



## A new species of *Spinturnix* (Acari: Spinturnicidae) from the Turkestani long-eared bat *Otonycteris leucophaea* (Chiroptera: Vespertilionidae) in Kazakhstan

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### Abstract

The female, male and protonymph of *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.** (Acari: Spinturnicidae) are described from specimens collected on the enigmatic and rarely captured vespertilionid bat *Otonycteris leucophaea* (Severcov, 1873) in South Kazakhstan. A key for the identification of the species of *Spinturnix* von Heyden, 1826 found in Kazakhstan is provided.

**Key words:** *Spinturnix*, bat ectoparasites, Central Asia

### Introduction

Parasitic mites of the family Spinturnicidae Oudemans, 1902 associated with bats may be vectors of important pathogens including *Bartonella* sp. (Hornok *et al.* 2012; Reeves *et al.* 2016). However, their systematics, host-associations, and geographic distributions are poorly known. Spinturnicid mites (11 genera, 110 species) are obligatory ectoparasites of bats that occur on wing membranes, on the skin of the ears, the uropatagium or rarely around the anal orifice of their hosts (Rudnick 1960; Morales-Malacara *et al.* 2018; Beron 2020). The genus *Spinturnix* von Heyden, 1826 is worldwide in distribution and is the most species-rich, with nearly 50 nominal species (Uchikawa *et al.* 1994) associated primarily with vesper bats, family Vespertilionidae Gray, 1821 (Rudnick 1960). Four species in the genus *Spinturnix* have been previously reported from Kazakhstan: *S. myoti* (Kolenati, 1856), *S. kolenatii* Oudemans, 1910, *S. acuminata* (Koch, 1836), and *S. mystacina* (Kolenati, 1857) (Stanyukovich 1997).

Only a few records of the Turkestani long-eared bat, *Otonycteris leucophaea* (Severcov, 1873) (Chiroptera: Vespertilionidae) are available from Central Asia (Rybin *et al.* 1989, Horáček 1991, Benda *et al.* 2011, Tadzhibaeva 2018). It has been collected at only two localities in the south of Kazakhstan, the most northern points in the species' range (Gvozdev & Strautman 1984). The first locality is in the Western Chink of Usturt, in the Karamaya mountains, next to Kugusem Fountain, in the foothills zone among clay-gypsum cliffs with bitter-salty springs. The second record originates from the Ak-Mechet' Cave in the western part of the Karatau range, 100 km north of the city of Shymkent. The species lives here in flattened desert landscapes cut by shallow rocky ravines, and was found here along with five other bat species (Gvozdev & Strautman 1984). The lack of information for the Turkestani long-eared bat is also evident in the IUCN Red List, where its status is Data Deficient with unknown population trends

(IUCN 2022). In this article we describe the new species *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.** collected from the Turkestani long-eared bat *Otonycteris leucophaea*, and provide a key to the genus *Spinturnix* of Kazakhstan.

## Materials and methods

Mites were collected from Turkestani long-eared bats on 27 July 2022 at Karatau Mountain, in the Turkestan Province of Kazakhstan. Bats were captured using mist-nets of different lengths above the flow on the lower reaches of Bazhansay river (43°04.08 N 69°54.18 E), 15 km to the east of the Ak-Mechet' Cave. Each individual was placed in a separate cloth bag and its field number, identification, sex, date, and collection locality recorded.

Mites were removed using a forceps and preserved in 70% ethanol; the bat hosts were then released into the wild. The host classification follows Benda & Gvoždik (2010). The nomenclature for the mite idiosomal chaetotaxy follows Lindquist & Evans (1965). All measurements are in micrometres (µm). Mites were mounted on slides with Faure-Berlese's mounting medium (Whitaker 1988). Photographs were taken with the digital camera AxioCam ICc5 (Zeiss, Germany) attached to a compound microscope AxioImager A2 (Zeiss, Germany) equipped with a phase-contrast and DIC optics. Drawings were made using a Leica microscope equipped with a camera lucida. Holotype and paratypes of the new species were deposited in the collection of the Tyumen State Medical University (Tyumen, Russia). In the species list, principal hosts (host species harboring the greatest number of feeding ectoparasites) are indicated in bold font.

## Family Spinturnicidae Oudemans, 1902

Spinturnicinae Oudemans, 1902: 69.  
Spinturnicidae.—Rudnick, 1960: 169.

## Genus *Spinturnix* von Heyden, 1826

*Spinturnix* von Heyden, 1826: 612  
*Spinturnix*.—Rudnick, 1960: 200.

