

Contribution to the Ectoparasite Fauna of Bats (Chiroptera: Vespertilionidae, Rhinolophidae) of Crimea

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Abstract—New data are presented on the ectoparasite fauna of several species of vesper and horseshoe bats (Chiroptera: Vespertilionidae, Rhinolophidae) of the Crimean Peninsula. In the studied territory, 11 species of ectoparasites (mites and insects) have been collected from 6 bat species; 2 of the ectoparasite species were new to Crimea. Findings of gamasid mites *Ichoronyssus scutatus* on an unusual host are discussed. The gamasid mite *Spinturnix emarginatus* (Acari: Mesostigmata: Gamasina) is described for the territory of Russia for the first time.

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Throughout the XX and the early XXI century, ectoparasites of bats were only irregularly collected in Crimea (Pliginsky, 1927; Stanyukovich, 1991; Bobkova, 2004; Chirniy, 2004). Meanwhile, the Crimean Peninsula is characterized by overlapping of several faunal complexes of bats (boreal, subboreal, and Mediterranean), whose specificity determines the importance of studying the specific fauna of ectoparasites of these hosts. Earlier, 23 species of parasitic arthropods associated with bats were described for different parts of the study region: 1 species from each of the acarine families Ixodidae, Argasidae, and Sarcoptidae, 13 species of gamasid mites (Acari: Mesostigmata: Gamasina) including 1 species described for the first time, 3 species of bat flies (Insecta: Diptera: Nycteribiidae), and 4 species of fleas (Insecta: Siphonaptera: Ischnopsyllidae) (Pliginsky, 1927; Stanyukovich, 1991, 1997; Bobkova, 2004; Chirniy, 2004; Ševčík et al., 2011).

MATERIALS AND METHODS

Our collections of bat ectoparasites were carried out in the spring and summer of 2017. The collection localities are listed in Table 1.

Ectoparasites were removed from bats with forceps and dissecting needles and fixed in 70% ethanol. The mites were mounted on slides in Faure-Berlese medium; fleas were cleared in 10% aqueous KOH solution and also mounted in Faure-Berlese medium

(Whitaker, 1988). The bat flies were fixed in ethanol. The mites and fleas were identified under a Nikon Eclipse 50i light microscope, and bat flies, under an MBS-10 stereomicroscope, using the available taxonomic publications (Theodor, 1967; Medvedev, 1996; Stanyukovich, 1997).

Altogether, 44 bats of 6 species were captured and examined. Ectoparasites were found on representatives of 4 species: the greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber, 1774), the lesser mouse-eared bat *Myotis blythii* (Tomes, 1857), Geoffroy's bat *Myotis emarginatus* (E. Geoffroy, 1806), and the common pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774) (Table 2). Bats of two species, David's myotis *Myotis davidii* Peters, 1869 (3 ind.) and the lesser horseshoe bat *Rhinolophus hipposideros* (Bechstein, 1800) (3 ind.), were not infested.

A total of 709 specimens of gamasid mites, fleas, and bat flies were collected. The infestation index (MI) was calculated as the mean number of ectoparasites per one infested host (i.e., not counting the uninfested host specimens). The occurrence index (P) was calculated as the percentage of infested hosts.

RESULTS AND DISCUSSION

The ectoparasites collected in the study territory were identified as 11 species of mites and insects. An annotated list of parasitic arthropods is given below (Table 2).

Table 1. Collection localities

No.	Collection locality	Coordinates	Biotope
1	Opuk nature reserve	45°01'N, 36°11'E	Dry steppe
2	T.I. Vyazemsky Karadag Scientific Station—Nature Reserve of the Russian Academy of Sciences	44°56'N, 35°14'E	Crooked hard-leaved forest
3	Kamenskoe (Ak Monai caves)	45°16'N, 35°31'E	Dry steppe
4	Yakovenkovo	45°04'N, 36°19'E	Dry steppe

Gamasid Mites (Mesostigmata: Gamasina)Family **Spinturnicidae***Eyndhovenia euryalis oudemansi*
(Eyndhoven, 1941)

Distribution: Palaearctic, subboreal (Orlova et al., 2016).

Hosts: horseshoe bats of the family Rhinolophidae.

Material: 2 spms. (♀ off a greater horseshoe bat, ♀ off a lesser mouse-eared bat).

Remarks: The species was previously recorded in Crimea on the greater horseshoe bat (Stanyukovich, 1997; Bobkova, 2004).

Spinturnix myoti (Kolenati, 1856)

Distribution: Palaearctic.

Hosts: mouse-eared bats of the genus *Myotis*.

Material: 212 spms. [63 ♀♀ (18 with intrauterine larvae), 49 ♂♂, 62 N1, 38 N2] (June 2016).

