Acta Soc. Zool. Bohem. **88**: 1–213, 2024
ISSN 2788-1369 (on-line)
ISSN 1211-376X (print)

Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 17. New records of bats and their ectoparasites from Tajikistan with a review of these faunas of the country including a description of a new species of horseshoe bat

Petr Benda[1,2], Martin Ševčík[3], Ivan Horáček[2], Marek Uvizl[1,2], Antonín Reiter[4] & Marcel Uhrin[5]

[1] Department of Zoology, National Museum (Natural History), Václavské nám. 68, CZ–115 79 Praha 1, Czech Republic; e-mail: petr.benda@nm.cz
[2] Department of Zoology, Faculty of Science, Charles University, Viničná 7, CZ–128 44 Praha 2, Czech Republic
[3] Institute of Virology, Biomedical Research Center, Slovak Academy of Sciences, Dúbravská cesta 9, SK–845 05 Bratislava, Slovakia
[4] South Moravian Museum in Znojmo, Přemyslovců 129/8, 669 02 Znojmo, Czech Republic
[5] Department of Zoology, Institute of Biology and Ecology, Faculty of Science, P. J. Šafárik University in Košice, Šrobárova 2, SK–041 54 Košice, Slovakia

Received 16 September 2024; *accepted 11 November 2024*
Published 27 December 2024

Abstract. A complete list of bat records available from Tajikistan was compiled from the literature and from new records, based mainly on field studies made in 2016. The record review is complemented with distribution maps, summaries of distributional status of the particular bat species, notes on their taxonomy, and records of their arthropod ectoparasites. From the territory of Tajikistan, at least 416 records of 20–21 bat species belonging to 3–4 families are known; viz. *Rhinolophus ferrumequinum* (Schreber, 1774) (47 record sites), *R. bocharicus* Kašenko et Akimov, 1918 (29), *R. hipposideros* s.l. (25), *Rhinolophus* aff. *lepidus* (5), *R. hipposideros* (André, 1797) s.str. (6), *Myotis blythii* (Tomes, 1857) (42), *M. emarginatus* (Geoffroy, 1806) (17), *M. davidii* (Peters, 1869) (24), *M. bucharensis* Kuzâkin, 1950 (2), *Vespertilio murinus* Linnaeus, 1758 (14), *Eptesicus serotinus* (Schreber, 1774) (26), *E. ognevi* Bobrinskoj, 1918 (17–18), *E. gobiensis* Bobrinskoj, 1926 (1–3), *Hypsugo savii* (Bonaparte, 1837) (17–18), *Pipistrellus pipistrellus* (Schreber, 1774) (61), *P. kuhlii* (Kuhl, 1817) (4), *Nyctalus noctula* (Schreber, 1774) (4–5), *Otonycteris leucophaea* (Severcov, 1873) (12), *Barbastella caspica* Satunin, 1908 (29), *Plecotus strelkovi* Spitzenberger, 2006 (21), *Miniopterus* cf. *pallidus* Thomas, 1907 (0–1), and *Tadarida teniotis* (Rafinesque, 1814) (13). Based on the results of molecular genetic and detailed morphological analyses, the populations of small-sized horseshoe bats formerly assigned to *Rhinolophus* aff. *lepidus* were found to represent a new separate species of the *Rhinolophus macrotis* group, which is here described. Echolocation data are given for 13 bat species from Tajikistan; in five species, *Rhinolophus bocharicus*, *R.* aff. *lepidus*, *Eptesicus ognevi*, *Otonycteris leucophaea*, and *Barbastella caspica*, these data are reported for the first time. Arthropod ectoparasites were newly collected from two species of bats in Tajikistan (*Rhinolophus* aff. *lepidus* and *Eptesicus ognevi*), while in 13 other bat species, data on their ectoparasites are available in literature; of them from eight species, additional parasites were newly collected. At least 42 species of ectoparasites belonging to eight families were recorded from Tajikistan in total and the following seven taxa of five families are here reported from the country for the first time: *Phthiridium szechuanum* (Theodor, 1954) and Sarcoptiformes fam. sp. (from *Rhinolophus* aff. *lepidus*), *Spinturnix carnificina* (Koch, 1839), *Steatonyssus pseudoheteroventralis* Orlova et Anisimov, 2023, and *Miyatrombicula* sp. (from *Eptesicus ognevi*), *Spinturnix nobleti* Deunff, Volleth, Keller et Aellen, 1990 (from *Hypsugo savii*), and *Macronyssus barbastellinus* Dusbábek et Pinčuk, 1971 (from *Barbastella caspica*).

Key words. Distribution, echolocation, taxonomy, Rhinolophidae, Vespertilionidae, Miniopteridae, Molossidae, ectoparasites, Ischnopsyllidae, Nycteribiidae, Spinturnicidae, Macronyssidae, Trombiculidae, West Turkestan, Central Asia, Palaearctic.

CONTENTS

INTRODUCTION

The territory of Tajikistan (ca. 142,600 km^2) represents the south-eastern natural limits of West Turkestan and the easternmost extent of the Mediterranean arboreal zone in its widest sense. West Turkestan, formerly also known as Russian Turkestan, is a part of Central Asia conquered by the Russian Empire, as a whole at the end of the 19th century (see also Benda et al. 2011). It is a mostly arid lowland region, naturally well demarcated – in the west by the eastern shore of the Caspian Sea, in the east by the highest ridges of the Pamirs and Tien-Shan. Only in the south the borders were created rather politically, although for demarcation of the southern border of Tajikistan the riverbeds of the Pamir – Panç – Amudarë (Amu Darya) rivers were used, and in the west, the Kopetdagh Mountains form a natural border between Turkestan and Persia. All the Turkestani mountainous areas eastwards up to the western Tien-Shan represent the easternmost parts of the distribution ranges of the Mediterranean faunal elements among bats (Rybin et al. 1989, Horáček et al. 2000).

Tajikistan is the smallest country that emerged from Russian Turkestan, its territory makes up only about 8% of the West Turkestani area, however it is one of the most diversified. Along with Kirghizstan, it is a mountainous country, in its physical geography clearly distinct from the remaining, mainly lowland countries of West Turkestan, i.e. Kazakhstan, Uzbekistan, and Turk-

menistan. Tajikistan is situated in the south-eastern corner of West Turkestan and is composed of two distinct regions, the western and northern rather low parts created by the Sirdarë (Syr Darya), Zarafšon, and Amudarë valleys and fringed by the westernmost Tien-Shan ridges, and the eastern part comprising high ridges and mountain plateaus of the Pamirs (Fig. 1). Therefore, the altitude span in Tajikistan is enormous, it is the largest among all West Turkestani countries; the lowest point being near Foteḩobod at 292 m a. s. l. in the Sirdarë lowland, the highest point is the Somoni peak in the Pamirs at 7495 m a. s. l. Besides hypsometry, the two parts differ markedly from each other in their climate, vegetation, fauna, and population density. The western part is characterised by arid steppes, while in the eastern part, the mountain tundra is prevailing.

The fauna of Tajikistan has been documented for more than 150 years; initially just as a part of collections made by explorers of Central Asia at the times of the gradual Russian seizure of the West Turkestani territory. Concerning bats, the oldest records from Tajikistan before the turn of the 19th and 20th centuries were made by Nikolaj Alekseevič Severcov (1827–1885; originally Sěvercov″ [Сѣверцовъ], also spelled as Severtzov or Severtzoff; for details on his travels see under *Eptesicus gobiensis* below), Valerian Fridrihevič Russov (1842–1879; for details on his travel see under *Eptesicus gobiensis* below), Lev Semenovič Barŝevskij (1849–1910; also Leon Barszewski), Bronislav Lûdvigovič Grombčevskij (1855–1926; also Bronislaw Grąbczewski), Nikolaj Alekseevič Zarudnyj (1859–1919; also spelled as Sarudny, Ssarudny, Zarudnoï, Zarudny,

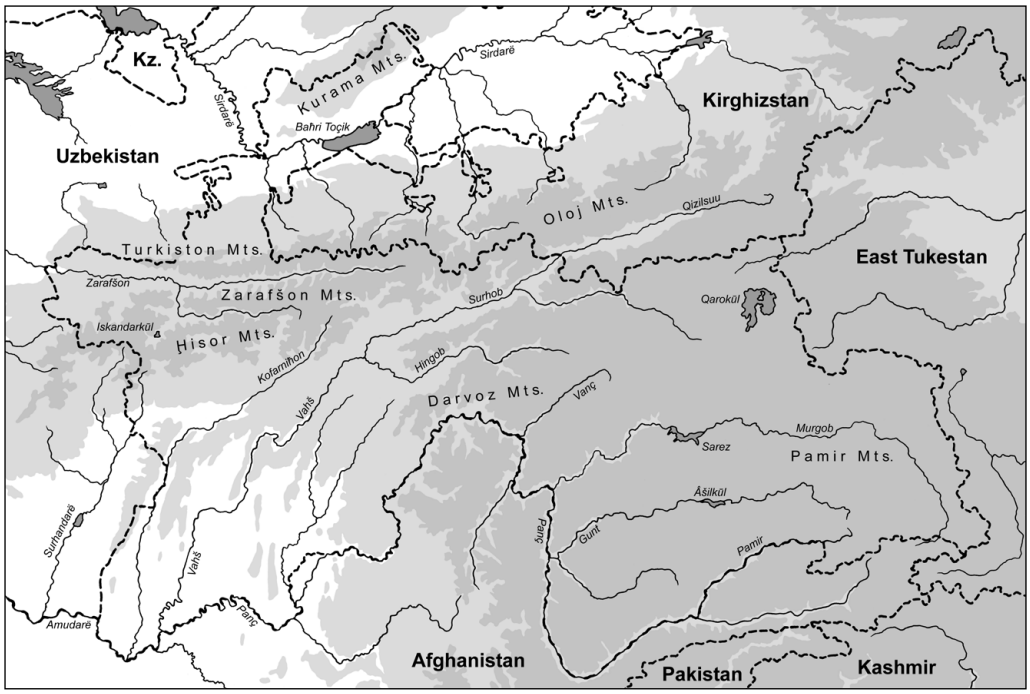


Fig. 1. General map of Tajikistan showing the main geographic features (pale grey shaded = area above 1000 m a. s. l., dark grey shaded = area above 2000 m a. s. l.); Kz. = Kazakhstan.

Table 1. Composition of the bat fauna of Tajikistan and the number of records of particular species according to subsequent reviews

species	Bobrinskoj 1925, 1926	Bogdanov 1956a	Habilov 1992	this review
Rhinolophus ferrumequinum	–	6	32	47
Rhinolophus bocharicus	–	3	20	29
Rhinolophus hipposideros s.l.	1	4	21	25
Rhinolophus kirghisorum sp. nov.	–	–	–	5
Rhinolophus hipposideros s.str.	–	–	–	6
Myotis blythii	1	3	27	42
Myotis emarginatus	1	1	10	17
Myotis davidii	5	6	16	24
Myotis bucharensis	–	1	1	2
Vespertilio murinus	–	1	9	14
Eptesicus serotinus	4	6	19	26
Eptesicus ognevi	3	4	9	17–18
Eptesicus gobiensis	1	1	3	1–3
Hypsugo savii	1	–	13	17–18
Pipistrellus pipistrellus	5	11	39	61
Pipistrellus kuhlii	–	–	–	4
Nyctalus noctula	1	1	5	4–5
Otonycteris leucophaea	2	2	7	12
Barbastella caspica	–	4	20	29
Plecotus strelkovi	1	2	13	21
Miniopterus cf. *pallidus*	–	–	1	0–1
Tadarida teniotis	–	1	4	13
total records	26	57	269	416–422
total species	12	17	19	20–21

Zarudnyy), Dmitrij Konstantinovič Glazunov (1869–1913; for details on his travels see under *Nyctalus noctula* below), Aleksandr Nikolaevič Kaznakov (1871–1933), and Boris Alekseevič Fedčenko (1872–1947; for details on his travels see under *Hypsugo savii* below). With the exception of Severcov, who published his findings and descriptions by himself (Sěvercov″ 1873a, b, 1879a, Severtzoff 1876; see also Tihomirov″ & Korčagin″ 1889), the bat specimens collected by the other explorers were only deposited in the museums in Saint-Petersburg or Moscow and later examined and published by Satunin″ (1910) and Bobrinskoj (1925, 1926). This initial period resulted in 18 records of at least nine bat species from the current territory of Tajikistan, although mostly from its northern and eastern parts (including the Pamirs), proper units of the Russian Empire (parts of the Governorate General of Turkestan), while the western and central parts remained within the Emirate of Bukhara, a vassal state of Russia. From this stage of rather unintentional bat collections, the following species are known from the present-day territory of Tajikistan (under current taxonomy): *Rhinolophus hipposideros* s.l., *Myotis davidii*, *Eptesicus serotinus*, *E. gobiensis*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *Nyctalus noctula*, *Otonycteris leucophaea*, and *Plecotus strelkovi*, and perhaps also *Eptesicus ognevi* (for details see under this species below). Interestingly, it is a combination of (currently) very common and very rare species. Among the results of these travels, a description of a new taxon appeared, *Plecotus leucophaeus* Severcov, 1873 [= *Otonycteris leucophaea*], being the first bat species described from Tajikistan.

In the subsequent stage, when the Russian/Soviet rule in West Turkestan became well established, the bats and other mammals of Tajikistan started to be studied more systematically by professional zoologists, viz. Mihail Konstantinovič Laptev (1885–1948), Vladimir Âkovlevič

Lazdin (1887–1916), Nikolaj Alekseevič Bobrinskoj (1890–1964; his surname spelled by himself as Bobrinskij after 1940), Mihail Pavlovič Rozanov (1891–1966), Boris Stepanovič Vinogradov (1891–1958), Roman Nikolaevič Meklenburcev (1905–2002; also spelled as Meklenburtsev), and Aleksandr Petrovič Kuzâkin (1915–1988; also spelled as Kusjakin, Kuzjakin, and Kuzyakin). Nikolaj A. Bobrinskoj, as a first of them, travelled to the Emirate of Bukhara before the WWI in 1914 and collected a series of bats there that brought the first evidence of *Myotis blythii*, *M. emarginatus*, and *Eptesicus ognevi* from the present-day Tajikistan, and the latter bat was first described as a species (Bobrinskoj 1918). Bobrinskoj (1925) published the first comprehensive review of bats of the whole West Turkestan, and from Tajikistan, he mentioned 26 records of twelve species (Table 1). Additional data on bats were gathered by the Tajikistan Complex Expedition carried out in 1932 and several other collection expeditions (Rozanov 1935, Vinogradov 1935, Meklenburcev 1936, Bobrinskoj & Kuzâkin 1937, Laptev 1937, Kornev 1941, L′vova 1945). Important results of this period are the descriptions of *Myotis mystacinus pamirensis* Kuzâkin, 1935 [= *M. davidii*] from the Pamirs and *M. longicaudatus bucharensis* Kuzâkin, 1950 [= *M. bucharensis*] from south-western Tajikistan.

Shortly after the WWII, Oleg Pavlovič Bogdanov (1925–2007) started a complex research of the West Turkestani fauna. He specially focused also on bats and made a series of new records and observations also from Tajikistan (Bogdanov 1952, 1953a, b, 1954, 1956a, b). He summarised the results of his research along with a review of the previous effort in the first detailed overview of distribution and field data on bats of Tajikistan (Bogdanov 1956a) and presented altogether 57 records (species vs. locality) of 17 bat species from the country (Table 1). The following period yielded only a few new bat records from Tajikistan until Tolibdžon Kadyrovič Habilov (*1953; also spelled as Khabilov) became a leading person of the bat research in West Turkestan and namely in northern Tajikistan, he published a series of papers dealing with distribution and biology of bats (e.g., Habilov 1979, 1980, 1982, 1986, 1988, 1990, 1991, 1995, Khabilov 1989a, b, Habilov & Zyrânova 1995). After a decade of intensive work, a comprehensive monograph *Fauna of the Republic of Tajikistan*. *Volume XX*. *Part VII*. *Mammals*. *Bats* (Habilov 1992), reviewing all data on bats available at that time, was published as a basis for Habilov's doctoral thesis (Habilov 1993). This voluminous book summarised most of the data on bats from the country, and besides his own, it included those present in several new distribution papers (Černyšev 1958, Ŝerbin 1968, Medvedev et al. 1984, Malinovskij 1988), in new collection catalogues and reports (Kuzâkin 1934, 1935, Rossolimo & Pavlinov 1979, Baranova et al. 1981, Habilov 1983), and in traditional and new compendia of the Russian/Soviet fauna (Satunin″ 1914, Ognev 1927, 1928, Kuzâkin 1944, 1950, 1965, Bogdanov 1953a, Strelkov 1963). In total, Habilov (1992) summarised 269 records of 19 bat species of Tajikistan (Table 1).

After a certain interruption in the research effort, the most recent stage of bat surveys occurred only in the last decade (ca. 2012–2021). In this period, numerous papers were published by T. K. Habilov and his student Dilbar Èrgašovna Zohidova (née Tadžibaeva), sometimes with other collaborators (Habilov & Tadžibaeva 2013, 2014a, b, 2016a, b, 2018, 2019a, b, 2020a, b, c, 2021a, 2022a, b, 2023, Khabilov & Tadzhibaeva 2013, Tadžibaeva 2015, 2018, Tadžibaeva & Habilov 2016a, b, c, d, 2017a, b, c, 2018, 2019a, b, c, d, e, 2021, Muratov et al. 2017, Habilov et al. 2018, Kazakov et al. 2020). This research mainly revised the bat fauna of known roosts in the northern part of Tajikistan (Suğd Province), but also brought some limited data on bats from localities all over the country. This recent stage of research has not yet been reviewed and represents a part of the data material summarised here.

In this review, we present new records of bats from southern and south-western Tajikistan made during a research trip in May 2016. We consider these records (59 records [species vs. locality] of 16 species) of a certain value as these parts of Tajikistan were traditionally less studied concerning

bats than the northern regions (see Tadžibaeva & Habilov 2019d) and we present them in the context of all known data on the bat distribution in the country. For the complete faunal review, we revised all available literature sources, all the above mentioned, plus collection catalogues and taxonomic reviews related to the distribution data on bats of Tajikistan (Strelkov 1983a, 1986, 1988, Benda & Tsytsulina 2000, Borisenko et al. 2001, Kaškarov & Mitropol′skaâ 2004, Benda et al. 2006, 2011, 2012, 2016a, b, 2022, 2024, Benda & Gaisler 2015, Spitzenberger et al. 2006, Uvizl & Benda 2021a, Uvizl et al. 2024, etc.).

Besides the new records and an updated review of published records of particular bat species, we also revised sources published in the 19th and early 20th centuries presenting records of bats supposedly from Tajikistan (and namely from the Pamirs) with the aim to confirm or reject their real or alleged Tajikistani geographical origin. Since the phylogenetic relations of the Tajikistani bat populations have not yet been evaluated properly, we review the knowledge of the taxonomic opinions concerning particular species and also the taxonomic and nomenclatural details on the names originating in Tajikistan as well as Turkestan. For the first time, we gathered and studied data on echolocation calls of the Tajikistani bats and our results are included. Since we collected also bat parasites, we present and comment the data on the ectoparasites of bats in Tajikistan, both new records and from published reports. As a whole, we present a revised and as complete as possible review of the distribution, taxonomy, echolocation, and ectoparasites of bats of Tajikistan. A part of this review is also a description of a new bat species from West Turkestan.

MATERIAL AND METHODS

Distribution

The lists of records (arranged in chronological order, in the published data according to the year of publication) include, for each item, the following information: name of the locality (each record is primarily listed by the name of the nearest settlement or notable physical feature) in its original form, transliterated to the Latin script from the Tajik cyrillic script (according to the system in Table 2), the currently used name of the locality (in case it differs from the original) is placed in square brackets, in the Latin script transliterated from the Tajik cyrillic; in brackets, serial number of the locality is given as indicated in the map; description of the record site, date, number of recorded bats with indication of their sex, age, and physiological condition (for details see Abbreviations below), and a reference to a museum collection, are added. The published distribution data available until the end of 2022 are mentioned.

In the plain text, the toponyms are mentioned in their current versions and spellings (transliterated to Latin), exceptions are the names of large cities (e.g., Moscow, Saint-Petersburg) or mountains (e.g., Tien-Shan, Pamirs, Urals). The orographical division of West Turkestan follows that by Merzlyakova (2002).

The newly collected specimens from the 2016 trip are currently deposited in the collection of the National Museum, Prague (NMP); however, approximately a half of the specimens will be transferred to the collection of the Huçand State University (HSU). The specimens that are currently a proper part of the NMP collection bear the five-numeral collection ID numbers, the specimens that are not a part of the collection bear the field numbers (a four-numeral number with the prefix pb-); after the transfer to the HSU collection they will receive their proper collection ID numbers.

Sound recordings and analysis

Acoustic recordings were made in the field using a portable ultrasound detector D-240x (Pettersson Elektronik AB, Uppsala, Sweden) set on the time-expansion mode connected to Edirol R-09HR recorder (Roland Corporation, Los Angeles, USA). The analysed bat calls were recorded in three situations, (1) bats in their roosts, (2) free flying and foraging bats under natural conditions, and (3) handled individuals netted or caught in their roosts. The recordings were analysed with the Bat Explorer 2.1.9.1 software (Elekon AG, Switzerland). Time-expanded sequences (expansion factor 10) were digitised at the sampling rate 48 kHz with 16-bit precision and saved as *wav files; oscillograms, power spectra, and spectrograms were evaluated.

For each echolocation call pulse, the following parameters were measured (see Table 5): pulse duration (D), start frequency (SF), end frequency (EF), frequency of maximum energy (peak frequency, PF), and inter-pulse interval (IPI, the time between two consecutive pulses). In most cases, we used only high quality recordings for the analyses.

In total, we analysed 61 call sequences (753 pulses) of at least 13 bat species (Table 5). Most figures of spectrograms of echolocation sequences in the text serve as an illustration of real field conditions, and, hence, they show real time of particular recordings on the time axes.

Table 2. Conversion table for transliteration of the Tajik, Kirghiz, and Russian Cyrillic scripts to the Latin script (ordered according to the Latin alphabet)

Cyrillic	Latin	Cyrillic	Latin	Cyrillic	Latin	Cyrillic	Latin
А, а …	A, a	Ф, ф …	F, f	Л, л …	L, l	Щ, щ …	Ŝ, ŝ
Я, я …	Â, â	Ө, ө	Ḟ, ḟ	М, м …	M, m	Т, т …	T, t
Б, б …	B, b	Г, г …	G, g	Н, н …	N, n	У, у …	U, u
Ц, ц …	C, c	Ғ, ғ …	Ǧ, ǧ	Ң, ң …	Ṇ, ṇ	Ӯ, ӯ …	Ū, ū
Ч, ч …	Č, č	Х, х …	H, h	О, о …	O, o	Ю, ю …	Û, û
Ҷ, ҷ …	Ç, ç	Ҳ, ҳ …	Ḥ, ḥ	Ө, ө …	Ö, ö	В, в …	V, v
Д, д …	D, d	И, и …	I, i	П, п …	P, p	Ы, ы …	Y, y
Е, е …	E, e	І, і …	Ì, ì	Қ, қ …	Q, q	З, з …	Z, z
Ё, ё …	Ë, ë	Й, ӣ …	Ī, ī	Р, р …	R, r	Ж, ж …	Ž, ž
Э, э …	È, è	Й, й …	J, j	С, с …	S, s	Ь, ь …	′
Ъ, ъ …	Ĕ, ĕ	К, к …	K, k	Ш, ш …	Š, š	Ъ, ъ …	″

Molecular genetic analysis

The genomic DNA was extracted from alcohol-preserved tissue of the museum specimens using Geneaid Genomic DNA Mini Kit. We targeted the complete mitochondrial gene for cytochrome *b* as it was frequently used in previous studies focused on bats. The genes were amplified with the primers mtDNA-R3-F (TGGCATGAAAAATCACCGTTGT; Puechmaille et al. 2011) and CytB-H (CTTTTCTGGTTTACAAGACCAG; Weyeneth et al. 2008). The PCR amplifications of the complete cytochrome *b* gene were treated as in Uvizl et al. (2024). The PCR products were Sanger-sequenced from both sides using the PCR primers by Macrogen, Inc. (Amsterdam, the Netherlands).

Sequences were edited and aligned using the MAFFT plugin (Katoh & Standley 2013) in Geneious 11.0.5 (https://www.geneious.com). Sequences were translated to amino acids to check for the presence of stop codons, which would indicate pseudogenes have been amplified. The final cytochrome *b* dataset was supplemented with available sequences of related *Rhinolophus* species from GenBank. The GenBank Accession Numbers of the newly defined haplotypes are listed in Appendix 2, along with the GenBank sequences extracted from published studies.

Phylogenetic analyses were run maximum likelihood (ML). The appropriate nucleotide substitution model was selected based on the Bayesian information criterion (BIC) by ModelFinder (Kalyaanamoorthy et al. 2017). We inferred the maximum-likelihood tree using the partition model in IQ-TREE (Nguyen et al. 2015). Searching for the best-scoring ML was performed by ultrafast bootstrap (UFBoot; Hoang et al. 2018) with 1,000 bootstrap and 1,000 topology replicates. To verify robustness of the ML tree, the branch supports were evaluated using SH-like approximate likelihood ratio test (SH-aLRT; Guindon et al. 2010) and a Bayesian-like transformation of aLRT (aBayes; Anisimova et al. 2011). SH-aLRT was performed with 1,000 replications. aBayes branch support was used instead of Bayesian posterior probabilities because aBayes is more conservative, more robust to model violation and moreover exhibits the more confident resolution (Anisimova et al. 2011). The ML, SH-aLRT and aBayes analysis were run on IQtree web server (Trifinopoulos et al. 2016).

Ectoparasite processing

Arthropod ectoparasites were collected directly from the captured bats and preserved in alcohol, all original records were made during the field trip in May 2016 (see above). All specimens were collected by P. Benda, A. Reiter & M. Uhrin, currently they are housed in the Martin Ševčík private collection (Nitra, Slovakia); this information is not repeated in the lists of parasite records below. Parasite specimens of the families Ischnopsyllidae and Nycteribiidae were simply examined using light microscope. Some selected specimens of the families Macronyssidae, Spinturnicidae, and Trombiculidae were examined with the microscope in detail and a selection of specimens was mounted in the 'Liquid de Swan' (Swan 1936) to permanent microscopic slides. The parasites were determined with the help of identification keys; viz. Ischnopsyllidae: Hopkins & Rothschild (1956) and Smit (1960); Nycteribiidae: Aellen (1959b), Theodor (1966, 1967), and Hůrka (1984, 1997); Macronyssidae: Till & Evans (1964), Ah & Radovsky (1967), Radovsky (1967), Stanyukovich (1997), and Orlova & Anisimov (2023); Spinturnicidae: Evans (1968) and Deunff et al. (1990, 1997); Trombiculidae: Kudrâšova (1978).

The lists of ectoparasite records (arranged in taxonomical, alphabetical, and/or chronological orders) include, for each item, the following information: name of the family, species name, number and stage/sex of the specimens recorded/examined, number and sex of hosts, name of the site, date of collection, and collector name. According to these data, the new record is detectable in the Records paragraph, where the circumstances of the host finding are available. Taxonomy and nomenclature of ectoparasites follow: Ischnopsyllidae: Ioff et al. (1946), Ioff et al. (1953), Hopkins & Rothschild (1956), Rybin (1961); Nycteribiidae: Maa (1965, 1975); Ixodidae: Filippova (1977); Argasidae: Mans et al. (2021);

Macronyssidae: Micherdziński (1980) and Orlova et al. (2015a); Spinturnicidae: Rudnick (1960) and Uchikawa et al. (1994); Trombiculidae: Mulârskaâ (1973) and Kudrâšova (1978). The terminology used in Trombiculidae follows Vercammen-Grandjean & Langston (1976), Goff et al. (1982), and Kudrâšova (1998); for dimensions taken in this group see Abbreviations, the dimensions are given in micrometres (μm).

ABBREVIATIONS

Dimensions

External. LC = head and body length; – LCd = tail length; – LAt = forearm length; – LA = auricle length; – LT = tragus length; – LaFE = horseshoe width.

Cranial. LCr = greatest length of skull incl. praemaxillae; – LOc = occipitocanine length of skull; – LCb = condylobasal length of skull; – LCc = condylocanine length of skull; – LaZ = zygomatic width; – LaI = width of interorbital constriction; – LaInf = rostral width between infraorbital foramens; – LaN = neurocranium width; – LaM = mastoidal width of skull; – ANc = neurocranium height; – LBT = largest horizontal length of tympanic bulla; – CC = rostral width between canines (incl.); – M^3M^3 = rostral width between third upper molars (incl.); – CM^3 = length of upper tooth-row between canine and third molar (incl.); – LMd = condylar length of mandible; – ACo = height of coronoid process; – CM_3 = length of lower tooth-row between canine and third molar (incl.).

Ectoparasites. AW = distance between scutal anterolateral setae; – PW = distance between scutal posterolateral setae; – SB = distance between sensilla; – ASB = distance from extreme anterior margin of scutum to the level of sensillary bases; – PSB = distance from extreme posterior margin of scutum to the level of sensillary bases; – SD = length of scutum (ASB+PSB); – AP = distance from anterolateral to posterolateral scutal setae on one side; – AM = length of scutal anteromedian seta; – AL = length of anterolateral scutal setae; – PL = length of posterolateral scutal seta.

Collections

BMNH = Natural History Museum, London, United Kingdom; – CUP = Department of Zoology, Charles University, Prague, Czech Republic; – FMNH = Field Museum of Natural History, Chicago, U. S. A.; – HSU = Huçand State University, Huçand, Tajikistan; – HNHM = Hungarian Natural History Museum, Budapest, Hungary; – IZPAN = E. N. Pavlovskij Institute of Zoology and Parasitology, National Academy of Sciences of Tajikistan, Dušanbe, Tajikistan; – MHNG = Natural History Museum, Geneva, Switzerland; – MZLU = Museum of Zoology and Entomology, Lund University, Sweden; – NMP = National Museum (Natural History), Prague, Czech Republic; – RMNH = Naturalis Biodiversity Center, Leiden, the Netherlands; – SAGU = Mirzo Ulugbek National University of Uzbekistan (formerly Central Asiatic State University), Toshkent, Uzbekistan; – SMF = Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany; – ZIN = Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; – ZMMU = Zoological Museum, Moscow State University, Moscow, Russia.

Other abbreviations

A = alcoholic preparation; – ad = adult individual; – B = dry skin (balg); – G = pregnant; – juv = juvenile individual; – M = mean; – min, max = dimension range margins; – P = mounted (parasite) preparation; – S = skull; – s = subadult individual; – SD = standard deviation; ♂ = male; – ♀ = female.

LIST OF SPECIES

Rhinolophus ferrumequinum (Schreber, 1774)

Records. **Original data**: Lučob [**1**], garden (Fig. 2), 3 May 2016: det. & obs. one foraging ind.; – Sariselom valley, at the Kalpisipar cave [**2**], 10 May 2016: det. & rec. calls of 1 foraging ind.; – Širg [**3**], in a small mine, 13 May 2016: coll. 1 ♂ (NMP 95743 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021); – Qarağoč [**4**], inside of a loess cavity, 15 May 2016: net. 2 ♂♂ (NMP 95744, HSU pb6218 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021), det. & rec. calls of several active inds.; – Kalkot [**5**], Ar Arak cave, 17 May 2016: obs. 1 roosting ind. (cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of 1 active ind.; Kalkot, near small lake under the Ar Arak cave, 17 May 2016: det. & rec. calls of 1 foraging ind.; – Magov [**6**], mine, 18 May 2016: obs. 23 roosting inds. (torpid; Fig. 14), coll. 4 ♂♂, 1 ♀♀ (NMP 95758–95760, HSU pb6242, 6243 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021), det. & rec. calls of several active inds.; Magov, garden, 18 May 2016: net. 1 ♂ (Fig. 15; HSU pb6262 [S+A]; cf. Habilov & Tadžibaeva 2016b). – **Published data**: Stalinabad [= Dušanbe] [**7**], 1932: 1 ind., leg. Parasitological Section of the Tajikistan Complex Expedition (Vinogradov 1935); near Stalinabad [= Dušanbe], in the Dûšambinka [= Varzob] river bank, loess cave, July–August 1935: 1 ind., leg. A. P. Kuzâkin, 23 March 1954: coll. 2 ♂♂, 3 ♀♀ (Bogdanov 1956a); – near Gulistan [= Guliston] kishlak [**8**], 8 km of Stalinabad [= Dušanbe], deep loess cave, 29 March 1953: coll. 3 ♂♂, 2 ♀♀, cave, 23 March 1954: exam. 2 ♂♂, 3 ♀♀

(Bogdanov 1954, 1956a); – Vahš river valley [**9**], Tygrovaâ balka [= Bešai Palangon] Reserve, Central′nyj forestry, summer 1951: 2 inds. (Bogdanov 1956a), 1950: obs. ind./s. (Černyšev 1958); – Mindona [= Mingdona] kishlak [**10**], cave, 4 December 1953: coll. 1 ♂, 4 ♀♀ (Bogdanov 1956a, b); southern slope of the Turkestanskij [= Turkiston] Mountains, Mindona [= Mingdona] kishlak, 15 February 1979: exam. 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – right bank of the Zeravšan [= Zarafšon] river, 5–6 km upstream of Pendžikent [= Pançakent] [**11**], mines, 3 December 1953: 2 ♂♂, 1 ♀ (Bogdanov 1956a, b); northern promontory of the Zeravšan [= Zarafšon] Mountains, 3 September 1953: 1 ind. (Filippova 1972); – Staraâ Pristan′ [= Bandari Kūḫna] [**12**], 12 km south of Džilikul′, attic of a living house, obs. ind./s. (Černyšev 1958); near Staraâ Pristan′ [= Bandari Kūḫna] (Tigrovaâ balka [= Bešai Palangon] Reserve), ruined sarai, 9 May 1965: obs. 1 ind., 26 May 1965: obs. 1 ind. (Ŝerbin 1968); – Ovgard [= Obgard] [**13**], Darvazskij [= Darvoz] Mountains, a narrow cave on the Pândž [= Panç] river bank, 22 February 1963: obs. a colony of ca. 30 inds., incl. 21 ♂♂, 3 ♀♀ (Ŝerbin 1968); Ovgard [= Obgard] kishlak, 9 April 1967: coll. 1 ♀, leg. Š. H. Muratov, 22 February 1963: coll. 9 ♂♂, 1 ♀, IZPAN, leg. Û. V. Ŝerbin (Habilov 1986); – near Dangara [= Danğara] [**14**], small cave, 26 October 1963: coll. 1 ♀ (Ŝerbin 1968); near Dangara [= Danğara], Guli-Zindan [= Gulizindon], 26 October 1963: coll. 1 ♀, IZPAN, leg. Û. V. Ŝerbin (Habilov 1992); – Hodža-Beh-Ob [**15**] (Ak-Tau [= Aktau] Mountains), ca. 1900 m a. s. l., 15 August 1964: shot 3 ♀♀, small cave, 16 August 1964: coll. 2 ♂♂ (Ŝerbin 1968); – Gul′bista [= Kulpista] [**16**] (near Dušanbe), small cave, 27 September 1966: coll. 9 ♀♀ (Ŝerbin 1968); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**17**], abandoned mine, 16/17 December 1978: coll. 2 ♀♀, 23 December 1978: obs. a colony of ca. 1000 / 600–650+380 inds. of *R. ferrumequinum* and *R. bocharicus*, exam. 16 / 28 ♂♂, 17 / 36 / 27 ♀♀ (Habilov 1979, 1988, 1992, Tadžibaeva & Habilov 2016c, 2017b, 2018), 4 December 1977: coll. 2 ♀♀ (Habilov 1980, 1992, Tadžibaeva & Habilov 2018), 1550 m a. s. l., 21 February 1986: obs. ca. 415 inds. of *R. ferrumequinum* and *R. bocharicus*, exam. 1 ♀ (Habilov 1988), 14 March 1981: exam. 2 ♀♀ (Habilov 1992), juniper tree zone, 1590 m a. s. l., abandoned mine, 5 February 2016: obs. 107 / 110 inds., incl. 3 ♂♂, 10 / 12 ♀♀ (Tadžibaeva & Habilov 2016b, 2018), mine, 1550 m a. s. l., 15 February 1980: obs. a colony of 1200–1300 inds. of *R. ferrumequinum* and *R. bocharicus*, Poj-bulok, mine, 1240 m a. s. l., 7 January 2016: obs. a colony of 650–700 inds. of *R. ferrumequinum* and *R. bocharicus* in a ratio of 1:2 (Tadžibaeva & Habilov 2016c, 2017b), Poj-bulok, mine, 1240 m a. s. l., 4 February 2016: obs. ca. 500 inds. of *R. ferrumequinum* and *R. bocharicus*, 25 February 2016: obs. 210 inds. of *R. ferrumequinum* and *R. bocharicus*, mine, 1280 m a. s. l., 18 December 2015: obs. 20 inds., 4 February 2016: obs. 3 inds., mine, 1280 m a. s. l., 4 February 2016: obs. 7 inds. (Tadžibaeva & Habilov 2017b, 2018), mine, 1300 m a. s. l., 26 February 2016: exam. 2 ♂♂ (Habilov & Tadžibaeva 2018, Tadžibaeva & Habilov 2018), mine,

Fig. 2. A view of the Ḥisor Mountains from the south, across a garden in Lučob, northern outskirts of Dušanbe; a site where foraging of *Rhinolophus ferrumequinum* was detected. Photo by M. Uhrin (3 May 2016).