## *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.**

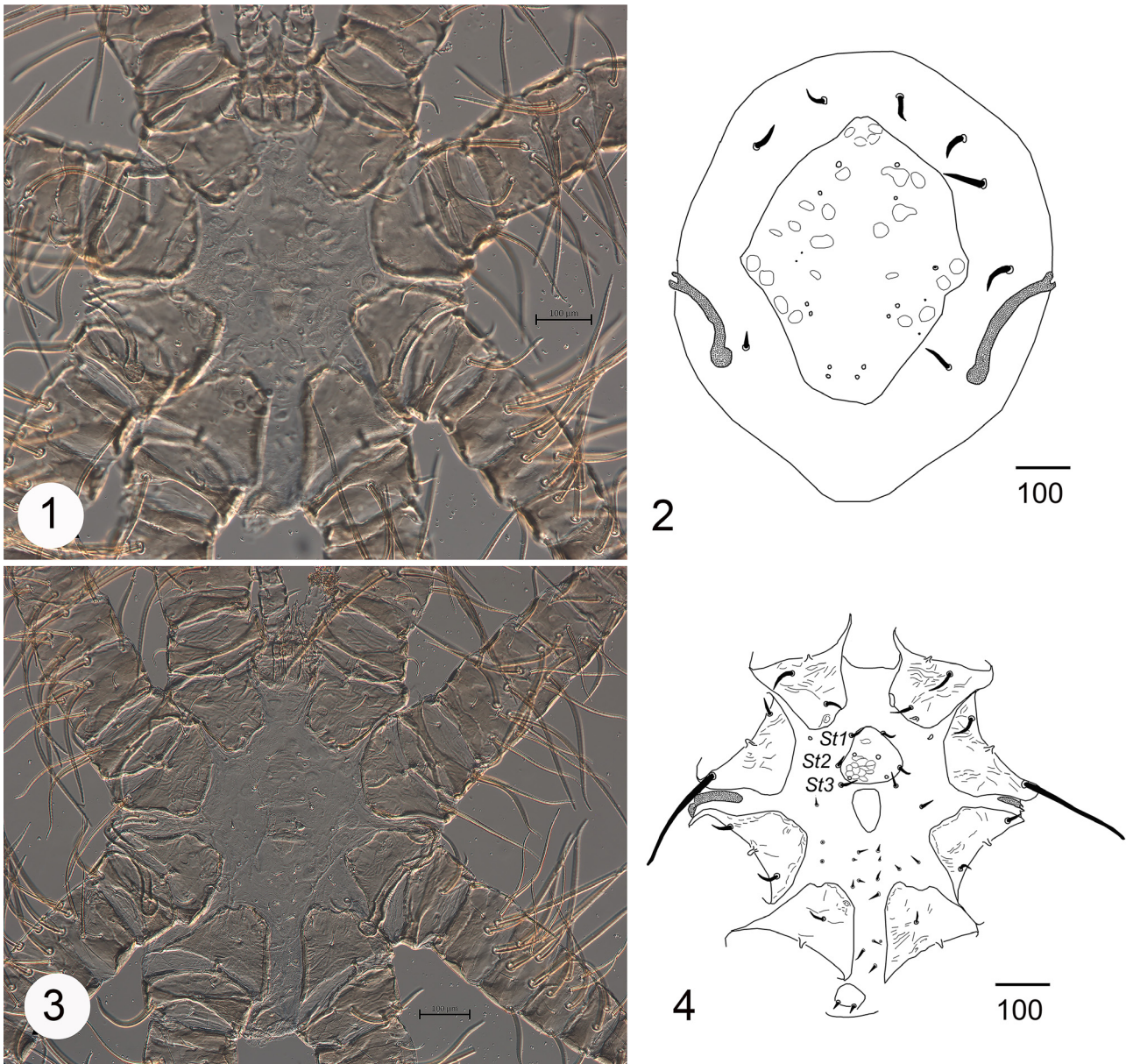
Figures 1–24.

## Description

### Female

*Dorsal idiosoma* (Figures 1, 2). Idiosoma about 840 long and 700 wide, broadly rounded anteriorly, widest at level of coxa II to III, with slightly pointed opisthosoma. Dorsal shield 524 long, 418 wide (519, 458 in paratype), with one anterior and two lateral small rounded projections; surface pitted. Shield widest at level of coxae II–III; with 11 pairs of pores (four of them small, others larger). Peritremes (199, 242 in holotype, 215, 239 in paratype) completely dorsal, with anterior ends between coxa II and III extending ventrally. Podonotal soft cuticle with four pairs of rough setae (43–61 in holotype, 39–49 in paratype) (only two setae on left side of body in holotype—Figure 2, four pairs in paratype). Metapodosomal setae (36, 56 in holotype; 47, 51 in paratype) proximal to stigma. Opisthonotal integument without setae.

*Ventral idiosoma* (Figures 3, 4). Tritosternum not visible. Sternal shield rounded triangular, 116 long, 124 maximal wide in holotype (118, 127 in paratype). Shield with weak cellular pattern and two pairs of setae on borders: *St1* (25, 28 in holotype, 22, 24 in paratype), *St2* (20, 24 in holotype, 28, 31 in paratype), and two pairs of small circular pores. Setae *St3* 21, 25 in holotype (36, 41 in paratype) on unsclerotised integument. One pair of endopodal sclerites on ventral surface between coxae I and II. Genital shield wedge-shaped, without setae, 91 long, 54 wide in holotype (93, 61 in paratype). Unsclerotised integument in ventral region with five pairs of setae, in intercoxal region 7–8 setae (13–25 long in holotype, 8–26 in paratype). Anal shield triangular, with one pair of setae.



**FIGURES 1–4.** *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.**, female. 1, photograph, dorsal; 2, drawing, dorsal; 3, photograph, ventral; 4, drawing, ventral.

