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The first data on bat ectoparasites (Acarina, Insecta) in the Baikal region and Yakutia (eastern Siberia)

Maria V. Orlova[1*], **Denis V. Kazakov**[2], **Evgeny S. Zakhahrov**[3,5], **Irina S. Troeva**[4] and **Leonid N. Vladimirov**[5]

1 National Research Tomsk State University, Department of Vertebrate Zoology and Ecology, Lenin str. 36, Tomsk, 634050, Russia
2 Irkutsk State University, Department of Vertebrate Zoology and Ecology, Carl Marx str. 1, Irkutsk, 664003, Russia
3 Institute for Biological Problems of Cryolithozone SB RAS, Laboratory of Zoological Studies, Lenin Ave. 41, Yakutsk, Republic of Sakha (Yakutia), 677000, Russia
4 Secondary School №33 with Depth Study of Certain Subjects, Microraion #202 21, Yakutsk, Republic of Sakha (Yakutia), 677000, Russia
5 Yakutsk State Agricultural Academy, Department of Farm Animal Physiology and Ecology, Krasilnikov Str. 15, Yakutsk, Republic of Sakha (Yakutia), 677007, Russia
* Corresponding author. E-mail: Masha_orlova@mail.ru

Abstract: This paper summarizes new data on ectoparasites from bats (Chiroptera: Vespertilionidae) from eastern Siberia (Russia). The existence of 14 bat ectoparasite species is confirmed for this territory, including eight species of gamasid mites (Gamasina: Spinturnicidae, Macronyssidae) and six species of insects belonging to two orders (Insecta: Diptera, Siphonaptera). The bedbugs (Insecta: Heteroptera: Cimicidae) found are undefined. These findings include six species (one species of gamasid mites and five species of insects) not previously reported from eastern Siberia. New hosts are described for some ectoparasites.

Key words: Spinturnicidae; Macronyssidae; Vespertilionidae; Siberia; Yakutia; Baikalia

Currently, the biology of Eastern Palaearctic boreal bats is the subject of intensive investigation. Several cryptic bat species (Chiroptera: Vespertilionidae) have been described in the Siberian and Far East territories using modern molecular genetic methods: *Myotis petax* Hollister, 1912, *Myotis sibiricus* (Kastschenko, 1905), *Plecotus ognevi* (Kishida, 1927) and others (Benda and Tsytsulina 2000; Matveev et al. 2005; Spitzenberger et al. 2006). The ecology of these species — including their host-parasite relationships — still needs to be investigated. Current data on Siberian arthropods parasitizing bats are both extremely limited and require revision because the taxonomic status of their hosts has changed. In fact, we still have no information about bat ectoparasites over an approximately 2 million km^2 area (see Figure 1).

Bats were collected in the boreal zone of the Baikal region and the *Yakutia* (Sakha Republic) (Figure 1) during the summers of 2014 and 2015. Captures were conducted during twilight and night-time hours using mist nets (Kunz and Kurta 1988) and Borisenko mobile traps (Borisenko 1999) in forest plots and open spaces (Figure 2). After examination, all animals were released or returned to their nursery roosts. A total of 52 individual bats belonging to five species of the family Vespertilionidae (Eastern Water Bat, *Myotis petax*; Siberian Bat, *Myotis sibiricus*; Ikonnikov's Bat *Myotis ikonnikovi* (Ognev, 1912); Northern Bat, *Eptesicus nilssonii* (Keyserling & Blasius, 1839); and Ognev's Long-eared Bat, *Plecotus ognevi*) were examined.

Ectoparasites were removed with a preparatory needle and forceps and fixed in 70% ethanol. Fleas and mites were *mounted* on permanent *slides* with *Faure-Berlese's mounting medium* (flea specimens were previously dipped into 5% KOH and washed in distilled water), bat flies were stored in 70% alcohol (Whitaker 1988). Ectoparasite species were identified using light microscopy according to several identification keys and articles (Medvedev 1985; Stanyukovich 1997; Lehr 1999).

Slides and bat flies in alcohol are deposited in the collection of Zoological Museum of National Research Tomsk State University (№ MGM(Sa)1 – № MGM(Sa)48, №SIs(Sa)1 – №SIs(Sa)14, №DNy(Sa)1 – №DNy(Sa)12; №MGM(B)1 – № MGM(B)503, №SIs(B)1 – №SIs(B)3, №DNy(B)1 – №DNy(B)55, №HCi(B)1 – №HCi(B)2).

