University. Tomsk, Russia.

ORLOVA, M. V., ZHIGALIN, A. V. & KHRITANKOV, A. M. (2015c). New findings of ectoparasites of bats (Chiroptera: Vespertilionidae) in Southern Siberia. *Entmol Rev*, 95: 681-686. https://doi.org/10.1134/S0013873815050127

ORLOVA, M. V., KSHNYASEV, I. A., ORLOV, O. L. & ZHIGALIN, A. V. (2015d). Some factors behind density dynamics of bat flies (Diptera, Nycteribiidae) - ectoparasites of the boreal Chiropterans: omitted predictors and hurdle model identification. *Vestnik Zoologii*, 49(4): 333-340. https://doi.org/10.1515/vzoo-2015-0036

ORLOVA, M. V. & KAZAKOV, D. V. (2016). New findings of rare species of the mite genus *Spinturnix* von Heyden, 1826 (Mesostigmata, Gamasina: Spinturnicidae) in Russia and Tajikistan. *Entmol Rev*, 96: 922-925. https://doi.org/10.1134/S0013873816070150

ORLOVA, M. V., KLIMOV, P. B., ORLOV, O. L., SMIRNOV, D. G., ZHIGALIN, A. V., BUDAEVA, I. V., EMELYANOVA, A. A. & ANISIMOV, N. V. (2021). A checklist of bat-associated macronyssid mites (Acari: Gamasina: Macronyssidae) of Russia, with new host and geographical records. *Zootaxa*, 4974(3). https://doi.org/10.11646/zootaxa.4974.3.4

ORLOVA, M. V., DUNDAROVA, H., ANISIMOV, N. V., SHAKULA, G. V., BASKAKOVA, S. V., SHAKULA, F. V., SHAKULA, S. V., KUZMINOV, I. V. & BOYARINTSEV, D. I. (2023). New geographical records of spinturnicid mites (Mesostigmata: Gamasina: Spinturnicidae) in Kazakhstan. *Ecol Montenegrina*, 63: 105-112. https://doi.org/10.37828/em.2023.63.10

PALLAS, P. S. (1811). Zoogeographia Rosso-Asiatica. ed: Petropolia Publ. Saint Petersburg, Russia, 658 pp.

PLAVILSHCHIKOV, N. N. (1994). Opredelitel' nasekomykh: Kratkiy opredelitel' naiboleye rasprostranennykh nasekomykh Yevropeyskoy chasti Rossii [Key to insects: a brief guide to the most common insects in the European part of Russia]. ed.: Topical Publ. Moskow, Russia, 543 pp.

ROSINA, V. V. (2004). Summer population of bat (Chiroptera) caves of the Northwestern Altai. *Plecotus et al.*, 7: 63-71.

RUEDI M., CSORBA G., LIN L-K., CHOU C-H. (2015) Molecular phylogeny and morphological revision of *Myotis* bats (Chiroptera: Vespertilionidae) from Taiwan and adjacent China. *Zootaxa* 3920:301–342.

SATO, A. & KATSUTA, S. (2018). Food habits of 16 species of bats in Japan. *JWCS*, 43: 55-73.

SCHEFFLER, I., DOLCH, D., ARIUNBOLD, J., BATSAJCHAN, N., ABRAHAM, A. & THIELE, K. (2010). Ectoparasites of bats in Mongolia (Ischnopsyllidae, Nycteribiidae, Cimicidae and Spinturnicidae). Erforschung biologischer ressourcen der Mongolei. Exploration into the biological resources of Mongolia.

SCHEFFLER, I., DOLCH, D., ARIUNBOLD, J., BATSAJCHAN, N., STUBBE, A., ABRAHAM, A. & THIELE, K. (2012). Ectoparasites of bats in Mongolia, Part 2 (Ischnopsyllidae, Nycteribiidae, Cimicidae and Acari). Erforschung biologischer ressourcen der Mongolei. Exploration into the biological resources of Mongolia.