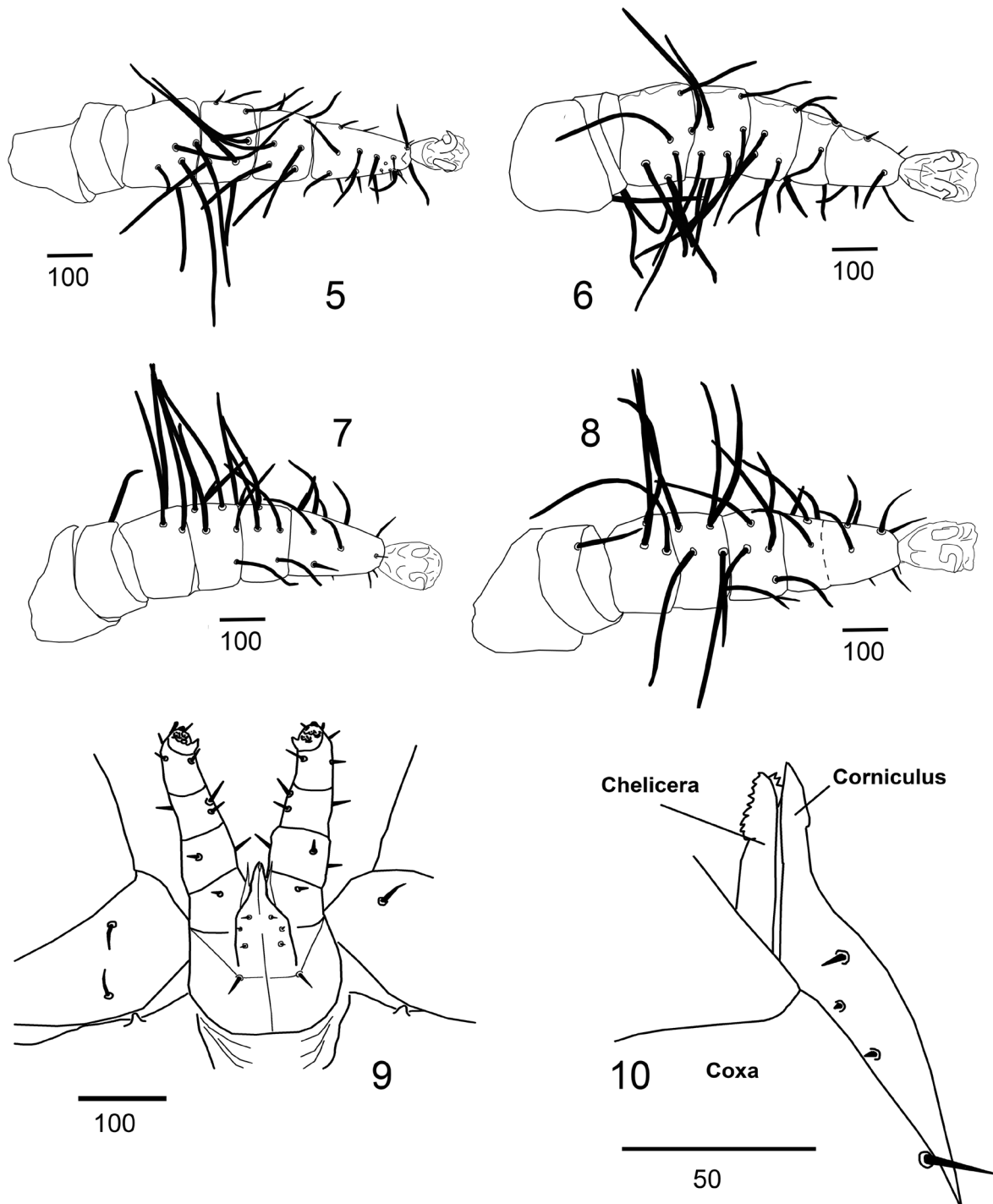
*Legs* (Figures 5–8). Legs stout, coxae unusually wide (length-width ratio of coxae as in Table 2), with wavy linear pattern. Posterior setae of coxae II long (211, 218 in holotype, 208, 226 in paratype), thick and smooth. Chaetotaxy and measurements of legs as in Tables 1 and 2 respectively. Ventral setae of legs mostly short (32–51), lateral and dorsal mostly long (87–373). Tarsal claws long, pulvilli well developed.

**TABLE 1.** Leg chaetotaxy of female and male *Spinturnix otonycterisi* **sp. nov.**

Leg	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	0 0/4 0 (4)	1 4/3 2 (10)	2 4/2 2 (10)	1 4/3 1 (9)	5 18/5 5 (33)
II	2	1 0/2 1 (4)	1 4/3 1 (9)	1 4/2 2 (9)	1 3/2 1 (7)	3 5/5 3 (16)
III	2	1 1/3 0 (5)	1 3/2 0 (6)	1 4/2 1 (8)	1 3/2 1 (7)	3 5/5 3 (16)
IV	1	1 1/3 0 (5)	1 3/2 0 (6)	1 4/2 1 (8)	1 3/2 1 (7)	3 5/5 3 (16)

**TABLE 2.** Measurements of legs of adult female *Spinturnix otonycterisi* **sp. nov.** (n=2)

Leg	Total length including coxa and pretarsus		Coxa length		Coxa length width ratio	Tarsus length	
	Holotype	Paratype	Holotype	Paratype		Holotype	Paratype
I	1028	1039	161	141	1:1.4	353	341
II	986	915	108	106	1:2.2	206	224
III	961	956	104	101	1:2	212	224
IV	951	981	153	147	1:1.9	225	206



**FIGURES 5–10.** *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.**, female. 5, leg I, dorsal; 6, leg II, dorsal; 7, leg III, dorsal; 8, leg IV, dorsal; 9, gnathosoma, dorsal; 10, chelicera, lateral.

*Gnathosoma* (Figures 9, 10). Length of gnathosoma 362, width 166 (incl. palps) and 199 long, 61 wide (without palps) (331 by 142 and 141 by 72 respectively in paratype). Epistome small and short. Hypostomal setae: *hyp1* 8–9 in length, *hyp2* and *hyp3* minute. Hypostomal processes pointed. Chelicera with toothed chela.