Remarks: The species was previously recorded in Crimea on the lesser mouse-eared bat and the lesser horseshoe bat (Stanyukovich, 1997; Bobkova, 2004).

Spinturnix emarginatus (Kolenati, 1856)

Distribution: probably Palaearctic, subboreal; findings are known in Europe: Spain, Bulgaria, Hungary, Czech Republic, and Poland (Dusbábek, 1964; Beron, 1965; Deunff, 1977; Peribañez-Lopez et al., 1989; Krištofik et al., 2012); within the former USSR territory the species was recorded only in Central Asia (Tajikistan) (Stanyukovich, 1997).

Host: Geoffroy's bat *Myotis emarginatus*.

Material: 5 spms. (2 ♀♀, ♂, N1, N2) off a Geoffroy's bat.

Remarks: The species is recorded herein for the first time for the Crimean Peninsula, and also for Russia and Ukraine as a whole.

Family **Macronyssidae***Ichoronyssus scutatus* (Kolenati, 1856)

Distribution: Palaearctic, subboreal.

Hosts: bent-winged bats of the family Miniopteridae.

Material: 76 spms. (75 ♀♀, N1) off a lesser mouse-eared bat.

Remarks: The species was previously repeatedly recorded in Crimea (Stanyukovich, 1997).

Macronyssus granulosus (Kolenati, 1856)

Distribution: circumpolar, subboreal.

Hosts: The range of hosts is extremely wide. The species has been found on representatives of several families of Chiroptera including fruit bats (Megachiroptera: Pteropodidae); this possibly indicates insufficient understanding of the taxonomic status of *M. granulosus*, which may in fact be a complex of morphologically close species. In the Palaearctic the species tends to occur on the lesser mouse-eared bat and the long-fingered bat.

Material: 288 spms. [54 ♀♀ (35 with intrauterine eggs), 15 ♂♂, 219 N1] off lesser mouse-eared bats; N1 off a Geoffroy's bat.

Remarks: The species was previously repeatedly collected in Crimea (Stanyukovich, 1997; Bobkova, 2004).

Steatonyssus periblepharus Kolenati, 1858

Distribution: boreal and partly subboreal zones of the Old World.

Hosts: various species of the genus *Pipistrellus*.

Material: N1 off a lesser mouse-eared bat, 14 N1 off a common pipistrelle.

Remarks: The species was previously known in Crimea from findings of two protonymphs (Bobkova, 2004).

Table 2. Distribution of ectoparasites by hosts

Species of ectoparasites	Collection localities (see Table 1)	Number of ectoparasites collected off different hosts				Total
		<i>Rhinolophus ferrumequinum</i> n = 2	<i>Myotis blythii</i> n = 32	<i>Myotis emarginatus</i> n = 2	<i>Pipistrellus pipistrellus</i> n = 2	
Acari: Mesostigmata, Gamasina						
Spinturnicidae						
<i>Eyndhovenia euryalis</i>	3	1	1	–	–	2
<i>Spinturnix myoti</i>	1–4	–	212 (7.3; 91)	–	–	212
<i>S. emarginatus</i>	2	–	–	5 (2.5; 100)	–	5
Macronyssidae						
<i>Ichoronyssus scutatus</i>	1–4	–	76 (6.3; 38)	–	–	76
<i>Macronyssus granulosus</i>	1–4	–	288 (10.7; 84)	1	–	289
<i>Steatonyssus periblepharus</i>	2	–	1 (1; 3)	–	14 (14; 50)	15
Insecta: Diptera, Nycteribiidae						
<i>Penicillidia dufouri</i>	1–4	–	46 (2.9; 50)	3 (1.5; 100)	–	49
<i>Nycteribia vexata</i>	1–4	–	56 (4; 44)	–	–	56
<i>Phthiridium biarticulatum</i>	3	1	–	–	–	1
Insecta: Siphonaptera, Ischnopsyllidae						
<i>Ischnopsyllus octactenus</i>	2	–	–	–	2	2
<i>Rhinolophopsylla unipectinata</i>	2	–	–	2	–	2
Total		2	680	11	16	709

MI and P indices are given in parentheses

Insecta: Diptera, Nycteribiidae

Penicillidia dufouri (Westwood, 1835)

Distribution: subboreal zone of the Palaearctic.

Hosts: the greater mouse-eared bat *Myotis myotis* (Borkhausen, 1797) and the lesser mouse-eared bat *M. blythii* (Szentiványi et al., 2016).

Material: 26 ♀♀, 20 ♂♂ off a lesser mouse-eared bat; ♀, 2 ♂♂ off a Geoffroy's bat.

Remarks: The species is recorded for the first time for the territory of Crimea.

Nycteribia vexata Westwood, 1835

Distribution: subboreal zone of the Palaearctic.

Hosts: the greater mouse-eared bat *Myotis myotis* (Borkhausen, 1797) and the lesser mouse-eared bat *M. blythii* (Szentiványi et al., 2016).