Investigated territory. The map was taken from Wikimedia Commons (2015). Bats were caught in the Eastern Siberian territory in the following localities:

1. Baikal region (sites 1–3; Figure 1):

a. Buryatia Republic, Kaban district, the foothills of the

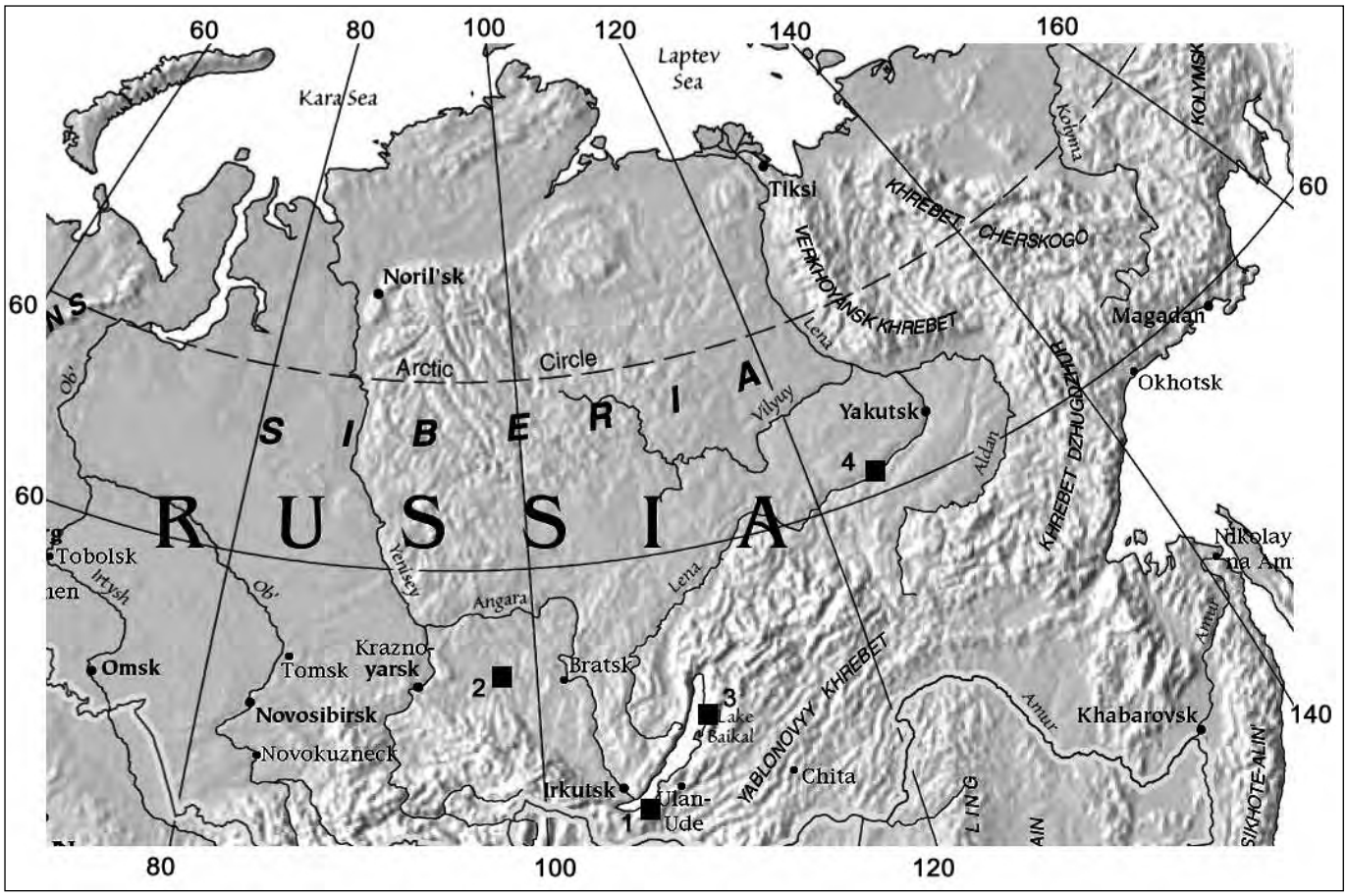

Figure 1. Map of collection sites in Eastern Siberia. 1: The northern macroslope of the Khamar-Daban Ridge. 2: The Biryusa river valley (near Taishet town). 3: Reserve "Barguzinskiy", the Davsha River valley. 4: Nature Park "The Lena Pillars" and Farm of Wood Buffalos "Ust-Buotama".