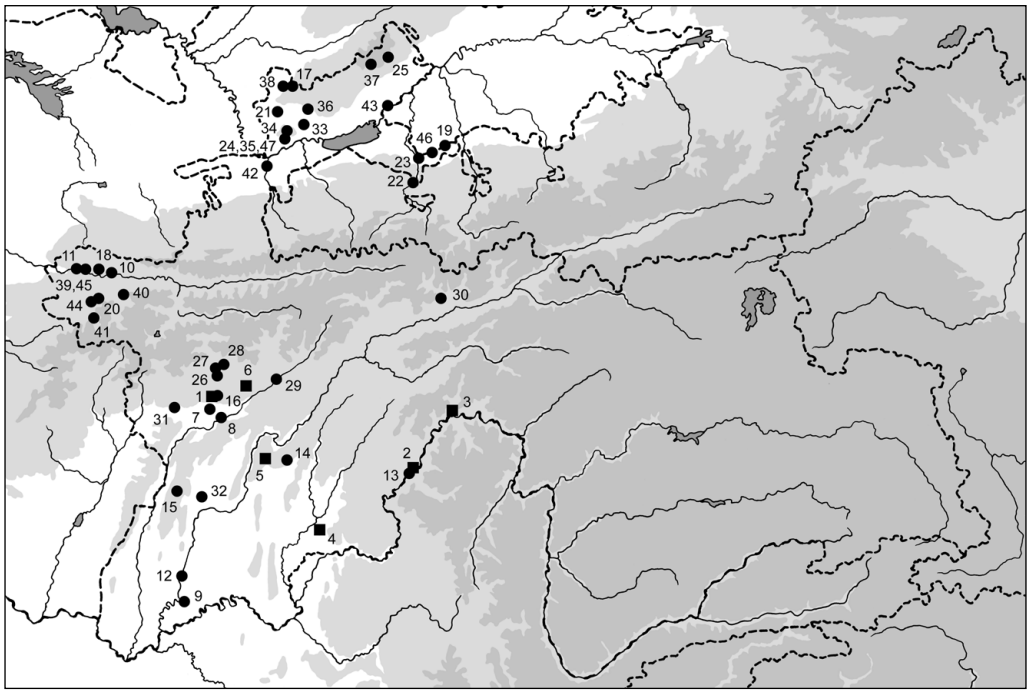


Fig. 3. Records of *Rhinolophus ferrumequinum* (Schreber, 1774) in Tajikistan; squares – new records, circles – published records.

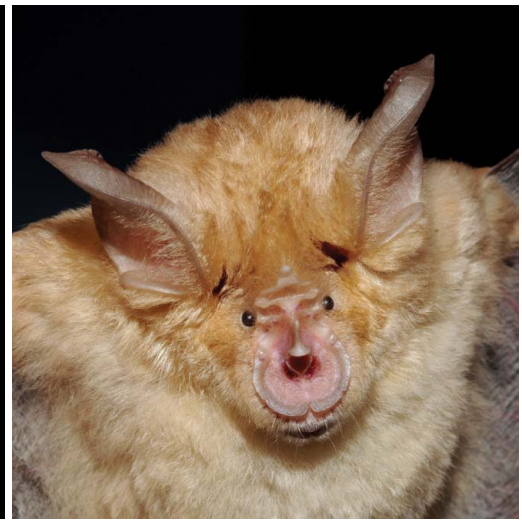
1550 m a. s. l., 30 March 1980: obs. a colony of 254 inds. of *R. ferrumequinum* and *R. bocharicus*, 13 April 1980: exam. 1 ♀ (Tadžibaeva & Habilov 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, near Jory [= Ërī] [**18**], ca. 1600 m a. s. l., cave on a mount peak, 11 January 1976: coll. 1 ♂, 3 ♀♀ (Habilov 1980, 1992, Tadžibaeva & Habilov 2017a); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Dahana [**19**], Guzlon Range, Isfara district, abandoned mine 4, 2 January 1976: coll. 1 ♀, 25 January 1976: obs. 5 inds., coll. 1 ♂ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), 11 November 1978: exam. 1 ♀ / 2 ♀♀, 5 January 1986: exam. 1 ♀, 22 February 1986: exam. 1 ♀ (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 12 April 2012: obs. 1 ind., 21 April 2013: obs. 1 ind., 17 May 2013: obs. 2 inds., 9 September 2013: obs. 10 inds., incl. 2 ♀♀, 24 January 2014: obs. 2 inds., incl. 1 ♀, 23 March 2014: obs. 4 inds., incl. 1 ♀, 23 August 2014: obs. 2 inds., 10 October 2014: exam. 2 ♂♂, 14 February 2015: exam. 1 ♂, 8 April 2016: obs. 4 inds., incl. 2 ♂♂, 1 ♀, 22 June 2017: obs. 1 ind., mine 6, 6 July 2012: obs. 1 ind., 2 November 2014: obs. 2 inds. (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), 14 September 2017: obs. 6 inds., 10 March 2019: exam. 1 ♂, 1 ♀, 30 March 2019: obs. 11 inds., incl. 9 ♀♀, 28 March 2020: obs. 4 inds. (Habilov & Tadžibaeva 2020a), mine 4, 26 February 2022: exam. 2 ♂♂ (Habilov & Tadžibaeva 2022c); – northern slope of the Zeravšanskij [= Zarafšon] Mountains, near Rovadin kishlak [**20**], abandoned mine, 30 April 1977: exam. 5 ♂♂, 2–3 May 1977: obs. 5 ♂♂, coll. 1 ♂ (Habilov 1980, 1992); – Kuraminskij [= Kurama] Mountains, near Takeli [**21**], abandoned mine, 19 November 1977: coll. 1 ♀ (Habilov 1980, 1992); – northern slope of the Turkestanskij [= Turkiston] Mountains, near Čorku [= Čorkuḥ] [**22**], Hučai-Gor cave, 14 / 16 January 1978: exam. 22 ♂♂, 5 ♀♀ (Habilov 1980, 1992, Tadžibaeva 2018), 26 March 1978: exam. 4 ♂♂, 9 June 1978: exam. 2 ♀♀ (Habilov 1992, Tadžibaeva 2018); Čarku / Čorku [= Čorkuḥ], mine, 3 July 1988: 1 ♂, NMP, leg. J. Červený, A. Červená & J. Obuch (Benda et al. 2011, 2012, Benda 2021); – 11 km north-east of Isfara [**23**], abandoned mine, 1 ♀ (Habilov 1980); at the Isfara waste dump, 18 December 1977: exam. 1 ♀, 20 November 1979: exam. 1 ♂, 1 ♀ (Habilov 1992, Tadžibaeva 2018); – Mogol-Tau [= Mogoltau] Mts., Uč Tepa [= Učteppa] [**24**], 6 June 1979: 1 ind., 18 November 1979: 1 ind. (Hůrka 1984); Mogol-Tau [= Mogoltau] Mountains, near Uč-Teppa [= Učteppa] kishlak, small mine, 26 June 1978: exam. 1 ♂, 24 ♀♀, 27 May 1979: obs. 800–1000 inds., exam. 3 ♂♂, 3 ♀♀, 6 June 1979: exam. 1 ♂, 24 ♀♀, 18 October 1979: obs. 50 inds., incl. 8 ♂♂,

4 ♀♀, two mines, 22 May 1980: obs. 25 inds., incl. 3 / 2 ♂♂, + obs. a colony of 800–1000 inds., 6 September 1980: obs. 9 inds., incl. 1 ♂, 27 August 1982: obs. 5 inds., incl. 2 ♂♂, 2 ♀♀, 23 May 1983: exam. 2 ♀♀, 27 June 1984: exam. 1 ♂, 17 April 1985: exam. 1 ♂, 1 July 1986: exam. 3 ♂♂ (Habilov 1992, 2003, Tadžibaeva & Habilov 2019a), 625 September 2015: obs. 8 inds., incl. 1 ♂, 1 ♀, 1 April 2017: obs. 17 inds., incl. 1 ♂, 2 ♀♀, 4 September 2017: obs. 10 inds., 21 April 2018: obs.3 inds., incl. 1 ♀, 25 March 2019: obs. 4 inds., incl. 2 ♀♀, 26 May 2019: obs. 1 ind. (Tadžibaeva & Habilov 2019a); – Kuraminskij khrebet [= Kurama] Mts., Gudos [**25**], 13 April 1980: 1 ind. (Hůrka 1984); Kuraminskij [= Kurama] Mountains, Gudos, 3 March 1979: exam. 1 ♀, 31 May 1979: exam. 4 ♂♂, 18 ♀♀, 1 June 1979: exam. 2 ♂♂, 13 April 1980: exam. 1 ♀ (Habilov 1992), mine, 19 February 2016: exam. 2 ♀♀, mine 2, 19 February 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2018); – Varzob river valley [**26**] (Malinovskij 1988); Varzob, 1984–1986: coll. 5 ♂♂, 11 ♀♀, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Kondara river valley [**27**] (Malinovskij 1988); Kondara, 1984–1986: coll. 4 ♂♂, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Takob [= Tagob] river valley [**28**] (Malinovskij 1988); Takob [= Tagob], 1984–1986: coll. 10 ♂♂, 2 ♀♀, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Sardaimiĕna river valley [**29**] (Malinovskij 1988); Romit, 1984–1986: coll. 12 ♂♂, 12 ♀♀, leg. K. Malinovskij, 6 April 1989: exam. 6 ♂♂, 9 ♀♀, 1 ind. (Habilov 1992, Tadžibaeva & Habilov 2019b); – Ossiobdara [= Osëbdara] river valley [**30**] (Malinovskij 1988); – near Nadžibolo [= Nodž] [**31**], loess cave, 31 May 1986: coll. 1 ♀, 1 ind. juv (Malinovskij 1988); – Kujbyševsk [= Abduraḥmoni Çomī] district, south of Uâly [= Uâli] [**32**], 21 August 1960: coll. 1 ♂, IZPAN, leg. Û. V. Šerbin (Habilov 1992); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**33**], mine, 5 April 1978: exam. 1 ♀, 3 March 1985: exam. 1 ♀, 1 November 1986: obs. 2 inds., 30 September 1987: exam. 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2019a), 4 March 2012: obs. 2 inds., 23 November 2012: obs. 12 inds., 15 April 2013: obs. 6 inds., 24 November 2013: obs. 14 inds., 21 April 2018: obs. 4 inds., incl. 1 ♂ (Tadžibaeva & Habilov 2019a); – Mogol-Tau [= Mogoltau] Mountains, Beškatan canyon [**34**], 25 May 1978: exam. 1 ♂, 1 ♀ (Habilov 1992); – Mogol-Tau [= Mogoltau] Mountains, 3 km north of Uč-Bog [= Boği bolo] kishlak [**35**], mine, 15 November 1978: exam. 14 / 15 ♂♂, 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2019a), 12 April 2010: exam. 1 ♂, 19 April 2012: obs. 2 inds. (Tadžibaeva & Habilov 2019a); – Kuraminskij [= Kurama] Mountains, near Kansaj [**36**], 19 July 1977: exam. 1 ♂, 9 November 1977: exam. 1 ♂, 7 April 1978: exam. 2 ♂♂, 7 May 1978: exam. 2 ♂♂, 15 December 1978: exam. 4 ♀♀ (Habilov 1992), Kansaj (Oktoš), 2 October 2016: obs. 3 inds., incl. 2 ♀♀ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, near Pangaz [**37**], 7 December 1980: exam. 2 ♂♂ (Habilov 1992), 14 March 1981: exam. 2 ♀♀, 21 February 1986: exam. 1 ♀, mine 1, 19 October 2015: exam. 1 ♀, mine 3, 19 October 2015: exam. 1 ♀ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, near Čol-Ata [= Čolota] [**38**], 13 May 1983: exam. 2 ♂♂ (Habilov 1992); – southern slope of the Turkestanskij [= Turkiston] Mountains, near Majkata [= Majkatta]

Fig. 4. The Obihumbou river valley at Širg, north of Qal″ai Humb, Darvoz Mountains; an area of occurrence of *Rhinolophus ferrumequinum*, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, and *P. kuhlii* was documented in May 2016. Photo by M. Uhrin (13 May 2016).

Figs. 5, 6. The entrance to and the interior of a small mine at Širg, north of Qal″ai Humb, Darvoz Mountains, a roosting site of *Rhinolophus ferrumequinum*. Photos by A. Reiter & M. Uhrin (13 May 2016).

kishlak [**39**], 15 February 1979: exam. 1 ♂, 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a), cave, 9 December 1978: obs. 13 inds. of *R. ferrumequinum* and *R. bocharicus*, 10 October 2009: obs. 1 ind. (Tadžibaeva & Habilov 2017a); – northern slope of the Zeravšanskij [= Zarafšon] Mountains, Pančrud [= Pançrud] [**40**], 21 August 1977: exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2017a); – northern slope of the Zeravšanskij [= Zarafšon] Mountains, Šingdar [= Šing river] [**41**] near Rudaksaj [= Padrud], 12 February 1979: obs. a colony of ca. 200 inds., incl. 1 / 7 ♂♂, 10 / 15 ♀♀, 29 February 1980: exam. 1 ♂, 6 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – near Nau [= Nov] (Tagoâk [= Tağoâk] kishlak) [**42**], 25 July 1980: exam. 6 ♂♂, 7 ♀♀ (Habilov 1992); – right bank of the Syrdar′â [= Sirdarë] river, Mahou-Tau [= Mahoutau] Mountains, near Kok-Kurak [= Kokkurak] [**43**] (Habilov 1992); – Zeravšanskij [= Zarafšon]



Figs. 7, 8. Portraits of *Rhinolophus ferrumequinum* (Schreber, 1774) from Širg. Photos by A. Reiter

Fig. 9. An adult male of *Rhinolophus ferrumequinum* (Schreber, 1774) roosting in a small mine at Širg, Darvoz Mountains (Figs. 5–8). Photo by A. Reiter (13 May 2016).

Mountains, near Šing [**44**] (Habilov 1992); above Šing kishlak, Šing river valley, northern slope of the Zeravšanskij [= Zarafšon] Mountains, Dahoniob / Dahoni ob mine, 16 October 2015: obs. 12 / 4 inds., 2 February 2016: obs. 44 inds. of *R. ferrumequinum* and *R. bocharicus*, leg. R. Oblokulov (Habilov & Tadžibaeva 2016a, 2018, 2020b), mine, 29 February 1980: exam. 1 ♂, 6 ♀♀, abandoned building of the Taror gold mine, 16 October 2015: obs. 14 inds., three mines, 16 October 2015: exam. 1 ♂, 2 ♀♀, obs. 12 inds., Dahani ob mine, 30 January 2016: obs. 8 inds., leg. R. Oblokulov (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2020b), abandoned building of the Taror gold mine, 22 September 2016: obs. 30 inds., incl. 4 juvs., Dahani ob mine, 22 September 2016: exam. 1 ♂, 1 ♀, abandoned building of the Taror mine, 26 May 2017: obs. inds. (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018, 2020b), Dahoni ob mine, 26 May 2017: exam. 1 ♂, 1 ♀, 5 October 2019: exam. 15 ♂♂, 3 ♀♀, 13 January 2020: os. 29 inds., incl. 1 ♂, 1 ♀, 3 October 2020: obs. 4 inds., incl. 1 ♂, 1 ♀ (Habilov & Tadžibaeva 2020b); – between Amondara and Majkata [= Majkatta] [**45**], mine, summer period, obs. a colony of ca. 500 inds. of *R. ferrumequinum* and *R. bocharicus* (Habilov 2003, Tadžibaeva & Habilov 2017a); – near Kul′kent [= Kūlkand] [**46**], Guzlon Range, mine 2, 21 June 2017: obs. 1 ind., mine 2 / 4, 22 June 2017: obs. 1 ind. (Tadžibaeva & Habilov 2017c, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine 5, 20 February 2015: obs. 2 inds. (Tadžibaeva 2018, Habilov & Tadžibaeva 2020c); – Kuraminskij [= Kurama] Mountains, near Obi-Ašt [= Obiašt] [**47**], mine, 18 October 2015: exam. 1 ♀ (Tadžibaeva & Habilov 2018).

Distribution. *Rhinolophus ferrumequinum* is distributed broadly in the south-western Palaearctic (Burgin 2019a, Uvizl et al. 2024); in Asia it occurs in the Mediterranean zone of the Middle East, in Transcaucasia, West Turkestan, and the Himalayas (Benda & Gaisler 2015, Uvizl et al. 2024). It belongs to the most common bat species in the southern and eastern regions of West Turkestan (Bobrinskoj 1925, Ognev 1928, Kuzâkin 1950, 1965, Bogdanov 1953a, 1968, Strelkov et al. 1978,

Table 3. Altitudinal distribution of particular bat species in Tajikistan (all records)

species	n	mean	median	min	max	range
Rhinolophus ferrumequinum	47	1112.6	1143.0	330	2250	1920
Rhinolophus bocharicus	29	1035.0	972.0	340	1935	1595
Rhinolophus sp.	25	1222.0	1197.0	405	2604	2199
Rhinolophus kirghisorum sp. nov.	5	1249.2	1300.0	781	1587	806
Rhinolophus hipposideros	6	1470.0	1282.5	816	2604	1788
Myotis blythii	42	1106.7	1036.0	405	2302	1897
Myotis emarginatus	17	965.2	948.0	340	1917	1577
Myotis davidii	24	1487.2	1331.5	330	3723	3393
Myotis bucharensis	2	852.0	852.0	323	1381	1058
Vespertilio murinus	14	790.2	713.0	332	1853	1521
Eptesicus serotinus	26	767.1	757.5	323	1691	1368
Eptesicus ognevi	18	821.8	800.5	323	1895	1577
Eptesicus gobiensis	2	2957.5	2957.5	2192	3723	1531
Hypsugo savii	18	1187.5	992.5	405	3723	3318
Pipistrellus pipistrellus	61	828.2	734.0	323	2279	1956
Pipistrellus kuhlii	4	1045.5	876.5	738	1691	953
Nyctalus noctula	5	836.2	995.0	336	1416	1080
Otonycteris leucophaea	12	924.7	751.5	323	2103	1780
Barbastella caspica	29	1250.3	1189.0	407	2250	1843
Plecotus strelkovi	21	1316.2	1252.0	341	2212	1871
Tadarida teniotis	13	1004.0	897.0	330	2096	1766
all sites	157	1108.2	1037.0	323	3723	3400

Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). The Tajikistani occurrence area of *R. ferrumequinum* represents the south-easternmost part of the distribution range of this bat in West Turkestan and a part of the range margin in Palaearctic Asia. This range margin continues from south-western Tajikistan southwards to north-western Afghanistan (Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan and south-eastern Kazakhstan, where the northern limits of the species distribution in Asia are found (Butovskij et al. 1985, Rybin et al. 1989).

Our new records contribute only slightly to detailed depiction of the eastern margin of the species range in Central Asia (Fig. 3); the male collected from a small mine at Širg in the Darvoz Mountains (north of Qal″ai Humb; Figs. 4–9) represents the easternmost record of *R. ferrumequinum* in the Amudarë Basin (70°48'E), although the new prolongation of the range is just 55 km of aerial distance to the north-east from Obgard (and 71 km along the Panç and Obihumbou rivers), the closest site previously known to create the easternmost range limit (Fig. 3; Ŝerbin 1968, Habilov 1986).

In Tajikistan, *R. ferrumequinum* ranks among very common bats (Fig. 3), at least 47 record sites are known, spread across the low to medium altitudes of the western section of the country. The available records come from a rather wide altitudinal range (1920 m); however, some three quarters of the records were made at the sites below 1350 m a. s. l., i.e. in rather low areas of Tajikistan (Fig. 10, Table 3). Our records come from a much smaller range of 704 m, however, the distribution of these record sites remains very similar (median 1260.5 m vs. 1143.0 m; see Fig. 11, Table 4).

Echolocation. Echolocation calls of *Rhinolophus ferrumequinum* were recorded at five sites during our research in Tajikistan, all sites but one were associated with roosts of this bat (three caves, one mine; see Records), at one site a foraging bat was detected above a small water body.

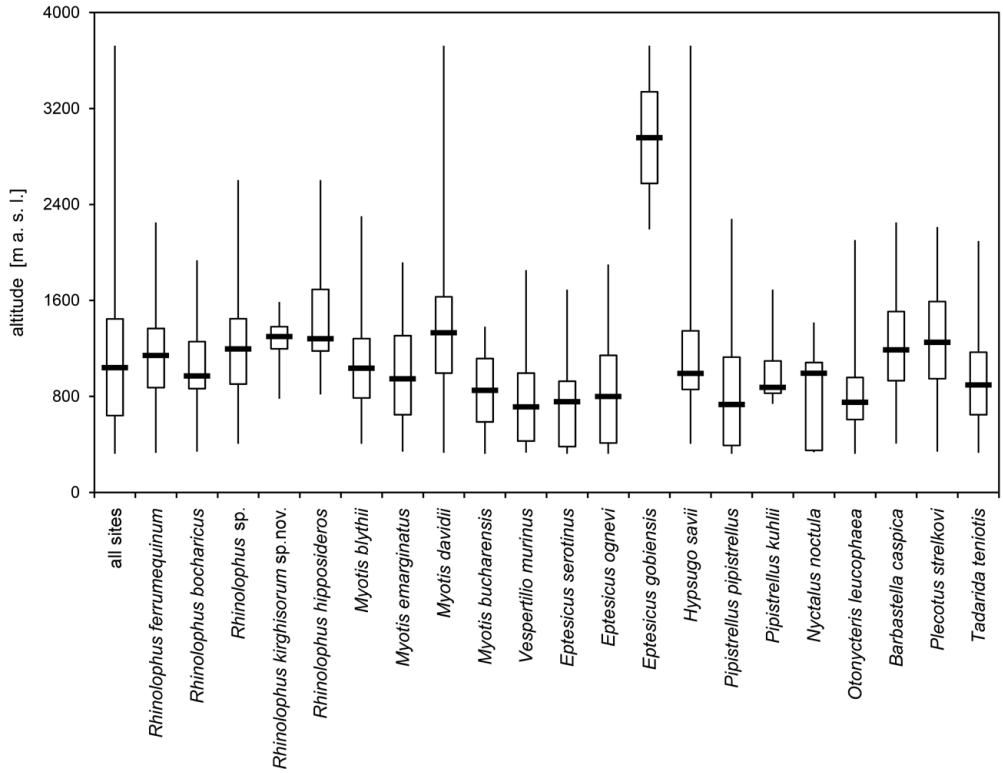


Fig. 10. Altitudinal distribution of particular bat species in Tajikistan (all records); boxes = ranges of the first and third quartiles, vertical lines = ranges of minimum and maximum values, horizontal bold lines = medians.

Table 4. Altitudinal distribution of particular bat species in Tajikistan (new records only)

species	n	mean	median	min	max	range
Rhinolophus ferrumequinum	6	1229.0	1260.5	883	1587	704
Rhinolophus bocharicus	5	796.8	897.0	340	1168	828
Rhinolophus kirghisorum sp. nov.	1		1587.0			
Rhinolophus hipposideros	1		1265.0			
Myotis blythii	7	1204.3	1168.0	647	1917	1270
Myotis emarginatus	5	1028.4	856.0	340	1917	1577
Myotis davidii	2	1363.5	1363.5	1282	1445	163
Vespertilio murinus	1		856.0			
Eptesicus serotinus	4	883.5	751.5	340	1691	1351
Eptesicus ognevi	2	1089.5	1089.5	897	1282	385
Hypsugo savii	3	1066.0	897.0	856	1445	589
Pipistrellus pipistrellus	9	900.2	856.0	330	1691	1361
Pipistrellus kuhlii	3	1148.0	897.0	856	1691	835
Otonycteris leucophaea	2	772.0	772.0	647	897	250
Barbastella caspica	2	914.5	914.5	897	932	35
Tadarida teniotis	6	706.3	751.5	330	1168	838
all sites	19	1133.5	1260.0	330	1917	1587

Altogether, we analysed five call sequences containing 45 particular pulses. The obtained data (Table 5) roughly conform with those available from the Middle Eastern parts of the species distribution range (Shalmon et al. 1993, Benda et al. 2010a, 2012, Smirnov et al. 2022a). The peak frequencies recorded there (range 78.5–85.0 kHz) are of similar values as those recorded in Tajikistan (81.4–83.3 kHz; Figs. 12, 13). On the other hand, the peak frequencies of the calls of *R. ferrumequinum* recorded in Tajikistan lie on average slightly above the values available from the European populations of this bat (range 76.3–83.8 kHz; Heller & von Helversen 1989, Jones & Rayner 1989, Russo & Jones 2002, Obrist et al. 2004, Papadatou et al. 2008, Benda et al. 2009, our own data).

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Rhinolophus ferrumequinum* are shown in Table 6. For the material examined see above.

Three subspecies names appeared during history concerning the taxonomic affiliation of *R. ferrumequinum* populations from Tajikistan and closely adjacent areas of West Turkestan and Afghanistan, viz. *R. f. ferrumequinum* (Schreber, 1774) (Bobrinskoj 1925, Ognev 1927, Ogneff & Heptner 1928, Meklenburcev 1935, 1937); *R. f. proximus* Andersen, 1905 (Ognev 1928, Kuzâkin

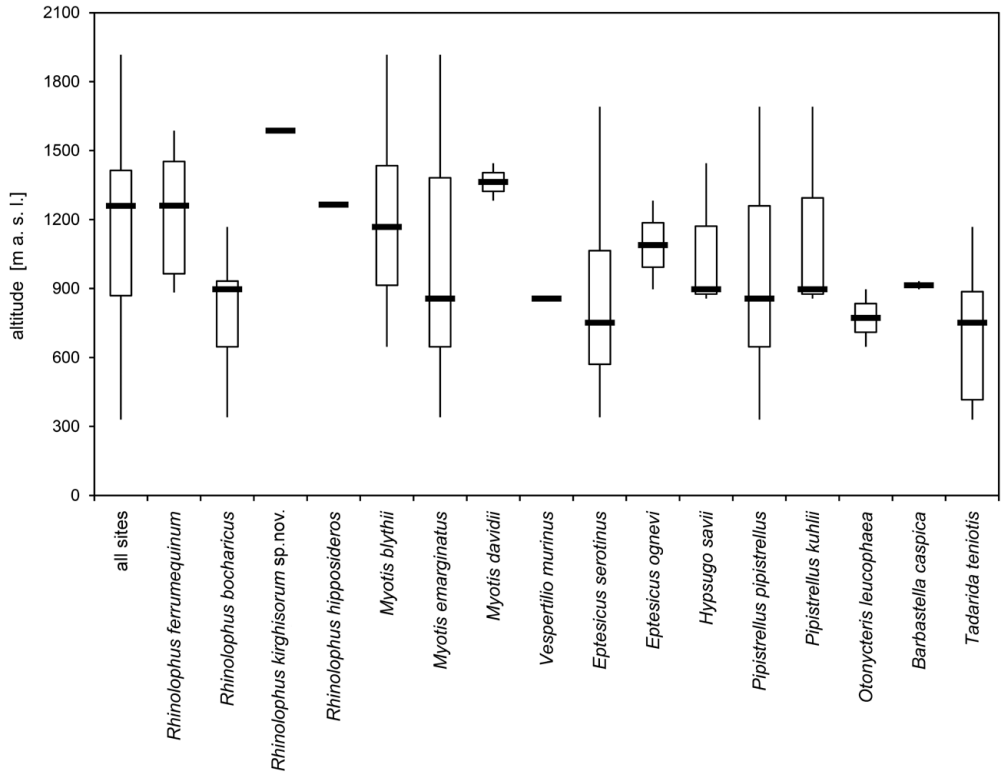


Fig. 11. Altitudinal distribution of particular bat species in Tajikistan (new records only); for explanations see Fig. 10.

Table 5. Descriptive parameters of the echolocation calls of bats from Tajikistan and calls of *Rhinolophus kirghisorum* sp. nov. from Kirghizstan. Explanations: n – number of analysed call sequences and/or particular call pulses: calls (sequences); D – pulse duration; SF – start frequency; EF – end frequency; PF – frequency of maximum energy (peak frequency); IPI – interpulse interval; upper lines – mean±SD; lower lines – range; conditions: F – calls of foraging bats, H – calls of handled bats, R – calls of bats in a roost, ER – calls of bats emerging from a roost

species	conditions	n	D ms	SF kHz	EF kHz	PF kHz	IPI kHz
Rhinolophus ferrumequinum	F	45 (5)	43.5±11.0 17.5–61.4	78.2±3.7 68.3–83.3	78.9±4.3 66.5–82.8	82.6±0.8 81.4–83.3	81.7±20.1 23.0–119.0
Rhinolophus bocharicus	all	135 (9)	43.9±12.8 17.5–73.0	93.1±4.1 85.2–102.5	89.0±5.3 80.0–102.0	101.2±1.0 97.8–103.4	88.3±53.6 25.0–355.0
	H	69 (4)	36.2±9.9 17.5–55.0	94.6±5.1 85.2–102.5	86.9±5.1 80.0–101.6	101.3±1.3 97.8–103.4	92.9±43.3 25.0–355.0
	R	54 (4)	53.1±10.7 31.7–73.0	91.6±3.7 87.0–102.0	91.3±4.2 84.2–102.0	102.0±0.8 99.7–102.7	105.0±24.1 40.0–172.0
	F	12(1)	48.2±3.0 18.3--55.0	90.7±2.9 88.5–97.3	90.7±6.0 82.8–98.5	98.0±0.4 97.8–98.7	75.4±8.5 57.0–89.0
Rhinolophus kirghisorum sp. nov.							
	R (Tajikistan)	21 (3)	21.9±5.5 13.7–34.7	93.1±4.0 88.5–100.2	84.2±4.5 79.6–99.7	99.8±0.5 99.2–100.2	102.3±24.3 42.0–153.0
	ER (Kirghizstan)	31 (3)	37.0±10.2 13.8–51.8	97.6±4.1 90.0–103.4	96.9±6.1 86.9–103.7	101.3±1.5 98.2–103.7	83.9±16.6 33.0–109.0
Rhinolophus hipposideros	F	20 (3)	36.5±12.2 20.1–52.5	104.0±5.0 95.5–109.5	107.7±7.5 89.9–110.4	109.9±0.6 109.0–110.4	84.1±27.9 27.0–136.0
Myotis emarginatus	F & ER	22 (2)	3.4±0.8 2.1–5.1	88.7±15.6 57.6–107.6	40.0±7.0 28.5–51.0	49.7±2.5 46.3–53.8	68.4±11.6 52.0–99.0
Eptesicus serotinus	F	48 (3)	8.3±1.6 6.0–11.5	51.8±6.1 41.2–62.7	25.0±1.3 22.5–28.1	28.4±1.6 24.8–32.3	163.3±67.5 66.0–358.0
Eptesicus ognevi	F	19 (2)	6.1±2.1 3.4–9.0	44.1±3.5 37.9–51.5	29.4±1.1 27.3–31.4	30.8±0.7 30.0–32.8	162.3±58.3 100.0–296.0
Hypsugo savii	F	3 (1)	8.8±1.3 7.3–9.7	37.0±4.2 33.7–41.7	31.5±0.7 30.9–32.3	32.1±0.3 31.8–32.3	– –
Pipistrellus pipistrellus	F	113 (7)	5.6±1.5 2.1–9.0	65.3±12.6 44.9–96.3	48.9±5.5 44.9–56.2	49.1±2.6 45.4–56.6	101.0±48.8 15.0–298.0
	F: extreme high calls	58 (4)	3.9±0.9 2.1–5.5	73.2±12.3 54.8–107.6	53.5±1.5 50.1–56.2	53.9±1.5 50.5–56.6	89.9±32.2 47.0–203.0
Pipistrellus kuhlii	F	68 (5)	7.8±2.0 3.8–13.7	48.6±7.3 37.9–70.7	37.6±1.3 35.1–40.2	39.1±2.8 36.0–48.2	127.9±51.7 68.0–278.0
Otonycteris leucophaea	F	5 (1)	15.9±1.1 14.5–17.5	26.0±0.7 2.1–5.5	21.0±0.2 20.6–21.1	21.3±0.2 21.1–21.5	667.5±292.9 376.0–962.0
Barbastella caspica	H (type A calls)	49 (3)	3.0±0.4 1.8–3.8	43.8±2.7 34.4–47.7	27.8±2.3 22.5–31.8	31.2±3.4 27.1–39.8	62.3±18.0 12.0–102.0
Tadarida teniotis	F	12 (4)	9.3±3.7 4.3–15.4	12.4±2.0 10.3–16.4	12.1±1.8 10.3–15.0	12.8±1.6 11.2–15.9	834.4±560.6 75.0–1771.0

1950, 1965, Strelkov 1963, Butovskij et al. 1985, Koopman 1994, Benda & Gaisler 2015); and *R. f. irani* Cheesman, 1921 (Aellen 1959a, Strelkov 1981, Pavlinov & Rossolimo 1987, 1998, Rybin et al. 1989, Habilov 1992). However, the name *R. f. ferrumequinum* was used by elder Russian authors for the populations of West Turkestan to differentiate *R. ferrumequinum* s.str.

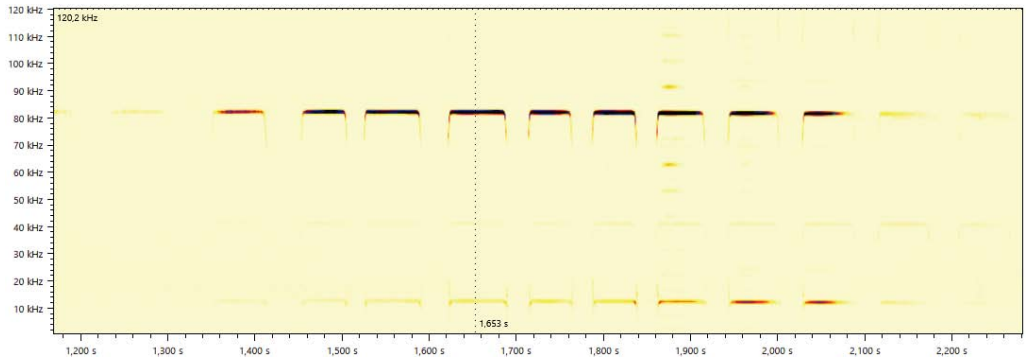


Fig. 12. Spectrogram of the echolocation calls of *Rhinolophus ferrumequinum* (Schreber, 1774); an individual foraging at the Kalpisipar cave, Sariselom valley, 10 May 2016.

from *R. ferrumequinum bocharicus*, then considered just a subspecies of the former species. Thus, in fact they did not refer to a subspecific position of the respective populations.

The name *R. f. proximus* is based on a specimen from Gilgit, Kashmir (Andersen 1905: 113) and concerning Tajikistan, it was first used by Ognev (1928) for affiliation of the Pamir populations. Later, Kuzâkin (1950) referred this name to all populations of *R. ferrumequinum* occurring in West Turkestan or, at least, its eastern part. A similar view was then adopted by Kuzâkin (1965), Strelkov (1963), and/or Koopman (1994), and moreover, these authors regarded *R. f. irani* as a junior synonym of *R. f. proximus*. On the other hand, based on morphometric comparisons, Aellen (1959a) differentiated between these two forms and considered both as separate subspecies distributed in south-western Asia. This opinion was broadly accepted (see e.g., Meyer-Oehme 1965, Gaisler 1970, Corbet 1978, DeBlase 1980, Csorba et al. 2003, Simmons 2005), and the Tajikistani and adjacent populations were referred by numerous authors (see above) to *R. f. irani*, a name based on a specimen from Shiraz [Fars Province, Iran] (Cheesman 1921: 576).