Material: 26 ♀♀, 30 ♂♂ off a lesser mouse-eared bat.

Remarks: *N. vexata* was earlier recorded from Crimea by Pliginsky (1927).

Phthiridium biarticulatum Hermann, 1804

Distribution: subboreal zone of the Western and Central Palaearctic.

Hosts: various horseshoe bats of the genus *Rhinolophus* sp., mainly the greater and the lesser horseshoe bats (Szentiványi et al., 2016).

Material: ♂ off a greater horseshoe bat.

Remarks: The species was previously recorded in Crimea only once (Ševčík et al., 2011).

Insecta: Siphonaptera, Ischnopsyllidae

Ischnopsyllus octactenus (Kolenati, 1856)

Distribution: Western Palaearctic, boreal and sub-boreal zones (Medvedev, 1996).

Hosts: mainly pipistrelles of the genus *Pipistrellus*.

Material: ♀ and ♂ off a common pipistrelle.

Remarks: The species was previously recorded for the Crimean Peninsula by Chirniy (2004).

Rhinolophosylla unipectinata
(Taschenberg, 1880)

Distribution: Subboreal zone of the Western and Central Palaearctic (Medvedev, 1996; Medvedev and Polkanov, 1997).

Hosts: various horseshoe bats of the genus *Rhinolophus*.

Material: ♀ and ♂ off a Geoffroy's bat.

Remarks: The species was previously recorded for the Crimean Peninsula by Chirniy (2004).

DISCUSSION

Thus, we have recorded 11 species of bat ectoparasites for the Crimean Peninsula. Two of them, the gamasid mite *Spinturnix emarginatus* and the bat fly *Penicillidia dufouri*, were found in the study region for the first time. Most of the collected ectoparasites are specific to bats of the genus *Myotis* or to *M. blythii*; the latter host was the most common in our collections, which must reflect its high abundance in the Crimean bat fauna. In our opinion, of special interest are quite numerous findings of the gamasid mite *Ichoronyssus scutatus*, a specific parasite of bent-wing bats (Chiroptera: Miniopteridae), on the lesser mouse-eared bat. The main host of *Ich. scutatus* is the common bent-wing bat *Miniopterus schreibersi* (Kuhl, 1817), a species listed in the Red Data Book of the Russian Federation. The current status of this bat in Crimea is unknown: its latest records were made in the middle of the XX century, after which the overall abundance of this species drastically decreased, and for a long time *M. schreibersi* was considered extinct in the territory of Crimea (Beskaravainyi et al., 1989;

Nature of Eastern Crimea..., 2013). Our findings of its specific parasite may, on the one hand, point to the presence of so far undiscovered colonies of the common bent-wing bat, which may be found during the future collections; on the other hand, they may indicate transition of *Ich. scutatus* onto an unusual host during contacts with the main host and subsequent inclusion of the lesser mouse-eared bat into the host range of this ectoparasite. A similar phenomenon was described for chewing lice associated with pigeons on the Galapagos Islands (Whiteman et al., 2004). The latter suggestion is supported by the fact that the ectoparasite was recorded on one-third of the examined lesser mouse-eared bats at infestation intensity of MI = 6; besides, infested bats were found in all the localities studied (Table 2). Such high abundance and wide distribution of *Ich. scutatus* can hardly be explained by co-occurrence of the host colonies, especially as the presence of *M. schreibersi* in Crimea still cannot be reliably confirmed. It should be noted that most representatives of Macronyssidae parasitic on bats reveal expressed host specificity. Besides, *Ich. scutatus* belongs to the most archaic genus of this family (Radovsky, 1968), and archaic parasites seldom switch to evolutionarily younger hosts (Szidat, 1940); the lesser mouse-eared bat belongs to the family Vespertilionidae which has a more recent evolutionary origin than Miniopteridae. Further studies in Crimea are necessary to establish the status of the common bent-wing bat on the peninsula and to determine the exact host associations of its specific parasite fauna.

Of great interest are findings of ectoparasites of Geoffroy's bat, another bat species included in the Red Data Book of the Russian Federation. In particular, the rare and little studied gamasid mite *Spinturnix emarginatus* was collected by us at the Karadag scientific station, on the northern boundary of its host's range. This mite is known from scarce collections in Europe and also in Tajikistan; here it is recorded for the first time for the territory of Russia. Besides, the flea *Rhinolophosylla unipectinata* was recorded on Geoffroy's bat. This finding may be the result of co-occurrence of this host and horseshoe bats which are the main hosts of this flea.

The bat fly *P. dufouri*, a widespread subboreal parasite of large mouse-eared bats (Szentiványi et al., 2016), was collected in Crimea for the first time; this is the fourth species of Nycteribiidae recorded for the Crimean Peninsula.

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