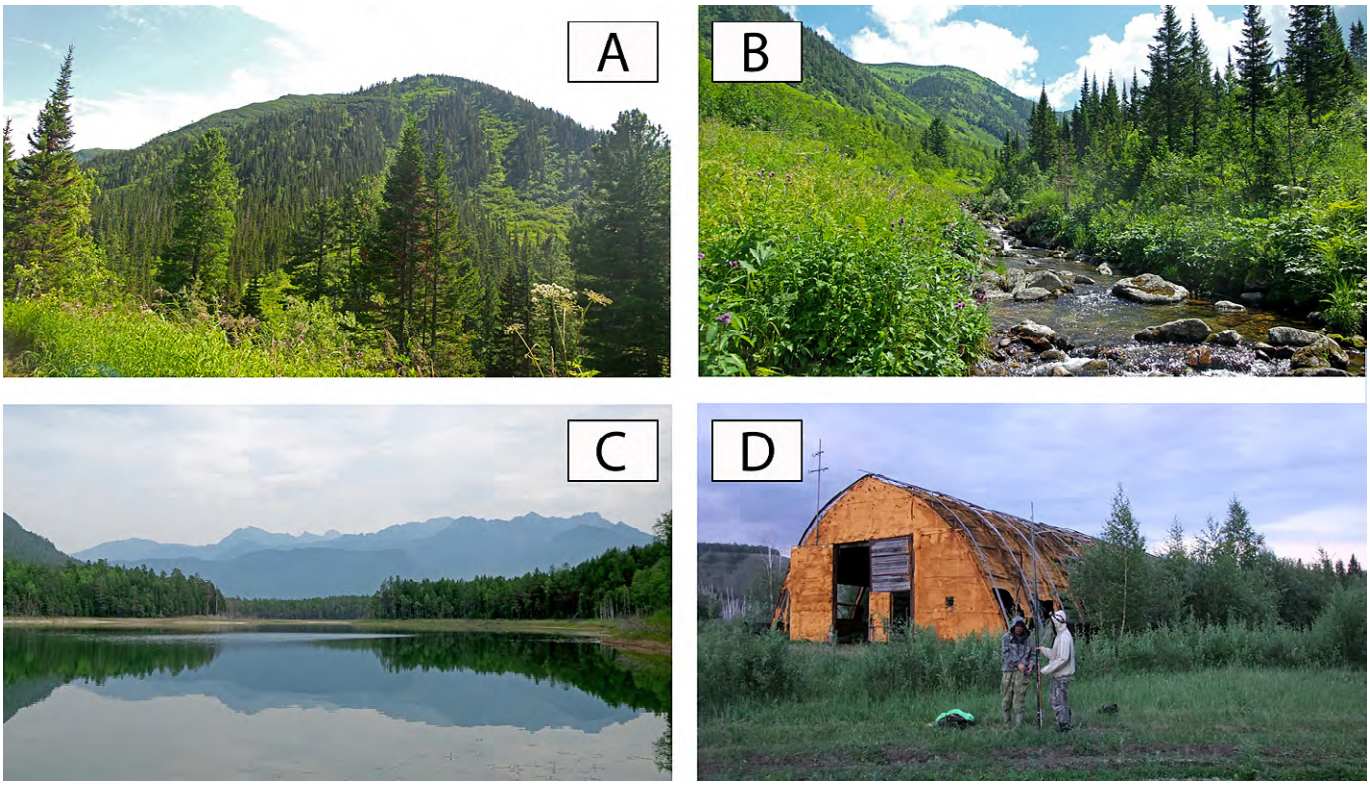

Figure 2. Habitat for bats in Eastern Siberia. **A**) Mountain forests. **B**) River banks. **C**) Wood lakes. **D**) Remains of buildings. Photos by D.V. Kazakov (A–C) and E.S. Zakharov (D).

northern macroslope of the Khamar-Daban Ridge (51°29′ N, 104°50′ E).

b. Irkutsk region, Taishet district, Biryusa River valley (near the town of Taishet) (55°33′ N, 97°42′ E).

c. Buryatia Republic, Severobaykal'sk district, Barguzinskiy reserve, Davsha River valley (12.5 km from the estuary) (54°24′ N, 109°39′ E).

2. Yakutia (site 4; Figure 1): Khangalassky ulus, Lena Pillars Nature Park (61°06′ N, 127°21′ E) and Farm of Wood Buffalos "Ust-Buotama" (61°16′ N, 128°46′ E).

In total, our material represents 637 specimens of 12 mites and insect species. Of these, 7 species of gamasid mites belong to the families Spinturnicidae (3) and Macronyssidae (4), and 5 species of insects belong to the orders Siphonaptera (fam. Ischnopsyllidae) (2) and Diptera (fam. Nycteribiidae) (3). An annotated species list of Eastern Siberian bat ectoparasites is presented below.

Acarina
Gamasina
Family Spinturnicidae

Spinturnix bregetovae Stanyukovich, 1995

Material: Baikal region: 1 ♂, 1 ♀, 1 N1 from *M. ikonnikovi*; Yakutia: 4 ♂, 7 ♀ (1 with internal protonymph), 2 N2 from *M. sibiricus*.

This extremely poorly studied species is included in the Siberian-Far East faunal complex. Only two earlier findings are known: in the Primorie Territory (Ussurian Reserve) from an unidentified host (Stanyukovich 1995) and in the Tuva Republic from the Eastern Water Bat (Orlova et al. 2015b). The species has been confirmed on *M. ikonnikovi* and *M. sibiricus* for the first time. It is likely that *S. bregetovae* associated with bats of the genus *Myotis* Kaup, 1829.