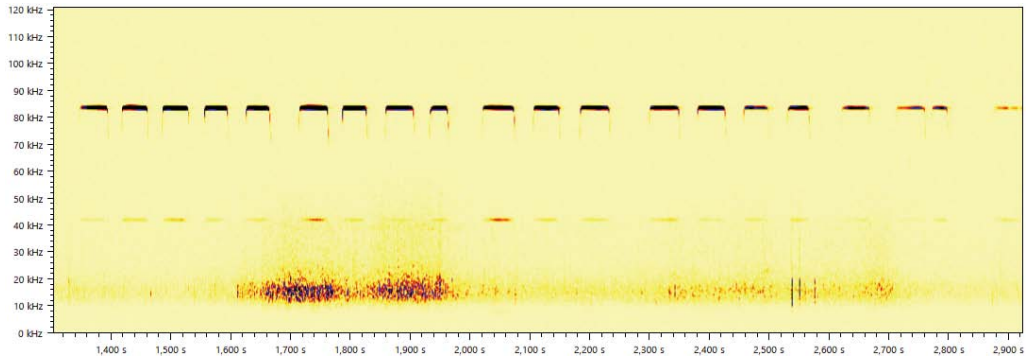


Fig. 13. Spectrogram of the echolocation calls of *Rhinolophus ferrumequinum* (Schreber, 1774); an individual foraging at a small lake under the Ar Arak cave near Kalkot, 17 May 2016.

However, Habilov (1992) was the only author who really evaluated the samples of *R. ferrumequinum* from Tajikistan. He compared the skull size and pelage colouration, but, only with bats from other parts of West Turkestan. He concluded that the Tajikistani bats do not differ from the comparative samples and, with a reference to Gaisler (1970), Chakraborty (1977), and Strelkov (1981), identified the Tajikistani populations as *R. f. irani*.

Similar results were obtained in the comparison of metric skull characters of representative sets of *R. ferrumequinum* specimens from south-western Asia by Benda et al. (2012: 224–225, Fig. 34). It demonstrated the West Turkestani samples (Uzbekistan, Kirghizstan; n=20) to fit the dimension ranges of the small-sized Asian populations (LCc 18.7–20.9 mm, CM^3 7.6–9.0 mm), i.e. those from Afghanistan, Iran, Transcaucasia, and Mesopotamia. The values of the holotype specimens of *R. f. proximus* and *R. f. irani* also fall into this cluster of small-sized samples. The specimens from the Levant represented large-sized bats (LCc 19.9–22.0 mm, CM^3 8.1–9.3 mm), showing only a small range overlap in metric traits with the small-sized bats; the Anatolian samples formed a dimensional transition between these two main clusters (LCc 19.7–21.4 mm, CM^3 8.3–9.0 mm). Thus, according to body and skull size, the West Turkestani populations could be assigned to *R. ferrumequinum proximus* (= *R. f. irani*), in line with the opinions of the previous authors, and along with the populations from Transcaucasia, Mesopotamia, Iran, and Afghanistan.

An addition of the newly collected bats from Tajikistan to the sets compared metrically by Benda et al. (2012), plus the data from Afghanistan gathered by Benda & Gaisler (2015), and their comparison (Fig. 16) showed an identical picture as the previous results described above.

Figs. 14, 15. *Rhinolophus ferrumequinum* (Schreber, 1774) from an abandoned mine at Magov. 14 (left) – a bat roosting in the mine. 15 – (right) portrait of an individual from the mine. Photos by A. Reiter (18 May 2016).

The Tajikistani bats fall into the cluster of other West Turkestani bats, i.e. of the small-sized Asian bats, representing *R. f. proximus*, when we employ the traditional view.

However, the geographical variation in mere metric characters does not describe sufficiently the phylogenetic relations that should be used as a basis for a relevant taxonomic assessment of a population, it thus has to be combined with a molecular genetic examination. See the discussions by Benda et al. (2006, 2012), and Benda & Gaisler (2015) concerning the available results of genetic analyses of the populations of *R. ferrumequinum* from the Middle East and adjacent regions. These data suggested that the body size variation in the Asian populations could be related to environment characteristics, individuals from the more humid habitats being larger than individuals from arid habitats. This relationship can explain the size differences among *R. ferrumequinum* samples from various parts of south-western Asia, and implies plasticity rather than conservatism in morphological traits in the particular taxa and thus, a limited use of body size differences for taxonomic division in this species.

The most recent revision of the phylogenetic relations within *R. ferrumequinum* by Uvizl et al. (2024), using comparisons of both mitochondrial and nuclear genomes of a very representative sample set, revealed very shallow genetic variation among populations of this bat in the western Palaearctic in both marker types. The authors concluded that such level of variability does not correspond to the conception of two or more subspecies in this bat and suggested to consider *R. ferrummequinum* a monotypic species. Such opinion contradicts the traditional morphometry-

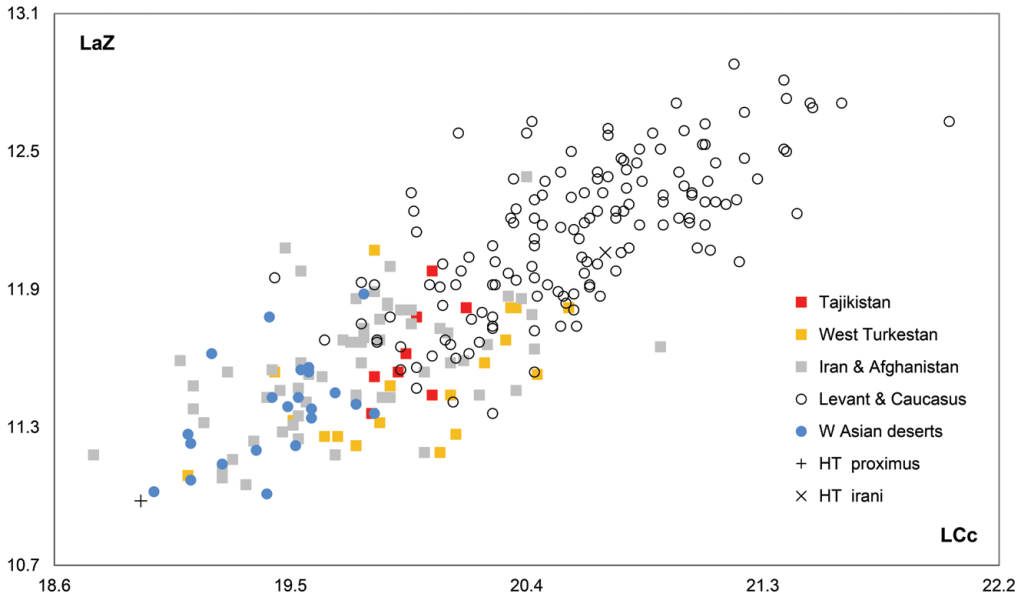


Fig. 16. Bivariate plot of the examined samples of *Rhinolophus ferrumequinum* (Schreber, 1774) from Tajikistan and other parts of south-western Asia: condylocanine length of skull (LCc) against the zygomatic width (LaZ). Explanations: West Turkestan = samples from Kirghizstan, Uzbekistan, and Turkmenistan; Levant & Caucasus = samples from Jordan, Lebanon, western Syria, Cyprus, Turkey, and Georgia; W Asian deserts = samples from Syrian Mesopotamia and eastern Azerbaijan; HT = holotype specimens of particular names; for comparative material origin see Benda et al. (2012) and Benda & Gaisler (2015).

Table 6. Basic biometric data on the newly collected specimens of *Rhinolophus ferrumequinum* (Schreber, 1774), *R. bocharicus* Kašenko et Akimov, 1918, and *R. hipposideros* (André, 1797) s.str. For abbreviations see p. 8

	Rhinolophus ferrumequinum					*Rhinolophus bocharicus*					*Rhinolophus*
	n	**M**	min	max	SD	n	**M**	min	max	SD	*hipposideros*
LC	9	**72.8**	71	75	1.394	18	**61.8**	58	66	2.282	46
LCd	9	**38.1**	34	42	2.421	18	**29.4**	26	34	1.723	34
LAt	9	**57.39**	55.7	59.6	1.178	18	**51.88**	50.5	53.4	0.871	40.5
LA	9	**25.12**	23.9	26.5	0.842	18	**24.49**	21.8	26.0	0.914	19.1
LFE	9	**8.83**	8.3	9.3	0.324	18	**7.29**	6.6	7.7	0.299	7.2
G	9	**17.01**	15.2	19.3	1.223	18	**12.46**	9.3	15.6	2.021	4.1
LCr	9	**22.96**	22.11	23.37	0.422	15	**20.17**	19.47	20.78	0.331	–
LOc	9	**22.40**	22.07	22.67	0.191	15	**19.64**	18.93	20.14	0.269	15.23
LCb	9	**19.93**	19.67	20.17	0.150	15	**17.36**	16.74	17.76	0.257	13.54
LaZ	9	**11.58**	11.18	11.98	0.248	15	**10.28**	9.62	10.63	0.245	7.19
LaI	9	**2.46**	2.23	2.67	0.164	15	**2.41**	2.23	2.62	0.121	1.43
LaInf	9	**5.79**	5.62	6.06	0.147	15	**5.00**	4.83	5.12	0.090	3.36
LaN	9	**9.17**	8.81	9.38	0.181	15	**8.31**	7.98	8.68	0.197	6.35
LaM	9	**10.26**	10.02	10.56	0.183	15	**9.28**	8.95	9.63	0.152	7.21
ANc	9	**6.73**	6.52	6.92	0.118	15	**6.14**	5.67	6.45	0.187	4.48
LBT	9	**3.49**	3.18	3.91	0.251	15	**3.15**	2.94	3.47	0.158	2.51
CC	9	**6.18**	6.02	6.42	0.134	14	**5.22**	5.08	5.44	0.096	3.37
M^3M^3	9	**8.48**	8.25	8.75	0.167	15	**7.52**	7.28	7.83	0.145	5.34
CM^3	9	**8.31**	8.16	8.48	0.111	15	**7.02**	6.74	7.21	0.124	5.28
LMd	9	**14.95**	14.81	15.08	0.093	15	**12.80**	12.31	13.17	0.223	9.59
ACo	9	**3.66**	3.48	3.81	0.113	15	**2.90**	2.74	3.05	0.087	1.81
CM_3	9	**8.89**	8.77	9.11	0.110	15	**7.53**	7.33	7.69	0.101	5.51

based view of subspecific division (expressed recently e.g. by Srinivasulu & Srinivasulu 2012 or Burgin 2019a) and suggests presence of the nominotypical population in Tajikistan.

Records of ectoparasites. **Original data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata turkestanica*: 1 ♀ ad [A], from 1 ♂ (NMP 95744), Qarağoč, loess cavity, 15 May 2016. – N y c t e r i b i i d a e: *Phthiridium biarticulatum*: 1 ♂ ad [A], from 1 ♂ (HSU pb6262), Magov, garden, 18 May 2016. – **Published data**: N y c t e r i b i i d a e: *Phthiridium biarticulatum*: 1 ♀, Mogol-Tau [= Mogoltau] Mts., Uč Tepa [= Učteppa], 18 November 1979 (Hůrka 1984); – 1 ♀, Kuraminskij khrebet [= Kurama] Mts., Gudos, 13 April 1980, leg. K. T. Khabilov (Hůrka 1984); – *Phthiridium khabilovi*: 1 ♀ G, Uč Tepa [= Učteppa], Mogol-Tau [= Mogoltau] mountains, 6 June 1979 (Hůrka 1984). – I x o d i d a e: *Ixodes vespertilionis*: 1 larva, northern promontory of the Zeravšan [= Zarafšon] Mountains, 3 September 1953 (Filippova 1972). – S p i n t u r n i c i d a e: *Eyndhovenia euryalis oudemansi*: 1 ♂, 2 ♀♀, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – M a c r o n y s s i d a e: *Macronyssus rhinolophi*: 1 ♀, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Steatonyssus* sp.: unspecified material, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Rhinolophus ferrumequinum*, the most diverse spectrum of ectoparasites was documented among the bats of Tajikistan, at least seven species of five families were found in total.

The bat flea *Rhinolophopsylla unipectinata* (Taschenberg, 1880) is a parasite of cave-dwelling bats of the genus *Rhinolophus*, which are the principal hosts of this flea that can be found only rarely on other cave bat species (*Myotis myotis*, *M. blythii*, *M. emarginatus*, *M. capaccinii*, *Miniopterus schreibersii*, and/or *Aselia tridens*; Hůrka 1963). This flea species is distributed in an extensive area stretching from the Maghreb in the west to the Himalayas in the east; several subspecies were differentiated within this range, based on morphological traits, viz. *R. u. unipe-*

ctinata (Taschenberg, 1880) found in Europe, the Caucasus and Middle East, Turkmenistan, and south-western Afghanistan (Hůrka 1963, Medvedev & Polkanov 1997); *R. u. indica* Jordan et Rothschild, 1921 in southern Afghanistan and the north-western Himalayas (Jordan & Rothschild 1921, Hůrka 1970); *R. u. arabs* Jordan et Rothschild, 1921 in the Maghreb and Iberia (Jordan & Rothschild 1921, Hopkins & Rothschild 1956, Vermeil 1961, Beaucournu et al. 1975, Hastriter & Tipton 1975, Beaucournu & Hellal 1977, Quetglas et al. 2014); *R. u. turkestanica* Ioff, 1953 in the eastern part of West Turkestan and in north-eastern Afghanistan; and an unspecified form (*Rhinolophopsylla unipectinata* subsp.?) in Yemen (Sanborn & Hoogstraal 1953).

The Turkestani subspecies *R. u. turkestanica* was recorded from Toshkent (Uzbekistan) and from the Kyzylkum desert of southern Kazakhstan (Ioff & Bondar′ 1956). The original description of *R. u. turkestanica* by Ioff et al. (1953) was rather brief, but was then supplemented by Ioff & Bondar′ (1956: 110–112), who also gave figures of the male's modified abdominal segments of this and the nominotypical subspecies. Additionally, Smit (1960) mentioned a record of both latter subspecies from Afghanistan, which indicates the south-easternmost point of the species range being in the southern half of this country, whereas *R. u. turkestanica*, which has a more restricted distribution range, probably does not reach much farther south of about 35°N.

The bat fly *Phthiridium biarticulatum* Hermann, 1804 is a typical parasite of the bat genus *Rhinolophus*, although perhaps it can parasitise other cave bat species too (Hůrka 1964). Besides *R. ferrumequinum*, it was collected also from *Rhinolophus bocharicus* from a loess cavity at Qarağoč in southern Tajikistan (along with from *R. ferrumequinum*), and also from Altyn-Topkan in the Kurama Mts. in the northern part of the country (Hůrka 1984). Another bat fly collected from *R. ferrumequinum*, *Phthiridium khabilovi* Hůrka, 1984, is a species described based on female specimens from Tajikistan (males remain unknown), and they represent the only known material of this bat fly. It belongs to the *P. biarticulatum* group and differs from other species of the genus in the shape and chaetotaxy of the anal segment (Hůrka 1984). Although it is known only from one host species, its occurrence is expected in more species of cave-dwelling bats, namely of the genus *Rhinolophus*, similarly as documented in other species of the genus *Phthiridium*.

The hard tick *Ixodes vespertilionis* Koch, 1844 was found on this bat at an unspecified locality in the northern promontory of the Zarafšon Mountains (Filippova 1972). The distribution range of *I. vespertilionis* covers Europe, Africa, the Middle East, southern and eastern Asia, and some of the Pacific islands (Kolonin 2007). In this extensive area, it is reported as a primary parasite of bats of the genus *Rhinolophus* (Arthur 1956, Filippova 1977).

The mite *Eyndhovenia euryalis* (Canestrini, 1884) also ranks among the parasites of bats of the genus *Rhinolophus* (Rudnick 1960). Three subspecies were defined based on morphology within the Palaearctic (Uchikawa & Dusbábek 1978, Lanza 1999, Stanyukovich 1997); the nominotypical form is known from Europe and Transcaucasia; *E. e. oudemansi* (Eyndhoven, 1941) from a very similar geographical range – the geographical limits of the two forms are not precisely known; and *E. e. cornuti* Uchikawa et Dusbábek, 1978, from Japan (see summary by Beron 2020). The respective record from Tajikistan belongs to *E. e. oudemansi* (also known from *R. bocharicus* in the country, see below and Stanûkovič & Malinovskij 1992). Nevertheless, a molecular genetic analysis is required for revision of the geographic variation in this species and re-definition of particular taxa.

The mite *Macronyssus rhinolophi* (Oudemans, 1902) occurs on a number of vespertilionid bats, although most frequently, it was documented to parasitise bats of the genus *Rhinolophus* (Radovsky 1967). Its distribution range stretches across most of the western Palaearctic including Great Britain, many countries of central and southern Europe, Ukraine, and Egypt (Turk & Turk 1952, Dusbábek 1964a, b, Radovsky 1967), in West Turkestan it was found additionally in southern Kirghizstan and Uzbekistan (Rybin et al. 1989, Stanyukovich 1997). From *R. ferrumequinum*

in Tajikistan, an unspecified macronyssid mite of the genus *Steatonyssus* was also reported by Stanûkovič & Malinovskij (1992). Concerning West Turkestan, a similar record of *Steatonyssus* sp. was reported from this bat also from southern Kirghizstan (Rybin et al. 1989).

Rhinolophus bocharicus Kaŝenko et Akimov, 1918

Records. **Original data**: Levap [**1**], old farm (Figs. 17–22), 5 May 2016: obs. a colony of ca. 120 inds. (mixed with a colony of ca. 120 inds. of *Myotis emarginatus*), coll. 1 ♂, 13 ♀♀ (NMP 95707–95711, 95713, HSU pb6156–6159, 6183 [S+A], NMP 95712, HSU pb6160, 6161 [A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021), det. & rec. calls of emerging inds.; – Kūlob [**2**], botanical garden, 6 May 2016: det. & rec. calls of 1 foraging ind.; – Qarağoč [**3**], inside of a loess cavity, 9 May 2016: net. 1 ♂ (Fig. 24; NMP 95729 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021); – Sariselom valley, at the Kalpisipar cave [**4**], 10 May 2016: det. & rec. calls of 1 ind.; – Hoça Šaqiqi Balhi, Danğara tunnel [**5**], 17 May 2016: obs. & coll. 3 ♂♂ (NMP 95750, 95751, HSU pb6232 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda 2021), det. & rec. calls of 1 ind. – **Published data**: Kurgan-Tûbe [= Bohtar], Vahš state farm [**6**], house No. 3, 12 August 1930: coll. 1 ♂ (Laptev 1937); – near Gulistan [= Guliston] kishlak [**7**], 8 km of Stalinabad [= Dušanbe], small dry cave, 29 March 1953: coll. 1 ind. (Bogdanov 1954, 1956a); – Zeravšan [= Zarafšon] river valley, near Mindona [= Mingdona] kishlak [**8**], cave, 4 December 1953: coll. 2 ♀♀ (Bogdanov 1956a, b); southern slope of the Turkestanskij [= Turkiston] Mountains, near Mindona [= Mingdona] kishlak, 15 February 1979: exam. 8 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**9**], 17 December 1978: obs. 33 inds., incl. 20 ♂♂, 12 ♀♀, 23 December 1978: obs. a colony of ca. 1000 / 600–650+380 inds. of *R. ferrumequinum* and *R. bocharicus*, exam. 2 ♂♂, 21 ♀♀ / 3 ♀♀ (Habilov 1979, 1992, Hůrka 1984, Tadžibaeva & Habilov 2016c, 2017b, 2018), 21 February 1986: obs. ca. 415 inds. of *R. ferrumequinum* and *R. bocharicus*, exam. 1 ♂, 1 ♀ (Habilov 1988, 1992), 1 April 1979: exam. 1 ♂, 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2018), 15 February 1980: obs. 1200–1300 inds. of *R. ferrumequinum* and *R. bocharicus*, exam. 1 ♂, 14 March 1981: exam. 1 ♂, 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2016c, 2017b, 2018), juniper tree zone, 1590 m a. s. l., abandoned mine 2, 5 February 2016: exam. 15 ♀♀ (Tadžibaeva & Habilov 2016b, 2017b, 2018), Poj-bulok, mine, 1240 m a. s. l., 7 January 2016: obs. a colony of 650–700 inds. of *R. ferrumequinum* and *R. bocharicus* in a ratio of 1:2 (Tadžibaeva & Habilov 2016c, 2017b, 2018), mine, 1280 m a. s. l., 4 February 2016: obs. ca. 500 inds. of *R. ferrumequinum* and *R. bocharicus*, 25 February 2016: obs. 210 / 220 inds. of *R. ferrumequinum* and *R. bocharicus*, mine, 1280 m a. s. l., 18 December 2015: obs. 52 inds. (Tadžibaeva & Habilov 2017b, 2018), mine, 1550 m a. s. l., 30 March 1980: obs. a colony of 254 inds. of *R. ferrumequinum* and *R. bocharicus*, 4 February 2016: obs. 115 inds., mine in a village, 15 February 2016: obs. 1 ind. (Tadžibaeva & Habilov 2018), Pojbulok,

Fig. 17. An old abandoned farm at Levap, Vahš river alluvium, a site of mass roosting of bats. In the higher building on the left, two partially mixed colonies of *Rhinolophus bocharicus* and *Myotis emarginatus* were observed, in the lower building on the right, a large colony of *Pipistrellus pipistrellus* was found. Calls of foraging *Eptesicus serotinus* and *Tadarida teniotis* were detected in the area, besides the foraging calls of the roosting species. Photo by A. Reiter (5 May 2016).

Fig. 18. A part of an old abandoned farm at Levap, Vahš river alluvium. On 5 May 2016, two partially mixed colonies of *Rhinolophus bocharicus* and *Myotis emarginatus*, ca. 240 individuals in total, were observed inside this building (see Fig. 17). Photo by A. Reiter (5 May 2016).

Figs. 19, 20. Two groups of *Rhinolophus bocharicus* Kašenko et Akimov, 1918 roosting in an old abandoned farm at Levap (Fig. 18) along with a colony of *Myotis emarginatus* (Geoffroy, 1806) (Figs. 67, 68). Photo by A. Reiter (5 May 2016).

mine 29 January 2022: obs. 80 inds., plus ca. 500 inds. in three groups (Habilov & Tadžibaeva 2022c); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Dahana [**10**], Guzlon Range, abandoned mine 4, 2 January 1976: obs. 2 inds., incl. 1 ♀, 25 January 1976: coll. 1 ♂, 2 ♀♀, 15 February 1976: obs. 3 inds., 12–13 March 1976: obs. 1 active ind., coll. 1 ♂, 1 / 2 ♀♀, 4 April 1976: obs. 23 inds., incl. 1 ♀, 11 April 1976: obs. 18 inds., incl. 13 ♂♂, 3 ♀♀, 17 April 1976: obs. 8 active inds., 24 April 1976: exam. 1 / 4 ♂♂, 2 ♀♀, 7 March 1977: obs. hibernating inds. and 1 active ind., 27 February 1977: 23 inds., incl. 5 / 7 ♂♂, 6 / 5 ♀♀, 16 October 1977: obs. a colony of 17 inds., incl. 7 / 11 ♂♂, 5 / 6 ♀♀ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), 18 April 1976: obs. 27 inds., incl. 1 ♂ / 19 ♂♂, 3 / 6 ♀♀, 8 May 1976: exam. 15 ♂♂, 3 ♀♀, 26 September 1976: obs. 6 inds., incl. 1 ♀, 8 May 1977: exam. 16 ♂♂, 3 ♀♀, 15 May 1977: exam. 1 ♀ / ♂, 10 December 1977: exam. 2 ♂♂, 3 ♀♀, 25 March 1978: exam. 1 ♀, 11 November 1978: exam. 3 ♂♂, 8 / 6 ♀♀, 3 April 1979: exam. 3 ♂♂, 1 ♀, 21 October 1979: exam. 2 / 7 ♂♂, 3 ♀♀, 15 March 1980: obs. 8 inds., incl. 2 ♂♂, 2 ♀♀, 3 / 23 November 1980: exam. 2 ♂♂, 2 ♀♀, 20 December 1980: exam. 1 ♀, 18 January 1981: obs. 5 inds., 10 January 1982: obs. 8 inds., 8 November 1983: obs. 3 inds., incl. 1 / 3 ♀♀, 5 January 1986: obs. 13 / 14 inds., incl. 3 / 2 ♂♂, 8 ♀♀, 22 February 1986: obs. 13 inds., incl. 3 ♂♂, 5 ♀♀, 12 November 1986: obs. 4 inds. (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), 13 July/May 2012: obs. 1 ind. (Habilov & Tadžibaeva 2013, 2020a, Tadžibaeva 2018), 21 March 1976: obs. 4 inds., 16 September 1976: obs. 4 inds., 18 December 1976: obs. 2 inds., 12 March 1977: obs. 12 inds., incl. 5 ♂♂, 5 ♀♀, 10 April 1977: exam. 6 ♂♂, 1 ♀ (Habilov & Tadžibaeva 2020a), mine 4, 12 April 2012: exam. 2 ♂♂, 21 April 2013: obs. 2 inds., 22 November 2013: exam. 2 ♀♀, 23 March 2014: obs. 6 inds., incl. 2 ♂♂, 2 ♀♀, 23 August 2014: obs. 1 ind., 10 October 2014: obs. 10 inds., incl. 1 ♂, 7 ♀♀, 2 November 2014: exam. 2 ♂♂, 1 ♀, 9 January 2015: obs. 3 inds., incl. 1 ♂, 1 ♀, 13 January 2015: exam. 7 ♀♀, 25 February 2016: exam. 1 ♂ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 22 January 2016: obs. 1 ♂, 2 ♀♀, mine 14, 13 May 2012: obs. 1 ind., 14 January 2014: obs. 1 ind., a dome mine nearby, 13 May 2012: 6 inds., incl. 1 ♂, mine 6, 22 November 2013: obs. 5 inds., 2 November 2014: obs. 9 inds., incl. 4 ♂♂, 2 ♀♀ (Tadžibaeva 2018), 14 September 2017: obs. 1 ind., 7 July 2018: obs. 1 ind., 10 March 2019: obs. 4 inds., incl. 2 ♂♂, 30 March 2019: obs. 6 inds., incl. 2 ♂♂, 3 ♀♀, 28 March 2020: exam. 1 ♀ (Habilov & Tadžibaeva 2020a), mine 4, 1 February 2021: exam. 2 ♀♀, 28 November 2021: exam. 1 ♀, 26 February 2022: exam. 4 ♀♀, 2 inds. (Habilov & Tadžibaeva 2022c); – Kuraminskij [= Kurama] Mountains, Kandžol [= Istiqlol] [**11**], mine, 16 January 1977: coll. 1 ♀ (Habilov 1980, 1992); – near Kul′kent [= Kūlkand] [**12**], foothills of the Turkestanskij [= Turkiston] Mountains, two mines, 27 March 1977: obs. 20 / 23 / 34 inds. and 4 inds., incl. 1 / 2 / 3 ♂♂, 21 / 18 ♀♀ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), 26 March 1978: exam. 1 ♂, 2 ♀♀, 29 April 1978: exam. 2 / 3 ♂♂, 24 April 1980: obs. 32 inds., incl. 5 ♂♂, 1 / 2 ♀, 17 April 1982: exam. 1 ♂, 17 May 1983: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine 2, 23 November 2013: obs. 1 ind. (Tadžibaeva 2015, 2018, Habilov & Tadžibaeva 2020c), mine 5, 20 February 2015: exam. 1 ♂, 1 ♀ (Tadžibaeva 2018), mine 5, 22 June 2017: obs. 1 ind. (Tadžibaeva & Habilov 2017c, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), abandoned mine, 19 March 1977: exam. 1 ♂, 2 ♀♀, 7 May 1978: exam. 1 ♂, 26–28 June 1977: obs. 2 inds., incl. 1 ♂, 20 February 2015: exam. 1 ♂, 1 ♀, 31 May 2018: obs. 2 inds., incl. 1 ♂ (Habilov & Tadžibaeva

Figs. 21, 22. Portraits of *Rhinolophus bocharicus* Kašenko et Akimov, 1918 from Levap. Photo by A. Reiter.

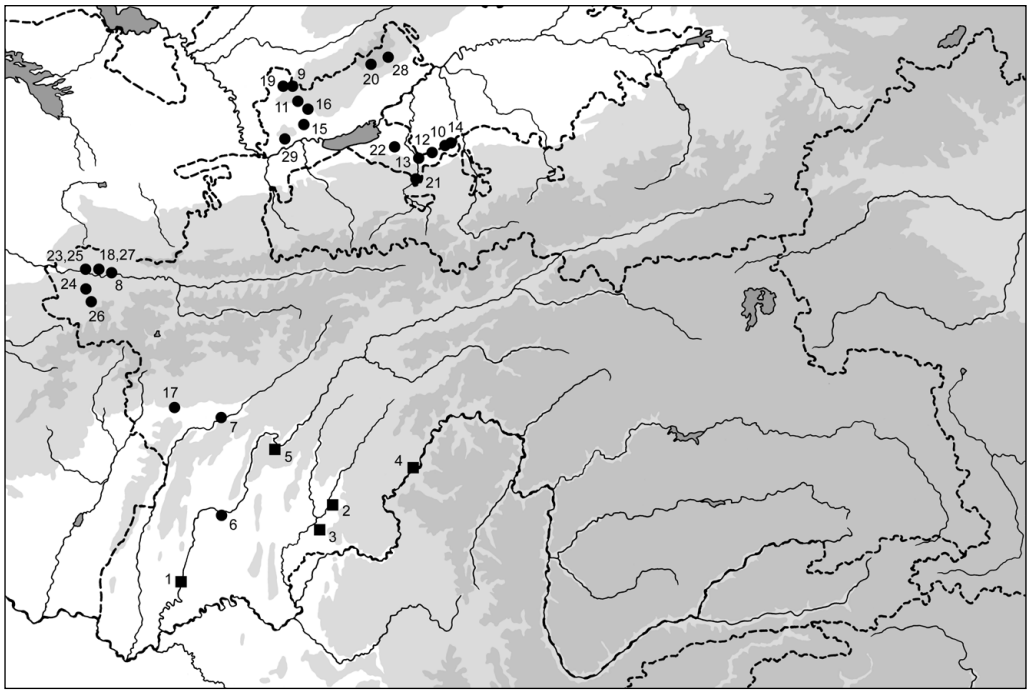


Fig. 23. Records of *Rhinolophus bocharicus* Kašenko et Akimov, 1918 in Tajikistan; squares – new records, circles – published records.

2020c); – 11 km north-east of Isfara [**13**], abandoned mine, 9 April 1977: coll. 1 ♂ (Habilov 1980); at the Isfara waste dump, mines, 9 April 1977: exam. 2 ♂♂, 5 May 1979: exam. 4 ♂♂, 20 November 1979: exam. 5 ♂♂, 6 ♀♀, 30 March 1980: exam. 2 ♂♂ (Habilov 1992, Tadžibaeva 2018); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, at the old road to Kokand [= Qo'qon] near Dahana [**14**], abandoned mine, 17 October 1977: coll. 2 ♂♂, 1 ♀ (Habilov 1980); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**15**], abandoned mine, 8 November 1977: exam. 1 ♂, 8 January 1978: exam. 1 ♀ / ♂ (Habilov 1980, 1992, Tadžibaeva & Habilov 2019a), 30 January 1979: exam. 1 ♂, 19 April 1984: exam. 1 ♂, 1 ♀, 13 January 1985: exam. 1 ♀, 29 September 1985: exam. 1 ♀ (Habilov 1992), 10 April 2012: obs. 3 inds., 2 October 2012: obs. 18 inds., 23 November 2012: obs. 43 inds., 15 April 2013 obs. 8 inds., 24 November 2013: obs. 34 inds., 15 August 2015: obs. 3 inds., 11 September 2015: obs. 3 inds., 2 October 2015: obs. 1 ind., 20 August 2016: obs. 1 ind., arge mine, 29 October 2017: obs. 19 inds., 1 April 2019: obs. 6 inds. (Tadžibaeva & Habilov 2019a); – Kuraminskij [= Kurama] Mountains, near Kansaj [**16**], mine, 9 November 1977: coll. 1 ♂, 1 ♀ (Habilov 1980, 1992), 15 December 1978: exam. 1 ♂, 5 ♀♀ (Habilov 1992), Kansaj (Oktoš), 2 October 2016: obs. 3 inds., incl. 1 ♀ (Tadžibaeva & Habilov 2018); – Nadžibolo [= Nodž] [**17**], two loess caves, 20 October 1986: coll. 1 ♂, 2 ♀♀ (Malinovskij 1988); – between Amondara and Mindona [= Mingdona] [**18**], Zeravšan [= Zarafšon] river valley, mine, 20 July 1959: coll. 1 ♀, ZMMU, leg. O. P. Bogdanov (Habilov 1992, Tadžibaeva & Habilov 2017a); – Kuraminskij [= Kurama] Mountains, Čol-Ata [= Čolota] [**19**], 5 May 1983: exam. 1 ♂ (Habilov 1992), 21 February 1986: exam. 1 ♂, 1 ♀ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, Pangaz [**20**], 7 December 1980: obs. 4 inds. (Habilov 1992), mine, 19 October 2015: exam. 8 ♀♀ (Tadžibaeva & Habilov 2018); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, Surh [**21**], 7 December 1976: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Kim (Belesenyk Range) [**22**], 6 May 1979: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, near Majkata [= Majkatta] kishlak [**23**], 15 February 1979: exam. 2 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a), cave, 9 December 1978: obs. 13 inds. of *R. ferrumequinum* and *R. bocharicus* (Tadžibaeva & Habilov 2017a); – northern slope of the Zeravšanskij [= Zarafšon] Mountains, Džilau [= Çilau] [**24**] (2000 / 2900 m a. s. l.), 14 February 1979: exam.

1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – between Amondara and Majkata [= Majkatta] [**25**], mine, summer period, obs. a colony of ca. 500 inds. of *R. ferrumequinum* and *R. bocharicus* (Habilov 2003, Tadžibaeva & Habilov 2017a); – above Šing kishlak [**26**], Šing river valley, northern slope of the Zeravšanskij [= Zarafšon] Mountains, Dahoni-ob / Dahoni ob mine, 16 October 2015: obs. 33 / 36 / 13 inds., 2 February 2016: obs. 44 inds. of *R. ferrumequinum* and *R. bocharicus*, leg. R. Oblokulov (Habilov & Tadžibaeva 2016a, 2018, 2020b, Tadžibaeva & Habilov 2017a), 30 January 2016: obs. 38 inds., leg. R. Oblokulov (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2020b), 13 January 2020: obs. 26 inds., incl. 1 ♂, 3 October 2020: obs. 3 inds., incl. 1 ♂ (Habilov & Tadžibaeva 2020b); – Ëri [= Ërī] kishlak, Somi cave [**27**], 15 October 2015: exam. 1 ♀ (Tadžibaeva & Habilov 2017a); – Tigrovaâ balka [= Bešai Palangon] Reserve, old farm 1 km of the main gate [**1**], 30 June 2017: obs. a colony of 72 inds., incl. 2 ♀♀ (Tadžibaeva & Habilov 2017c); – near Gudos [**28**], mine, 19 February 2016: exam. 1 ♂, in the field, 19 February 2016: coll. 1 ♂ (Tadžibaeva & Habilov 2018); – Mogol-Tau [= Mogoltau] Mountains, Uč-Teppa [= Učteppa] [**29**], mine, 7 August 2015: obs. 1 ind., mines 1–3, 25 September 2015: obs. 5 inds., 1 April 2019: obs. 34 inds., 26 May 2019: obs. 30 inds., 2 June 2019: obs. 1 ind. (Tadžibaeva & Habilov 2019a).

Distribution. *Rhinolophus bocharicus* represents one of the endemics of Central Asia, it occurs mostly in the southern part of West Turkestan (except south-western Turkmenistan) and it extends only marginally to northern Afghanistan (Rybin et al. 1989, Horáček et al. 2000, Burgin 2019a). The only record from Iran published by Farhang-Azad (1969) was based on a misidentified juvenile of *R. ferrumequinum* (Strelkov et al. 1978, Benda et al. 2012). The Tajikistani distribution of *R. bocharicus* represents a part of the eastern margin of the distribution range of this bat. This margin continues from south-western Tajikistan southwards to north-western Afghanistan and southern Turkmenistan, where the southern limits of the species distribution are found (Benda & Gaisler 2015), and from northern Tajikistan to southern Kirghizstan and central and eastern Uzbekistan, where the north-eastern limits of the distribution range of *R. bocharicus* lie (Bogdanov 1953a, Rybin et al. 1989).