SCHEFFLER, I., ARIUNBOLD, J., BOLORCHIMEG, I., STUBBE, A., STUBBE, M., ABRAHAM, A. & THIELE, K. (2016). Bat ectoparasites of Mongolia, Part 3. Erforschung biologischer ressourcen der Mongolei. Exploration into the biological resources of Mongolia.

SCHEFFLER, I. (2016). Key to the bat fleas of Mongolia. Erforschung biologischer ressourcen der Mongolei. Exploration into the biological resources of Mongolia.

SHIEL, C., MCANEY, C., SULLIVAN C. & FAIRLEY, J. (1997). Identification of arthropod fragments in bat droppings. ed.: The Mammal Society. London, United Kingdom, 56 pp.

SPITZENBERGER, F., STRELKOV, P. P., WINKLER, H. & HARING, E. (2006). A preliminary revision of the genus *Plecotus* (Chiroptera, Vespertilionidae) based on genetic and morphological results. *Zool Scr,* 35(3): 187-230. https://doi.org/10.1111/j.1463-6409.2006.00224.x

STANYUKOVICH, M. K. (1997). Keys to the gamasid mites (Acari: Parasitiformes, Mesostigmata, Macronyssoidea et Laelaptoidea) parasiting bats (Mammalia, Chiroptera) from Russia and adjacent countries. *Rydolst Natur Histor Schriften*, 7: 13-46.

STUKANOVA, T. E. (1976). On the ecology of bats in the southeast of Western Siberia. *Problems Of Ecology Tomsk*, 4: 183-190.

STUKANOVA, T. E. & PUPINA G. P. (1976). On the ecology of the common noctule. *Problems Of Biology And Agrochemistry Tomsk*, 111-115.

TIUNOV, M. P., KRUSKOP, S. V. & ORLOVA, M. V. (2021). Bats of the Russian far east and their ectoparasites. ed.: Pero Publishing House. Moskov, Russia, 191 pp.

TSYTSULINA, K. A. (2001). *Myotis ikonnikovi* (Chiroptera, Vespertilionidae) and its relationships with similar species. *Acta Chiropterol,* 3(1): 11-19.

VASENKOV, D. A. & TOMILENKO, A. A. (2005). Bats (Chiroptera) Tigireksky reserve. *Trudy Tigirekskogo Zapovednika,* 1: 55-56.

VASENKOV, D. A. & POTAPOV, M. A. (2007). Application of body condition index to the ecological study of bats (Mammalia, Chiroptera). *Plecotus et al.,* 10: 21-31.

VASENKOV, D. A., TOMILENKO, A. A. & POTAPOV, M. A. (2008). Records of bats (Chiroptera, Mammalia) from the Salair Ridge (Southern Siberia). *Archives of the Zoological Museum of Moscow State University*, Vol. 49: 256 - 264

YASHINA, T. V., ARTEMOV, I. A., KOROLYUK, A. Y., SKRIPNIKOVA, M. I., USPENSKAYA, O. N., NAGIBINA, E. Y., CHEREPANOV, V. E. & SHARAVINA, L. V. (2006). Katunskiy biosfernyy zapovednik. Trudy FGU «Zapovednik «Katunskiy» ed.: Pyat' plyus. Barnaul, Russia, 83 pp.

ZAKHAROV, E. S., TROEVA, I. S., ORLOVA, M. V., KORYAKINA, L. P. & PAVLOVA, A. I. (2016). On the fauna and ecology of bats in Central Yakutia. *Nauka i obrazovanie,* 4: 134-140.

ZHIGALIN, A. V. & KHRITANKOV, A. M. (2014). Bats of SPNAs of the Altai-Sayan mountain country. *Plecotus et al.,* 17: 85-95.

ZHIGALIN, A. V., GADZHIEV, A. A., DAUDOVA, M. G., SALIMKHANOV, N. G. & SHESTOPALOV, A. M. (2019). Ecology of chiroptera bats in Altai-Sayan region of Southern Siberia. *South Russ: Ecol Dev,* 14(1): 9-25. https://doi.org/10.18470/1992-1098-2019-1-9-25