Taxonomic remark: Females of *Spinturnix bregetovae* have 40–50 setae on a dorsal opisthosoma and an invisible tritosternum (Figures 3 C and D). Males belonging to this species have 27–30 setae on a dorsal opisthosomal surface, a spade-shaped sternogenital shield with three setal pairs and an indissernible tritosternum (Stanyukovich 1995, Stanyukovich 1997) (Figures 3 A and B).

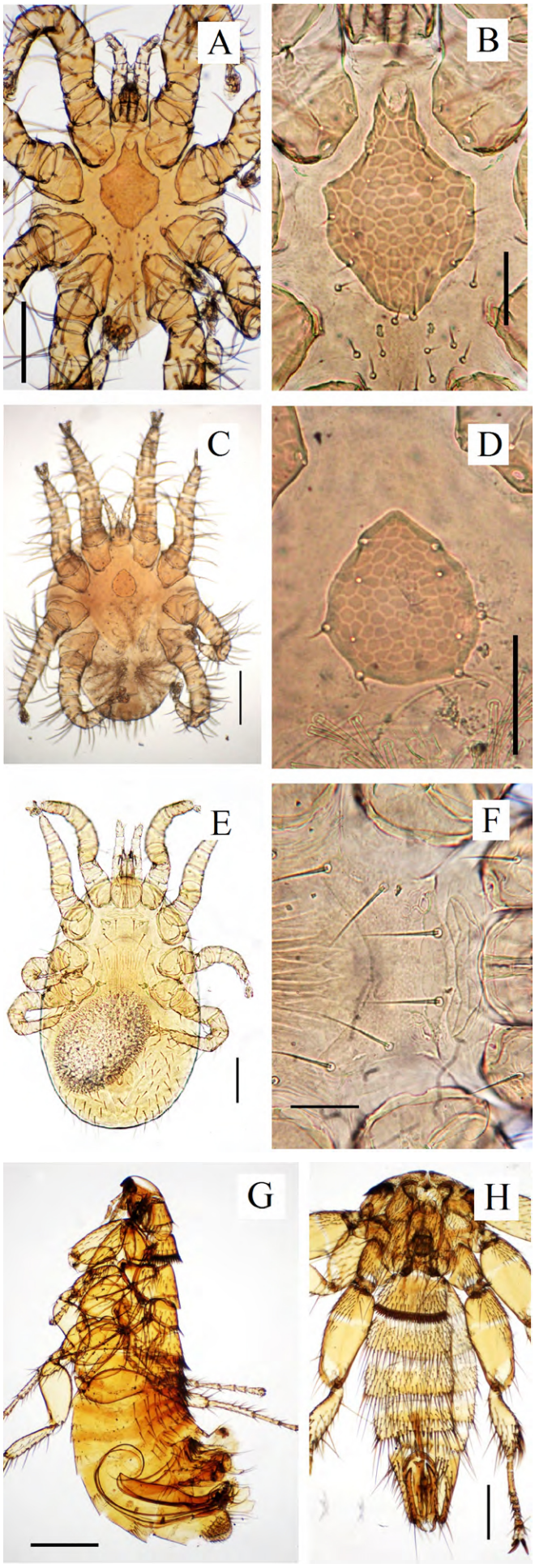

Figure 3. Species of bat ectoparasites occuring in Eastern Siberia. **A**) *Spinturnix bregetovae*, ♂ ventrally (scale bar 300 μm). **B**) *Spinturnix bregetovae*, ♂, sternogenital shield (scale bar 100 μm). C) *Spinturnix bregetovae*, ♀ (with internal protonymph) ventrally (scale bar 300 μm). **D**) *Spinturnix bregetovae*, ♀, sternal shield (scale bar 200 μm). **E**) *Macronyssus charusnurensis*, ♀ (with internal egg) ventrally (scale bar 100 μm). **F**) *Macronyssus charusnurensis*, ♀, sternal shield (scale bar 50 μm). **G**) *Myodopsylla trisellis*, ♂ (scale bar 500 μm). **H**) *Nycteribia quasiocellata* ♂ ventrally (scale bar 500 μm). Photos by O.L. Orlov.

Spinturnix myoti (Kolenati, 1856)

Material: Baikal region: 28 ♂, 10 ♀, 16 N1, 8 N2 from *M. petax*.

This is a trans-Palaearctic oligoxenous species (from the United Kingdom to the Far East) (Rudnick 1960; Uchikawa and Wada 1979; Medvedev et al. 1991; Stanyukovich 1997; Rupp et al. 2004; Orlova 2015) whose principal hosts are bat species belonging to the genus *Myotis*.

Taxonomic remark: Females of *S. myoti* are characterized by 90 dorsal opisthosomal setae and a pear-shaped sternal shield (Rudnick 1960; Stanyukovich 1997). Males of *S. myoti* have a sternogenital shield with four setal pairs and a small rounded tritosternum.

Spinturnix plecotinus (Koch, 1839)

Material: Baikal region: 2 ♂ from *P. ognevi*.