*Differential diagnosis.* The females of *Spinturnix otonycterisi* differ from other *Spinturnix* species by the dorsal shields having three small projections (*vs* oval, diamond-shaped or with one or two large projections in other species), and the absence of dorsal opisthosomal setae (*vs* presence of dorsal opisthosomal setae in all other species).

#### Male

*Dorsal idiosoma* (Figures 11, 12, Table 3). Idiosoma about 830 long and 640 wide, rounded diamond-shaped, widest at level of coxa II to III. Dorsal shield widest at level of coxae II–III; with 11 pairs of pores (two of them large, situated on edges of shield, others on shield). Peritremes with stigma completely dorsal, with anterior ends between coxa II and III extending ventrally. Podonotal soft cuticle with four pairs of rough setae. Metapodosomal setae proximal to stigma. Opisthonotal region without setae.

*Ventral idiosoma* (Figures 13–18, Table 3). Tritosternum not visible. Sternogenital shield angular, with a constriction in the upper third (Figure 13, 14) or with transverse projections (Figures 15–18). Shield with round pattern and three pairs of setae and two pairs of small pores. Three pairs of endopodal sclerites on ventral surface; one pair between coxae I and II, and two pairs between coxae II and III. Unsclerotised cuticle with weak scaly pattern. Unsclerotised integument in ventral region with four pairs of setae (including one microsetal pair), intercoxal region with one pair of setae. Anal shield triangular, with one pair of setae.

*Legs.* Mostly as in females: stout, with wide coxae having wavy linear pattern. Chaetotaxy of legs is presented in Table 1, measurements as in Table 4.

*Gnathosoma.* Generally characteristic of species of genus *Spinturnix*. Palps 327 long, chelicerae 318 long (Figure 20). Fixed digit slightly curved, 68 long, spermatodactyl massive, 53 long, movable digit rectangular, 62 long.

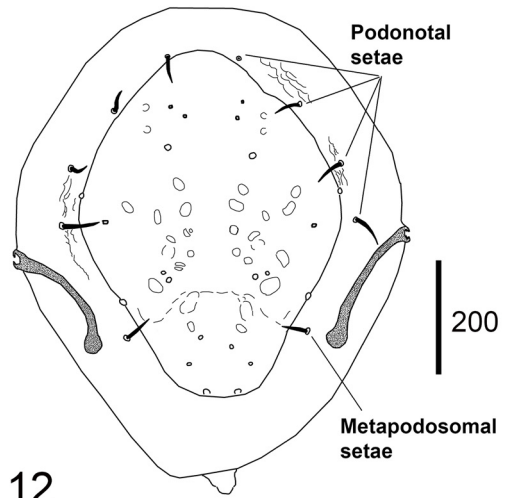
*Differential diagnosis.* The males of *Spinturnix otonycterisi* differ from other *Spinturnix* species by the absence of dorsal opisthosomal setae (*vs* presence of dorsal opisthosomal setae in all other species) and by the bizarre shape of the sternogenital shield (presence of constrictions and transversal projections).

**TABLE 3.** Basic metric data of adult males of *Spinturnix otonycterisi* sp. nov. (n=3)

Structure	Measurement	Mean
Dorsal shield	Length	571, 600, 603
	Width	440, 459, 471
Peritremes	Length	224, 235, 258
Podonotal setae	Length	53–74
Metapodosomal setae	Length	29–65
Sternogenital shield	Length	241, 243, 253
	Width at level of setae <i>St1</i>	51, 82, 106
	Maximal width (at level of setae <i>St2</i> )	171, 182, 183
	<i>St1</i> length	18, 26, 29
	<i>St2</i> length	24, 29, 32
	<i>St3</i> length	24, 29, 29
Anal shield	Length	35, 47, 57
	Width	59, 71, 79
Ventral opisthosomal setae	Length	18–30
Gnathosoma including palps	Length	306, 338, 365
	Width	147, 153, 165
Gnathosoma without palps	Length	194, 206, 244
	Width	65, 71, 91



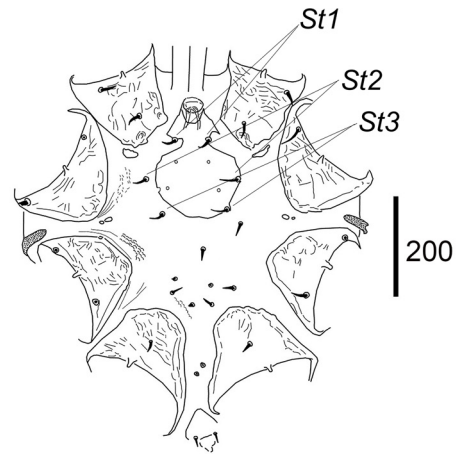
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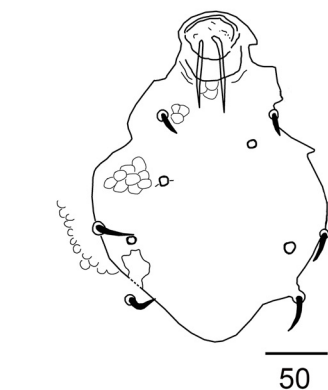
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FIGURES 11–16. *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.**, Male. 11, photograph, dorsal; 12, drawing, dorsal; 13, photograph, ventral; 14, drawing, ventral; 15, photograph, sternogenital shield; 16, drawing, sternogenital shield.