In Tajikistan, *R. bocharicus* belongs to common bats (Fig. 23), at least 29 record sites are available from the western section of the country. The localities are situated mainly in the lowlands with only a slight coverage of medium altitudes; the available records come from a medium wide altitudinal range (1595 m), with some three quarters of the records originating from the sites below 1250 m a. s. l. (Fig. 10, Table 3). Since this bat inhabits mainly lowland areas, its range in Tajikistan is divided into three parts separated by mountain ranges, to the south-western, western, and northern sections (Fig. 23).

Our new records from Tajikistan contribute to the depiction of the eastern margin of the species range in West Turkestan rather significantly; until now, this bat was only marginally known from the south-western section of the country (Fig. 23). In the Amudarë Basin in its broad sense, the easternmost record was available from near Taloqan, Takhar Province of Afghanistan (36°40'N, 69°39'E; DeBlase 1980). Three new records from south-western Tajikistan lie more to the east, and the call recording made at the Kalpisipar cave in the Darvoz Mountains represents the easternmost record of *R. bocharicus* in this range section (70°28'E). In Tajikistan, this record prolongs the known range by ca. 150 km to the east (Fig. 23). Although Habilov (1992: 93) mentioned a record from Qal″ai Humb, i.e. even more eastwards, to be mentioned in an abstract by Ŝerbin (1964), this is most probably an error. Ŝerbin (1968), who properly published his records from the early 1960s, did not report any finding of *R. bocharicus*, but one record of *R. ferrumequinum* from Obgard in the Darvoz Mountains (= near Qal″ai Humb) made on 22 February 1963 (see Fig. 3). This is most likely a previously misidentified record of *R. bocharicus* presented to originate from Qal″ai Humb; no record of *R. bocharicus* from Qal″ai Humb was reported also by Habilov (1986), who gave a review of bats of Badakhshan (Badahšan).

Our new records of *R. bocharicus* in south-western Tajikistan come from a small altitudinal range of 828 m (ca. a half of the range of this bat in the whole country; Table 3) and the altitudes of these record sites are rather low (median 897 m vs. 960 m; see Fig. 11, Table 4). The preference

for lower altitudes in *R. bocharicus* is most apparent from the comparison with the altitude distribution of *R. ferrumequinum* (and also other bats, see Fig. 11). While both large-sized *Rhinolophus* species were documented at similar number of localities, these localities are almost completely separated by their altitude distribution. This comparison indicates that in the steppe landscape of south-western Tajikistan, these species have exclusive altitude preferences and distribution, which is not true for the distribution pattern in the whole Tajikistan.

Echolocation. Echolocation calls of *Rhinolophus bocharicus* were recorded at four sites in Tajikistan and description of the echolocation parameters of this bat is given here for the first time (see Table 5). The calls of a foraging bat were recorded just once (at Kūlob), while the calls of bats active in or near their roosts were obtained three times, at a cave (Kalpisipar cave), inside a mine-like shaft/tunnel (Danğara tunnel), and inside an abandoned building (former stable at Levap). This bat produces FM-CF-FM calls typical for the genus *Rhinolophus* (Figs. 25, 26), with the peak frequencies in the range of 97.8–103.4 kHz (mean 101.2 kHz), see Table 5 (also for further descriptive parameters of the calls). The peak frequencies are slightly lower during the foraging flight (mean 98.0 kHz) compared to the calls recorded inside roosts or calls obtained from a handled bat (mean 102.0 and 101.3 kHz, respectively). This difference is caused by the

Fig. 24. Portrait of *Rhinolophus bocharicus* Kašenko et Akimov, 1918 from Qarağoč. Photo by A. Reiter.

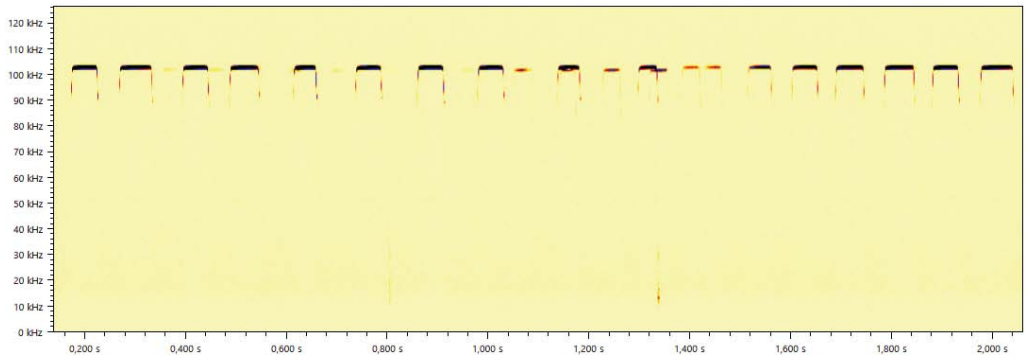


Fig. 25. Spectrogram of the echolocation calls of *Rhinolophus bocharicus* Kaŝenko et Akimov, 1918; an individual emerging from the colony roost in an old farm at Levap, 5 May 2016.

Doppler shift compensation when the bat forages under natural conditions. In comparison with the call parameters of *R. clivosus* Cretzschmar, 1828, a closely related bat species from the Middle East, those of *R. bocharicus* show much higher values (see Benda et al. 2008, 2010a, Razgour et al. 2010). The peak frequencies of the calls of the former bat lie in the range of 83.5–87.9 kHz, i.e. some 12–20 kHz lower than in *R. bocharicus*.

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Rhinolophus bocharicus* are shown in Table 6. For the material examined see above. A comparison of these dimensions with those of samples from other parts of the species distribution range (Afghanistan, other parts of West Turkestan; Fig. 27) did not reveal any significant difference between these geographical sample sets.

The specimens of *R. bocharicus* collected in the eastern part of West Turkestan in the second half of the 19th century were originally assigned to *R. euryale* Blasius, 1853 by several collectors (cf.

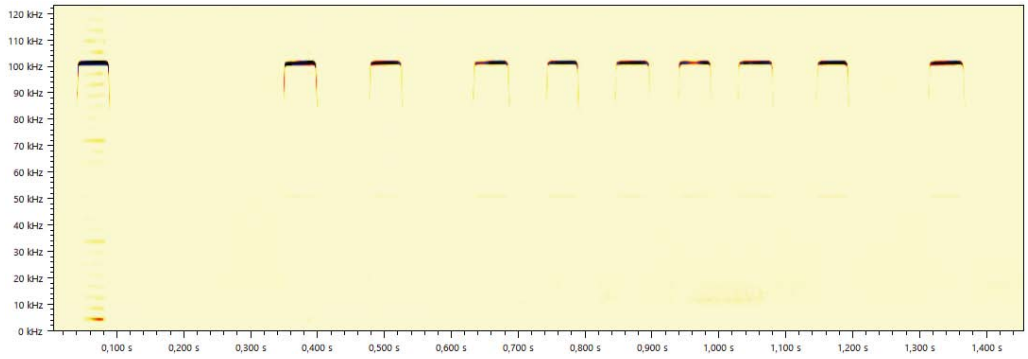


Fig. 26. Spectrogram of the echolocation calls of *Rhinolophus bocharicus* Kaŝenko et Akimov, 1918; a handled individual collected from a loess cavity at Qarağoč, 9 May 2016.

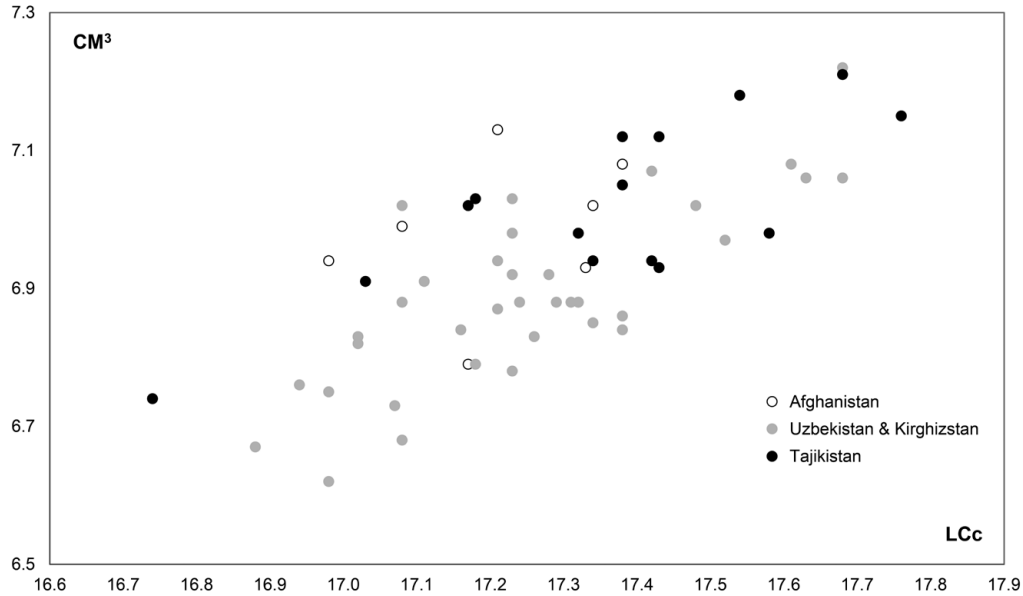


Fig. 27. Bivariate plot of the examined samples of *Rhinolophus bocharicus* Kašenko et Akimov, 1918: condylocanine length of skull (LCc) against the length of the upper tooth-row (CM^3); for comparative material see text.

Sěvercov″ 1873a, Fedčenko 1875; see the reviews by Bobrinskoj 1925 and/or Ognev 1928). Later on, they were re-identified as *R. ferrumequinum* (Tihomirov″ & Korčagin″ 1889, Kašenko 1905), until Kašenko & Akimov″ (1918) described *R. bocharicus* as a separate species. However, initially some Russian authors (Bobrinskoj 1925, Ognev 1927, 1928, Vinogradov 1935) considered it as the West Turkestani subspecies of *R. ferrumequinum*, and concerning the Tajikistani populations, this is valid also for the first country's record by Laptev (1937) from Kurgan-Tûbe [= Bohtar]. However, Kuzâkin (1934) found two species, *R. ferrumequinum* and *R. bocharicus* occurring in sympatry in eastern Uzbekistan and described clear morphological differences between them in the size of body, ear, tail, and metacarpal bones. Since then, *R. bocharicus* is almost universally considered a separate species, and concerning the Tajikistani or West Turkestani populations as well, without exception (Meklenburcev 1935, Bobrinskoj & Kuzâkin 1937, Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, 1954, 1956a, b, Strelkov 1963, 1971, 1981, Babaev 1965, Hanák 1969, Felten et al. 1977, Strelkov et al. 1978, Habilov 1979, 1980, 1988, 1992, 2003, Strelkov & Šajmardanov 1983, Butovskij et al. 1985, Pavlinov & Rossolimo 1987, 1998, Malinovskij 1988, Benda et al. 2011, 2012, Rybin et al. 1989, Habilov 1992, Borisenko & Pavlinov 1995, Horáček et al. 2000, Kaškarov & Mitropol′skaâ 2004, Simmons 2005, Benda et al. 2011, 2012, Gricina et al. 2013, Habilov & Tadžibaeva 2013, 2016a, b, 2018, 2020a, b, c, d, 2021a, b, Benda & Gaisler 2015, Habilov et al. 2016, Tadžibaeva & Habilov 2016b, c, 2017a, b, c, 2018, 2019a, d, Benda 2021, etc.). Based on examination of a single specimen of *R. bocharicus* from Afghanistan, Aellen (1959a) suggested to consider this bat a subspecies of an Afro-Arabian species, *R. clivosus* Cretzschmar, 1828 (see Benda & Gaisler 2015 for a review). This suggestion was accepted by some authors (Lindberg 1961, Harrison 1964, Koopman 1966, 1993, 1994, Gaisler 1971, Hayman & Hill 1971, Corbet 1978, Niethammer 1983), although

Hanák (1969), Strelkov (1971) and Felten et al. (1977) found a series of morphological traits differing *R. bocharicus* from *R. clivosus*, and suggested again the separate species position for *R. bocharicus*. Currently, *R. bocharicus* is regarded a separate monotypic species endemic to Central Asian lowland deserts and dry steppes; this status is supported by the available results of molecular genetic analyses (Bailey et al. 2016, Uvizl et al. 2024).

Kaŝenko & Akimov″ (1918: 223) described *R. bocharicus* as a new species based on 50 specimens (without sex identification) from present-day Uzbekistan, one bat originating from Samarkand [Самарканд; = Samarqand; 39°39'N, 66°58'E] and the remaining specimens being from Termez [Термез; = Termiz; 37°13'N, 67°17'E]. This type series is still present in the ZIN collection, Baranova et al. (1981: 13) specified the whole series as alcoholic specimens and the only Samarqand specimen as a male. However, Baranova et al. (1981) reported on 52 specimens instead of 50, and more importantly, they designated a lectotype specimen from the series (the Samarqand bat, ZIN 8702), with a reference to Ognev (1928: 397). However, Ognev (1928: 397) just mentioned a locality of (one of) the type origin and did not designate the lectotype specimen*. Thus, the lectotype designation by Baranova et al. (1981) is unsubstantiated and the type series still represent syntypes, as originally designated by the description authors and the type locality of *R. bocharicus* thus remains 'Samarqand and Termiz'. Bobrinskoj (1925: 358) mentioned his examination of 32 type specimens, so, his understanding corresponded with the original statement by Kaŝenko & Akimov″ (1918).

Interestingly, three different incorrect type localities of *R. bocharicus* appeared in literature (besides the correct version, mentioned by e.g., Bobrinskoj 1925 or Benda et al. 2011). Based perhaps on the slightly confusing note by Ognev (1928), several authors mentioned Samarqand as the type locality (Bogdanov 1953a, Baranova et al. 1981, Strelkov 1981, Pavlinov & Rossolimo 1987). On the other hand, Kuzâkin (1950, 1965) reported Termiz as the type locality, maybe because of the prevailing number of specimens coming from this site. However, a completely erroneous site was mentioned as the type locality most frequently, the Murghab river, South Russian Turkestan [= Murgap river, south-eastern Turkmenistan; ca. 36°08'N, 62°42'E]. This error was first introduced most probably by Ellerman & Morrison-Scott (1951) and then repeated by numerous subsequent authors (DeBlase 1980, Corbet & Hill 1992, Horáček et al. 2000, Csorba et al. 2003, Simmons 2005, Burgin 2019a). The latter site really is an area of occurrence of *R. bocharicus*, however, this bat was first discovered there in 1930, twelve years after the species description and 18 years after the whole type series was collected (1908 and 1912; see Bobrinskoj & Kuzâkin 1937, Baranova et al. 1981).

The year 1917 is frequently mentioned erroneously as the year of description of *R. bocharicus* (see e.g., Bobrinskoj 1925, Ognev 1927, 1928, Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, Aellen 1959a, Strelkov 1963, 1971, 1981, Hanák 1969, Felten et al. 1977, Corbet 1978, Strelkov et al. 1978, Habilov 1979, 1988, 1992, DeBlase 1980, Strelkov & Šajmardanov 1983, Butovskij et al. 1985, Pavlinov & Rossolimo 1987, Corbet & Hill 1992, Borisenko & Pavlinov 1995, Horáček et al. 2000, Csorba et al. 2003, Kaškarov & Mitropol′skaâ 2004, Simmons 2005, Gricina et al. 2013, Habilov & Tadžibaeva 2016b, Burgin 2019a, etc.). However, the description was published in the No. 1–3 of the volume 22 (for 1917) of the *Ežegodnik″ Zoologičeskago Muzeâ Rossijskoj Akademìi Nauk″* (*Ежегодникъ Зоологическаго Музея Россійской Академіи Наукъ*; *Annual of the Zoological Museum of the Russian Academy of Sciences*) which was in fact issued in 1918 (pp. 1–310+i–xvi), and this is the true year of the species description; the rest of the volume 22 (No. 4, pp. 311–350+xvii–xxxviii) was issued in

* Ognev's (1928: 397) statement reads as follows: "Locality of type description: Samarqand (specimen in the collection of the Zoological Museum of the Academy of Sciences)." [Own translation from Russian.] In original it reads as follows: "Место описания типа: Самарканд (Экз. в колл. Зоол. музея Академии наук.)"

1922, when the whole volume was bound. Perhaps for this reason, Baranova et al. (1981: 13) erroneously reported 1922 as the year of description of *R. bocharicus.*

Comparative material. **Afghanistan**: 1 ♂, 1 ♀ (MHNG 974.005, MZLU L59/3167, L59/3185 [S+A]), Grotte Khaftar Khaneh, pres Aibak/Haïbak, alt. 1200 m, 17 May 1959, leg. K. Lindberg; – 1 ♀ (MZLU L57/3116, L57/3183 [S+A]), Grotte Zarmast, 18 October 1957, leg. K. Lindberg; – 1 ♂ (SMF 39222 [S+A]), Pashtunkot, Fariab, Grotte Zarmast, 1295 m, 27 August 1964, leg. D. Meyer-Oehme; – 1 ♂, 1 ♀ (SMF 39221, 39224 [S+A]), Sholgara, Balkh, unbekannte Höhle im Darra Bandi-Haba, 725 m, 11 April 1965, leg. D. Meyer-Oehme; – 1 ♂ (SMF 39223 [S+A]), Takhtar Pul, Balkh, 390 m, 10 April 1965, leg. D. Meyer-Oehme. – **Kirghizstan**: 1 ♂ (NMP 58445 [S+A]), Oš district, 1987, leg. J. Obuch; – 4 ♂♂ (MHNG 1806.062, NMP 58336/2–58336/4 [S+A]), Samarkandyk, Kanigut, 2 July 1988 & 30 September 1992, leg. R. Arlettaz, J. Červený, A. Červená & J. Obuch. – **Uzbekistan**: 1 ♀ (ZMMU S-94718 [S+B]), between Amandara and Mandana, 20 July 1959, leg. O. P. Bogdanov; – 1 ♂, 2 ♀♀ (ZMMU S-94724, S-94737, S-94741 [S+B]), Kara-Kamyš [= Qorakamish], vicinity of Taškent [= Toshkent], 2 November 1945, leg O. P. Bogdanov; – 1 ♂ (ZMMU S-150228 [S]), Samarkand [= Samarqand], date unlisted, leg. A. P. Fedčenko; – 1 ♂, 11 ♀♀ (NMP 91458–91461, 91489–91496 [S+B]), Samarqand, cave, 28 September & 14 October 1963, leg. V. Hanák & A. Sagitov; – 1 ♀ (ZMMU S-15362 [S+B]), Šurča [= Sho'rchi], Surhana [= Surxondaryo] valley, 20 August 1935, leg. A. P. Kuzâkin; – 1 ♂ (ZMMU S-94746 [S+B]), Šurči [= Sho'rchi] District, 20 June 1950, leg. O. P. Bogdanov; – 3 ♂♂, 3 ♀♀ (ZMMU S-15348, S-15349, S-15352, S-15354, S-15355, S-15357 [S+B]), Taškent [= Toshkent], loess cave, 18 September 1935, leg. A. P. Kuzâkin; – 1 ♀ (ZMMU S-29193 [S+B], Taškent [= Toshkent], old town, 16 September 1932, leg. A. P. Kuzjakin; – 1 ♀ (ZMMU S-83963 [S+B], Taškent [= Toshkent] Province, Kurumdûk, 17 May 1950, leg. O. P. Bogdanov; – 2 ♂♂ (ZMMU S-103752, S-103755 [S]), vicinity of Taškent [= Toshkent], 17 November 1921, leg. Alekseev; – 2 ♂♂ (ZMMU S-83961 [S+B]), vicinity of Taškent [= Toshkent], 19 September 1950 & 20 October 1950, leg. O. P. Bogdanov; – 1 ♂ (ZMMU S-94744 [S+B]), vicinity of Taškent [= Toshkent], Karakumuk river, 12 May 1949, leg O. P. Bogdanov; – 1 ♀ (ZMMU S-94747 [S+B]), Termez [= Termiz], 12 May 1949, leg. O. P. Bogdanov.

Records of ectoparasites. **Original data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata turkestanica*: 3 ♂♂ ad, 4 ♀♀ ad [A], from 1 ♂, 12 ♀♀ (NMP 95707–95713, HSU pb6156–6161), Levap, old farm, 5 May 2016. – N y c t e r i b i i d a e: *Phthiridium biarticulatum*: 1 ♀ ad [A], from 1 ♂ ad (NMP 95729), Qarağoč, loess cavity, 9 May 2016. – S p i n t u r n i c i d a e: *Eyndhovenia euryalis oudemansi*: 1 ♂ ad, 1 ♀ ad [P], 17 inds. [A], from 1 ♂, 12 ♀♀ (NMP 95707–95713, HSU pb6156–6161), Levap, old farm, 5 May 2016. – **Published data**: N y c t e r i b i i d a e: *Phthiridium biarticulatum*: 1 ♀, Kuraminskij khrebet [= Kurama] Mts., Altyn-Tonkan [= Altyn-Topkan], 17 December 1978 (Hůrka 1984).

Comments on ectoparasites. In *Rhinolophus bocharicus*, a typical representation of the Palaearctic ectoparasites of the genus *Rhinolophus* was documented in Tajikistan, three species of three families were found in total. All three parasites, *Rhinolophopsylla unipectinata turkestanica* Ioff, 1953, *Phthiridium biarticulatum* Hermann, 1804, and *Eyndhovenia euryalis oudemansi* (Eyndhoven, 1941) were collected in Tajikistan also from *R. ferrumequinum* (although in different localities than from *R. bocharicus*), see above for comments on these taxa. The latter two parasites were found only on these two *Rhinolophus* species in Tajikistan (own data, Hůrka 1984, Stanûkovič & Malinovskij 1992), while *R. u. turkestanica* additionally also on *Myotis blythii* and *M. emarginatus* (own data), see below for details.

Rhinolophus sp. (*Rhinolophus hipposideros* s.l.)

Records. **Published data**: Varzaminar″ [= Ajnī] [**1**], Zarevšan″ [= Zarafšon] river valley, 23 August [= 4 September NS] 1892: coll. 3 inds., ZIN, leg. Glazunov″ (Satunin″ 1910); Varziminor kishlak [= Ajnī], middle Zeravšan [= Zarafšon] river valley, 23 August 1892: coll. 3 inds., leg. D. K. Glazunov (Bobrinskoj & Kuzâkin 1937, Bogdanov 1953a); Varziminor [= Ajnī] in the upper reaches of the Zeravšan [= Zarafšon] river (Kuzâkin 1950); Zeravšan [= Zarafšon] river valley (Kuzâkin 1965); Aini [= Ajnī], southern slopes of the Mountains Turkestanskiy khrebet [= Turkiston Mts.], 8 August 1978 (Hůrka 1984); – Stalinabad [= Dušanbe] [**2**], 1932, leg. Parasitological Section of the Tajikistan Complex Expedition (Vinogradov 1935); near Stalinabad [= Dušanbe], in the Dûšambinka [= Varzob] river bank, loess cave, 22–27 April 1932: 6 inds., ZIN, leg. Parasitological Section of the Tajikistan Complex Expedition, 20 July – 4 August 1935: coll. 6 inds., leg. A. P. Kuzâkin (Bobrinskoj & Kuzâkin 1937, Bogdanov 1953a); near Stalinabad [= Dušanbe], Stalinabadskaâ cave, 20 July 1935: obs. lactating females and nonvolant juveniles, 3–4 August 1935: obs. non-lactating adult females (Kuzâkin 1950); near Dušanbe (Kuzâkin 1965); loess cave in the Dušanbinka river bank (near Gulistan [sic!]), 20 July – 4 August

1935: coll. 6 inds., leg. A. P. Kuzâkin (Tadžibaeva & Habilov 2019b); – Gissar [= Ḩisor] [**3**], 7 July 1935: coll. 1 ind., leg. A. P. Kuzâkin (Bobrinskoj & Kuzâkin 1937, Bogdanov 1953a); Gissar [= Ḩisor] town (Kuzâkin 1950, 1965); Gissar, obs. 2 inds., coll. 1 ind., leg. A. P. Kuzâkin (Bogdanov 1956a); – Horog [= Horuğ] [**4**], a canyon at the confluence of the Šah-Dar′â [= Šahdara] and Gunt rivers, summer 1937: remains of 2 skulls in *Bubo bubo* pellets (Kornev 1941); Horog [= Horuğ], botanical garden, 19 April 1960: coll. 1 ind., leg. A. V. Popov (Ŝerbin 1968); – near Gulistan [= Guliston] kishlak [**5**], 8 km of Stalinabad [= Dušanbe], small cave, 29 March 1953: obs. 1 ♀, deep cave, 23 March 1954: obs. 46 ♂♂, 14 ♀♀ (in four groups), 14 August 1954: obs. 30–40 inds., coll. 1 ♀, ZMMU, leg. O. P. Bogdanov (Bogdanov 1954, 1956a, Habilov 1992); loess cave in the Dušanbinka river bank (near Gulistan), 14 August 1954: coll. 1 ♀, leg. O. P. Bogdanov (Tadžibaeva & Habilov 2019b); – Gandžino [= Gançina] [**6**], 28 August 1964: coll. 1 ind., 25 August 1965: coll. 1 ind., sandstone cave, 29 May 1964: coll. 2 inds., 28 August 1964: obs. 2 inds. (Ŝerbin 1968); – near Zigar kishlak [**7**] (Darvazskij [= Darvoz] Mountains), cowshed building, 21 September 1965: coll. 1 ♀ (Ŝerbin 1968); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan [= Zarnisor] [**8**], abandoned mine, 17 December 1978: coll. 1 ♀ (Habilov 1979, 1992, Tadžibaeva & Habilov 2018), vertical hole, 4 December 1977: exam. 1 ♀ (Habilov 1980, 1992, Habilov & Tadžibaeva 2018), 1 April 1979: exam. 1 ♂, 15 February 1980: exam. 1 ♀, 14 March 1981: exam. 3 ♀♀ (Habilov 1992, Habilov & Tadžibaeva 2018); – near Garm-Čašma [= Garmčašma] [**9**] (40 km south of Horog [= Horuğ]), small karst cave, 14 June / July 1985: obs. 5 inds., coll. 4 ♀♀ (Habilov 1986, 1992); – Varzob river valley [**10**] (Malinovskij 1988); near Varzob, mine, 13 November 1985: coll. 4 ♂♂, 22 March 1986: coll. 2 ♂♂, leg. Malinovskij (Habilov 1992); Varzob river canyon, 18 km cave, 23 August 1986: coll. 1 ♀, leg. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); Romit [sic!], mine, 13 November 1985: coll. 4 ♂♂, 22 March 1986: coll. 2 ♂♂, leg. Malinovskij (Tadžibaeva & Habilov 2019b); – Kondara river valley [**11**] (Malinovskij 1988); near Kondara, mine, 28 September 1985: coll. 2 ♀♀, 29 October 1985: 1 ♂, 4 ♀♀, 17 October 1986: coll. 1 ♂, 2 ♀♀, leg. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); Romit [sic!], mine, 28 September 1985: coll. 2 ♀♀, leg. K. Û. Malinovskij (Tadžibaeva & Habilov 2019b); near Kondara, mine, 29 October 1985: 1 ♂, 4 ♀♀, leg. K. Û. Malinovskij (Tadžibaeva & Habilov 2019b); – Takob [= Tagob] river valley [**12**] (Malinovskij 1988); – Sardaimiena river valley, near Ramit [= Romit] [**13**], mine, 30–40 inds. (Malinovskij 1988);

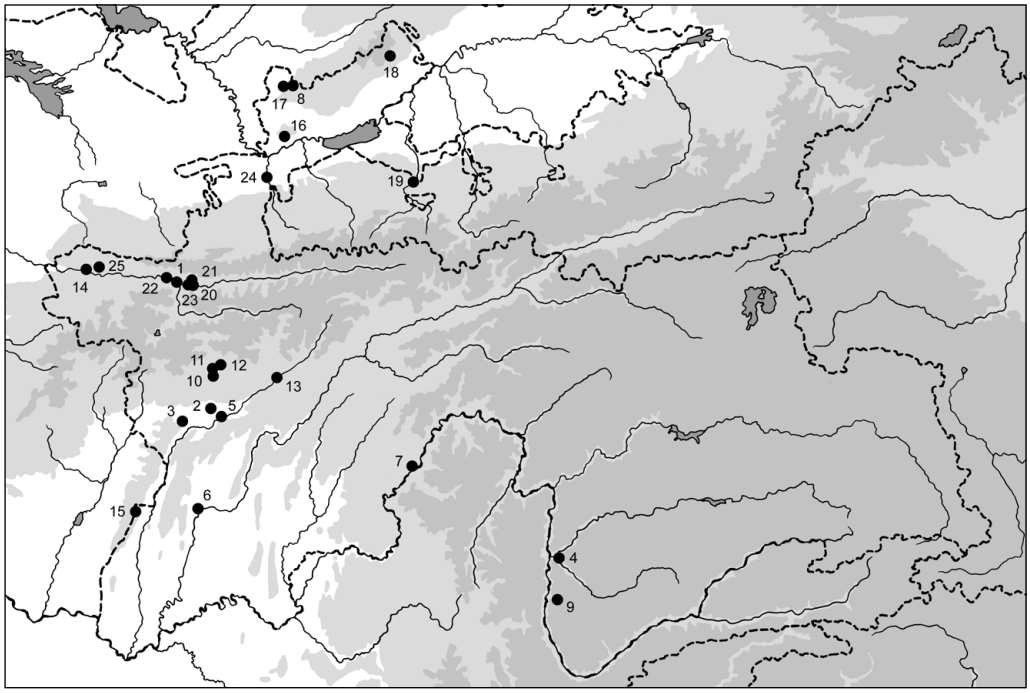


Fig. 28. Records of the small-sized horseshoe bats (*Rhinolophus* sp. / *Rhinolophus hipposideros* s.l.) in Tajikistan.

near Romit, mine, 6 May 1984: coll. 4 ♂♂, 9 November 1985: coll. 15 ♂♂, 4 ♀♀, 20 March 1986: coll. 14 ♂♂, 2 ♀♀, 12 April 1986: coll. 5 ♂♂, 7 ♀♀, 6 April 1989: exam. 29 inds., incl. 7 ♂♂, 13 ♀♀, leg. Malinovskij (Habilov 1992); Varzob river valley [sic!], 9 November 1985: exam. 15 ♂♂, 4 ♀♀, 20 March 1986: coll. 14 ♂♂, 2 ♀♀, 12 April 1986: coll. 5 ♂♂, 7 ♀♀, leg. K. Û. Malinovskij (Tadžibaeva & Habilov 2019b); Romit, mine, 6 April 1989: exam. 29 inds., incl. 7 ♂♂, 13 ♀♀, leg. T. K. Habilov & K. Û. Malinovskij (Tadžibaeva & Habilov 2019b); – near Majkata [= Majkatta] kishlak [**14**], Zeravšan [= Zarafšon] river valley, 27 March 1979: 1 ♂, leg. Š. H. Muratov (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018); – Babatag [**15**], 1973: 1 ind., leg. G. Zarubin (Habilov 1992); – Mogol-Tau [= Mogoltau] Mountains, near Uč-Teppa [= Učteppa] kishlak [**16**], abadoned mine, 12 May 1979: coll. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2019a); – Kuraminskij [= Kurama] Mountains, near Čol-Ata [= Čolota] [**17**], 5 May 1983: exam. 3 ♂♂, 1 ♀, 13 May 1983: coll. 1 ♂, 1 ♀ (Habilov 1992, Habilov & Tadžibaeva 2018); – Kuraminskij [= Kurama] Mountains, Gudos [**18**], 3 March 1979: exam. 3 ♂♂ (Habilov 1992, Habilov & Tadžibaeva 2018); – northern slope of the Turkestanskij [= Turkiston] Montains, near Čorku [= Čorkuḫ] kishlak [**19**], Hučai-gor cave, 26 March 1978: exam. 1 ♂ (Habilov 1992, Habilov & Tadžibaeva 2018, Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, Tomin kishlak [**20**], obs. a colony of 14 inds., incl. 3 ♂♂, 9 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, Puthin kishlak [**21**], 12 August 1978: exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, Dar-Dar / Dardar [**22**], 16 August 1978: exam. 1 ♂, 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, Zoosun [= Zasun] [**23**], 19 August 1978: exam. 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018); – Ak-Su [= Aksu] river bank, Metar [= Meḫtar] kishlak («Mazori Langar») [**24**], 15 May 1979: exam. 1 ♀ (Habilov 1992, Habilov & Tadžibaeva 2018); – Zeravšan [= Zarafšon] river valley, near Jory [= Ërī] / Ëri [= Ërī] kishlak [**25**] (Habilov 1992, Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018).

Distribution. The small-sized bats of the genus *Rhinolophus* were traditionally assigned to *Rhinolophus hipposideros* [s.l.], in fact a parataxon comprising two species, *R. hipposideros* s.str. and *R.* aff. *lepidus* (the name sensu Horáček et al. 2000: 101; *R. lepidus* sensu Benda et al. 2011 and subsequent authors, see below). The distribution data obtained before 2016, when the co-occurrence of these two species was first documented in Tajikistan, cannot be assigned to either of them without a revision and proper re-identification of particular records.

The small-sized *Rhinolophus* has two occurrence areas in West Turkestan separated by a ca. 750 km wide gap of the desert lowlands (see reviews by Benda et al 2011, 2016a); the smaller, western area of the Kopetdagh Mountains (in south-western Turkmenistan) and the larger, eastern area along the western slopes of the Tien-Shan and Pamirs (southern Kazakhstan, central and eastern Uzbekistan, south-western Kirghizstan, western Tajikistan). The biggest number of records in the larger eastern area is available from Tajikistan (see Habilov 1992 and Benda et al. 2016a). While only *R. hipposideros* s.str. was found in the western area, wide co-occurrence of both concerned species was documented in the eastern area (Benda et al. 2011, 2016a, Habilov & Tadžibaeva 2016a, b, 2018, 2020b, Tadžibaeva & Habilov 2016b, 2018, 2017a).

Considering the published data, this parataxon is a common faunal element in Tajikistan (Fig. 28), 25 record localities are known. Of them, only two records, based on bats housed in the ZIN and ZMMU collections, were re-identified concerning the new knowledge on taxonomic affiliation of the small-sized *Rhinolophus* bats, both from the Dušanbe area (Benda et al. 2016a; see also the species accounts below). Five ZIN specimens collected by the Tajikistan Complex Expedition in April 1932 and two ZMMU specimens collected by A. P. Kuzâkin in August 1935, all in a cave in the Varzob river bank at Dušanbe (cf. Vinogradov 1935, Bobrinskoj & Kuzâkin 1937, Kuzâkin 1950), were identified as *R. hipposideros* s.str. A female housed in the ZMMU collection and collected by O. P. Bogdanov in a small cave near Guliston (then 8 km east of Dušanbe, today a part of Dušanbe) on 14 August 1954 (cf. Bogdanov 1954, 1956a) was identified as *R.* aff. *lepidus*. However, more records were made from these two sites situated closely to each other (see Habilov 1992), and in fact, both species could be found at both sites. Thus, all 25 localities still remain potential record sites of both species included in the parataxon and cannot be assigned to only one of them. The revised specimens just confirmed the occurrence of both species in sympatry in the

area of Dušanbe, but did not exclude any record site as an exclusive occurrence spot of only one species. Such common occurrence was documented also in other parts of eastern West Turkestan, viz. Oš Province of southern Kirghizstan (Benda et al. 2011), Nuratau Mountains and Toshkent Province in Uzbekistan (Benda et al. 2016a), and the Kurama Mountains of northern Tajikistan (Habilov & Tadžibaeva 2018), as well as in south-eastern Afghanistan (see Benda & Gaisler 2015).

Although it is clear that the old data from Tajikistan published as *R. hipposideros* s.l. cannot be simply assigned to one of the newly recognised species without a revision (and based on the revised records, both species are almost equally frequent, see below), Tadžibaeva & Habilov (2017a, 2018, 2019a, b) and Tadžibaeva (2018) mentioned the published records of *R. hipposideros* s.l. as proper records of *R. hipposideros* s.str. However, this approach is not followed here and all records made before 2016 that were not revised concerning the species determination are here referred to the parataxon *R. hipposideros* s.l. The records of this parataxon come mainly from medium altitudes (median 1197 m a. s. l.; Fig. 10, Table 3) of the western and southern parts of Tajikistan (Fig. 28). Although they are spread across a wide altitudinal range (2199 m), the distribution of records indicates that both species of the parataxon prefer a more or less similar landscape type, hilly areas at 800–1500 m a. s. l. (Fig. 10).