This is an oligoxenous species with a trans-Palaearctic range. Bats of the genus *Plecotus* Grey, 1821 are the principal hosts, but they can also be found on other vespertilionid bats (Rudnick 1960; Stanyukovich 1990; Stanyukovich 1997).

Taxonomic remark: Females have 14 or fewer setae at the end of the opisthosoma and lanceolate setae on the dorsal tips of tarsi II–IV. Males have two setae at the end of the opisthosoma, lanceolate setae on the dorsal tips of tarsi II–IV are present.

Family Macronyssidae
Subfamily Macronyssinae

Macronyssus charusnurensis (Dusbabek, 1962)

Material: Baikal region: 32 ♂, 55 ♀, 317 N1, 4 N2 from *M. petax*; *Yakutia*: ♂, 2 ♀ (1 with internal egg), 12 N1. Hosts are *M. petax* and *M. sibiricus*.

This is a Siberian-Far East monoxenous species penetrating the Urals (Orlova 2014; Orlova et al. 2015a) and range from western Siberia to Japan. Accidental findings in the Perm territory and the Bashkiria Republic have been recorded (Orlova 2014). The principal host is *M. petax*, but sometimes it can also be found on other representatives of the genus *Myotis* (Stanyukovich 1997).

Taxonomic remark: Species belonging to the genus *Macronyssus* differ from each other in the chaetotaxy of the dorsal shield and the pattern of the sternal glands (anterolateral sculpturing). The sternal glands of *M. charusnurensis* are with striae and cross-pieces in the oval zone (Figures 3 E and F). Males have 10 thick and long setal pairs on the opisthosoma with a hollow.

Macronyssus crosbyi (Ewing & Stover, 1915)

Material: Baikal region: 3 ♀ (all with internal eggs) from *P. ognevi*; *Yakutia*: 5 ♂, 1 ♀ with internal egg, 13 N1 from *M. sibiricus*.

This holarctic pleoxenous species (Stanyukovich 1990; Medvedev et al. 1991; Czenze and Broders 2011) is associated with various bats of the family Vespertilionidae (Radovsky 1967).

Taxonomic remark: Females have a sternal plate with distinct anterolateral sculpturing consisting of 3 or 4 cells and indistinct striae. Males have thick setae Z5 (like claw) on the dorsal shield, and the opisthosomal setae on the unarmed integument are very long (100–120 μm).

Macronyssus hosonoi (Uchikawa, 1979)

Material: Baikal region: 1 ♀ from *M. petax*.

This is a rare and insufficiently studied Siberian-Far East species (Uchikawa 1979; Medvedev et al. 1991; Orlova et al. 2015b). Findings are scarce. Most likely, this is an oligoxenous species, parasitizing bats of the genus *Myotis*.

Taxonomic remark: Females of *M. hosonoi* are characterized by the unique form of the dorsal shield, which is without the narrow of the posterior margin inherent to all other *Macronyssus* species. The sternal shield of females is crescent-shaped without anterolateral sculpturing.

Subfamily Ornithonyssinae

Steatonyssus superans (Zemskaja, 1951)

The only published records (Zhovtiy et al. 1962) are from the Baikal region (near the village of Kaylastuya Borzinsky district, Chita region) in July, 1959, from the Particoloured Bat, *Vespertilio murinus* (Linnaeus, 1758).

This species' range covers the boreal zone of the Urals, Western Siberia, Far East, and Japan. There are known findings in the subboreal zone (Kazakhstan) (Medvedev et al. 1991; Stanyukovich 1997; Orlova 2014). Principal hosts are bats of the genus *Vespertilio* (Linnaeus, 1758).

Ornithonyssus pipistrelli (Oudemans, 1902)

Material: Baikal region: 24 N1 from *M. petax*, *M. sibiricus* and *E. nilssonii*.

This is a poorly studied Holarctic pleoxenous species harboured by bats of the family Vespertilionidae. A few findings from Europe, the Urals, Altay, Western Siberia and the New World (Mexico) have been recorded (Stanyukovich 1997; Villegas-Guzman et al. 2005; Marchenko 2007; own data).

Taxonomic remark: Protonymphs of *O. pipistrelli* have six setal pairs on the pygidial shield unlike other *Ornithonyssus* species associated with bats (Micherdzinsky 1980).

Insecta
Order Diptera
Family Nycteribiidae

Nycteribia quasiocellata (Theodor, 1966)

Material: Baikal region: 5 ♂, 10 ♀ from *M. petax*; *Yakutia*: 2 ♂, 2 ♀ from *M. petax*.

This Siberian-Far East oligoxenous species (Orlova and Orlov 2015) parasitizes bats belonging to the genus *Myotis*, mostly Eastern Water Bats (Orlova et al. 2014).

Taxonomic remark: In males sternit V has a row of 8–10 short spines. Claspers are straight, basally curved; the aedeagus is long and narrow, strongly curved at the top and sharpened (Figure 3H). Sternit 6 in females is divided into two sclerites. The genital plate has an irregular form, with 6 or 7 setae. There is a large anal sclerite in females (Lehr 1999).