**TABLE 4.** Measurements of legs of adult males of *Spinturnix otonycterisi* sp. nov. (n = 3)

Leg	Total length (including coxa and pretarsus)	Coxa length	Coxa length-width ratio	Tarsus length
I	941, 965, 994	124, 135, 141	1:1.4	199, 212, 214
II	824, 882, 947	99, 101, 112	1:2	194, 201, 207
III	776, 858, 912	106, 106, 100	1:2	206, 212, 224
IV	824, 859, 847	124, 123, 129	1:2	229, 229, 218

**Protonymph**

*Dorsal idiosoma* (Figures 19, 21, 22). Idiosoma about 800 long and 650 wide, obovate, widest at level of fourth pair of podonotal setae. Dorsal surface with two shields. Large podonotal shield (382 long, 374 wide) rounded with almost straight posterior margin, surface pitted. Ten pairs of pores (three of them large, others smaller) situated on podonotal shield. Opisthonotal shield small (153 long, 171 wide), pitted, with three pairs of setae. Peritremes completely dorsal, with anterior ends between coxa II and III, extending ventrally. Podonotal soft cuticle with four pairs of rough setae (111–124). Metapodosomal setae proximal to stigma (135). Opisthonotal region with two pairs of setae (136–147).

*Ventral idiosoma* (Figures 23, 24). Tritosternum not visible. Sternal shield (173 long, 113 wide) weakly sclerotised, with granular pattern and two pairs of small pores. Sternal setae on unsclerotised integument: *St1* 10 long, *St2* 12 long, *St3* 11 long. Unsclerotised integument in ventral region with one pair of setae, intercoxal region with five pairs of setae (11–19 long). Anal shield triangular (53 long, 47 wide), with two posterior setae.

*Legs*. Mostly as in females: stout, with wide coxae having wavy linear pattern. Posterior setae of coxae II long (167), thick and smooth. Leg chaetotaxy as in Table 5, measurements as in Table 6. Ventral setae of legs mostly short (18–41), lateral and dorsal mostly long (90–190). Tarsal claws long, pulvilli well developed.

**TABLE 5.** Leg chaetotaxy of protonymph of *Spinturnix otonycterisi* sp. nov.

Leg	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	0 0/2 0 (2)	2 4/2 2 (10)	1 4/2 1 (8)	1 4/2 1 (8)	5 15/6 3 (29)
II	2	0 0/2 0 (2)	1 4/2 1 (8)	1 4/1 1 (7)	1 3/2 1 (7)	3 5/4 3 (15)
III	2	1 1/2 0 (4)	1 3/1 0 (5)	1 4/1 1 (7)	1 3/2 0 (6)	3 5/4 3 (15)
IV	1	1 1/2 0 (4)	1 3/0 0 (4)	1 4/2 0 (7)	1 3/2 0 (6)	3 5/4 3 (15)

**TABLE 6.** Measurements of legs of protonymph of *Spinturnix otonycterisi* sp. nov. (n=1)

Leg	Total length including coxa and pretarsus	Coxa length	Coxa length-width ratio	Tarsus length
I	875	163	1:1.3	188
II	775	125	1:2	163
III	750	123	1:2	175
IV	825	138	1:2	173

**Deutonymph**

Unknown.

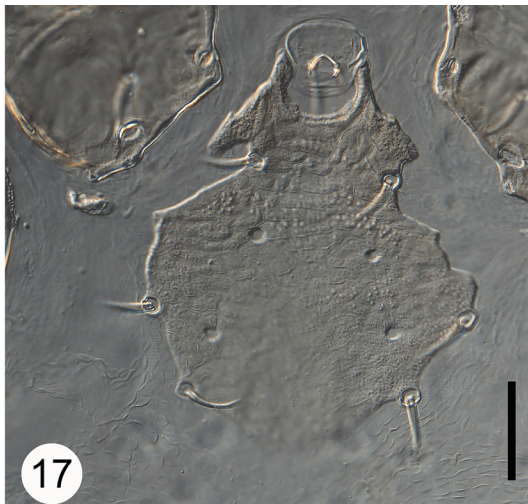
**Taxonomic summary**

*Type material*. Holotype female, 1 paratype female; 3 paratype males; 1 paratype protonymph.

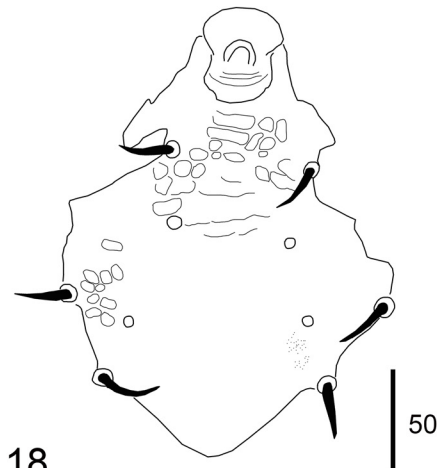
*Type host*. Turkestani long-eared bat *Otonycteris leucophaea*.

*Type locality*. Kazakhstan: Karatau Mountains, Bazhansay river 43°04.08 N 69°54.18 E, 27 July 2022, leg. H. Dundarova, det. M.V. Orlova.

*Etymology*. The new species is named after the type host *Otonycteris leucophaea*.