Records of ectoparasites. **Published data**: N y c t e r i b i i d a e: *Phthiridium simile*: 7 ♂♂, 3 ♀♀, Aini [= Ajni], southern slopes of the mountains Turkestanskiy khrebet [= Turkiston Mts.], 8 August 1978 (Hůrka 1984).

Comments on ectoparasites. The bat fly *Phthiridium simile* Hůrka, 1984 is a species described based on the specimens originating from western Tajikistan (Ajni; see Records of ectoparasites) and south-western Kirghizstan (Ohna Cave near Kadamdžaj, Batken Prov.; 40°03'N, 71°39'E), collected from *Rhinolophus hipposideros* [s.l.] (Hůrka 1984). It remains an endemic of the eastern part of West Turkestan, the known records of this bat fly are restricted to these two mentioned localities (Hůrka 1984).

Variation. As indicated above, the parataxon *Rhinolophus hipposideros* s.l. comprises two species in the eastern part of West Turkestan including Tajikistan, *R. hipposideros* s.str. and *R.* aff. *lepidus*. The geographical variation of *R. hipposideros* s.str. in its whole distribution range has been recently revised by Benda et al. (2022), see below for a review concerning the Tajikistani populations.

The other species, previously identified and here named tentatively as *Rhinolophus* aff. *lepidus*, has been proved to occur in Tajikistan only recently, see Benda et al. (2016a) and Habilov & Tadžibaeva (2016a, b), and below. From Kirghizstan and Uzbekistan, the occurrence of this bat was reported earlier, based on specimens collected in the 1980s (see Zima et al. 1992a, Horáček & Zima 1996, Horáček et al. 2000, Benda et al. 2011, 2016a).

Traditionally, all small-sized horseshoe bats from West Turkestan were considered belonging to *R. hipposideros* (Satunin″ 1910, 1914, Ognev 1927, 1928, Bobrinskoj 1925, Bobrinskoj & Kuzâkin 1937, Kuzâkin 1950, 1965, Bogdanov 1953a, 1956a, 1974, Strelkov 1963, 1981, Rybin 1980, Khabilov 1989b, Habilov 1992, 1993, 2003, Rybin et al. 1989, etc.). In the 1980s, a series of small-sized horseshoe bats was collected during several research trips to Kirghizstan, and these specimens exhibited clear differences from the western Palaearctic populations of *R. hipposideros* s.str. both in the morphological characters and, in particular, in the karyotype.

Thus, the first indications of the occurrence of *R.* aff. *lepidus* in West Turkestan arose from the analyses of specimens of small-sized horseshoe bats collected during field expeditions to the Oš Province in southern Kirghizstan, supplemented with the karyological studies by Zima et al. (1991, 1992a). From these bats (under *R. hipposideros* or *R.* aff. *hipposideros*), the latter authors reported the chromosome number of 2n=62, a number typical for Oriental representatives of the genus *Rhinolophus* as reviewed by Zima et al. (1992a). Later on, Horáček & Zima (1996) sum-

marised morphological differences between the concerned small-sized Kirghizstani populations of horseshoe bats and *R. hipposideros* s.str. from Europe and south-western Asia with 2n=56 and 2n=58, compared them with a set of Asian small-sized forms and suggested its separate species status. Horáček et al. (2000) again suggested a possible separate taxonomic position of the Kirghizstani horseshoe bats and mentioned their close affinity to *R. lepidus* Blyth, 1844 and not to *R. hipposideros* s.str. In various parts of their comprehensive paper, Horáček et al. (2000) used three name variants considering the Kirghizstani populations, *R. lepidus*, *R*. aff. *lepidus* and *R. kirgisorum* (see the synonymy below). However, they did not give any description of the species named by the latter name, which thus represents a nomen nudum.

Horáček et al. (2000) mentioned their findings made on the specimens (referred to a possible new species) collected during a trip to southern Kirghizstan in August 1984. Benda et al. (2011) reported on specimens that were caught during two trips by J. Červený and his colleagues to southern Kirghizstan in July 1988 and May 1990, and by J. Moravec to central Uzbekistan in October 1985, and all of them deposited in the NMP collection. From two of the NMP specimens from Kirghizstan collected in 1990, the standard karyotype characteristics were described by Zima et al. (1991, 1992a). Moreover, Benda et al. (2011) demonstrated that *R.* aff. *lepidus* occurs in sympatry (and even in syntopy) with *R. hipposideros* s.str. in southern Kirghizstan and this situation perhaps explains the contradictory results of the molecular genetic analysis by Guillén Servent et al. (2003; see Comments below for details); most probably, the latter authors analysed *R. hipposideros* s.str. from Kirghizstan instead of *R.* aff. *lepidus*, and thus, the recorded genetic distance naturally corresponded to differences within a single species.

Benda et al. (2011), who referred the specimens of *R.* aff. *lepidus* to *R. lepidus*, added basic morphological characteristics of these bats to differentiate them from sympatric *R. hipposideros*, the only small-sized congener formerly reported to occur in West Turkestan (see above). They reported differences between these two species in the body and skull size, noseleaf morphology, relative dimensions of wing finger segments, and skull shape, their findings could be summarised as follows: specimens of *R.* aff. *lepidus* are larger in the body size than the samples of *R. hipposideros* from West Turkestan, the Middle East, Africa, and the European Mediterranean; in *R.* aff. *lepidus* the connecting process of the noseleaf is high and prominent, while it is almost absent in *R. hipposideros*; the tip of sella is shorter in *R.* aff. *lepidus* than in *R. hipposideros*; the third wing metacarpal is relatively (to the length of the third digit) much longer in *R*. aff. *lepidus* than in *R. hipposideros*; the medial phalanx of the fourth wing finger is relatively (to the length of the proximal phalanx) much longer in *R. hipposideros* than in *R*. aff. *lepidus*; skulls of *R.* aff. *lepidus* have absolutely and relatively more massive (longer, higher, and wider) rostra and broader braincases than the skulls of *R. hipposideros*; the upper canines are more massive in *R.* aff. *lepidus* than in *R. hipposideros*, while the small upper premolars are absolutely and relatively more gracile in *R.* aff. *lepidus* than in *R. hipposideros*. Thus, the differentiation and identification of the two species in West Turkestan is not a problematic task (see also Benda & Gaisler 2015, Benda et al. 2016a, Habilov & Tadžibaeva 2016a, 2018, Habilov et al. 2018).

Benda et al. (2016a), besides the revision of identification tools differentiating between the two small-sized *Rhinolophus* species occurring in sympatry in West Turkestan, compared the wing and cranial dimensions of the West Turkestani samples of *R*. aff. *lepidus* and Afghanistani specimens identified as *R. lepidus* by previous authors (Aellen 1959a, Lindberg 1961, Felten et al. 1977, Bates & Harrison 1997, Csorba et al. 2003). This comparison did not show any significant difference in absolute and relative dimensions, the Afghanistani bats were just slightly larger in their size parameters. Aellen (1959a) and Felten et al. (1977) assigned their Afghanistani specimens of *R. lepidus* to the subspecies *R. l. monticola* Andersen, 1905. The latter form was described as a separate species similar to *R. lepidus* by Andersen (1905), based on a specimen collected in

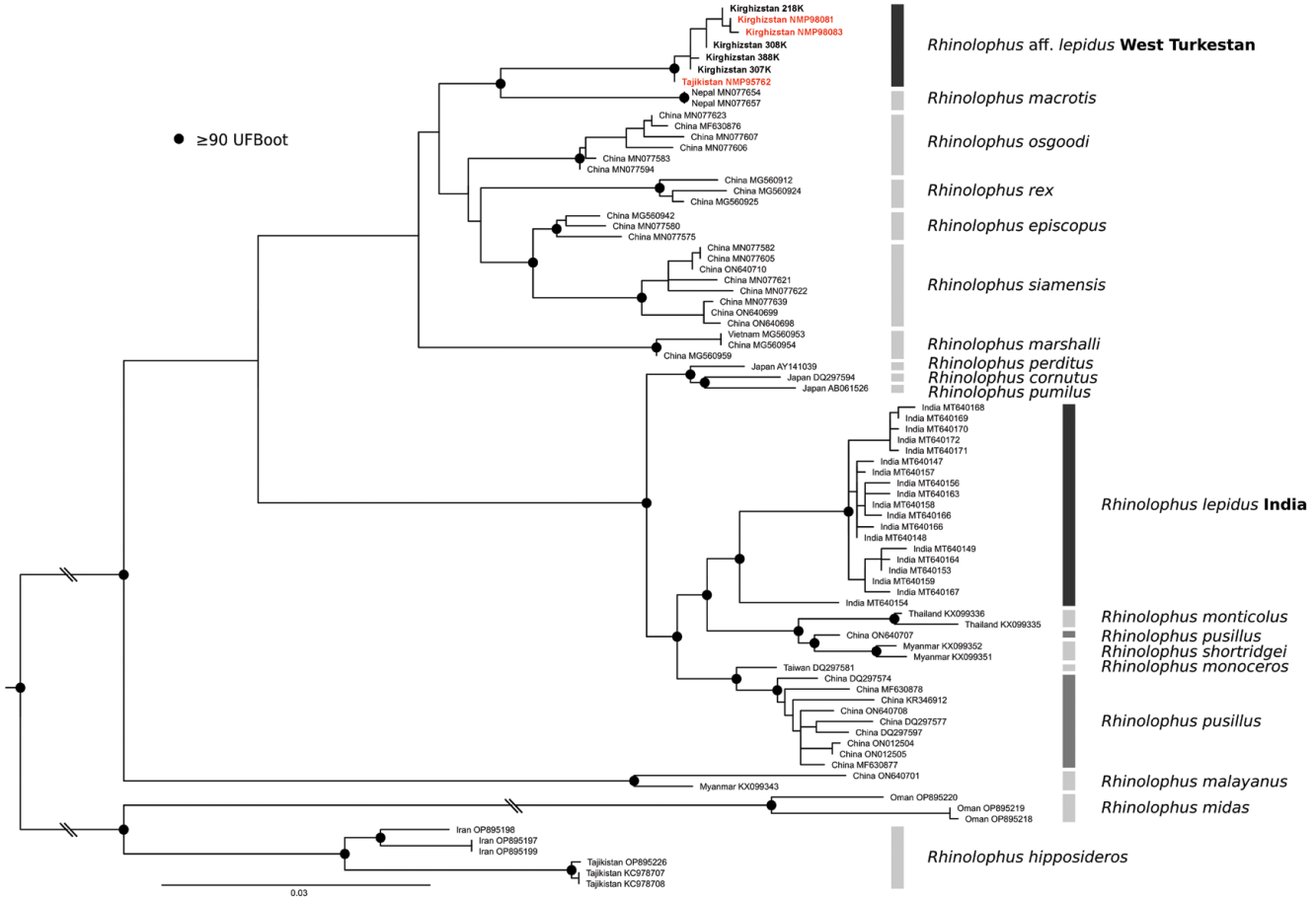


Fig. 29. Maximum likelihood tree depicting the phylogenetic relationships among *Rhinolophus* species within the *R. macrotis* and *R. pusillus* groups, reconstructed using a cytochrome *b* dataset; red labelled haplotypes denote type specimens (for details see text). Black dots on the nodes indicate branch support values ≥90% UFBoot. The lineages *R. siamensis*, *R. episcopus*, and *R. osgoodi* correspond to Clades 1, 2, and 3, respectively, by Liu et al. (2019).

Masuri (= Mussoorie, Uttarakhand, India; 30°27'N, 78°05'E; Andersen 1905: 124). As a separate species morphologically close to *R. lepidus* Blyth, 1844, this form was regarded by Ellerman & Morrison-Scott (1951) and Sinha (1973), while as a subspecies of the latter species by Aellen (1959a), Felten et al. (1977), Hill & Yoshiyuki (1980), Koopman (1994), Bates & Harrison (1997), Csorba et al. (2003), Simmons (2005), Srinivasulu & Srinivasulu (2012), Choudhury (2016), and Burgin (2019a). On the other hand, Das (1986) and Corbet & Hill (1992) considered *R. monticola* just a junior synonym of *R. lepidus*, without a separate subspecies status.

The dimensions of the type specimen of *R. monticola* given by Andersen (1905) are similar to those presented by Felten et al. (1977) for the samples from Afghanistan and Benda et al. (2016a) from West Turkestan (only the forearm length is markedly smaller in the type of *monticola*). This dimensional proximity suggests possible taxonomic affiliation of the Turkestani populations, and this view was generally followed by Benda et al. (2011, 2016a), Benda & Gaisler (2015), and Burgin (2019a) in the assignation of the Turkestani and Afghanistani populations (of *R.* aff. *lepidus*) to *R. lepidus* s.str. On the other hand, Bates & Harrison (1997) suggested possible confusion of the type material of *R. monticola* that is housed in the BMNH collection, which implies a question of applicability of this name.

As demonstrated by Benda et al. (2011, 2016a), the simple comparison of body and skull dimensions is a useful method for the differentiation between *R.* aff. *lepidus* and *R. hipposideros* in the conditions of their sympatric occurrence in West Turkestan and Afghanistan, where no other small-sized *Rhinolophus* bats are known to occur. However, as the morphology and karyology showed, the West Turkestani *R.* aff. *lepidus* is a part of the Oriental radiation of the genus *Rhinolophus*, and its close phylogenetic position cannot be solved without the use of molecular genetic methods. The taxonomic arrangement of the Oriental fauna of small-sized horseshoe bats underwent considerable changes in the last years, the composition of particular species groups was re-built with respect to the results of molecular genetic studies (Li et al. 2006, Soisook et al. 2008, 2016, Sun et al. 2008, 2016, Zhang et al. 2018, Liu et al. 2019, Chattopadhyay et al. 2021, Chornelia et al. 2022, etc.). Such studies showed existence of cryptic lineages, suggested re-arrangements of particular group compositions based on phylogenetic relations among populations/species, and mainly, apparent limits of the traditionally employed morphological characters for taxonomical assessments, suggesting an adaptive and convergent nature of many phenotypes.

Thus, a relevant evaluation of the phylogenetic position of the West Turkestani populations affiliated with *R.* aff. *lepidus* seems to be possible only after the use of molecular genetic methods. For such analysis, we newly generated three cytochrome *b* gene sequences giving one haplotype from the specimens of *R.* aff. *lepidus* from Tajikistan and eight sequences of six haplotypes from Kirghizstani bats. These unique sequences were supplemented with GenBank sequences and the final mitochondrial dataset thus comprised 103 sequences of the Asian *Rhinolophus* bats. The cytochrome *b* gene dataset was 1140 bp long and contained 321 parsimony informative positions (28.16% of the total length). In the phylogenetic tree obtained by the maximum likelihood analysis (Fig. 29), *R.* aff. *lepidus* from West Turkestan formed a separated branch (bootstrap percentage [BP]=100) in close relationship to *R. macrotis* Blyth, 1844 from Nepal (BP=95), and *R. osgoodi* Sanborn, 1939, *R. rex* Allen, 1923, *R. episcopus* Allen, 1923, *R. marshalli* Thonglongya, 1973, and *R. siamensis* Gyldenstolpe, 1917, all of them sampled in China (plus one sequence of *R. marshalli* from Vietnam), altogether members of the *R. macrotis* group (as defined by Zhang et al. 2018 and reviewed by Burgin 2019a). The node connecting all these species (= *R. macrotis* group) was moderately supported (BP=89), while the exact relationships among the species of the group were not properly resolved. The sequences of *R. lepidus* s.str. from India, where the type locality of this species is situated*, formed another separated branch (BP=93) in close relationship with a lineage composed of *R. monticolus* Soisook, Karapan, Srikrachang, Dejtaradol, Nualcharoen, Bumrung-

sri, Oo, Aung, Bates, Harutyunyan, Buś et Bogdanowicz, 2016, *R. shortridgei* Andersen, 1918, *R. monoceros* Andersen, 1905, and one sequence assigned to *R. pusillus* Temminck, 1834 from China, both groups in a sister position to a group of other sequences of *R. pusillus* from China and Taiwan, and then to a lineage containing the Japanese taxa, *R. cornutus* Temminck, 1834, *R. pumilus* Andersen, 1905, and *R. perditus* Andersen, 1918, all members of the *R. pusillus* group (Burgin 2019a). The group connecting these species together (= *R. pusillus* group) had a high branch support (BP=100). As outgroups, *R. malayanus* Bonhote, 1903 from Burma and China and *R. hipposideros* group (*R. hipposideros* from Tajikistan and Iran and *R. midas* Andersen, 1905 from Oman) formed two branches (BP=100) that were not closely related to any species mentioned above.

The analysis of the mitochondrial marker demonstrated the lineage created by the sequences of *R.* aff. *lepidus* from West Turkestan being neither a part of the species rank of *R. lepidus* nor a part of the *R. pusillus* group containing *R. lepidus* s.str. (Burgin 2019a). Instead, this lineage is embedded within the *R. macrotis* group (contra Horáček et al. 2000, Benda et al. 2011, 2016a, Benda & Gaisler 2015, Burgin 2019a), where it creates a lineage separated from all other sequences and lineages. This lineage shows a genetic distance of 3.44–5.63% from other lineages/species of the group (Table 7). This range represents rather a large difference considering the distances found among other members of the group,

* the type locality of *Rhinolophus lepidus* was defined by Blyth (1844: 487) as follows: "[The type specimens] were both probably obtained in the vicinity of Calcutta [= Kolkata, West Bengal, India; 22°34'N, 88°22'E].''; for discussion of the type locality see Das (1986), Koopman (1993), and/or Simmons (2005), all these authors mentioned the type locality as Calcutta with a question mark.

Table 7. Percent pairwise unncorrected genetic distances among and within reconstructed *Rhinolophus* phylogroups (see Fig. 29) based on analysis of the cytochrome *b* gene sequences (see Appendix II)

	aff. *lepidus*	*macrotis*	*osgoodi*	*rex*	*episcopus*	*siamensis*	*marshalli*	*perditus*	*cornutus*	*pumilus*	*lepidus*	*monticolus*	*shortridgei*	*pusillus*	*malayanus*
aff. *lepidus*	0.00–0.54														
macrotis	3.51–3.99	×													
osgoodi	3.53–5.27	3.51–4.55	0.00–1.14												
rex	4.36–5.18	4.08–4.47	3.34–4.66	0.70–1.23											
episcopus	3.44–4.38	3.60–3.80	2.37–3.86	2.81–3.51	0.00–1.14										
siamensis	3.83–4.91	3.88–4.27	2.98–4.12	3.83–4.83	2.27–2.89	0.00–1.64									
marshalli	4.80–5.63	4.84–5.22	3.95–5.27	4.13–5.18	3.78–4.75	4.19–5.54	0.00–0.70								
perditus	6.71–7.07	7.08–7.10	6.82–7.39	7.01–8.14	7.20–7.58	7.77–8.33	7.20–7.39	×							
cornutus	7.17–7.62	7.41	6.68–7.29	7.38–8.08	7.29–7.56	7.21–7.73	7.29–7.56	1.14	×						
pumillus	6.99–7.45	7.20–7.21	6.49–7.28	7.03–7.73	7.12–7.37	7.02–7.47	7.12–7.21	2.08	1.76	×					
lepidus	7.81–8.49	8.15–8.83	7.63–8.84	8.00–9.21	7.81–8.65	7.81–8.65	8.19–8.93	3.21–4.01	3.44–4.09	3.44–4.28	0.00–2.88				
monticolus	8.09–8.31	9.32–9.68	8.43–9.45	8.66–9.34	8.77–9.57	8.77–9.23	8.77–9.11	3.81–4.44	3.87–4.44	3.87–4.21	3.30–5.01	0.80			
shortridgei	7.53–7.74	8.85–9.08	7.64–8.66	8.10–8.88	8.10–8.77	8.21–8.77	8.31–8.67	2.96–3.17	3.64–3.76	3.87–3.99	3.53–4.79	2.05–2.96	0.57		
pusillus	7.17–8.33	7.69–8.37	7.00–8.17	7.38–8.61	7.29–8.10	7.38–8.20	7.73–8.41	2.65–4.36	2.46–3.51	2.81–3.87	2.42–4.56	1.71–4.78	1.25–4.22	0.09–3.38	
malayanus	8.7–10.2	8.8–9.4	8.4–9.1	9.1–9.8	8.8–9.5	8.7–9.3	8.4–9.4	9.5–10.6	9.5–9.7	9.1–9.8	8.3–10.2	10.1–11.4	9.6–10.7	9.0–10.4	2.85
hipposideros	11.8–13.2	11.9–12.8	11.1–12.8	11.8–12.9	11.6–13.1	11.7–13.0	12.2–13.2	12.5–14.2	12.7–13.9	12.5–13.5	12.9–14.5	13.1–14.4	13.2–14.9	11.8–14.2	12.5–14.1
midas	12.5–13.3	13.4–14.0	12.4–13.1	12.3–13.4	13.2–14.1	13.0–13.8	12.8–13.8	13.3–13.6	13.5–13.8	13.6–13.9	13.9–15.4	13.3–14.2	13.7–14.1	13.0–14.1	13.3–14.2

representing the range of 2.27–5.54%; the smallest distance being between *R. episcopus* and *R. siamensis* (2.27–2.89%) and the largest between *R. siamensis* and *R. marshalli* (4.19–5.54%; Table 7). Regarding the morphological differences among the species of the *R. macrotis* group and the genetic distances among their mitochondrial sequences, the particular species are better defined by the traditional- ly employed evidence, the morphological traits like body and skull size, noseleaf structure, and echolocation parameters, than the differences in their mitochondrial genome, which are rather minute (although these species were shown to be sufficiently defined by their nuclear genomes, see Liu et al. 2019). The genetic separation of West Turkestani *R*. aff. *lepidus* in the compared mitochondrial marker from other lineages is one of the deepest among all of the *R. macrotis* group, and this gives a strong cause to regard this lineage a species of its own, in concurrence with suppositions by Zima et al. (1992a) and Horáček et al. (2000).

All members of the *R. macrotis* group are distributed in southern China and/or Indochina but *R. macrotis* (Table 8). The latter species occurs in southern China, Indochina, Malaya, Sumatra, and Philippines, but also in northern India, Nepal, and northern Pakistan (Csorba et al. 2003, Burgin 2019a). While the nominotypical subspecies of *R. macrotis* has been reported from Nepal and India (including Uttarakhand), a separate subspecies *R. macrotis topalius* Csorba et Bates, 2016 was described from northern Pakistan, and other subspecies live in the eastern part of the species range (Csorba et al. 2003, Csorba & Bates 2016, Burgin 2019a). The Pakistani population (originally described as *R. macrotis topali* Csorba et Bates, 1995 nec *R. ferrumequinum topali* Kretzoi, 1977), known from several (type) specimens collected only at the type locality, the Kakul phosphate mine, Abottabad, Pakistan (Khyber Pakhtunkhwa Prov.; 34°12'N, 73°17'E; Csorba & Bates 1995: 286), is the population of the *R. macrotis* group, distributed closest to the range of *R*. aff. *lepidus* from West Turkestan. The smallest geographic distance between these ranges is ca. 620 km; however, it is across the highest ranges of the Hindu Kush preventing any possibility of contacts between the populations.

Since the population of *R. macrotis topalius* has not been sampled for sequencing and its phylogenetic position in relation to *R.* aff. *lepidus* thus remains uncertain, it is particularly important to mention the comparison of morphological characters of these two populations. The diagnosis of *R. m. topalius* by Csorba & Bates (1995) stressed the extremely small second lower premolar (P_3), conforming to the situation in *R.* aff. *lepidus*. However, Csorba & Bates (1995) mentioned several differences from *R.* aff. *lepidus*; *R. m. topalius* is distinctly larger than *R.* aff. *lepidus*, moreover without a dimensional overlap (LAt 44.7–46.2 mm, mean 45.4 mm, in *R. m. topalius*, vs. 38.4–43.0 mm, mean 41.1 mm, in *R.* aff. *lepidus*; LOc 18.01–18.32 mm, mean 18.16 mm, vs. 15.87–16.63 mm, mean 16.26 mm; CM^3 6.48–6.68 mm, mean 6.59 mm, vs. 5.59–6.29 mm, mean 5.86 mm; see Csorba & Bates 1995: 287, and Table 9). The pelage colouration in *R. m*. *topalius* is reported as very pale with almost white underparts, while in *R.* aff. *lepidus* it is pale brown and only slightly paler in its ventral aspect (Figs. 30–32, 47, 48). The connecting process of the noseleaf is high and tapered, and curved anteriorly in *R. m*. *topalius*, while simply rounded in *R.* aff. *lepidus*. Correspondingly to other forms of the *R. macrotis* group, the palate is rather long in *R. m*. *topalius* (53.6–56.6% of the upper tooth-row length, CM^3, mean 54.8%; 50–70% in other species of the group, see Tu et al. 2017), compared to the relatively short palate in *R.* aff. *lepidus* (36–40%). The infraorbital foramen is situated above the distal margin (metastyle) of the second upper molar (M^2) in *R. m*. *topalius* and in most of the remaining species of the group (see Csorba & Bates 1995, Csorba et al. 2003, Tu et al. 2017), while above the mesostyle of M^2 in *R.* aff. *lepidus*. A lack of overlap in body and skull size and various phenetic characters suggests that *R. m*. *topalius* from Pakistan and *R.* aff. *lepidus* from West Turkestan represent two separate phenotypically distinct entities. Other populations of the *R. macrotis* group, either from northern India and Nepal or from southern China and Indochina represent separate phylogenetic lineages,

Table 8. Review of species, their body size and basic echolocation parameters of the *Rhinolophus macrotis*, *R. pusillus*, and *R. hipposideros* groups; LAt – forearm length range (sensu Burgin 2019a), PF – peak frequency (mean±SD / range; reference/s added)

species	distribution range	LAt [mm]	PF [kHz]	echolocation data origin	reference
R. kirghisorum sp. nov.	West Turkestan, Afghanistan	39–42	104.8±4.4 98.2–110.4	Tajikistan, Kirghizstan	this study
***macrotis* group**					
R. macrotis Blyth, 1844	India, Indochina, Sumatra, Philippines	40–50	57.2±0.7	China	Sun et al. 2008, Shi et al. 2009, Li et al. 2014
			66.4±0.9 65.2–67.7	Vietnam	Furey et al. 2009
			50.0±2.2 47.2–53.9	China	Zhang et al. 2009, 2018
			49.5±3.2 49.3–52.8	China	Wu et al. 2015, Sun et al. 2016
			74.6–77.7		Chornelia & Hughes 2023
R. osgoodi Sanborn, 1939	China	40–45	47.1±0.3	China	López-Bosch et al. 2021
			69.1±0.4	China	Wu et al. 2015
			91.3±0.8	China	Dai et al. 2023
R. episcopus Allen, 1923	China, Indochina	40–52	48.8±0.6	China	Sun et al. 2008
			51.1±5.2 44.8–52.9	China	Liu et al. 2021
			57.32±0.6	China	López-Bosch et al. 2021
			59.2±7.1 43.8–63.6	Vietnam	Győrössy et al. 2024
R. siamensis Gyldenstolpe, 1917	China, Indochina	36–41	65.5±4.9 60.0–69.3	China Laos,	Zhang et al. 2009, 2018
			68.0–76.4	Cambodia	Furey et al. 2021
			73.6±3.6 68.3–77.8	Vietnam	Győrössy et al. 2024
R. schnitzleri Wu Yi et Thong, 2011	China	54–58	24.0±0.5	China	López-Bosch et al. 2021
R. rex Allen, 1923	China, Indochina	53–63	24.9±0.4 23.7–26.4	China	Zhang et al. 2009, 2018, Wu et al. 2015, Chornelia & Hughes
			29.6±2.2 25.1–34.19	Vietnam	Győrössy et al. 2024 2023
R. marshalli Thonglongya, 1973	China, Indochina	38–48	43.6±1.0 41.8–44.6	China Laos,	Liu et al. 2009, Zhang et al. 2009, 2018, Wu et al. 2015
			43.5 40.0–45.8	Cambodia	Furey et al. 2021, Chornelia & Hughes 2023
			44.3±1.3 42.4–46.1	Vietnam	Győrössy et al. 2024
***pusillus* group**					
R. cornutus Temminck, 1834	Japan	37–42	105.1±0.4	Japan	Huihua et al. 2003
			109.7±1.05 107.1–110.8	Japan	Funakoshi 2010, Funakoshi et al. 2010
			103–111	Japan	Burgin 2019a
R. pumilus Andersen, 1905	Ryukyu Isls.	36–44	105.6–120.1	Ryukyu Isls.	Yoshino et al. 2006
R. perditus Andersen, 1918	Ryukyu Isls.	40–43	92–98		Burgin 2019a

Table 8. (continued)

species	distribution range	LAt mm	PF kHz	echolocation data origin	reference
R. monticolus Soisook et al., 2016	Indochina	42–44	83.6–93.0	Thailand, Laos	Soisook et al. 2016
R. shortridgei Andersen, 1918	India, Burma, China	38–43	94.5–100.7	Burma	Soisook et al. 2016
R. monoceros Andersen, 1905	Taiwan	34–40	109–114	Taiwan	Chen et al. 2009
			111.1±2.6	Taiwan	Chou & Cheng 2012
R. pusillus Temminck, 1834	India, Indochina, China, Sunda Isls.	33–42	90.0–95.0	Thailand	Robinson 1996
			107.1±2.1	China	Li et al. 2006, Zhang et al. 2009,
			100.3–113.9		Jiang et al. 2010, Wu et al. 2015
			110.8±1.7	China	Wei et al. 2006
			105.0±1.2	Vietnam	Furey et al. 2009
			102.3–106.1		
			112.2±1.3	Cambodia	Phauk et al. 2013
			108.9–114.1		
			110.7±1.9	Thailand	Soisook et al. 2016
			107.3–115.2		
			111.5	Uttarakhand	Chakravarty et al. 2020
			106.1±7.5	Vietnam	Győrössy et al. 2024
			72.6–119.2		
R. subbadius Blyth, 1844	India, China, Indochina	33–38		no data	López-Bosch et al. 2021
R. convexus Csorba, 1997	Indochina	42–43	92		Burgin 2019a
R. cognatus Andersen, 1906	Andaman Isls.	37–41	89.9±1.5	Andaman Isls.	Srinivasulu et al. 2017
			85.2–92.1		
R. refulgens Andersen, 1905	Indochina, Sumatra	36–43	102.1±1.7	Thailand, Burma	Soisook et al. 2016
			98.6–105.2		
R. lepidus Blyth, 1844	India, China, Indochina	37–43	103.0–105.0	India	Soisook et al. 2016
			102.9±2.2	Gujarat	Shah & Srinivasulu 2020
			98.5–105.3		
			106.3±4.3	Uttarakhand	Chakravarty et al. 2020
			102.5±1.82	Kerala	Raman & Hughes 2020
			98.3–105.9		
			90.5±1.4	Vietnam	Győrössy et al. 2024
			89.0–93.6		
R. hipposideros (André, 1897)	W Palaearctic, NE Africa	35–43	110.9±2.8	S Europe	Russo & Jones 2002, Papadatou
			106.4–114.9		et al. 2008
			107.6±0.5	Israel	Hackett et al. 2017
			103.5–109.3		
			110.3±08	Iran	Benda et al. 2012
			109.0–111.1		
			109.1±1.5	Saudi Arabia	Benda et al. 2022
			105.8–111.0		
R. midas Andersen, 1905	Middle East	36–39	98.2±1.6	Oman	Benda et al. 2022
			94.1–100.6		
R. malayanus Bonhote, 1903	Indochina	38–44	75.0–91.0	Thailand	Robinson 1996, Soisook et al.
			83.0±0.7	Cambodia	2008, Phauk et al. 2013
			81.1–84.7		
			85.5±5.6	Vietnam	Győrössy et al. 2024
			80.2–96.2		

specifically distinct from *R.* aff. *lepidus* (Fig. 29); see also discussion below concerning the morphological differences.

In any case, the West Turkestani populations here named tentatively as *Rhinolophus* aff. *lepidus* are to be considered a separate species that is described below.

Rhinolophus kirghisorum Horáček, Uvizl et Benda, sp. nov.

Rhinolophus hipposideros (André, 1797): Bogdanov 1956a: 69 [partim]; Neuhauser 1969: 63–64 [partim]; Rybin et al. 1989: 423–429, 433, 438–440 [partim]; Zima et al. 1991: 31, 33; Habilov 1992: 58 [partim]; Zima et al. 1992a: 230, 232–235 [partim]; Hůrka 1997: 28, 30; Zima 2004: 114–116 [partim].

Rhinolophus lepidus Blyth, 1844: Felten et al. 1977: 18 [partim]; Bates & Harrison 1997: 68–70 [partim]; Horáček et al. 2000: 156; Csorba et al. 2003: 104–107 [partim]; Benda et al. 2011: 168; Benda & Gaisler 2015: 299–301 [partim]; Benda et al. 2016a: 11–19; Habilov & Tadžibaeva 2016a: 102; Habilov & Tadžibaeva 2016b: 63; Tadžibaeva & Habilov 2017a: 5; Habilov & Tadžibaeva 2018: 3–9; Habilov et al. 2018: 57; Hron et al. 2018: 5; Tadžibaeva & Habilov 2018: 130; Burgin 2019a: 315 [partim]; Habilov & Tadžibaeva 2019a: 101; Tadžibaeva & Habilov 2019b: 43; Tadžibaeva & Habilov 2019d: 209–210; Habilov & Tadžibaeva 2020b: 75; Habilov & Tadžibaeva 2020d: 23; Hutson et al. 2020: 140 [partim]; Benda 2021: 180; Dundarova et al. 2021: 598–603; Habilov & Tadžibaeva 2021b: 36–37; Habilov & Tadžibaeva 2021d: 66; Habilov & Tadžibaeva 2022b: 62, 64; Tadžibaeva & Habilov 2022: 71–73; Habilov & Tadžibaeva 2023: 26; Hutson et al. 2023: 480 [partim]; Khabilov & Zohidova 2023: 37.

Rhinolophus kirgisorum Horáček, Hanák et Gaisler, 2000: 19–21, 47, 156. [nomen nudum]

Rhinolophus aff. *lepidus*: Horáček et al. 2000: 101.

Type material. **Holotype**: ♀ ad. (NMP 98083 [field No. pb7855, alcohol specimen with skull extracted]), Kolodec Fersmana mine [Колодец Ферсмана], 2 km NW of Kara-koktu [Кара-кокту], 10 km N of Nookat [Ноокат], Kirghizstan,

Figs. 30, 31. Face and noseleaf of the holotype specimen of *Rhinolophus kirghisorum* sp. nov. (NMP 98083), Kolodec Fersmana mine, Kara-koktu, Kirghizstan. Photo by L. Bufka.

Fig. 32. Portrait of the holotype specimen of *Rhinolophus kirghisorum* sp. nov., (NMP 98083), Kolodec Fersmana mine, Kara-koktu, Kirghizstan. Photo by L. Bufka.

25 July 2024, leg. P. Benda, L. Bufka & M. Uhrin. – **Paratypes** (45): 3 ♀♀ (NMP 98082, 98084 [field Nos. pb7854, 7856, alcohol specimens with skull extracted], NMP 98081 [field No. pb7853, alcohol specimen]), locality, date, and collectors as in the holotype; – 4 ♂♂, 9 ♀♀ (NMP 98089, 98094, 98096, 98098–98101, 98104–98106, HNHM-MAM 2000.15.1. [field Nos. CT84/46, 51, 53, 55–59, 63–65, alcohol specimens with skull extracted], NMP 98097, 98107 [field Nos. CT84/54, 66, alcohol specimens]), locality as in the holotype, 2 August 1984, leg. J. Červený, I. Horáček & S. N. Rybin; – 2 ♂♂ (NMP 58324/1, 58324/3 [field Nos. K267/88, K269/88, alcohol specimens with skull extracted]), locality as in the holotype, 12 July 1988, leg. J. Červený, J. Obuch & S. N. Rybin; – 17 ♀♀ (NMP 98108–98116, 98118–98122 [field Nos. CT84/73–81, 83–87, alcohol specimens with skull extracted], NMP 98117 [field No. CT84/82, skull and skeleton], NMP 98123, 98124 [field Nos. CT84/88, 89, alcohol specimens]), Pobednaâ [Победная] Cave, Kara-koktu [Кара-кокту], 7 km N of Nookat [Ноокат], Kirghizstan, 3 August 1984, leg. J. Červený, I. Horáček & S. N. Rybin; – 3 ♂♂, 2 ♀♀ (NMP 58896/1, 58896/3, 60517, 60518 [field Nos. K104/90, K111/90, G2323, G2324, alcohol specimens with skull extracted], NMP 58896/2 [field No. K110/90, alcohol specimen]), small cave, Dangi canyon [Данги каньон], 3 km NW of Kara-koktu [Кара-кокту], 11 km N of Nookat [Ноокат], Kirghizstan, 28 May 1990, leg. J. Červený, J. Obuch & S. N. Rybin; – 3 ♂♂, 3 ♀♀ (NMP 95762–95765 [field Nos. pb6246, 6248, 6251, 6252, alcohol specimens with skull extracted], NMP 95761, 95766 [field Nos. pb6245, 6255, alcohol specimens]), Magov [Магов], mine, 17 km NE of Vaḑdat [Ваҳдат], Tajikistan, 18 May 2016, leg. P. Benda, A. Reiter & M. Uhrin.