Basilia rybini (Hurka, 1969)

Material: Baikal region: 12 ♂, 17 ♀ from *M. petax*; *Yakutia*: 3 ♂, 3 ♀ from *M. petax* and *M. sibiricus*.

This Siberian-Far East oligoxenous species (Orlova and Orlov 2015) parasitizes bats belonging to the genus *Myotis*. Their preferred host is *M. petax* (Orlova et al. 2014).

Taxonomic remark: *B. rybini* belongs to the *natterer*i-group, but clearly differs from other species in the form of the female genital plate, which is horseshoe-shaped, and in the form of the male genitalia (the parameres are bifurcate, the upper lobe larger and is bearing three setae) (Hurka 1969).

Penicillidia monoceros (Speiser, 1900)

Material: Baikal region: 6 ♂, 5 ♀ from *M. petax*; *Yakutia*: 1 ♂ and 1 ♀ from *M. petax* and *M. sibiricus*.

This is a trans-Palaearctic boreal oligoxenous species (bats of the genus *Myotis*) (Lehr 1999). In the western Palaearctic, it tends to parasitize the Pond Bat, *Myotis dasycneme* (Boie, 1825), and less often, the Water Bat *Myotis daubentonii* (Kuhl, 1817). In the eastern Palaearctic it has been found on *Myotis petax* (Orlova et al. 2014).

Taxonomic remark: Both males and females of *P. monoceros* have a notable hornlike projection on their heads. The ventral genital plate of females is narrow and curved, the dorsal genital plate is triangular, with 5 or 6 setae. In males, sternit V has two large lateral projections; the parameres are clearly longer than the aedeagus (Lehr 1999).

Order Hemiptera
Family Cimicidae

***Cimex* sp.** (*Cimex* ex gr. *pipistrelli*?)

Material: Baikal region: 2 nymphs from *M. petax*.

Order Siphonaptera
Family Ischnopsyllidae

Myodopsylla trisellis (Jordan, 1929)

Material: Baikal region: 2 ♂, 1 ♀ from *M. petax*; *Yakutia*: 5 ♂, 9 ♀ from *M. petax* and *M. sibiricus*.

This is a Palaearctic oligoxenous species (bats of the genus *Myotis*) that is widely distributed from the Baltic States to the Pacific coast (Medvedev 1996).

Taxonomic remark: *M. trisellis* has false combs of the thickened bristles in the dorsal area of abdominal terga I–III (Fig. 3G). Sternit VIII of males without bundles of long hair-like bristles on the inner side (Hopkins and Rothschild 1956).

Ischnopsyllus (Ischnopsyllus) obscurus (Wagner, 1898)

The only published records (Zhovtiy et al. 1962) are from the Baikal region (near the village of Kaylastuya, Borzinsky district, Chita region). These were recorded in September 1958 from the Asian Particoloured Bat, *Vespertilio sinensis* (Peters, 1880).

This is a widely distributed trans-Palaearctic boreal species (Medvedev 1996). According to Medvedev (1989) and Rupp et al. (2004) the principal host of *I. obscurus* is the Particoloured Bat.

Taxonomic remark: *I. obscurus* has eight combs on the thorax and abdomen. The comb of metanotum is composed of more than 40 spines. Bristles of sternum VIII are not conspicuously long (Hopkins and Rothschild 1956).

Ischnopsyllus (Hexactenopsylla) hexactenus (Kolenati, 1856)

Material: *Yakutia*: 1 ♂ from *M. sibiricus*.

This is a trans-Palaearctic species broadly distributed in Europe (Haitlinger and Ruprecht 1992; Rupp et al. 2004). In Russia, there are findings known from the Urals, Western Siberia and the Far East (Medvedev et al. 1991; Orlova et al. 2015). According to the literature (Medvedev and Masing 1987), the principal host of *I. hexactenus* is the Brown Long-eared Bat, *Plecotus auritus* (Linnaeus, 1758), but some specimens were collected on several different species of bats including the Grey Long-eared Bat, *Plecotus austriacus* (Fischer, 1829), and species of the genus *Myotis* (Brandt's Bat, Eastern water bat and Ikonnikov's Bat) (Rupp et al. 2004; Orlova 2011).

Taxonomic remark: *I. hexactenus* has six combs on the thorax and abdomen. Males have large bristles at the apex of the movable process of the clasper; the apex of sternit VIII is broadened gradually (Hopkins and Rothschild 1956).