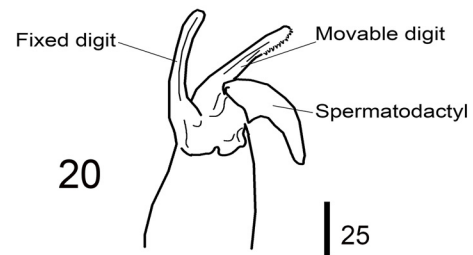
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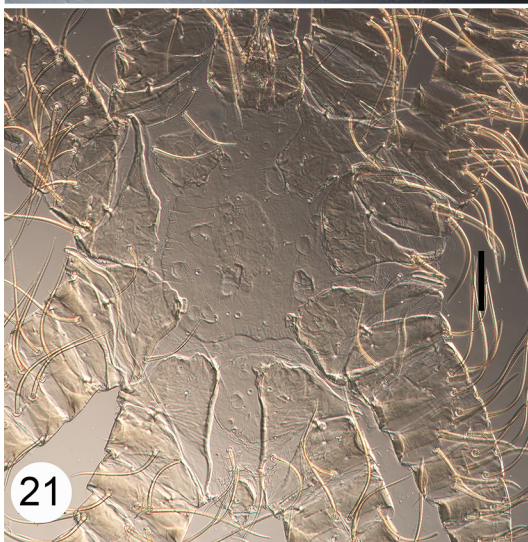
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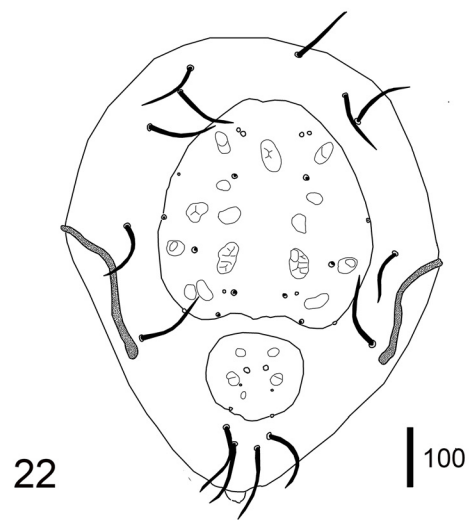
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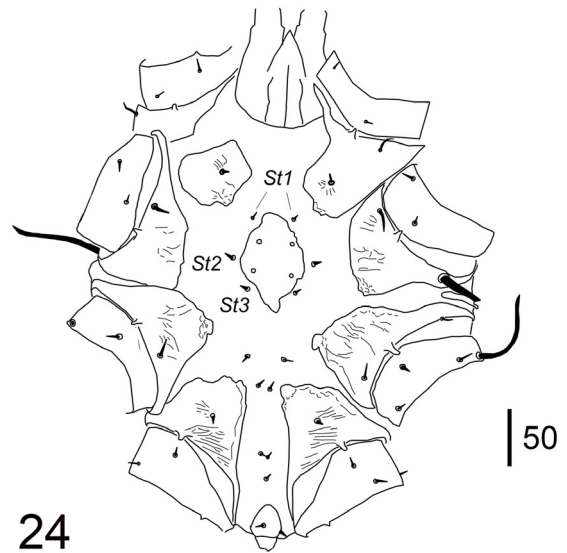
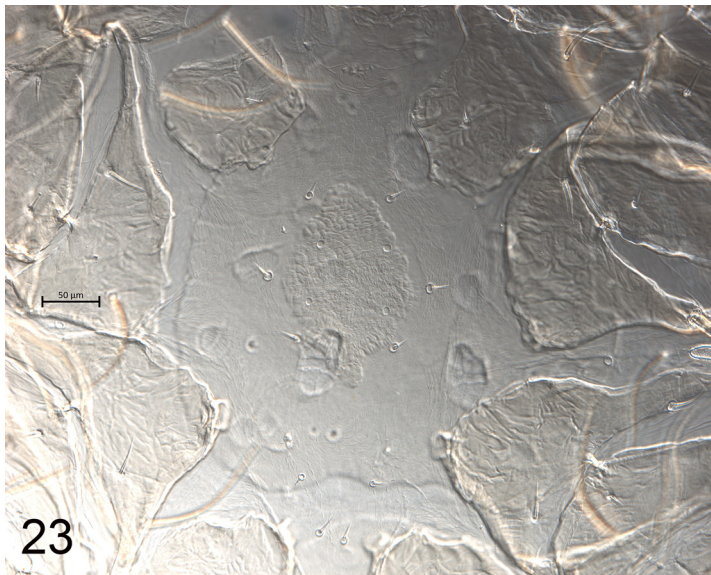
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**FIGURES 17–22.** *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.** 17, Male, photograph, sternogenital shield; 18, Male, drawing, sternogenital shield; 19, Protonymph, habitus. 20, Male, chelicera. 21, Protonymph, photograph, dorsal; 22, Protonymph, drawing, dorsal.





FIGURES 23–24. *Spinturnix otonycterisi* Dundarova & Orlova, **sp. nov.** 23, Protonymph, photograph, ventral; 24, Protonymph, drawing, ventral.

## Discussion

The new species is an ectoparasite of *Otonycteris leucophaea* and possibly other bats in the genus *Otonycteris*. Despite the available information about the close relationship between the genera *Otonycteris* Peters, 1859 and *Plecotus* E. Geoffroy, 1818 (Zima *et al.* 1992, Bogdanowicz *et al.* 1998), we should note that the new species does not show any similarity with the mite specific to the genus *Plecotus*, *Spinturnix plecotina* (Koch, 1839). The phylogenetic position of *Otonycteris* is still unresolved (Hofer & Van den Bussche 2003, Roehrs *et al.* 2010), which is confirmed by the pronounced morphological isolation of its specific ectoparasite *Spinturnix otonycterisi*—the bizarre form of the female dorsal shield and male sternogenital shield, and the absence of dorsal opisthosomal setae amongst others. We expect that this parasite is distributed within the range of its host, i.e. this is a Central Asian species.