Type locality. Kirghizstan, Oš Province [Ош облусу], Nookat District [Ноокат району], Kolodec Fersmana mine [Колодец Ферсмана / Fersman's well], at the southern edge of Dangi canyon [Данги каньон], Aravan-saj river [Араван-сай], Tuâ-Moûn massif [Туя-Моюн / Тоо-Моюн], 2 km NW of Kara-koktu [Кара-кокту], 10 km N of Nookat [Ноокат]; 40°21'13"N, 72°36'34"E, 1110 m a. s. l. (Fig. 33).

Diagnosis. *Rhinolophus kirghisorum* sp. nov. is a small-sized horseshoe bat (LAt 38–43 mm, LOc 15.8–16.6 mm) with a broad horseshoe, pointed lancet, parallel-sided sella, medium high and rounded connecting process, and three grooves at lower lip. Pelage relatively long, buff brown on back, pale beige on belly. The following combination of cranial traits seems to be quite characteristic: (1) Palate relatively long (34–43% of CM^3), its distal margin at the level of M^3

protocone. (2) Infraorbital foramen narrow, dot-like (at the level of M^2 mesostyle), infraorbital commissure broad. (3) Supraorbital crests distinct yet only exceptionally with sharp ridges. (4) Zygomatic arch thin, not enlarged dorsally. (5) Dentition high, canines and large premolars (P^4/P_4) markedly pointed. (6) Last upper premolar (P^4) and maxillary molars without marked talonal extensions; distal margin of P^4 straight without mesial undulation; no sign of talonal distopalatal cingular extension either on M^1 or M^2. (7) small upper premolar (P^2) relatively small, in lateral view not exceeding height of the cingulum of P^4. (8) The mandibular canine, last lower premolar (P_4) and molar protoconids are conspicuously high and upward pointed. (9) Labial cingulum of P_4 distally lowered, in occlusal view with a clear distolabial incision in most specimens. (10) The middle lower premolar (P_3) is extremely reduced and displaced labially from the tooth row, in several specimens even absent, the first (P_2) and third (P_4) are in contact. (11) Karyotype 2n=62.

Rhinolophus kirghisorum sp. nov. differs from the *R. hipposideros* group in the characters 1, 3, 5, 6, 7, 8, 9, 11, from most forms of the *R. pusillus* group in 1, 2, 4, 6, 8, 9, 10, from *R. lepidus* Blyth, 1844 s.l. in 1, 2, 4, 6, 9, 10 (partly), from *R. macrotis* Blyth, 1844 in 1 (yet in a shorter palate which in *macrotis* group varies in 50.0–56.6% of CM^3), 7, 10 (except for *R. macrotis topalius* Csorba et Bates, 2016).

Description. *Rhinolophus kirghisorum* sp. nov. is a small-sized horseshoe bat, in most respects (body size, structure and relative size of the noseleaf, and the ear size) similar to some other small-sized Oriental forms of the genus *Rhinolophus* Lacépède, 1899 of the *R. macrotis* and *R. pusillus*

Fig. 33. The Aravan-saj river and the southern edge of the Dangi canyon with entrance to the Kolodec Fersmana mine, ca. 2 km NW of Kara-koktu, Kirghizstan, the type locality of *Rhinolophus kirghisorum* sp. nov. Photo by L. Bufka (25 July 2024).

groups, namely the species complexes of *R. macrotis* Blyth, 1844, *R. cornutus* Temminck, 1834, *R. lepidus* Blyth, 1844, and/or *R. pusillus* Temminck, 1834.

Forearm length 38–43 mm, ear length 16.3–20.3 mm, horseshoe width 6.3–7.5 mm, condylocanine length of skull 14.0–14.7 mm, length of the upper tooth-row 5.5–6.3 mm.

The horseshoe of *R. kirghisorum* sp. nov. is relatively broad (Figs. 30, 32), markedly notched in the middle of its rostral margin, the secondary noseleaf is well developed but concealed by the horseshoe; the connecting process of the noseleaf is hairy, medium high and rounded in side view, its posterior margin is slightly convex dorsally; the sella is long, narrow and parallel-sided, tip of the sella is long, narrow (in side view; Fig. 31) and pointed; lancet is hairy, triangular in shape, with slightly convex lateral margins in its distal part and obtusely pointed. Three medial grooves are present in the lower lip (Fig. 30).

The dorsal pelage of *R. kirghisorum* sp. nov. is long, coloured pale brown, sometimes with a reddish tinge, ventral pelage is of slightly paler tinge than the dorsal aspect, in some individuals dark brown spots are beneath the eyes (Figs. 31, 32, 48); in juveniles and subadult animals, the dorsal pelage is greyish with very weak brown tinge, ventral pelage is pale grey. Noseleaf is very pale, almost unpigmented to very pale brown, proximal parts are pinkish in tinge (Figs. 30, 32). Ears and wing membranes are greyish brown or dark greyish brown, the ears are pale or unpigmented in their proximal parts (Figs. 32, 47, 48).

Skull is relatively narrow, the zygomatic arch thin, not enlarged dorsally, the zygomatic width is roughly equal to the mastoidal width (LaZ 7.6–8.3 mm, LaM 7.7–8.2 mm; LaZ/LCc 0.543–0.569, LaM/LCc 0.538–0.572), rostral part of the skull including the nasal swellings is long and medium wide (LaInf 4.0–4.4 mm; CC 3.6–4.3 mm; LaInf/LCc 0.278–0.306), and relatively rather short (CM^3/LCc 0.393–0.417; Fig. 34). The braincase is relatively medium-wide, but relatively low (LaN 6.7–7.4 mm, ANc 4.8–5.3 mm; LaN/LCc 0.467–0.508, ANc/LCc 0.337–0.368), the sagittal crest is low and rather undeveloped, the infraorbital foramen is narrow, dot-like, at the level of mesostyle of the second upper molar (M^2), the infraorbital commissure is broad (Fig. 34). The supraorbital crests are distinct, yet only exceptionally with sharp ridges.

The nasal swellings are well developed, the anterior median swellings are long and highly inflated, longer than the posterior median swellings, the lateral swellings (both anterior and posterior) are smaller than the median swellings, the frontal depression is deep (Fig. 34). The palate is medium long (34–43% of the length of the upper tooth-row, CM^3), its distal margin is at the level of protocone of the third upper molar (M^3).

The teeth are relatively weak and high (Figs. 34, 35), canines and large premolars (P^4/P_4) markedly pointed. The large upper premolar (P^4) and maxillary molars are without marked talonal extensions, the distal margin of P^4 straight, without mesial undulation. No sign of talonal distopalatal cingular extension either on M^1 or M^2. The small upper premolar (P^2) is relatively small, in lateral view not exceeding the height of cingulum margin on P^4. The third lower premolar (P_4) and molar protoconids are conspicuously high, the labial cingulum on P_4 is distally lowered, in occlusal view with a clear distolabial incision in most specimens. The small (middle) lower premolar (P_3) is extremely reduced and displaced labially from the tooth-row, in several specimens even absent, the first (P_2) and third (P_4) lower premolars are in contact (Fig. 35).

The baculum of *R. kirghisorum* sp. n. is a long thin shaft with a broad basal cone; length ca. 3.5 mm, basal width ca. 0.9 mm in dorsal aspect, 1.0 mm in lateral aspect (Fig. 44). Only slight incisions are present in the ventral side of the basal cone. The shaft is markedly curved ventrally, slightly compressed laterally in its distal half, the distal tip is rounded off with both a lateral and dorso-ventral widening.

Dimensions. For external and cranial dimensions of the holotype and the paratype series see Table 9.

Fig. 34. Skull of the holotype specimen of *Rhinolophus kirghisorum* sp. nov. (NMP 98083); lateral (top) and ventral (bottom) aspects. Scale bar – 2 mm.

Mitochondrial sequences. **Holotype and two paratypes (Kirghizstan)**: NMP 98082–98084 (partial sequence [1130 bp] of the mitochondrial gene for cytochrome *b*; GenBank Accession Number PQ635182; 5' end). ttc gca aat ccc acc cac tat tta aaa tta tca acg act cat tca tcg acc tac caa ccc cat caa gca tct ctt cct gat gaa act tcg ggt ccc tac tag gag tct gtc tag ccg tac aaa tcc tca cag gcc ttt tcc tag cca tac act aca cat cag aca ccg cta ccg cct tct act ccg taa ccc aca ttt gcc gag acg tca att acg gct gaa tcc tac gct acc tcc atg cca acg gag cct cca tat tct tta ttt gcc tat tcc tgc acg tag gac ggg gga tct att acg gct cct ata cat tct cag aaa cat gaa aca ttg gaa tta ttc ttc tct ttg ccg tca tag cca cag cat tca tag gtt acg tac ttc cat ggg gcc aaa tat cct tct gag gag cta cag tca tca caa acc tcc tct cag cca ttc cgt atg tcg gaa caa ccc tcg tag agt gag tct gag ggg ggt tct cag tcg aca aag cca cac tca ccc gat ttt tcg ccc tac act tcc tac tcc cct tca tca tct cgg cca tag tca tgg ttc acc tac ttt tcc tcc acg aaa cag gct caa aca atc caa ctg gaa tcc cat ccg aca tgg ata taa ttc cat tcc acc cct act aca cca tta aag ata tcc tag gcc tcg tgc taa tac taa tag cac tac tat ccc tag tcc tat tcg ccc ccg acc tgc tcg gcg acc cag aca att aca ccc cag cca acc cac tta aca ccc cac ccc aca tca aac cag agt gat act tcc tat ttg cat acg caa tcc tac gct caa tcc caa aca aac ttg gcg gag tag tag ccc tag tac tat cta ttc tta tcc tag ctg

Table 9. Biometric data on *Rhinolophus kirghisorum* sp. nov. For abbreviations see p. 8.
NB: the external measurements of the Kirghizstani specimens were taken by three different persons, the presented data are combined from all three of them; the external measurements of the Tajikistani specimens and all skull measurements were taken by one author

	Tajikistan					Kirghizstan					holotype
	n	**M**	min	max	SD	n	**M**	min	max	SD	NMP 98083
LC	11	**50.2**	48	53	1.888	40	**45.5**	42	53	2.459	49
LCd	11	**20.0**	18	22	1.265	39	**20.3**	17	26	1.829	21
LAt	11	**40.50**	39.5	41.8	0.733	40	**41.29**	38.4	43.0	1.054	42.8
LA	11	**19.65**	18.8	20.3	0.565	40	**17.88**	16.3	20.0	0.942	19.7
LaFE	11	**7.13**	6.5	7.5	0.265	6	**7.05**	6.3	7.4	0.389	7.1
G	11	**6.1**	5.2	8.0	0.920	37	**5.8**	4.0	6.7	0.517	5.7
LCr	7	**17.14**	16.85	17.41	0.205	28	**17.07**	16.49	17.49	0.209	17.49
LOc	7	**16.27**	16.05	16.63	0.184	34	**16.25**	15.87	16.57	0.163	16.29
LCc	7	**14.43**	14.19	14.58	0.129	33	**14.40**	14.07	14.64	0.154	14.32
LaZ	7	**7.99**	7.60	8.17	0.193	34	**8.05**	7.80	8.24	0.123	8.14
LaI	8	**1.97**	1.85	2.14	0.100	34	**2.03**	1.88	2.27	0.095	1.97
LaInf	7	**4.24**	4.17	4.34	0.052	34	**4.24**	3.98	4.35	0.087	4.32
LaN	8	**6.95**	6.76	7.28	0.155	34	**7.07**	6.77	7.35	0.141	7.23
LaM	8	**7.98**	7.76	8.20	0.140	33	**7.95**	7.72	8.09	0.091	7.98
ANc	8	**5.04**	4.84	5.21	0.106	33	**5.09**	4.81	5.28	0.111	5.12
LBT	8	**2.75**	2.61	2.87	0.097	34	**2.77**	2.58	3.05	0.122	2.71
CC	6	**4.09**	4.02	4.17	0.062	33	**4.01**	3.68	4.29	0.114	4.08
M^3M^3	6	**6.10**	6.04	6.18	0.051	31	**6.04**	5.73	6.31	0.112	6.03
CM^3	8	**5.94**	5.59	6.29	0.205	33	**5.84**	5.62	5.98	0.090	5.84
LMd	8	**10.51**	10.19	10.81	0.217	34	**10.41**	10.11	10.74	0.142	10.31
ACo	8	**2.35**	2.27	2.42	0.058	34	**2.22**	2.07	2.38	0.072	2.34
CM_3	8	**6.22**	6.04	6.39	0.103	34	**6.08**	5.88	6.31	0.107	6.03

taa tcc cac tac tcc aca cat cga aac aac gca gca tga cat tcc gac ctc taa gcc aat gct tat tct gac tcc tag tag cag acc ttc tca cac taa cct gaa ttg ggg gcc aac ctg ttg agc acc cat tca tta tca tcg gac aac tag cct cca tcc tat act tcc taa tta tcc tag tct taa tac cgc ttg caa gca tcg cag aaa acc atc tat aaa atg aag ag. **Paratypes** (**Tajikistan**): NMP 95762, 95764, 95765 (partial sequence [1138 bp] of the mitochondrial gene for cytochrome *b*; GenBank Accession Number PQ635180; 5' end). cca aca ttc gca atc cca ccc act att taa aat tat caa cga ctc att cat cga cct acc aac ccc atc aag cat ctc ttc ctg atg aaa ctt cgg gtc cct act agg agt ctg tct agc cgt aca aat cct cac agg cct ttt cct agc cat aca cta tac atc aga cac cgc tac cgc ctt cta ctc cgt aac cca cat ttg ccg aga cgt caa tta cgg ctg aat cct acg cta cct cca tgc caa cgg agc ctc cat att ctt tat ttg cct att cct gca cgt agg acg ggg gat cta tta cgg ctc cta tac att ctc aga aac atg aaa cat tgg aat tat tct tct ctt tgc cgt cat agc cac agc att cat agg tta cgt act tcc atg ggg cca aat atc ctt ctg agg agc tac agt cat cac aaa cct cct ctc agc cat tcc gta tgt cgg aac aac cct cgt aga gtg agt ctg agg ggg gtt ctc agt cga caa agc cac act cac ccg att ttt cgc cct aca ctt cct act ccc ctt cat cat ctc ggc cat agt cat ggt tca cct act ttt cct cca cga aac agg ctc aaa caa tcc aac tgg aat ccc atc cga cat gga tat aat tcc att cca ccc cta cta cac cat taa aga tat cct agg cct cgt gct aat act aat agc act act atc cct agt cct att cgc ccc cga cct gct cgg cga ccc aga caa tta cac ccc agc caa ccc act taa cac ccc acc cca cat caa acc aga gtg ata ctt cct att tgc ata cgc aat cct acg ctc aat ccc aaa caa act tgg cgg agt agt agc cct agt act atc tat tct tat cct agc tgt aat ccc act act cca cac atc gaa aca acg cag cat gac att ccg acc tct aag cca atg ctt att ctg act cct agt agc aga cct tct cac act aac ctg aat tgg ggg cca acc tgt tga gca ccc att cat tat cat cgg aca act agc ctc cat cct ata ctt cct aat tat cct agt ctt aat acc gct tgc aag cat cgc aga aaa cca tct ata aaa tga aga gtc t.

Karyology. The conventionally stained karyotype of *Rhinolophus kirghisorum* sp. nov. was examined in two female paratype specimens (NMP 60517, 60518). It consisted of thirty pairs of acrocentric (autosomal) chromosomes and one pair of subtelocentric choromosomes, 2n=62; the subtelocentric pair was identified as the X chromosome, one pair of acrocentrics possessed a distinct secondary constriction (Zima et al. 1991, 1992a, Benda et al. 2011).

Echolocation. *Rhinolophus kirghisorum* sp. nov. produces a call of the FM-CF-FM shape typical for all members of the genus *Rhinolophus* (Figs. 50, 51). The call pulses show the following values of particular parameters: duration 13.7–51.8 ms, peak frequency 98.2–103.7 kHz (mean

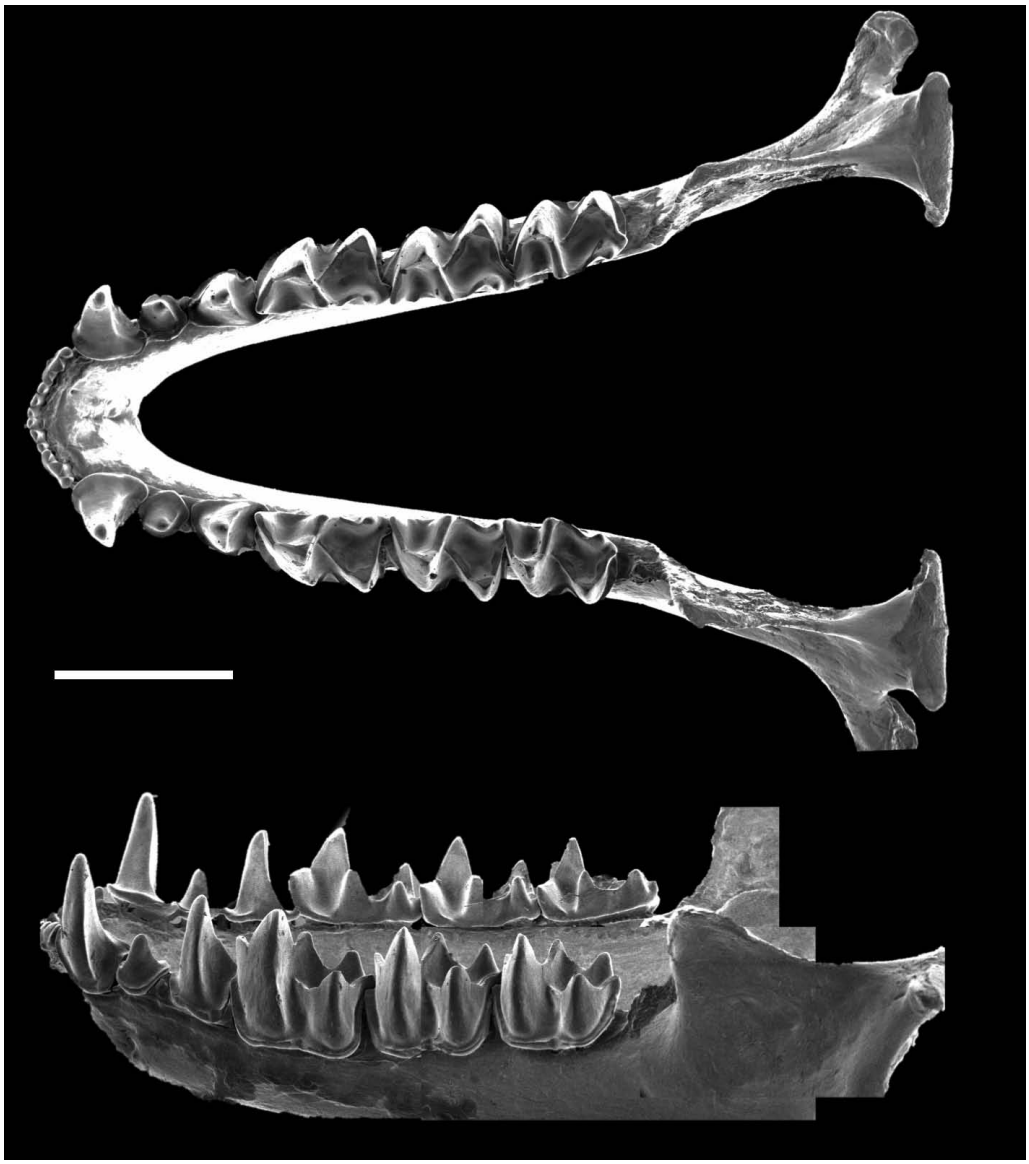


Fig. 35. Mandible of the holotype specimen of *Rhinolophus kirghisorum* sp. nov. (NMP 98083); occlusal (top) and lateral (bottom) aspects. Scale bar – 2 mm.

104.8 kHz; n=50), start frequency 88.5–103.4 kHz, end frequency 79.6–103.7 kHz. The data come from the calls recorded from bats inside their day roost (mine, Tajikistan) and from bats emerging from an underground roost (mine/cave, Kirghizstan), for details see Table 5.

Derivatio nominis. *Rhinolophus kirghisorum* sp. nov. is named after the country of the first discovery of this bat, Kirghizstan (see Zima et al. 1991, 1992a, Horáček & Zima 1996, Horáček et al. 2000, Benda et al. 2011), a part of the region named traditionally 'terra Kirghisorum' (for the use of the name in taxonomy see e.g. de Thuemen 1880, Savič″ 1912, Smirnow 1925, Fedorov & Fedorov 1949, Ognev 1950). The species name *kirghisorum* is a noun in apposition.

A similar name *Rhinolophus kirgisorum* was used for this bat by Horáček et al. (2000). However, this use of the name does not constitute a species description, the name *kirgisorum* Horáček, Hanák et Gaisler is a nomen nudum, and thus, it remains unavailable for nomenclatural purposes.

ZooBank. urn:lsid:zoobank.org:pub:40B476A8-4561-439D-A624-C835DC9FDBC1.

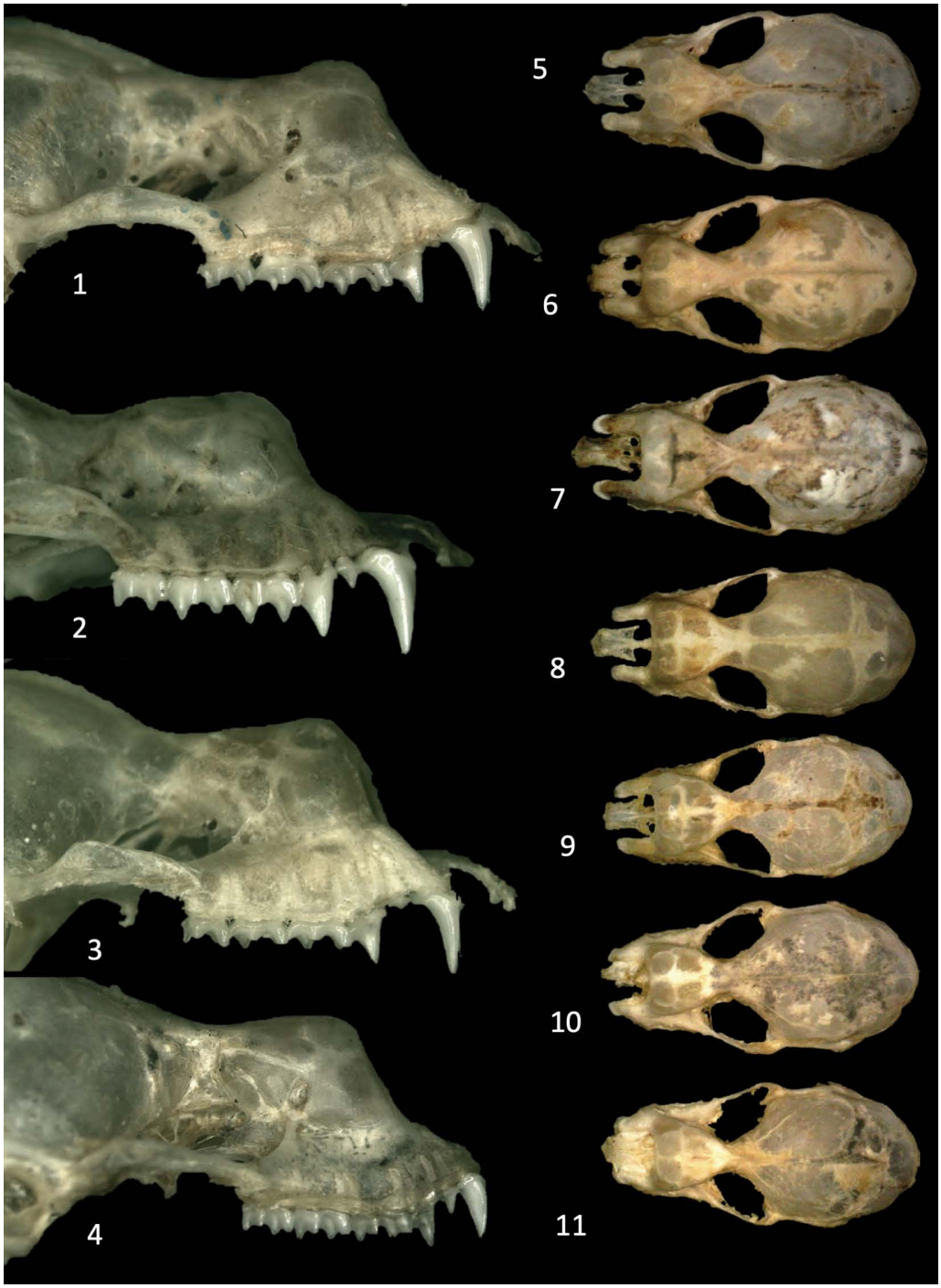
Distribution. *Rhinolophus kirghisorum* sp. nov. occurs in a limited range within the eastern part of West Turkestan and in northern Afghanistan. It inhabits a north-southward belt of broadleaf forests and dry shrublands, covering the western slopes of the south-western Tien-Shan Mts., western Pamirs, and the northern slopes of the Hindu Kush mountain system. For a detailed description of the known distribution range of *R. kirghisorum* sp. nov. see Benda et al. (2016a) and the additions given below.

Comparisons and comments. The molecular genetic record demonstrated convincingly that *Rhinolophus kirghisorum* sp. nov. represents a coherent distinct entity clearly different from all the other taxa for which molecular record is available. Contrary to expectations, the molecular evidence does not support relations of *R. kirghisorum* sp. nov. to the species of the *R. pusillus* group but indicates its embedding within the *R. macrotis* group. Yet, such a kind of confusion is nothing exceptional in the small-sized horseshoe bats of the Eurasian realm, which traditionally rank among the most puzzling topics of bat taxonomy. Despite an obviously quite large alpha diversity of that group (more than 80 named taxa, almost 30 valid species, see Csorba et al. 2003, Simmons 2005, Burgin 2019a), all its members share almost an identical state in vast majority of phenotype traits being distinguished by minute differences in few external and cranial characters, mostly the shape and size of the sella and connecting process and shapes and positions of small premolars. The modern taxonomic reviews (Corbet & Hill 1992, Bogdanowicz 1992), subsequently supported by molecular analyses (Guillén Servent et al. 2003), split these taxa into four species groups: *R. phillipinensis* group (incl. *R. macrotis*), *R. pusillus* group (incl. *R. lepidus*), *R. borneensis* group, and *R. hipposideros* group. The revised molecular phylogeny of the family (Dool et al. 2016) identified the former three groups as a core element of the Oriental clade of the family, and stressed an unresolved position of the monotypic *R. hipposideros* group for which a separate subgeneric status (as *Phyllorhina* Leach, 1816) was proposed by Guillén Servent et al. (2003).

Rhinolophus hipposideros is the only species representing small-sized horseshoe bats in the western Palaearctic (except the south-eastern Middle East), its range covers large parts of Europe,

→

Fig. 36. Skulls of selected specimens of the small-sized horseshoe bats from Eurasia (*Rhinolophus* sp.): lateral views of the rostrum (1–4) and dorsal views of skull (5–11). 1 – *R. kirghisorum* sp. nov. (paratype, NMP 98114; Kirghizstan); 2, 7 – *R. lepidus* Blyth, 1844 (HNHM-MAM Csorba 622; Maharashtra, India); 3, 8 – *R. pusillus* Temminck, 1834 (HNHM-MAM CAM45; Thailand); 9 – *R. pusillus* Temminck, 1834 (HNHM-MAM 95.60.7.; Vietnam); 4 – *R. hipposideros* (André, 1797) (CUP A10; Czech Republic); 5 – *R. kirghisorum* sp. nov. (holotype, NMP 98083; Kirghizstan); 6 – *R. kirghisorum* sp. nov. (paratype, NMP 98113; Kirghizstan); 10 – *R. hipposideros* (André, 1797) (CUP A17; Czech Republic); 11 – *R. hipposideros* (André, 1797) (CUP TK93/66; Turkey).


1
2
3
4
5
6
7
8
9
10
11

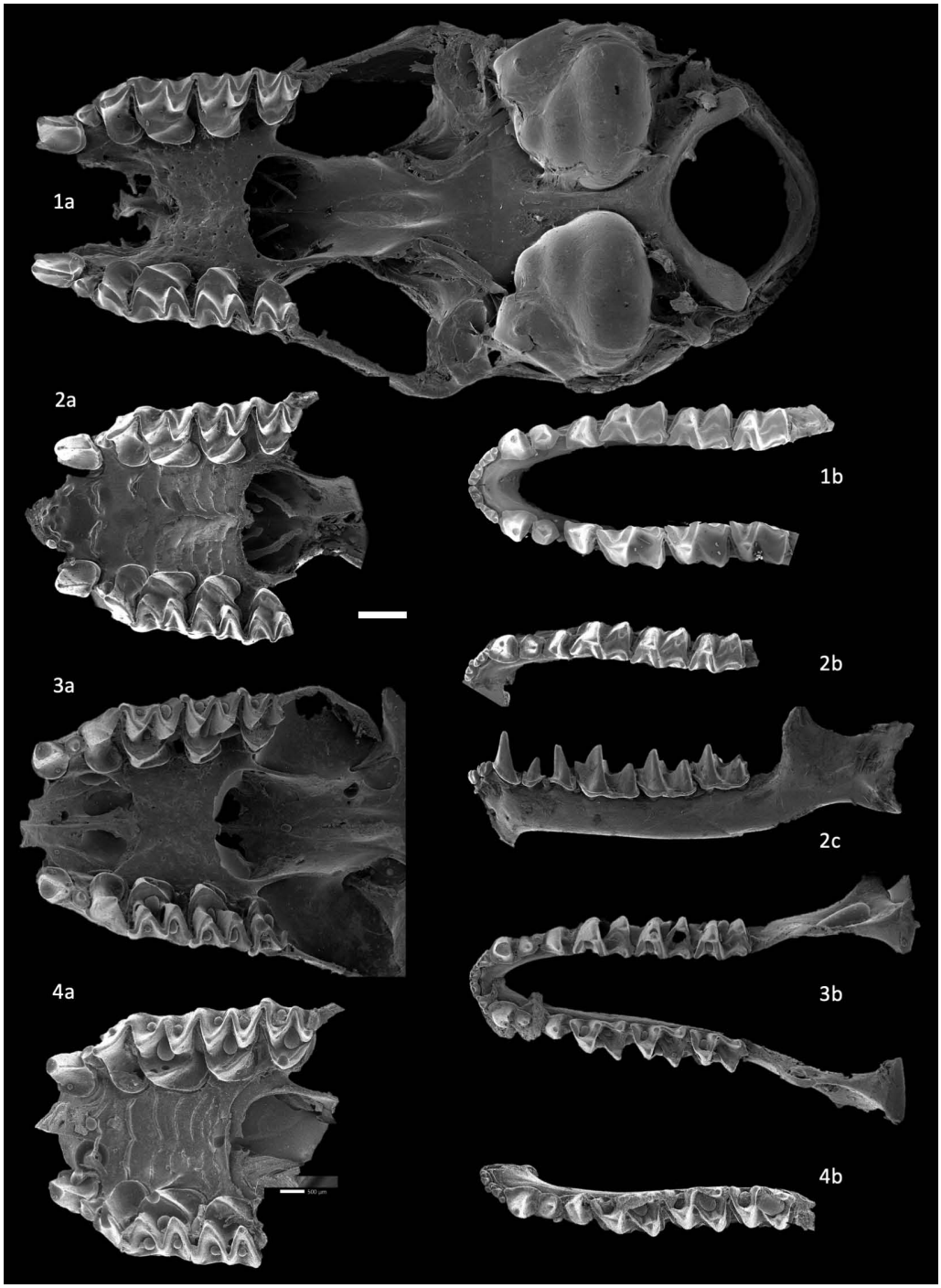
northern Africa, and south-western Asia (see below for details). Already for that reason, the first comparisons of *R. kirghisorum* sp. nov. were focused to differentiate it from *R. hipposideros*, the species to which it was originally co-identified. Most of its diagnostic characters refer to these differences (see Figs. 36–39). As in the other forms of the Oriental clade, its third upper molar lacks the postmetacrista which is invariably well developed in *R. hipposideros* (see also Csorba et al. 2003).

The idea of close relation of *R. kirghisorum* sp. nov. to *R. lepidus* (and hence to the *R. pusillus* group) suggested by the initial evaluations of morphologic pattern of *R. kirghisorum* sp. nov. (Horáček & Zima 1996, Horáček et al. 2000, Benda et al. 2011) was supported by the widespread distribution of *R. lepidus* in the neighbouring regions of the Oriental region (Afghanistan, Pakistan, India, Nepal), by sharing of certain morphological characters, such as robust rostrum, high canines, large premolars, phalangeal proportions, and also by the ancestral form of the karyotype. The morphology of *R. kirghisorum* sp. nov. also corresponds to the diagnostic characteristics of the *R. pusillus* group as proposed by Corbet & Hill (1992) – triangular shape of the connecting process of the noseleaf with a small sella without lateral projections at its base, and those by Csorba et al. (2003) – the anterior medial swelling is high and directing upwards – as well as to the diagnostic characters of *R. lepidus* as proposed by Koopman (1994). Nevertheless, *R. kirghisorum* sp. nov. markedly differs both from *R. lepidus* and other forms of the *R. pusillus* group by the absence of distinct talons in the large upper premolar (P^4) and first upper molar (M^1), relatively long palate, and substantially great degree of the small premolar reduction. Particularly worth mentioning is that all these differences are distinctly marked also in comparison with *R. lepidus monticola* to which the bats from West Turkestan (together with all other records from the north-western part of the range of the *R. pusillus* group – Afghanistan, Pakistan, northern India, Nepal) have been arranged by Burgin (2019a) – comp. Fig. 38 and the diagnosis of *R. monticola* by Andersen (1905). Quite distinct differences between the examined members of the *R. pusillus* group and *R. kirghisorum* sp. nov. are in the morphology of the infraorbital region; in the latter bat, the infraorbital foramen is a minute, dot-like opening, with a broad commissure, situated above the mesial part of the second upper molar (M^2), while in the former group it is a large opening with a distinct narrow commissure situated at the level of distal margin of M^2 (Figs. 34, 36). The arrangement of the infraorbital region in *R. kirghisorum* sp. nov. suggests a distal prolongation of the lateral rostral wall supposedly correlated with a distal prolongation of the palate.

The prolonged palate (the palatal bridge of more than $^1/_3$ length of the maxillary toothrow, CM^3), together with a long and wide sella of the noseleaf with a long tapered connecting process, are reported as key diagnostic characters of the *R. philippinensis* group then covering also the *R. macrotis* group (Corbet & Hill 1992, Csorba et al. 2003). Yet in both these regards *R. kirghisorum* sp. nov. exhibits only a partial agreement, namely showing a relatively narrow and not markedly prolonged sella and connecting process of the noseleaf (Fig. 31). At the time of our first comparisons the *R. philippinensis* group appeared to be restricted exclusively to the south-eastern part of the Oriental region, except the range of *R. macrotis* s.str. in Nepal (Corbet & Hill 1992). All the forms of the *R. macrotis* group figured by Tu et al. (2017) show the distal margin of the palate at a level of the protocone of the third molar (M^3), a broad infraorbital commissure, and a reduced small lower premolar (P_3) though not completely displaced from the toothrow (i.e., P_2

→

Fig. 37. Skulls of selected specimens of the *Rhinolophus hipposideros* group: occlusal views of skull/rostrum (a) and mandible (b), and lateral views of mandible (c). 1 – *R. hipposideros* (André, 1797) (CUP A13; Czech Republic), 2 – *R. hipposideros* (André, 1797) (CUP TK93/66; Turkey); 3 – *R. midas* Andersen, 1905 (holotype [cast], BMNH 94.11.16.1; Iran); 4 – *R.* cf. *hipposideros* (cast, BMNH 81.3.1.11; Gilgit, Kashmir). Scale bar – 1 mm.