Few data exist in the literature on bat ectoparasites of the Baikal region, and no data exist on bat ectoparasites of the Yakutia. A short communication from Zhovtiy et. al. (1962) is devoted to the discovery of gamasid mites, bat flies and bat fleas in the Transbaikalian forest-steppe. However, the taxonomic status of some bat hosts and their ectoparasites has been changed recently. In particular, it has been determined that the Whiskered Bat, *Myotis mystacinus* (Kuhl, 1817), does not inhabit the study area, and the species to which the bats

formerly classified as *M. mystacinus* by Zhovtiy et al. (1962) belong is unknown. Moreover, the classifications of the gamasid mite species *Spinturnix vespertilionis* and *Ichoronyssus flavus* mentioned in the article are no longer valid at present, and the species status of representatives of the genus *Cimex* in the eastern Palaearctic requires clarification. Actually, according to Zhovtiy et. al. (1962), only two species of parasitic arthropods associated with bats have been unambiguously confirmed in the Baikal region: the gamasid mite *Steatonyssus superans* (Zemskaja, 1951) and the flea *Ischnopsyllus obscurus* (Wagner, 1898) (Table 1).

The gamasid mite *Ornithonyssus pipistrelli*, bat flies *Nycteribia quasiocellata*, *Basilia rybini*, and *Penicillidia monoceros,* and the flea *Myodopsylla trisellis* were confirmed in eastern Siberia for the first time. These ectoparasite species belong to the Siberian-Far East and trans-Palaearctic (Holarctic) fauna complexes. It is difficult to discuss prior findings of *Spinturnix bregetovae*, *S. myoti*, *S. plecotinus*, *Macronyssus charusnurensis*, *M. crosbyi*, and *M. hosonoi* because it is impossible to determine what species were collected. These were identified by the authors as *Spinturnix vespertilionis* and *Ichoronyssus flavus*, which are currently invalid species.

In general, the ectoparasite species composition of the studied area is largely similar to that of western Siberia and the Far East (Table 1), which confirms the conservatism of eastern Palaearctic boreal bat ectoparasite fauna throughout the huge territory from the Yenisey River to the Pacific coast.

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LITERATURE CITED

Benda, P. and K.A. Tsytsulina. 2000. Taxonomic revision of *Myotis mystacinus* group (Mammalia: Chiroptera) in the western Palaearctic. Acta Societatis Zoologicae Bohemicae 64: 331–398.

Borisenko, A.V. 1999. Mobil trap for bat catching. Plecotus et al. 2: 10–19 (In Russian).

Czenze, Z.J. and H.G. Broders. 2011. Ectoparasite community structure of two bats (*Myotis lucifugus* and *M. septentrionalis*) from the Maritimes of Canada. Journal of Parasitology Research. 2011: 1–9. doi: 10.1155/2011/341535

Hopkins, G.H.E. and M. Rothschild. 1956. An illustrated catalogue of the Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural history). London. Vol. 2: Family Ischnopsyllidae. 445 p.

Hurka, K. 1969. *Basilia (Basilia) rybini* sp. n. and notes on the Nycteribiidae of the Caucasus and Central Asia (Diptera, Pupipara).

Table 1. The findings of specific ectoparasites of bats from Eastern Siberia.

			Published records		
Ectoparasite species	**Baikal region**	**Yakutia**	**Transbaikalian forest steppe zone (Zhovtiy et al. 1962)**	**Western Siberia (Orlova et al. 2015a, 2015b)**	**Far East (Medvedev et al. 1991)**
Arachnida Acarina Gamasina Spinturnicidae					
Spinturnix bregetovae	3	13	?	X	X
S. myoti	62	–	?	X	X
S. plecotinus	2	–	?	X	X
Macronyssidae					
Macronyssus charusnurensis	408	15	?	X	X
M. crosbyi	3	19	?	X	X
M. hosonoi	1	–	?	X	X
Steatonyssus superans	–	–	X	X	X
Ornithonyssus pipistrelli *	24	–	–	X	–
Insecta Diptera Nycteribiidae					
Nycteribia quasiocellata *	15	4	–	X	X
Basilia rybini *	29	6	–	X	X
Penicillidia monoceros *	11	2	–	X	X
Hemiptera Cimicidae					
Cimex sp. (*Cimex* ex gr. *pipistrelli*?)	2	–	–	–	–
Siphonaptera Ischnopsyllidae					
Myodopsylla trisellis *	3	14	–	X	X
Ischnopsyllus obscurus	–	–	X	X	X
Ischnopsyllus hexactenus *	–	1	–	X	X
Total	563	74			

* This may be the first record of this species in the studied territory.
? Accurate interpretation of the literature data is impossible because of the changed taxonomic status of the parasite.