## Key to species of the genus *Spinturnix* of Kazakhstan and adjacent countries

### Females

1. Dorsal opisthosoma without setae . . . . . *S. otonycterisi* Dundarova & Orlova, **sp. nov.**
- Dorsal opisthosoma with four or more pairs of setae . . . . . 2
2. With four pairs of dorsal setae posterior to stigmata . . . . . *S. kolenatii* Oudemans, 1910
- With more than 20 pairs of dorsal setae posterior to stigmata . . . . . 3
3. Dorsal opisthosoma with 20–40 pairs of setae, anterior and posterior ends of dorsal shield with a large rounded projection . . . . . *S. acuminata* (Koch, 1836)
- Dorsal opisthosoma with 40 or more pairs of setae, dorsal shield oval, without projections . . . . . 4
4. Dorsal opisthosoma with 45–65 pairs of setae, genital setae not on genital shield . . . . . *S. myoti* (Kolenati, 1856)
- Dorsal opisthosoma with 40–45 pairs of setae, genital setae on genital shield . . . . . *S. mystacina* (Kolenati, 1857)

### Males

1. Dorsal opisthosoma without setae . . . . . *S. otonycterisi*
- Dorsal opisthosoma with four or more pairs of setae . . . . . 2
2. With four pairs of dorsal setae posterior to stigmata . . . . . *S. kolenatii*
- With more than 20 pairs of dorsal setae posterior to stigmata . . . . . 3
3. Sternogenital shield bottle-shaped . . . . . *S. acuminata*
- Sternogenital shield spade-shaped . . . . . 4
4. Posterior margin of sternogenital shield pointed . . . . . *S. myoti*
- Posterior margin of sternogenital shield straight . . . . . *S. mystacina*

## List of hosts and distributions

### *Spinturnix acuminata* (Koch, 1836)

Distribution. Russia (Stanyukovich 1997), Europe (Stanyukovich 1997), Caucasus (Azerbaijan) (Stanyukovich 1997), Asia (Kazakhstan, Tajikistan, Kyrgyzstan, China, India) (Stanyukovich 1997; Beron 2020), Africa (Morocco) (Beron 2020). Hosts are presented in Table 7.

**TABLE 7.** Host records for *Spinturnix acuminata* (Koch, 1836)

Host	Reference
<i>Myotis daubentonii</i> (Kuhl, 1817)	Stanyukovich 1997; Beron 2020
<i>M. dasycneme</i> (Boie, 1925)	Stanyukovich 1997; Beron 2020
<i>M. myotis</i> (Borkhausen, 1797)	
<i>M. blythii</i> Tomes, 1857	
<i>Murina leucogaster</i> (Milne-Edwards, 1872)	Stanyukovich 1997; Beron 2020
<i>Nyctalus noctula</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>N. lasiopterus</i> (Schreber, 1780)	Beron 2020
<i>N. leisleri</i> (Kuhl, 1817)	Stanyukovich 1997; Beron 2020
<i>Pipistrellus pipistrellus</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>P. kuhlii</i> Kuhl, 1817	Beron 2020
<i>Hypsugo savii</i> Bonaparte, 1837 (as <i>Pipistrellus savii</i> )	Stanyukovich 1997; Beron 2020
<i>Eptesicus serotinus</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>Barbastella leucomelas</i> Cretzschmar, 1826	Beron 2020
<i>Scotophilus kuhlii</i> Leach, 1821 (as <i>Scotophilus wroughthoni</i> Thomas, 1897)	Stanyukovich 1997
<i>S. heathii</i> Horsfield, 1831	Beron 2020

### *Spinturnix kolenatii* Oudemans, 1910

Distribution. Russia (Stanyukovich 1997), Europe (Stanyukovich 1997; Beron 2020), Asia (Afghanistan, Japan, Mongolia) (Beron 2020), Africa (Namibia) (Orlova *et al.* 2020). Hosts are presented in Table 8.

### *Spinturnix myoti* (Kolenati, 1856)

Distribution: Russia (Stanyukovich 1997), Caucasus (Georgia) (Stanyukovich 1997), Asia (Kyrgyzstan, Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan, India, Japan *et al.*) (Stanyukovich 1997; Beron 2020), Africa (Algeria) (Beron 2020). Hosts are presented in Table 9.

### *Spinturnix mystacina* (Kolenati, 1857)

Distribution. Russia (Stanyukovich 1997), Europe (Stanyukovich 1997), Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Japan) (Beron 2020). Hosts are presented in Table 10.

**TABLE 8.** Host records for *Spinturnix kolenatii* Oudemans, 1910

Host	Reference
<i>Myotis daubentonii</i> (Kuhl, 1817)	Stanyukovich 1997; Beron 2020
<i>M. brandtii</i> (Eversmann, 1845)	
<i>M. mystacinus</i> (Kuhl, 1817)	
<i>M. blythii</i> (Tomes, 1857)	
<i>Myotis sibiricus</i> (Kastschenko, 1905) (as <i>M. brandtii</i> )	Medvedev <i>et al.</i> 1991
<i>Murina hilgendorfi</i> (Peters, 1880) (as <i>Murina leucogaster</i> )	Stanyukovich 1997
<i>Nyctalus noctula</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>Pipistrellus pipistrellus</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>P. nathusii</i> (Keyserling & Blasius, 1839)	Beron 2020
<i>Vespertilio murinus</i> Linnaeus, 1758	Beron 2020
<i>Eptesicus serotinus</i> (Schreber, 1774) (as <i>E. turcomanus</i> )	Stanyukovich 1997; Beron 2020
<i>E. nilssonii</i> (Keyserling & Blasius, 1839) (as <i>E. parvus</i> )	Uchikawa & Wada 1979; Stanyukovich 1997; Beron 2020
<i>E. turcomanus</i> (Eversmann, 1840)	Beron 2020
<i>E. gobiensis</i> Bobrinskii, 1926	Scheffler <i>et al.</i> 2016
<i>E. hottentotus</i> A. Smith, 1833	Orlova <i>et al.</i> 2020
<i>Plecotus auritus</i> Linnaeus, 1758	Stanyukovich 1997; Beron 2020