1a
2a
1b
3a
2b
2c
4a
3b
4b

and P_4 are not in contact). Also the small upper premolar (P^2) seems to be a bit higher than the cingulum margin in the larger premolar (P^4). The relative length of palate in these forms lies in the range of 50–70% of the upper tooth-length, CM^3 (Tu et al. 2017). In these regards they clearly differ from *R. kirghisorum* sp. nov.

Among the forms referred to the *R. macrotis* group (sensu Liu et al. 2019), *R. macrotis topalius* Csorba et Bates, 2016 from Pakistan is particularly worth mentioning both for its geographic proximity to the range of *R. kirghisorum* sp. nov. and correspondence in several diagnostic traits. The diagnosis of this subspecies stressed as follows (Csorba & Bates 1995: 288): "[It is] distinguished by having extremely small second lower premolar (P_3), its tip not reaching the cingula of the P_2 and P_4, and in every cases totally extruded from the toothrow", which conforms quite well to the situation in *R. kirghisorum* sp. nov. Yet, considering the detailed description provided by Csorba & Bates (1995), there are several significant differences from *R. kirghisorum* sp. nov. According to the dimensions given, *R. m. topalius* is distinctly larger than *R. kirghisorum* sp. nov., moreover without a dimensional overlap (LAt 44.7–46.2 mm, mean 45.4 mm, in *R. m. topalius*, vs. 38.4–43.0 mm, mean 41.1 mm, in *R. kirghisorum* sp. nov.; LOc 18.01–18.32 mm, mean 18.16 mm, vs. 15.87–16.63 mm, mean 16.26 mm; CM^3 6.48–6.68 mm, mean 6.59 mm, vs. 5.59–6.29 mm, mean 5.86 mm; see Csorba & Bates 1995: 287, and Table 9). The pelage colouration in *R. m. topalius* is reported to be very pale with almost white underparts, while in *R. kirghisorum* sp. nov. it is pale brown and only slightly paler in the ventral aspect (Fig. 32). The connecting process of the noseleaf is high and tapered, and curved anteriorly in *R. m. topalius*, while simply rounded in *R. kirghisorum* sp. nov. Correspondingly to other forms of the *R. macrotis* group, the palate is rather long in *R. m. topalius* (53.6–56.6% of the upper tooth-length, CM^3, mean 54.8%; 50–70% in other species of the group, see Tu et al. 2017), compared to relatively short palate in *R. kirghisorum* sp. nov. (34–43%). The infraorbital foramen is situated above the distal margin (metastyle) of the second upper molar (M^2) in *R. m. topalius* and in most of the remaining species of the group (see Csorba & Bates 1995, Csorba et al. 2003, Tu et al. 2017), while above the mesostyle of M^2 in *R. kirghisorum* sp. nov. A lack of overlap in these characters suggests that *R. m. topalius* and *R. kirghisorum* sp. nov. represent separate phenotypically distinct entities. In any case, regarding possible doubts on the real taxonomic value of the above mentioned differences, the presented hypothesis calls for a profound testing in terms of the molecular phylogenetics.

Seemingly impressive differences in the peak frequencies of echolocation calls reported for particular clades of small-sized horseshoe bats (Table 8) suggest marked differences between *R. kirghisorum* sp. nov. and all other bats of the *R. macrotis* group. It should be remembered, of course, that the echolocation records reported for the latter forms from China and Indochina were obtained most probably from handled bats. Then, they obviously refer to fundamental frequencies, not the first harmonics to which the sonar energy is transposed when horseshoe bats forage in an open space. Considering this, the first harmonics frequencies tentatively assumed for bats of the *R. macrotis* group might not differ essentially from the variation span of all the other small-sized horseshoe species under study.

In any case, as suggested by a number of recent studies (Li et al. 2006, Soisook et al. 2008, 2016, Sun et al. 2008, 2016, Tu et al. 2017, Zhang et al. 2018, Liu et al. 2019, Chattopadhyay et al. 2021, Chornelia et al. 2022, etc.), the actual diversity of both main groups of small horseshoe bats of the Oriental clade is perhaps even considerably larger than formerly expected. In general, these bats are not disposed to distant migrations and/or large-scale range dynamics and in the course of dramatic climatic and tectonic rearrangements accompanying the Late Cenozoic history of the Oriental region, they obviously underwent a plethora of sorting events, parapatric speciation efforts, and range fragmentations, particularly in the marginal parts of their ranges. We expect

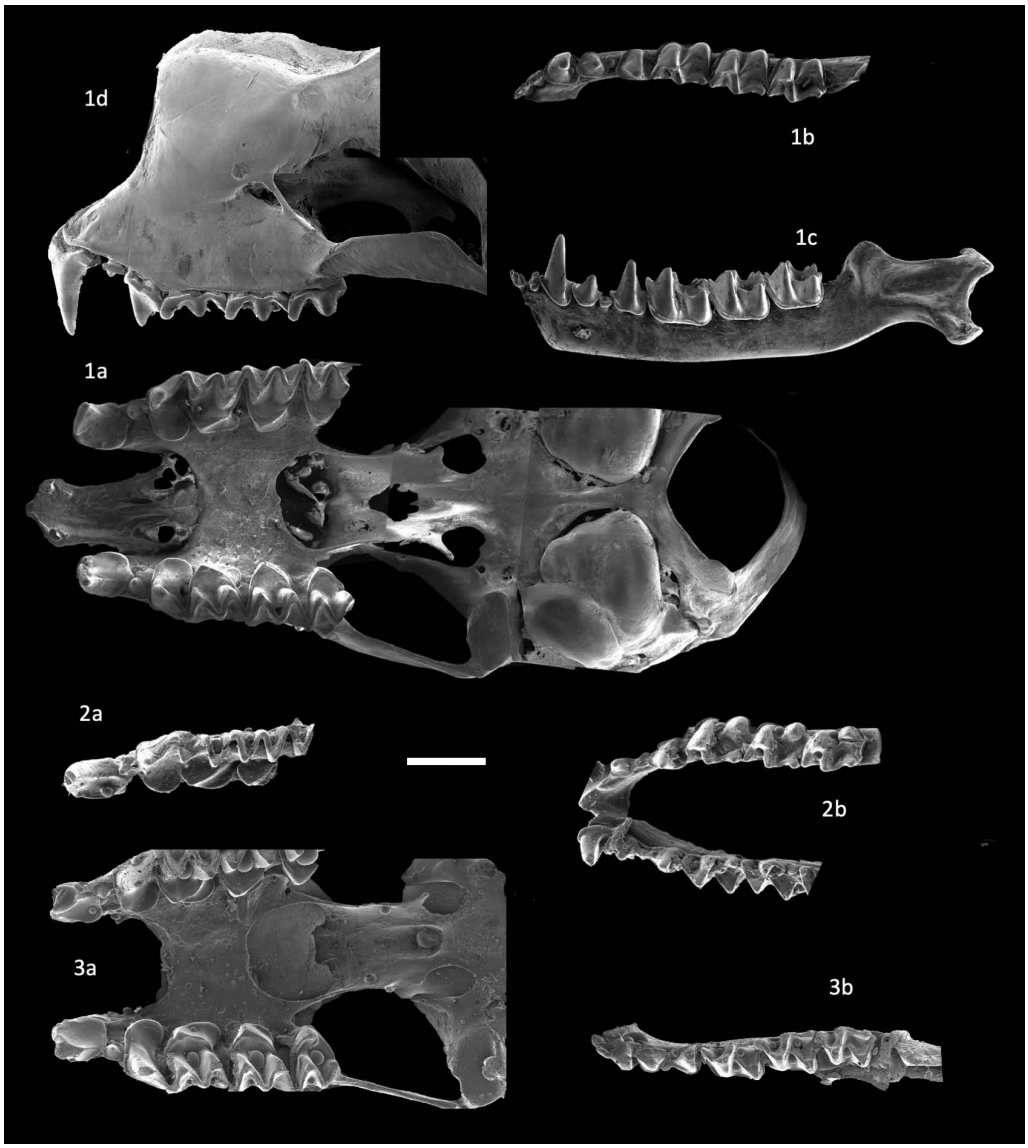
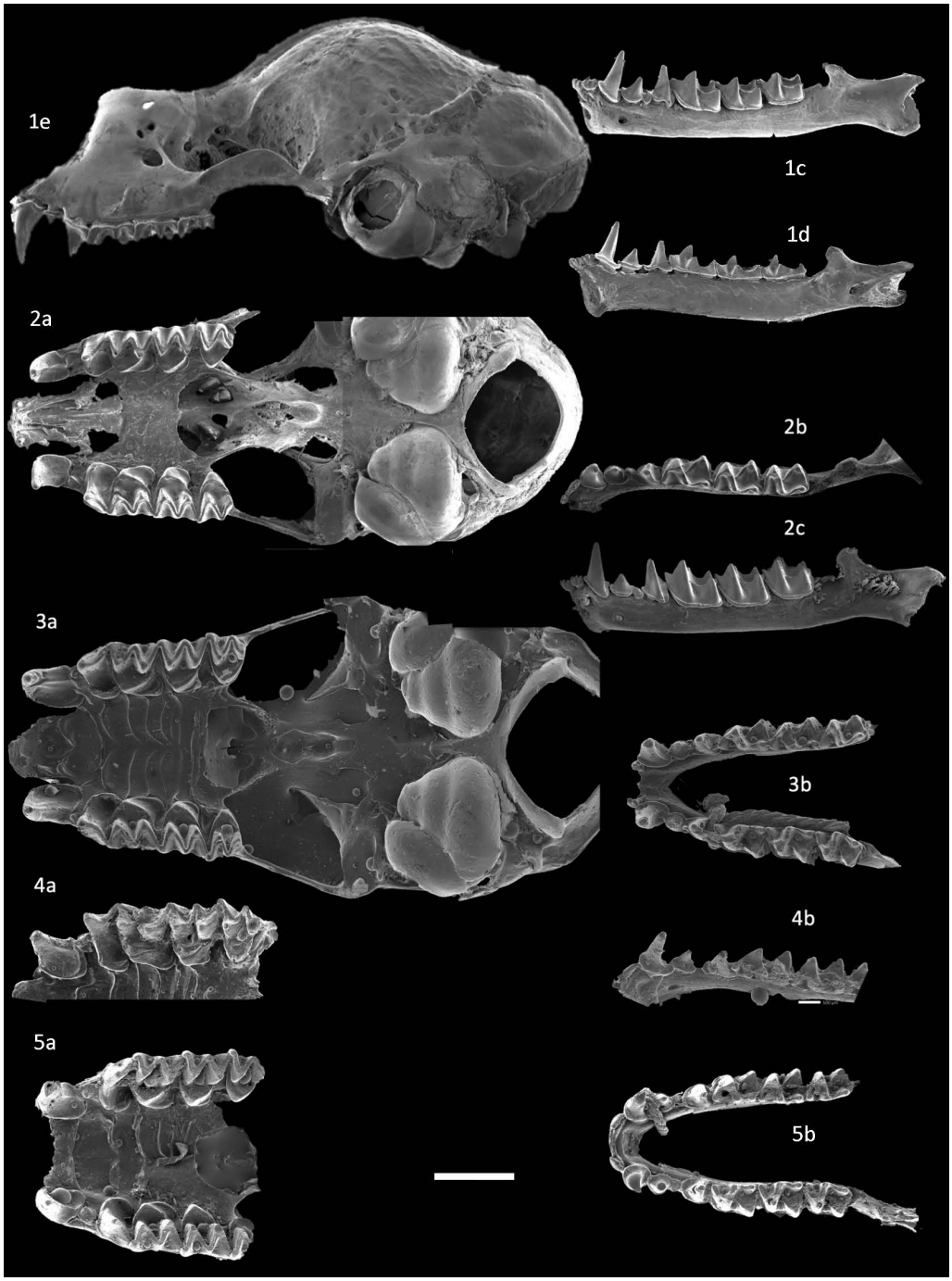


Fig. 38. Skulls of selected specimens of the *Rhinolophus pusillus* group: occlusal views of rostrum (a) and mandible (b), and lateral views of mandible (c) and rostrum (d). 1 – *R. lepidus* Blyth, 1844 (HNHM-MAM Csorba 622; Maharashtra, India); 2 – *R. monticola* Andersen, 1905 (holotype [cast], BMNH 79.11.21.151; Kumaon, India); 3 – *R. feae* Andersen, 1907 (syntype [cast], BMNH [unnumb.]; Burma). Scale bar – 2 mm.

that *R. kirghisorum* sp. nov. is one of the relic clades illustrating these processes. It can well be expected that along the boundary areas of the Oriental and Palaearctic regions further studies will disclose a number of similar forms.


1e
1c
1d
2a
2b
2c
3a
3b
4a
4b
5a
5b

←

Fig. 39. Skulls of selected specimens of the *Rhinolophus pusillus* group: occlusal views of skull/rostrum (a) and mandible (b), and lateral (c) and medial (d) views of mandible, and lateral view of skull (e). 1 – *R. pusillus* Temminck, 1834 (HNHM-MAM CSOTA 41; Taiwan); 2 – *R. pusillus* Temminck, 1834 (HNHM-MAM 95.60.7; Vietnam); 3 – *R. pumilus* Andersen, 1905 (holotype [cast], BMNH 2.10.7.18.; Okinawa, Japan); 4 – *R. blythi* Andersen, 1918 (holotype [cast], BMNH 18.8.3.2; Kumaon, India), 5 – *R. minor* Horsfield, 1824 (holotype [cast], BMNH 79.11.21.684; Java). Scale bar – 2 mm.

Concluding remark. *The story of the description*: *why a nomen nudum appeared*? The small-sized horseshoe bats from West Turkestan were traditionally considered *Rhinolophus hipposideros*. The material collected during research trips to Kirghizstan (see Rybin et al. 1989) exhibited clear differences from the western Palaearctic *R. hipposideros* both in the morphological characters and, in particular in the karyotype. Results of this comparisons were presented by Horáček & Zima (1996) at a conference with the following summary: "In the distribution range of *R. hipposideros* s.l., populations of three distinct karyotypes with the diploid number of 56, 58, and 62 chromosomes were documented. The 56-chromosome race was found in the European part of the range, the 58-chromosome race in the Middle East, and the 62-chromosome race in southern Kirghizstan. The European karyotype can be derived from 58-pattern after a single Robertsonian fusion of two autosomal pairs. The 58-chromosome karyotype can be derived from the 62-pattern by two centric fusions of autosomes. The centromeric position in the X chromosome in the 62-chromosome karyotype [Fig. 40] seems to be also slightly different from the sex chromosomes found in the other two races. Very similar karyotype with 62 chromosomes was found in a number of *Rhinolophus* species from the tropics of south-eastern Asia. That is why this karyotype should be generally considered plesiomorphic [see Zima et al. 1992a].

A series of horseshoe bats obtained in southern Kirghizstan was compared with about 200 specimens of *R. hipposideros* from various parts of its distribution range [Figs. 41–44]. The Kirghizstani bats invariably differed from *R. hipposideros* particularly by a very robust rostrum, long palate, high and foreprominent canines, greatly reduced small upper and lower premolars (P^3/P_3), high upper large premolars (P^4) and first upper molars (M^1) without any talons, minute infraorbital foramen, etc. [Fig. 41]. No transitional state of these characters to the western Palaearctic morphotype of *R. hipposideros*, including the specimens from regions neighbouring southern Kirghizstan, were found. All this indicated a separate species status of the Kirghizstani populations.

Yet the situation is more complicated. The Oriental region bordering the Turkestani mountains yields a large number of diverse forms of small-sized horseshoe bats either of the *R. pusillus* or *R. macrotis* groups [Fig. 42]. The type specimens of many of them were examined (*blythi* Andersen, 1918, *cognatus* Andersen, 1906, *cornutus* Temminck, 1834, *dohrni* Andersen, 1907, *famulus* Andersen, 1918, *macrotis* Blyth, 1844, *monoceros* Andersen, 1905, *monticola* Andersen, 1905, *perditus* Andersen, 1918, *pumilus* Andersen, 1905, *pusillus* Temminck, 1834, *refulgens* Andersen, 1907, *szechwanus*

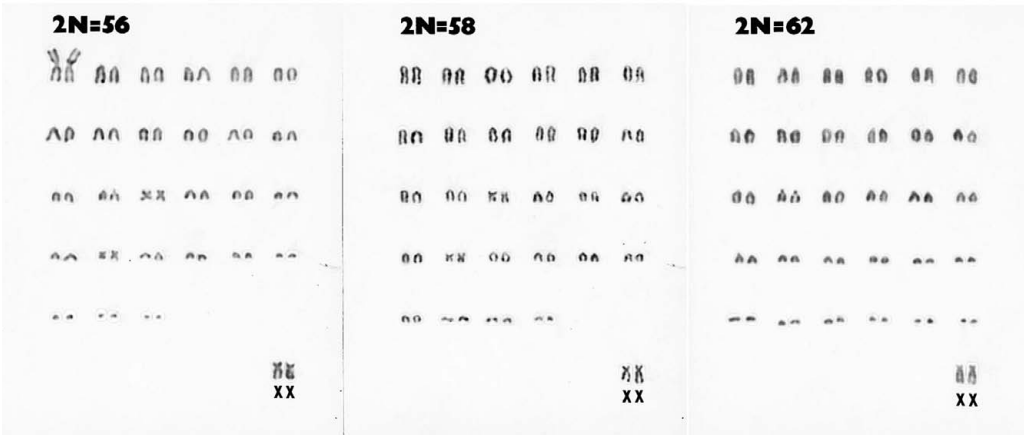


Fig. 40. G-stained standard karyotypes of *Rhinolophus hipposideros* (André, 1797) (2n=56, 2n=58) and *R. kirghisorum* sp. nov. (2n=62): 2n=56 – ♀, Líščia diera cave, Slovakia; 2n=58 – ♀, CUP 93/63, Narlikuyu, Turkey; 2n=62 – ♀, NMP JZ678, Kolodec Fersmana, Kirghizstan (after Horáček & Zima 1996).

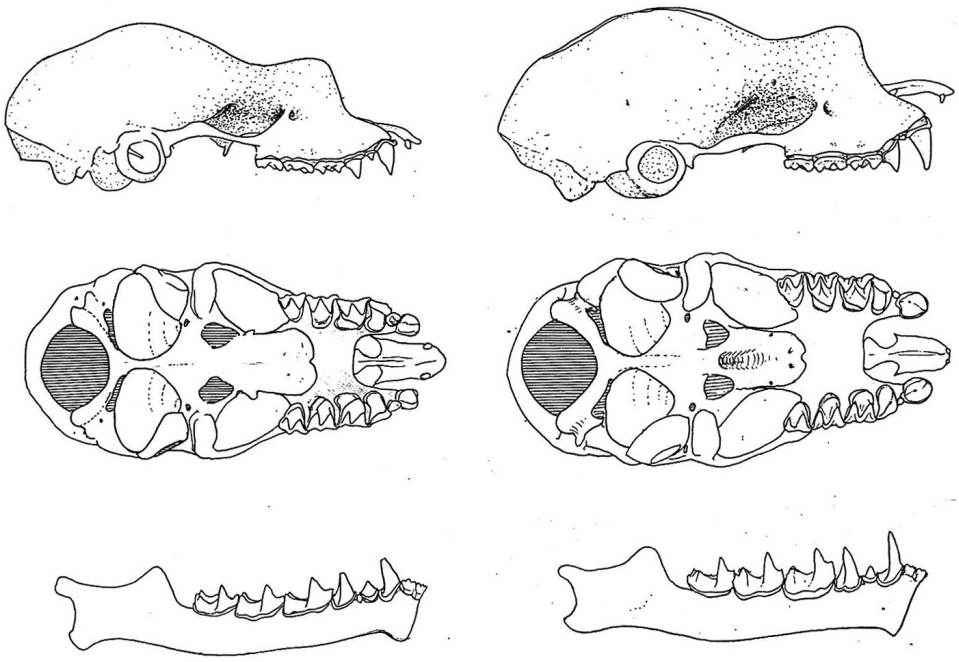


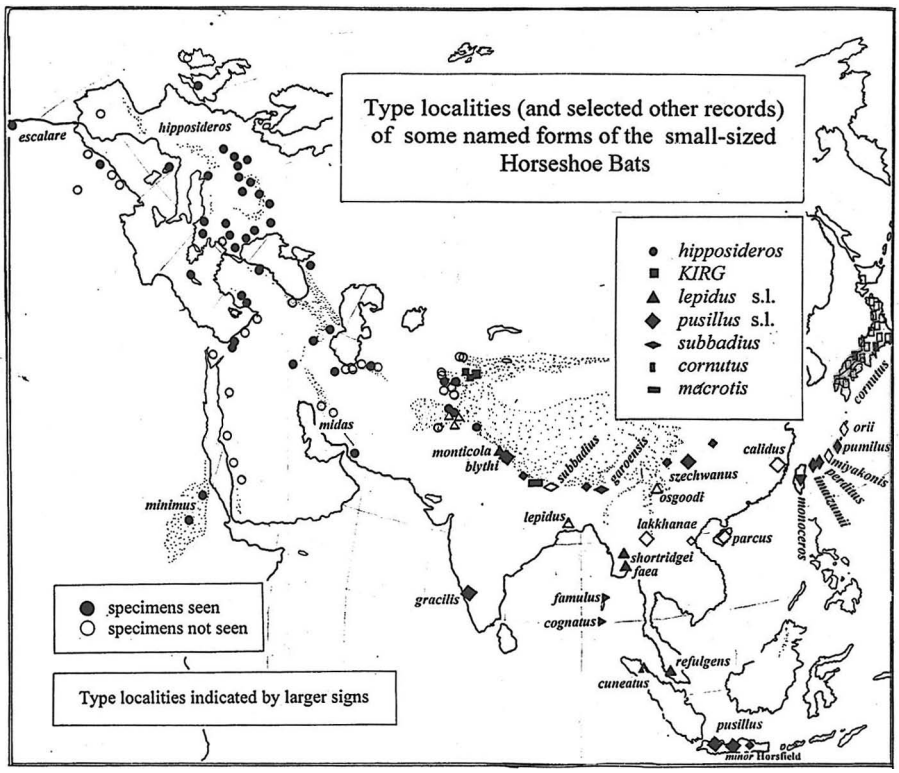
Fig. 41. A comparison of skull and dental morphology in *Rhinolophus hipposideros* (André, 1797) from Turkey and *R. kirghisorum* sp. nov. from Kirghizstan (after Horáček & Zima 1996).

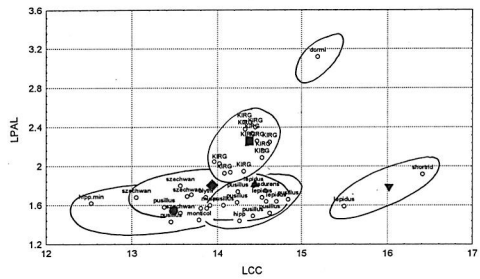
Andersen, 1918) in addition to further BMNH specimens assigned to *R. lepidus* or *R. pusillus.* In no case a complete correspondence to the morphological features of the Kirghizstani form was found. Its distant status was also suggested by biometric comparisons [Fig. 43] particularly with regard to the proportions of the palatal length, rostral width, reduced size of small premolars (P^3/P_3), and the form of infraorbital foramen which were found to be least dependent upon the overall isometry of the cranial phenotype variation among small-sized horseshoe bats. Consequently, the Kirghizstani form seems to represent a separate species, different from both *R. hipposideros* s.str. and the examined forms of the *R. pusillus* group with which it shares some diagnostic characters. Tentatively we consider it as an isolated Palaearctic offshoot of the latter clade, restricted to the south-eastern part of the Fergana / Farg'ona basin, separated from its relatives in the Oriental region by the Tien-Shan, Alay, and Pamir Mts. in the south and by West Turkestani deserts in the west. It supposedly represents a relic species, maybe one of the rarest elements of the Palaearctic bat fauna."

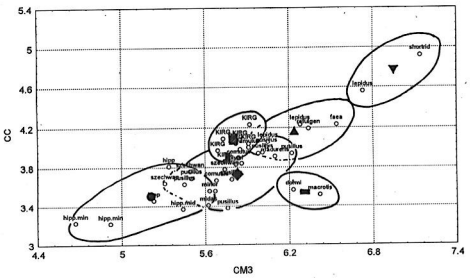
Expecting an immediate formal description of a new species, Horáček et al. (2000: 101–102) reported on *R.* aff. *lepidus* as follows: "Horáček and Zima (1996) demonstrated that the lesser horseshoe bat from S Kirghizia reported until then as *R. hipposideros* represents in fact a different species belonging neither to *R. hipposideros* group nor *R. pusillus* group but close to *Rhinolophus lepidus* Blyth, 1844 (t.t. Calcutta?). At the same time they demonstrated that it differs also from the Indian and E-Oriental forms of that group and, hence, is to be considered a separate species. Unfortunately, its formal description has not been published as yet. // […] *R.* "*kirgisorum*" (the samples from S-Kirghizia and Afghanistan) was compared with *monticola*, *blythi*, *refulgens*, *shortridgei*, *midas*, *szechwanus* etc. (including the respective types) and was found different in more characters. The type material of *lepidus* is probably lost, the S-Indian specimens differ from the

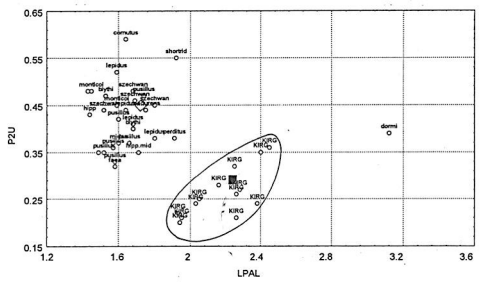
→

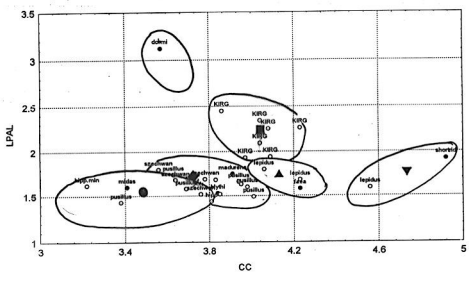
Figs. 42, 43. Illustrations of the studies of the small-sized horsehoe bats presented by Horáček & Zima (1996). 42 (top) – a map outline of the localities of the small-sized horseshoe bats (*Rhinolophus* sp.). 43 (bottom) – biometric comparisons of the small-sized horseshoe bats (*Rhinolophus* sp.). *KIRG = R. kirghisorum* sp. nov.


Type localities (and selected other records) of some named forms of the small-sized Horseshoe Bats
hipposideros
KIRG
lepidus s.l.
pusillus s.l.
subbadius
cornutus
macrotis
specimens seen
specimens not seen
Type localities indicated by larger signs
escalare
hipposideros
midas
minimus
monticola
blythi
subbadius
gurounsis
szechwanus
osgoodi
calidus
orii
pumilus
imbyakonis
peregrinus
inaticumi
monoceros
cornutus
lepidus
takkhanae
parcus
shortridgei
faea
gracilis
famulus
cognatus
refulgens
cuneatus
pusillus
minor Horsfield


LPAL
LCC


CC
CM3


P2U
LPAL


LPAL
CC

Kirghizian sample, too. The examined samples of the lesser horseshoe bat from other regions of Central Asia [= West Turkestan] (incl. Uzbekistan, Tadjikistan, Turkmenistan, NW Afghanistan) were found to belong to *R. hipposideros*."

Meanwhile the idea of a formal description of the species was largely disproved by the mitochondrial DNA sequence data obtained from a bat collected in southern Kirghizstan in 1993 by Jan Zima, the only specimen being not fixed by formalin (which was the case of the whole previously collected material). It exhibited only moderate divergence from the European haplotypes of *R. hipposideros* s.str. Thus, the story was concluded by Guillén Servent et al. (2003: xvii), who stated as follows: "[…] sequences from the three chromosomal races, including material from Kyrgyzstan, give genetic distances of 3.3 to 4.6% (k2p). Although relatively large, these distances are within the range of variability in mitochondrial DNA expected for a colonial species with high female philopatry." Bona fide to these conclusions, further studies were postponed to the time when new specimens of the form enabling an examination of genetic sequences will be available.

The next step of the story is associated with the studies by Benda et al. (2011, 2016a) surveying bats from Transcaucasia and West Turkestan in the NMP and ZMMU collections. They reported further specimens of the form under the name *Rhinolophus lepidus* Blyth, 1844 (sensu Horáček et al. 2000: 101, 156) and provided biometric comparisons, particularly with the sympatric *R. hipposideros*. Following their conclusion, the current outline by Burgin (2019a: 315) attributed the respective populations to the subspecies *R. lepidus monticola* Andersen, 1905 (in accordance with Aellen 1959a and Felten et al. 1977) whose distribution range he characterised as follows: "SE Uzbekistan, SW Kyrgyzstan, Afghanistan (Faryab, Kabul, Nangarhar, Parwan and Zabul Provinces), N Pakistan (Khyber Pahtunkwa and Punjab Provinces), NW India (Himachal Pradesh and Uttarakhand), and Nepal."

Yet, new specimens obtained in the recent years in Tajikistan and Kirghizstan enabled a new molecular genetic analysis which disproved the latter conclusions and robustly supported a separate species status that was suggested nearly 30 years ago.

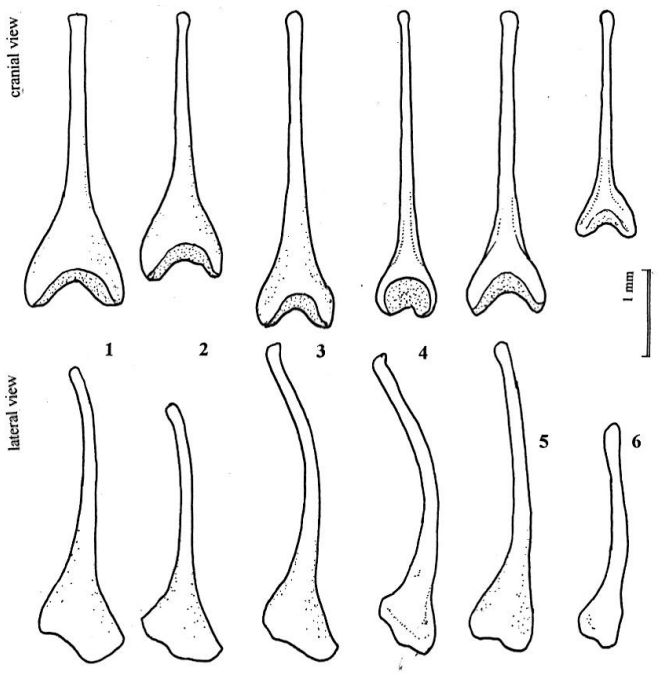


Fig. 44. Bacula of the small-sized horseshoe bats; 1 – *Rhinolophus hipposideros* (André, 1797) (Czech Republic); 2 – *R. hipposideros* (André, 1797) (Turkey); 3 – *R. kirghisorum* sp. nov. (Kirghizstan); 4 – *R.* cf. *hipposideros* (Kashmir); 5 – *R. blythi szechwanus* Andersen, 1918 (Vietnam); 6 – *R. lepidus* Blyth, 1844 (India); top – dorsal view, bottom – lateral view; 1–3 – after Horáček & Zima (1996), 4–6 – after Topál (1975).

Records. **Original data**: Magov [**1**], abandoned mine (Figs. 45–48), 18 May 2016: obs. a colony of ca. 20 active inds., coll. 5 ♂♂, 6 ♀♀ (NMP 95762–95765, HSU pb6247, 6249, 6250, 6253 [S+A], NMP 95761, 95766, HSU pb6254 [A]; cf. Habilov & Tadžibaeva 2016b, 2018, Tadžibaeva & Habilov 2019b, Benda 2021), det. & rec. calls of active inds. inside the mine. – **Published data**: above Šing kishlak [**2**], Šing river valley, northern slope of the Zeravšanskij [= Zarafšon] Mountains, Dahoniob / Dahoni ob mine, 16 October 2015: obs. 4 inds., incl. 2 ♂♂, 1 ♀, 2 February 2016: exam. 2 / 3 ♂♂, leg. R. Oblokulov (Habilov & Tadžibaeva 2016a, 2018, 2020b, Tadžibaeva & Habilov 2017a), 22 September 2016: obs. 5 inds., incl. 2 ♂♂, 26 May 2017: obs. 11 inds., incl. 6 ♂♂ (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018, 2020b), 5 October 2019: exam. 2 ♂♂, 1 ♀, 13 January 2020: obs. 2 inds., 3 October 2020: obs. 2 inds. incl. 1 ♂ (Habilov & Tadžibaeva 2020b); – Altyn-Topkan / Zarnisor [**3**], 1300 / 1500 m a. s. l., mine, 15 February 2016: coll. 1 ♀, leg. A. Pahomov / A. V. Pastuhov (Habilov & Tadžibaeva 2016a, 2018, Tadžibaeva & Habilov 2018); – Ramit [= Romit] [**4**], Kofarnihon [= Kofarniḫon] river spring, 60 km ENE of Dušanbe, 17 June 1983: 1 ♂, ZMMU, leg. I. Â. Pavlinov (Benda et al. 2016a); – near Stalinabad [= near Guliston kishlak, 8 km of Dušanbe] [**5**], 14 August 1954: 1 ♀, ZMMU, leg. O. P. Bogdanov (Benda et al. 2016a).

Distribution. *Rhinolophus kirghisorum* sp. nov. is distributed in the eastern part of West Turkestan, where it inhabits the western slopes of the south-western Tien-Shan Mts. and western Pamirs (sensu Merzlyakova 2002). The northernmost confirmed record of this bat is available from north-eastern Uzbekistan (middle part of the Ugam river valley, ca. 41°42'N, 69°56'E; Benda et al. 2016a), the easternmost record in the Oš Province of southern Kirghizstan (Kolodec Fersmana [Fersman's Well] mine, type locality, 40°21'N, 72°37'E; Benda et al. 2011, Habilov et al. 2018), and the westernmost record in the Nurota (Nuratau) Mts. in central Uzbekistan (Sen-

Fig. 45. Valley of the Magov stream at the Magov village, an area of occurrence of at least five bat species; numerous roosting individuals of *Rhinolophus ferrumequinum*, *R. kirghisorum* sp. nov., and *Myotis blythii* were discovered in an abandoned mine accessible from the eastern slope of the valley, foraging individuals of *Rhinolophus ferrumequinum*, *Myotis blythii*, *M. davidii*, and *Hypsugo savii* were documented in the riparian garden vegetation. Photo by A. Reiter (18 May 2016).

Fig. 46. Roosting individuals of *Rhinolophus kirghisorum* sp. nov. in a mine at Magov. Photo by A. Reiter (18 May 2016).

tob, 40°36'N, 66°40'E; Benda et al. 2016a). The localities in the Dušanbe region of Tajikistan (Fig. 49) represent the southernmost area of occurrence of *R. kirghisorum* sp. nov. known in West Turkestan (Guliston, 38°32'N, 68°52'E). Our new record originates from the latter area, a medium-sized colony was discovered in an abandoned mine in a mountain slope above the village of Magov, it was composed of both males and females, and of both adult and subadult bats. Among six examined females, two were found pregnant, each of them contained a single foetus of the crown-rump length 14.3 mm and 16.8 mm, respectively. The locality is situated at 1587 m a. s. l. and represents the highest roost and occurrence site of *R. kirghisorum* sp. nov. known in Tajikistan (this bat seems to be documented only from its roosts in Tajikistan).