Acta Entomologica Bohemoslovaca 66(6): 387–398.
Kunz, T.H. and A. Kurta. 1988. Capture methods and holding devices; pp. 1–29. in: T.H. Kunz (ed.). Ecological and behavioral methods for the study of bats. Washington: Smithsonian Institution Press.
Lehr, P.A. 1999. Keys to the insects of the Russian Far East. VI: Diptera and Siphonaptera. Vladivostok: Dal'nauka (In Russian). 665 pp.
Marchenko, I.I. 2007. Gamasid mites (Parasitiformes, Mesostigmata) from the Altaiskiy State Nature Reserve. Euroasian Entomological Journal 6(4): 373–378 (In Russian).
Matveev, V.A., S.V. Kruskop and D.A. Kramerov. 2005. Revalidation of *Myotis petax* Hollister, 1912 and its new status in connection with *M. daubentoni* Kuhl, 1817. Acta Chiropterologica 7(1): 23–37.
Medvedev, S.G. 1996. Fleas of the family Ischnopsyllidae (Siphonaptera) of the fauna of Russia and adjacent countries. Entomological Review 76(4): 480–493.
Medvedev, S.G. and M.V. Masing. 1987. Fleas of family Ischnopsyllidae (Siphonaptera) of Baltic region. Parasitologiya 21(3): 459–466. (In Russian).
Medvedev, S.G., M.K. Stanyukovich, M.P. Tiunov, and G.V. Farafonova. 1991. Ectoparasites of Bats of the Russian Far East. Parazitologiya 25(1): 27–37. (In Russian).
Micherdzinsky W. 1980. Eine taxonomische Analyse der Familie Macronyssidae, Oudemans, 1936. I: Subfamilie Ornithonyssinae, Lange, 1958 (Acarina: Mesostigmata). Warszawa: Polska Akad. Nauk. 254 pp.
Orlova, M.V. 2014. Invasion of specific ectoparasites of Siberian-Far Eastern bat species to the Urals. Russian Journal of Biological Invasions 5(1): 29–31.
Orlova, M.V., O.L. Orlov and A.V. Zhigalin. 2014. 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. Entomological Review 94(9): 1306–1312.
Orlova, M.V., A.V. Zhigalin, O.L. Orlov, S.V. Kruskop and I.I. Bogdanov. 2015a. Contribution to the ectoparasite fauna of rare and poor studied bat species of southern Siberia. Biology Bulletin 42(3): 254–259.
Orlova, M.V., A.V. Zhigalin and A.M. Khritankov. 2015b. New findings of ectoparasites of bats (Chiroptera: Vespertilionidae) in southern Siberia. Entomological Review 95(5): 681–686.
Radovsky, F.J. 2010. Revision of genera of the parasitic mite family Macronyssidae (Mesostigmata: Dermanyssoidea) of the world. West Bloomfield: Indira Publishing House. 288 pp.
Rudnick, A. 1960. A revision of the mites of the family Spinturnicidae. University of California Publications in Entomology 17(2): 157–248.
Rupp D., A. Zahn and P. Ludwig. 2004. Actual records of bat ectoparasites in Bavaria (Germany). Spixiana 27(2): 185–190.
Spitzenberger F., P.P. Strelkov, H. Winkler and E. Haring. 2006. A preliminary revision of the genus *Plecotus* (Chiroptera, Vespertilionidae) based on genetic and morphological results. Zoologica Scripta 35(3): 187–230. doi: 10.1111/j.1463-6409.2006.00224.x
Stanyukovich, M.K. 1990. The gamasid mites and argasid ticks of bats from Pribaltica and Leningrad district. Parasitologiya 24: 193–199.
Stanyukovich, M.K. 1995. *Spinturnix bregetovae* sp. nov. (Gamasina: Spinturnicidae), a new species of parasitic mite from bats. Acarina 3(1/2): 105–122.
Stanyukovich, M.K. 1997. Keys to the gamasid mites (Acari: Parasitiformes, Mesostigmata, Macronyssoidea et Laelaptoidea) parasiting bats (Mammalia, Chiroptera) from Russia and adjacent countries. *Rudolstädter naturhistorische Schriften* 7: 13–46.
Uchikawa, K. 1979. Bat mites of the genus *Macronyssus* Kolenati (Acari, Macronyssidae). Annotationes Zoologicae Japonenses 52(4): 246–256.
Uchikawa, K. and Y. Wada. 1979. Studies on mesostigmatid mites parasitic on mammals and birds in Japan. IX. Bat mites of the genus *Spinturnix* von Heyden, 1829 (Part I) (Spinturnicidae). Medical entomology and zoology 30(2): 121–125.
Villegas-Guzman, G.A., C. López-González and M. Vargas. 2005. Ectoparasites associated to two species of *Corynorhinus* (Chiroptera: Vespertilionidae) from the Guanaceví mining region, Durango, Mexico. Journal of Medical Entomology 42(2): 125–127.
Whitaker J.O.J. 1988. Collecting and preserving ectoparasites for ecological study; pp. 459–474, in: T.H. Kunz (ed.): Ecological and behavioral methods for the study of bats. Washington: Smithsonian Institute Press.
Wikimedia Commons, the free media repository. [2015]. Accessed at https://commons.wikimedia.org, 30 November 2015.
Zhovtiy I.F., V.N. Zarubina, V.N. Prokopiev and L.P. Shvedko. 1962. About bat ectoparasites of southeast Transbaikalia and adjacent areas of the Mongolian People's Republic. Proceedings of Irkutsk State Scientific Anti-Plague Institute of Siberia and the Far East 24(9): 338–343. (In Russian).

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