**TABLE 9.** Host records for *Spinturnix myoti* (Kolenati, 1856)

Host	Reference
<i>Rhinolophus hipposideros</i> (Borkhausen 1797)	Stanyukovich 1997; Beron 2020
<i>R. ferrumequinum</i> (Schreber, 1774)	
<i>R. euryale</i> Blasius, 1853	
<i>Myotis daubentonii</i> (Kuhl, 1817)	Stanyukovich 1997; Orlova 2011; Orlova <i>et al.</i> 2011; Beron 2020
<i>M. dasycneme</i> (Boie, 1925)	Stanyukovich 1997; Orlova 2011; Orlova <i>et al.</i> 2014a; Beron 2020
<i>M. capaccinii</i> Bonaparte, 1837	Benda <i>et al.</i> 2012; Beron 2020
<i>M. brandtii</i> (Eversmann, 1845)	Stanyukovich 1990; Stanyukovich 1997; Orlova 2011; Beron 2020
<i>M. mystacinus</i> (Kuhl, 1817)	Stanyukovich 1997
<i>M. ikonnikovi</i> Ognev, 1912	Medvedev <i>et al.</i> 1991; Stanyukovich 1997; Orlova <i>et al.</i> 2015; Beron 2020
<i>M. nattereri</i> (Kuhl, 1817)	Stanyukovich 1990; Stanyukovich 1997; Beron 2020
<i>M. emarginatus</i> (Geoffroy Saint-Hilaire, 1806)	Stanyukovich 1997; Beron 2020
<i>M. myotis</i> (Borkhausen, 1797)	Stanyukovich 1997; Beron 2020
<i>M. blythii</i> (Tomes, 1857)	Stanyukovich 1997; Orlova <i>et al.</i> 2015; Beron 2020
<i>M. punicus</i> Felten, 1977	Benda <i>et al.</i> 2014; Beron 2020
<i>M. petax</i> Hollister, 1912 (as <i>M. daubentonii</i> )	Medvedev <i>et al.</i> 1991; Orlova <i>et al.</i> 2014b; Orlova <i>et al.</i> 2015; Beron 2020
<i>M. macrodactylus</i> Temminck, 1840 (as <i>M. capaccinii</i> )	Medvedev <i>et al.</i> 1991; Beron 2020
<i>M. sibiricus</i> (Kastschenko, 1905) (as <i>M. brandtii</i> )	Medvedev <i>et al.</i> 1991; Orlova <i>et al.</i> 2017

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**TABLE 9. (Continued)**

Host	Reference
<i>Murina hilgendorfi</i> (Peters, 1880) (as <i>Murina leucogaster</i> )	Stanyukovich 1997; Orlova <i>et al.</i> 2015
<i>Nyctalus noctula</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>Pipistrellus pipistrellus</i> (Schreber, 1774)	Stanyukovich 1997
<i>P. nathusii</i> (Keyserling & Blasius, 1839)	Stanyukovich 1997; Beron 2020
<i>Vespertilio murinus</i> Linnaeus, 1758	Stanyukovich 1997
<i>V. sinensis</i> Peters, 1880 (as <i>V. superans</i> )	Stanyukovich 1997
<i>Barbastella barbastellus</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>Otonycteris hemprichii</i> Peters, 1859	Stanyukovich 1997
<i>Plecotus auritus</i> Linnaeus, 1758	Stanyukovich 1997; Beron 2020
<i>Miniopterus schreibersii</i> (Kuhl, 1817)	Stanyukovich 1997; Beron 2020
<i>Tadarida teniotis</i> (Rafinesque, 1814)	Benda <i>et al.</i> 2014

**TABLE 10.** Host records for *Spinturnix mystacina* (Kolenati, 1857)

Host	Reference
<i>Myotis dasycneme</i> (Boie, 1925)	Stanyukovich 1997; Beron 2020
<i>M. brandtii</i> (Eversmann, 1845)	Stanyukovich 1990, 1997; Beron 2020
<i>M. mystacinus</i> (Kuhl, 1817)	Stanyukovich 1990, 1997; Beron 2020
<i>M. ikonnikovi</i> Ognev, 1912	Beron 2020
<i>M. davidii</i> Peters, 1869 (as <i>M. aurascens</i> )	Beron 2020
<i>M. sibiricus</i> (Kastschenko, 1905) (as <i>M. gracilis</i> and <i>M. hosonoi</i> )	Orlova <i>et al.</i> 2017; Beron 2020
<i>M. alcathoe</i> von Helversen & Heller, 2001	Beron 2020
<i>M. nattereri</i> (Kuhl, 1817)	Beron 2020
<i>M. myotis</i> (Borkhausen, 1797)	Stanyukovich 1997; Beron 2020
<i>Nyctalus noctula</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>Hypsugo alaschanicus</i> Bobrinski, 1926	Beron 2020
<i>Vespertilio murinus</i> Linnaeus, 1758	Stanyukovich 1997
<i>Eptesicus serotinus</i> (Schreber, 1774)	Stanyukovich 1997; Beron 2020
<i>E. gobiensis</i> Bobrinski, 1926	Beron 2020
<i>Plecotus auritus</i> Linnaeus, 1758	Stanyukovich 1997; Beron 2020

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