In Tajikistan, the few confirmed records imply *R. kirghisorum* sp. nov. to be a rare bat, only five record sites are known. On the other hand, the highest number of the localities of *R. kirghisorum* sp. nov. is available from Tajikistan and their geographical extent is the largest among the Turkestani countries (see also Habilov et al. 2018 for a review). The Tajikistani occurrence area represents the south-eastern part and south-eastern margin of the species distribution range. Based on biogeographical grounds, we consider northern Afghanistan also a part of the distribution range of *R. kirghisorum* sp. nov. The SMF and FMNH specimens assigned to *R. hipposideros* s.l. by Neuhauser (1969) and *R. lepidus* s.l. by Felten et al. (1977), Bates & Harrison (1997), Csorba et al. (2003), and Benda & Gaisler (2015), and collected in the Zarmast Cave near Maymana (35°51'N, 64°54'E) in north-western Afghanistan, most probably also belong to the new species. The taxonomic affiliation of other records of *R. lepidus* s.l. from Afghanistan, made in the areas south of the Hindu Kush, is more problematic, since they originate from a different biogeographical

Figs. 47, 48. Portraits of the paratype of *Rhinolophus kirghisorum* sp. nov. from Magov, Tajikistan. Photo by A. Reiter.

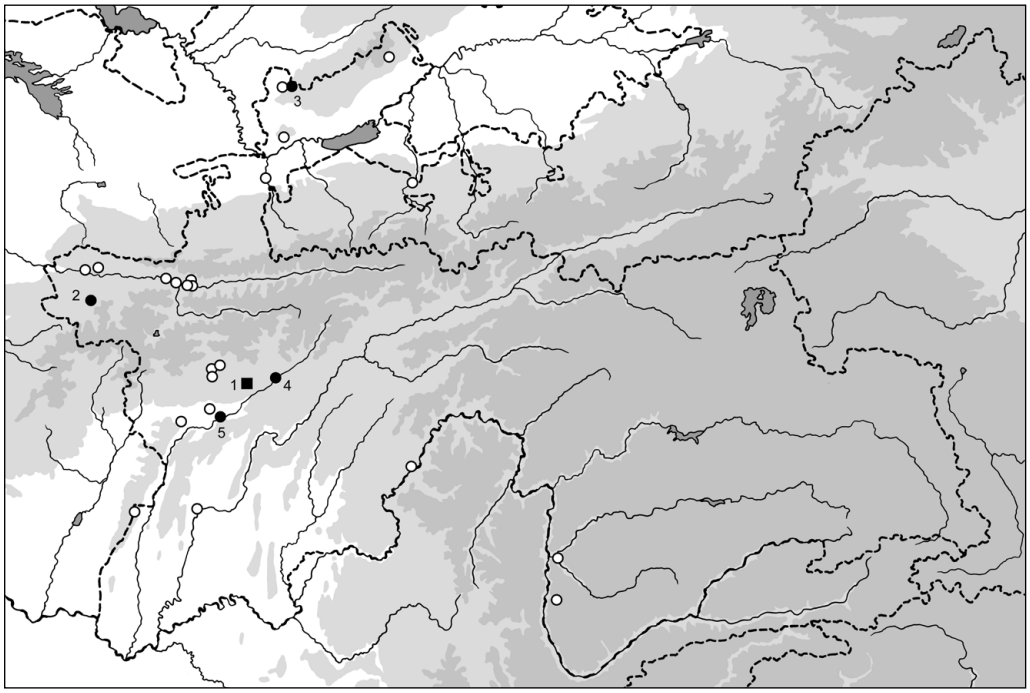


Fig. 49. Records of *Rhinolophus kirghisorum* sp. nov. in Tajikistan; full square – new record, full circles – published records, open circles – unspecified records of the small-sized horseshoe bats (*Rhinolophus hipposideros* s.l.; see Fig. 28).

realm and thus represent a different faunal element. However, the actual taxonomic identity of the Afghanistani populations traditionally assigned to *R. lepidus* s.l. suggested by morphometric comparisons has to be confirmed with the help of a molecular genetic analysis.

The limited records of *R. kirghisorum* sp. nov. in Tajikistan show the species to be distributed in three parts separated by high mountain ridges, it is the only species of the parataxon *R. hipposideros* s.l. confirmed in the Tajikistani section of the Zarafšon river valley (Figs. 28, 49). The records come from a very narrow altitudinal range (806 m), the smallest among the bats of Tajikistan (Table 4). The distribution statistics show *R. kirghisorum* sp. nov. to occur in similar altitudes as *R. hipposideros* s.str., which, however, was documented in a broader altitudinal range in Tajikistan, including high mountains (Fig. 11). Most of the localities of *R. kirghisorum* sp. nov. lie in the altitude range of 1100–1400 m a. s. l. and the value of its altitude median (1300.0 m a. s. l.; Table 4) is the third highest among the bats of Tajikistan. The character of distribution of *R. kirghisorum* sp. nov. in Tajikistan indicates this bat to be an inhabitant of medium-high to high areas of West Turkestan.

Echolocation. The data on echolocation parameters recorded in *Rhinolophus kirghisorum* sp. nov. are described above, see also Table 5, Figs. 50, 51. The use of the peak frequency enables a clear acoustic differentiation of *R. kirghisorum* sp. nov. from two species of the genus *Rhinolophus*

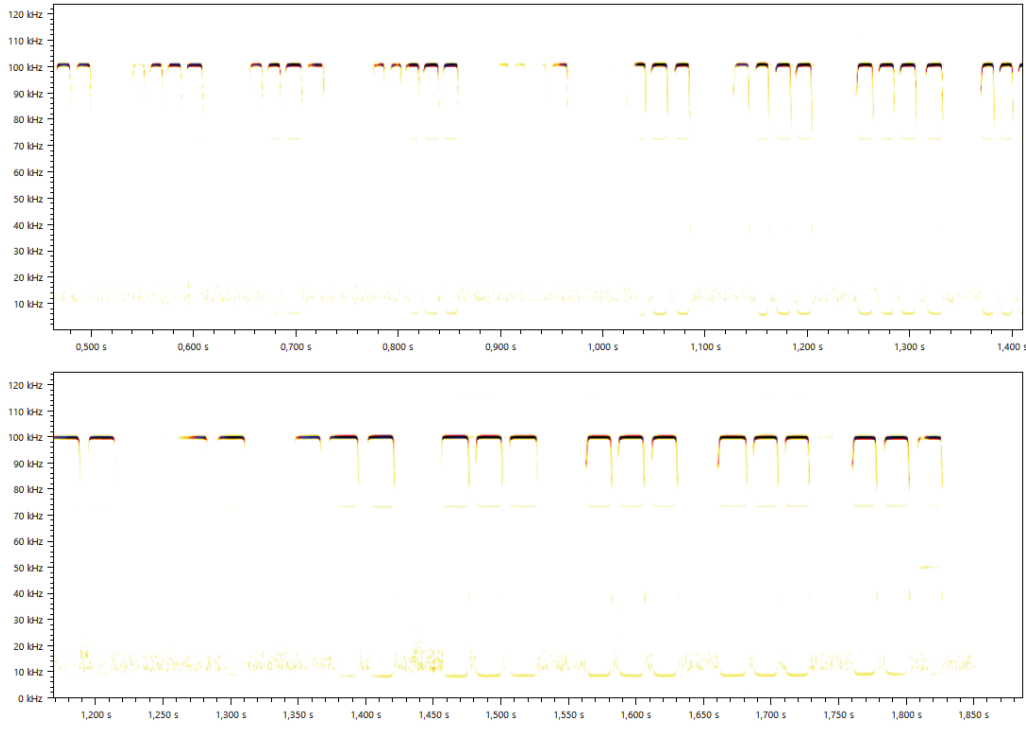


Fig. 50, 51. Spectrograms of the echolocation calls of *Rhinolophus kirghisorum* sp. nov.; individuals flying inside a mine at Magov, 18 May 2016.

sympatrically occurring in Tajikistan, large-sized *R. ferrumequinum* with peak frequency of the calls in the range of 81.4–83.3 kHz, and small-sized *R. hipposideros* with these values in the range of 109.0–110.4 kHz (comp. 98.2–103.7 kHz in *R. kirghisorum* sp. nov.), based on values from these bats recorded in the country (Table 5). Comparing the echolocation data on *R. kirghisorum* sp. nov. to the third horseshoe species from Tajikistan, medium-sized *R. bocharicus*, overlaps are present in all measured parameters (Table 5), not only the peak frequency that was recorded in the range of 99.5–103.4 kHz in the latter bat.

Records of ectoparasites. **Original data**: N y c t e r i b i i d a e: *Phthiridium szechuanum turkestanicum*: 3 ♂♂ ad, 2 ♀♀ ad [A], from 5 ♂♂, 6 ♀♀ (NMP 95761–95766, HSU pb6247, 6249, 6250, 6253, 6254), Magov, mine, 18 May 2016. – S a r c o p t i f o r m e s: Sarcoptiformes fam. sp.: 3 cysts [A], from 5 ♂♂, 6 ♀♀ (NMP 95761–95766, HSU pb6247, 6249, 6250, 6253, 6254), Magov, mine, 18 May 2016.

Comments on ectoparasites. At least two species of ectoparasites belonging to two different groups were documented from *Rhinolophus kirghisorum* sp. nov. in Tajikistan.

The known records of the bat fly *Phthridium szechuanum turkestanicum* Hůrka, 1997 come from three localities in a relatively small area; most of them represent sites of origin of the type material, viz. Dangi canyon, Tuâ-Moûn massif (cf. type locality of *R. kirghisorum* sp. nov.), Kyzyl-Unkur Cave (both Kirghizstan), and Amankutan (Uzbekistan). All known (type) specimens of *P. s. turkestanicum* were collected from specimens affiliated to *Rhinolophus* aff. *hipposideros* (Hůrka 1997: 30), here and by Benda et al. (2011) re-identified as *R. kirghisorum* sp. nov.

The specimens of bat host of *P. s. turkestanicum* from Kirghizstan (Kyzyl-Unkur) were assigned to *R. hipposideros* [s.l.] by Hůrka (1969) and the bat flies originally to *Stylidia szechuana* Theodor, 1954 (= *P. szechuanum*), i.e. to the nominotypical form of this bat fly that was described from southern China (Kwan Yen Chiao [= Guanyinqiao], Sichuan; 31°11'N, 107°57'E) and collected from *Rhinolophus blythi szechwanus* Andersen, 1918 (= *R. pusillus szechwanus*) (Theodor 1954, 1967). However, Hůrka (1969: 391) added a note on the female from Kirghizstan that, despite its morphology corresponding well with the main characters described and figured in the original description by Theodor (1954), some distinctions in chaetotaxy in this specimen were observed. The finding of *P. szechuanum turkestanicum* at Magov, Tajikistan, extends its known distribution range southwards, and the bat host species, *R. kirghisorum* sp. nov. could represent the principal host of this parasite. The biogeographical affinity of this bat fly to the Oriental fauna corresponds entirely with the phylogenetical affinity of its bat host.

From *R. kirghisorum* sp. nov. in Tajikistan, dermal cysts of astigmatic mites were collected. However, the instar of the collected parasites does not allow a species or higher taxon identification based on morphological characters. Among the astigmatic mites, those creating large and distinct cysts in bat patagium are the species of the genus *Nycteridocoptes* Oudemans, 1898 (Sarcoptidae Trouessart, 1892). *Nycteridocoptes eyndhoveni* Fain, 1959 represents one of the members of this genus that are typically associated with the bat genus *Rhinolophus* (Fain 1959, Klompen 1992).

Rhinolophus hipposideros (André, 1797) s.str.

Records. **Original data**: Zingroğ [**1**], small cave above the village (Figs. 52–55), 12 May 2016: obs. a colony of ca. 10 inds., net. 1 ♀ (NMP 95742 [S+A]; cf. Habilov & Tadžibaeva 2016b, 2018, Benda 2021, Benda et al. 2022), det. & rec. calls of emerging inds. – **Published data**: Sogdiyskaya Oblast [= Suğd Province] [undef.], 1 ind. (Dool et al. 2013); – near Stalinabad [= Dušanbe, in the Varzob river bank] [**2**], loess cave, 5 inds., ZIN, 4 August 1935: 2 ♂♂, ZMMU, leg. A. P. Kuzâkin (Benda et al. 2016a); – near Altyn Topkan / Zarnisor [**3**], juniper tree zone, 1590 m a. s. l., abandoned mine 2, 5 February 2016: coll. 2 ♂♂, 1 ♀ (Tadžibaeva & Habilov 2016b, 2017b, 2018, Habilov & Tadžibaeva 2018), mine, 1300 m a. s. l., 26 February 2016: exam. 1 ♂, mine, 2000 m a. s. l., 26 February 2016: exam. 1 ♂ (Habilov & Tadžibaeva 2018, Tadžibaeva & Habilov 2018); – near Garm-Čašma [= Garmčašma] [**4**], small cave, 30 May 2016: exam. 1 ♂ (Habilov & Tadžibaeva 2018); – near Gudos kishlak [**5**], mine, 19 February 2016: exam. 1 ♂ (Tadžibaeva

Fig. 52. View of the Panç river valley with the Zingroğ village; the Panç river makes a part of the state border between Tajikistan and Afghanistan, the Afghanistani bank on the left, Tajikistani bank with the village on the right. Two bat species were documented in this small island of vegetation, *Rhinolophus hipposideros* and *Pipistrellus pipistrellus*. Photo by A. Reiter (13 May 2016).

Fig. 53. Rocks above gardens of the Zingroğ village, Panç river valley; a foraging site of *Rhinolophus hipposideros* and *Pipistrellus pipistrellus*, additionally, in a cavity among rocks in the left part of the view, a colony of some ten individuals of *R. hipposideros* was observed. Photo by A. Reiter (13 May 2016).

Figs. 54, 55. Portraits of *Rhinolophus hipposideros* (André, 1797) from Zingroğ. Photo by A. Reiter.

& Habilov 2018); – near Kansaj [**6**], central part of the Kuraminskij [= Kurama] Mountains, small mine, 15 April 2017: exam. 1 ♂ (Tadžibaeva & Habilov 2018).

Distribution. *Rhinolophus hipposideros* is distributed broadly in the Mediterranean and temperate zones of Europe, North Africa, and western Asia, it extends also to the Afrotropics, southwards to Ethiopia and the Sudan (Hayman & Hill 1971, Corbet 1978, Bates & Harrison 1997, Horáček et al. 2000, Burgin 2019a, Benda et al. 2022); in Asia it occurs in a large part of the Middle East, in south-western Arabia, the Caucasus region, Afghanistan, and West Turkestan (Horáček et al. 2000, Benda et al. 2006, 2022), the previously mentioned occurrence in Kashmir was doubted by Csorba et al. (2003). The Tajikistani occurrence area of *R. hipposideros* s.str. represents the easternmost part of the confirmed distribution range of this bat in West Turkestan and a part of the eastern margin of the whole species range. This range margin continues from southern Tajikistan southwards to eastern Afghanistan (Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan and central Uzbekistan, where the northern limits of the confirmed species distribution are situated (Benda et al. 2016a).

The limited revised records of *R. hipposideros* s.str. in Tajikistan – including those made by us – show the species to be broadly distributed across the country and cover the whole geographical extent of the distribution range of the parataxon *R. hipposideros* s.l. (Figs. 28, 56). These records come from a medium wide altitudinal range (1788 m), and concerning the distribution statistics, this species is the third highest living among the Tajikistani bats (Fig. 10); most of its localities lie in the altitude range of 1100–1800 m a. s. l. (median 1282.5 m a. s. l.; Table 3). The highest locality of *R. hipposideros* s.str., Garmčašma in the south-western Pamirs (2604 m a. s. l.; Habilov & Tadžibaeva 2018), is the fourth highest site of bat occurrence in Tajikistan. These characteristics indicate this bat to be a mountain dweller of eastern West Turkestan.

Echolocation. Echolocation calls of *Rhinolophus hipposideros* s.str. were recorded just at one site in Tajikistan, they were emitted by individuals emerging from their roost in a small cave in Zingroğ in the Darvoz region. We recorded and analysed three call sequences (20 particular

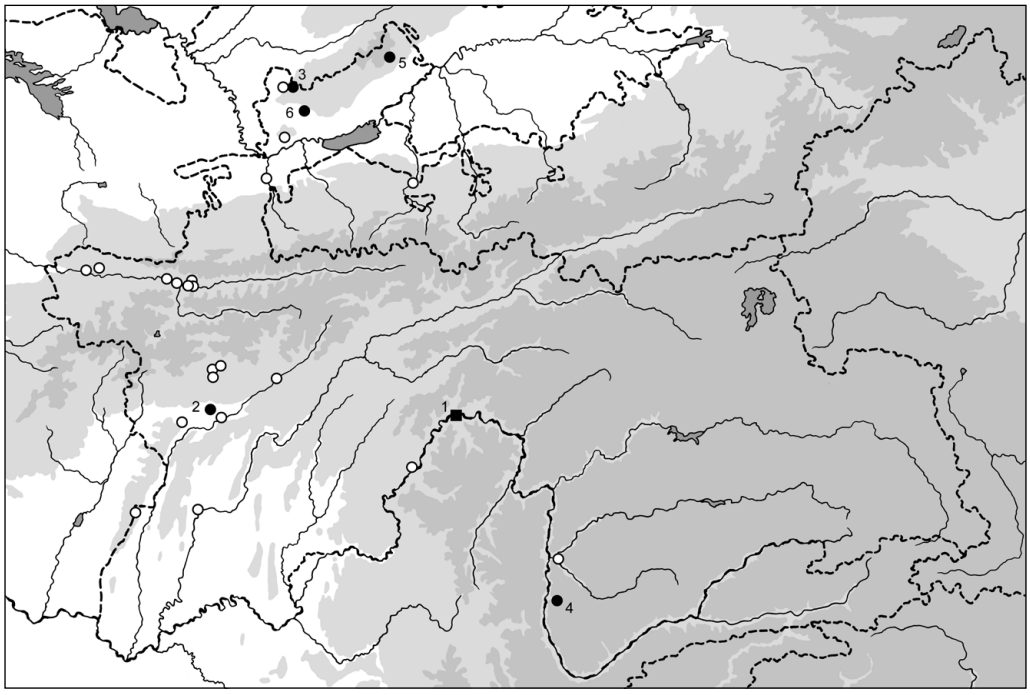


Fig. 56. Records of *Rhinolophus hipposideros* (André, 1797) in Tajikistan; full square – new record, full circles – published records, open circles – unspecified records of the small-sized horseshoe bats (*Rhinolophus hipposideros* s.l.; see Fig. 28).

pulses). The calls were of a typical FM-CF-FM shape (Fig. 57), with peak frequencies in the range of 109.0–110.4 kHz (Table 5; Benda et al. 2022). These values lie within the range of this parameter in most of the European and Middle Eastern populations (103.5–115.2 kHz; Shalmon et al. 1993, Russo & Jones 2002, Benda et al. 2008, 2012, 2022, Papadatou et al. 2008, Razgour et al. 2010, Hackett et al. 2016, Smirnov et al. 2022a, our own data), the only exception are the frequencies recorded from an island population of Malta being much higher (115.0–122.0 kHz; Mifsud & Vella 2019). See Benda et al. (2022) for a detailed comparison of call parameters in particular populations of *R. hipposideros*.

Variation. External and cranial dimensions of the newly collected Tajikistani specimen of *Rhinolophus hipposideros* s.str. are shown in Table 6.

Three subspecies names appeared during history concerning the taxonomic affiliation of the populations of *R. hipposideros* from Tajikistan and closely adjacent areas of West Turkestan and Afghanistan, viz. *R. h. hipposideros* (André, 1797) (Bobrinskoj 1925, Ognev 1927, 1928, Vinogradov 1935); *R. h. minimus* von Heuglin, 1861 (Meklenburcev 1937); and *R. h. midas* Andersen, 1905 (Kornev 1941, Kuzâkin 1950, 1965, Ellerman & Morrison-Scott 1951, Aellen 1959a, Strelkov 1963, Gaisler 1970, Ânuševič et al. 1972, Felten et al. 1977, Corbet 1978, Butovskij et al. 1985, Koopman 1994, Horáček et al. 2000, Csorba et al. 2003, Benda & Gaisler 2015, Burgin 2019a). Besides this, some authors expressed indecision to affiliate the West Turkestani populations of

R. hipposideros to a particular subspecies with respect to the published characters and/or available evidence (Kuzâkin 1944, Habilov 1992).

The most frequent opinion, attributing the populations of the eastern section of the Middle East and Central Asia to *R. h. midas*, was originally based on comparisons of samples from the most of the species range by Andersen (1918) and in deeper detail, by Felten et al. (1977). Additionally, Benda et al. (2012) co-identified several morphotypes revealed by the previous comparisons with phylogenetic lineages resulting from a molecular genetic analysis of the cytochrome *b* gene (Kůs 2008). This synthesis suggested the Middle Eastern (Iranian) populations of *R. hipposideros* to represent a taxon separated from the Mediterranean populations, being well differentiated both morphologically and genetically, and identified it with *R. h. midas* (type locality: Jask, Persian Gulf [Hormozgan, south-eastern Iran; 25°43'N, 57°49'E]; Andersen 1905: 139). However, this comparison comprised neither samples from Tajikistan nor from West Turkestan as well. Nevertheless, results of a very profound analysis using several different markers (Dool et al. 2013) conformed to the previous views, the eastern populations of *R. hipposideros*, originating from the Middle East and mainly also from Tajikistan, were shown in a separate position from the Mediterranean populations. Hence, the subspecific status of the West Turkestani populations seemed to be clear enough from these analyses, and the traditionally reported name, *R. h. midas*, was then considered appropriate (see Benda & Gaisler 2015, Burgin 2019a).

However, a new comprehensive taxonomic revision of the *R. hipposideros* group (Benda et al. 2022) demonstrated the name *R. midas* Andersen, 1905 unavailable for any population of *R. hipposideros* s.str., since it represents a species of its own that occurs in the Persian Gulf region. The extensive range of *R. hipposideros* s.str. was suggested to be inhabited by at least two subspecies, *R. h. hipposideros* in Europe and the Maghreb, and *R. h. minimus* in Crimea, the Caucasus, Middle East, and north-eastern Africa. The populations of the eastern part of the species distribution range (eastern West Turkestan, Afghanistan, ?Kashmir) remain in an unresolved position due to the limited samples used for comparison and ambiguous resulting support of phylogenetic clades. These populations represent either a part of the eastern subspecies, *R. h. minimus*, or alternatively, they could pertain to a separate lineage of the species and represent a taxon of its own. In the latter case, no name is available for such taxon/populations and it remains to be created (see Strelkov 1981, Corbet & Hill 1992, Bates & Harrison 1997, Pavlinov & Rossolimo 1998, Csorba et al. 2003).

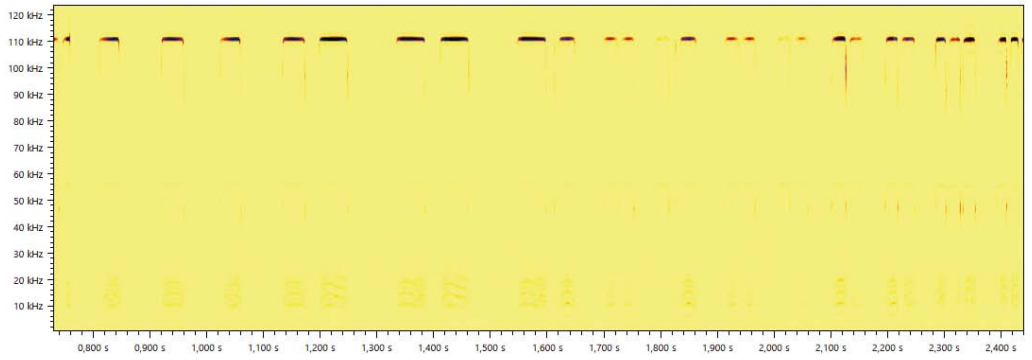


Fig. 57. Spectrogram of the echolocation calls of *Rhinolophus hipposideros* (André, 1797); a handled individual netted at a small cave at Zingroğ, 12 May 2016.

Myotis blythii (Tomes, 1857)

Records. **Original data**: Kūlob [**1**], botanical garden, 6 May 2016: net. 1 ♀ (Fig. 58; NMP 95723 [S+A]; cf. Habilov & Tadžibaeva 2016b); – Čilduhtaron [**2**], at a rock overhang, 8 May 2016: net. 1 ♂ (NMP 95728 [S+A]; Habilov & Tadžibaeva 2016b); – Qarağoč [**3**], inside of a loess cavity, 9 May 2016: net. 7 ♂♂ (NMP 95731, 95732, HSU pb6194–6197 [S+A], NMP 95730 [A]), 15 May 2016: net. 1 ♂ (NMP 95745 [S+A]; cf. Habilov & Tadžibaeva 2016b); – Sariselom valley [**4**], at the Kalpisipar cave (Figs. 59–61), 10 May 2016: net. 8 ♂♂ (NMP 95739–95741, HSU pb62011–6214 [S+A], NMP 95738 [A]; cf. Habilov & Tadžibaeva 2016b); – Hoça Šaqiqi Balhi [**5**], Dañgara tunnel, 17 May 2016: coll. 1 ♂ (NMP 95752 [S+A]; cf. Habilov & Tadžibaeva 2016b); – Kalkot [**6**], above a small lake under the Ar Arak cave, 17 May 2016: net. 1 ♂ (NMP 95755 [S+A]; cf. Habilov & Tadžibaeva 2016b); – Magov [**7**], mine, 18 May 2016: obs. 8 roosting inds. (torpid; Fig. 63), coll. 5 ♂♂ (NMP 95767, 95768, HSU pb6258–6260 [S+A]; cf. Habilov & Tadžibaeva 2016b); Magov, garden, 18 May 2016: net. 1 ♂ (HSU pb6263 [S+A]; cf. Habilov & Tadžibaeva 2016b). – **Published data**: Sohta-Činar″ [= Činor] kishlak [**8**], Kafirnigan [= Kofarniḫon] river bank near the village, 30 June [= 13 July NS] 1914: shot 1 ♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); – near Koktaš [= Somonien] [**9**], 18 km of Stalinabad [= Dušanbe], Kafirnigan [= Kofarniḫon] river bank, caves, 1950: coll. 2 ♂♂, leg. O. P. Bogdanov (Bogdanov 1953a, 1956a); – near Gulistan [= Guliston] kishlak [**10**], 8 km of Stalinabad [= Dušanbe], deep cave, 29 March 1953: exam. 6 ♀♀, summer 1953: obs. several thousand of inds, leg. G. P. Usačev (Bogdanov 1954, 1956a), 14 August 1954: obs. more than 2000 inds. (Bogdanov 1956a); – Gul′bista [= Kulpista] [**11**], cave, 21 June 1963: obs. ca. 60 inds., 11 June 1965: obs. ca. 40 inds. (Ŝerbin 1968); near Dušanbe, Gul′pista [= Kulpista] kishlak, 8 October 1954 & 19 April 1959: coll. 1 ♂, 7 ♀♀, 1 ind., IZPAN, leg. S. A. Said-Aliev & A. Sinel′nikov (Habilov 1992, Tadžibaeva & Habilov 2019b); – Gandžino [= Gançina] (Vahš river valley) [**12**], 5–23 July 1964: shot 5 ♀♀, 2 inds. juv. (Ŝerbin 1968); – Ok-Bulak (Ak-Tau [= Aktau] Mountains) [**13**], ca. 2000 m a. s. l., 14 August 1964: obs. several inds. (Ŝerbin 1968); – Âhči-Sor [=

Fig. 58. Portrait of *Myotis blythii* (Tomes, 1857) from Kūlob. Photo by A. Reiter.

Fig. 59. Sariselom valley, a tributary of the Panç river valley, ca. 1150 m a. s. l. (the Afghanistani side of the valley in the background), an area of documented occurrence of at least four bat species (cf. Figs. 60, 61). Photo by M. Uhrin (10 May 2016).

Âhčisor] (Darvazskij [= Darvoz] Mountains) [**14**], fissure under a rock ledge, 26 September 1965: obs. 1 ind. (Ŝerbin 1968); – Dagana [= Daḥana] (Dangara [= Danǧara] district) [**15**], at a cave on the Vahš river bank, 8 and 11 July 1966: shot 2 ♂♂ (Ŝerbin 1968); – Kuraminskij / Kuraminskiy khrebet [= Kurama Mts.], Adrasman [= Adrasmon] [**16**], 9 April 1978, May 1978, 19 June 1978, 19 April 1979, 4 May 1979 (Hůrka 1984); Kuraminskij [= Kurama] Mountains, near Adrasman [= Adrasmon], mine, 9 April 1978: exam. 1 ♀, 19 April 1979: exam. 2 ♂♂, 2 ♀♀, 26 May 1979: exam. 4 ♂♂, 2 ♀♀, 25 August 1982: obs. 4 inds., incl. 2 ♂♂ (Habilov 1992, Tadžibaeva & Habilov 2018), Koni-Mansur cave, 22 July 1977: obs. a colony of more than 3000 inds., 19 July 1980: obs. a colony of ca. 700 inds. (Tadžibaeva & Habilov 2018); – Mogol-Tau [= Mogoltau] mountains, Uč Tepa [= Učteppa] [**17**], 19 July 1978, 22 April 1980 (Hůrka 1984); vicinity of Uč-Tepe [= Učteppa], mine, May 1983: obs. a colony of 700–800 inds. (Medvedev et al. 1984); mines near Leninabad [= Huçand], end of May 1983: obs. a colony of 700–800 inds. (Medvedev 1992); Mogol-Tau [= Mogoltau] Muntains, near Uč-Teppa [= Učteppa] kishlak, mines, 27 May 1979: obs. 804 inds., incl. 44 ♂♂, 59 ♀♀, 6 June 1979: exam. 1 ♂, 22 April 1980: exam. 2 ♀♀, 27 June 1984: exam. 1 ♂, 17 April 1985: exam. 1 ♂, 18 April 1985: exam. 1 ♂, 1 July 1986: exam. 6 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2019a), 18 July 1980: obs. 12 inds., incl. 8 ♂♂, 1 ♀, 14 May 1983: obs. 700 inds., 29 August 2013: obs. 60 inds., incl. 1 ♂, 1 ♀ (Tadžibaeva & Habilov 2019a), 7 August 2015: obs. 80 inds., incl. 13 ♂♂, 13 ♀♀ (Tadžibaeva & Habilov 2016d, 2019a), 25 September 2015: obs. 29 inds., incl. 1 ♂, 1 ♀, 21 August 2016: obs. 54 inds., 15 ♂♂, 9 ♀♀, 1 April 2017: obs. 203 inds., incl. 1 ♂, 1 ♀, 4 September 2017: obs. 50 inds., 21 April 2018: obs. 400 inds., 3 July 2018: obs. ca. 2000 inds., 1 April 2019: obs. 84 inds., 26 May 2019: obs. 1000 inds., 2 June 2019: obs. ca. 1000 inds., mine 2, 2 June 2019: obs. 2 inds., mine 3, 16 June 2019: obs. 6 inds., incl. 1 ♂ (Tadžibaeva & Habilov 2019a); – Tagojak [= Tağoâk] [**18**], 25 km SW Leninabad [= Huçand], July 1979 (Hůrka 1984); near Nau [= Nov] (Metar [= Meḥtar] kishlak), obs. & coll. (Habilov 1992); – Petra Pervogo [= Pëtri Âkim] Mountains [**19**], 1 ind., ZMMU (Habilov 1986); Petra I [= Pëtri Âkim] Mountains, 6 September 1977: coll. 1 ♂, ZMMU, leg. V. Dolgov (Habilov 1992); – Varzob river valley, near Varzob [**20**], small cave, 13 November 1985: obs. inds., incl. 1 ♀ (Malinovskij 1988, Tadžibaeva & Habilov 2016b); Varzob canyon (18 km, cave), 12 September 1985: coll. 4 ♂♂, 1 ♀, 13 November 1985: coll. 1 ♂, 23 August 1986: coll. 12 ♂♂, 3 ♀, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Kondara river valley [**21**] (Malinovskij 1988); – Takob [= Tagob] river valley [**22**] (Malinovskij 1988); near Takob [= Tagob], mine, 25 May 1985: coll. 1 ♂, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Sardaimiena

river valley, Ramit [= Romit] [**23**], mine, 9 August 1986: obs. 17 inds., incl. 6 ♂♂, 10 ♀♀ (Malinovskij 1988, Tadžibaeva & Habilov 2019b); near Romit, 1 June 1985: coll. 2 ♂♂, 5 August 1985: coll. 1 ♂, 1 ♀, 3 September 1985: coll. 5 ♂♂, 1 ♀, 9 August 1986: coll. 4 ♂♂, 10 ♀♀, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Guzgarf [= Ğusğarf] [**24**], mine, 9 May 1986: obs. ind. (Malinovskij 1988); – Kulâb [= Kūlob] [**1**], 26 July 1941: 1 ind., ZIN, leg. B. Vinogradov & S. Stroganov (Habilov 1992, Benda et al. 2006, 2012, Benda & Gaisler 2015); – canyon at Nadži [= Nodž] kishlak [**25**], 26 July 1934: 1 ind., ZIN, leg. L′vova (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Čol-Ata [= Čolota] [**26**], 5 May 1983: exam. 1 ♂, 13 May 1983: exam. 1 ♂ (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Dagana [= Dahana] [**27**], 21 April 1979: exam. 2 ♂♂ (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Gudos kishlak [**28**], 31 May 1979: exam. 1 ♂ (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Pangaz [**29**], 17 June 1979: exam. 1 ♂ (Habilov 1992); – Mogol-Tau [= Mogoltau] Muntains, near Uč-Bog [= Boği bolo] kishlak [**30**], 9 May 1978: exam. 9 ♂♂, 15 ♀♀, 26 June 1978: exam. 2 ♂♂, 19 July 1978: exam. 1 ♂, 6 ♀♀, 20 July 1980: exam. 6 ♂♂, 14 ♀♀, 22 April 1988: exam. 5 ♀♀ (Habilov 1992), mines, 19 May 1978: obs. 250 inds., 13 May 1979: obs. 65 inds., incl. 45 ♂♂, 4 July 1979: obs. 50–60 inds., 22 April 1980: obs. 700–800 inds., 12 April 2010: exam. 1 ♂, 2 ♀♀, 19 April 2012: obs. 28 inds., 24 August 2016: obs. 135 inds., incl. 3 ♂♂ (Tadžibaeva & Habilov 2019a); – Mogol-Tau [= Mogoltau] Muntains, near Čajruh-Dajron [= Čoruh-Dajron] [**31**], mines, 19 June 1984: exam. 1 ♂, 26 June 1984: exam. 4 ♂♂, 19 April 1985: exam. 1 ♂, 15 April 1986: exam. 1 ind., 7 July 1987: exam. 4 ♂♂, 21 April 1988: exam. 3 ♂♂, 22 June 1989: exam. 5 ♂♂ (Habilov 1992), 6 August 1980: obs. 7 inds., incl. 4 ♂♂, 1 ♀, 10 April 2012: obs. 2 inds., incl. 1 ♂, 2 October 2012: obs. 1 ind., large mine, 11 September 2015: obs. 16 inds., mine, 2 October 2015: obs. 1 ind., large mine, 20 August 216: obs. 19 inds., incl. 5 ♂♂, 6 ♀♀, 5 september 2017: obs. 14 inds. (Tadžibaeva & Habilov 2019a); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, Guzlon Range near Dahana [**32**], mine 4, 8 May 1978: exam. 2 ♂♂ (Habilov 1992, Habilov & Tadžibaeva 2014a, 2020a, Tadžibaeva 2018), mine 4, 6 July 2012: obs. 8 inds., incl. 2 ♂♂, mine 13, 13 July 2012: obs. 14 inds., incl. 1 ♂ (Habilov & Tadžibaeva 2013, 2014a), mine 4, 19 June 1978: exam. 1 ♂, 7 August 1980: exam. 4 ♂♂, 3 ♀♀, 1 ind. (Habilov & Tadžibaeva 2014a, 2020a, Tadžibaeva & Habilov 2016d), 12 April 2012: exam. 1 ♀, 6 July 2012: obs. 8 inds., incl. 2 ♀♀, mine 6, 6 July 2012: obs. 13 inds., incl. 3 ♂♂, 1 ♀, mine 13, 7 July 2012: obs. 48 inds., incl. 5 ♂♂, mine 14, 13 / 15 July 2012: obs. 10 / 14 inds., mine 4, 21 April 2013: obs. 3 inds., incl. 1 ♂, 17 May 2013: obs. 10 inds., 9 September 2013: obs. 12 inds.,

Figs. 60, 61. The Kalpisipar cave above the Sariselom valley; four bat species were documented to occur at this site, *Rhinolophus ferrumequinum*, *R. bocharicus*, *Myotis blythii* and *Tadarida teniotis*. Photo by A. Reiter (11 May 2016).

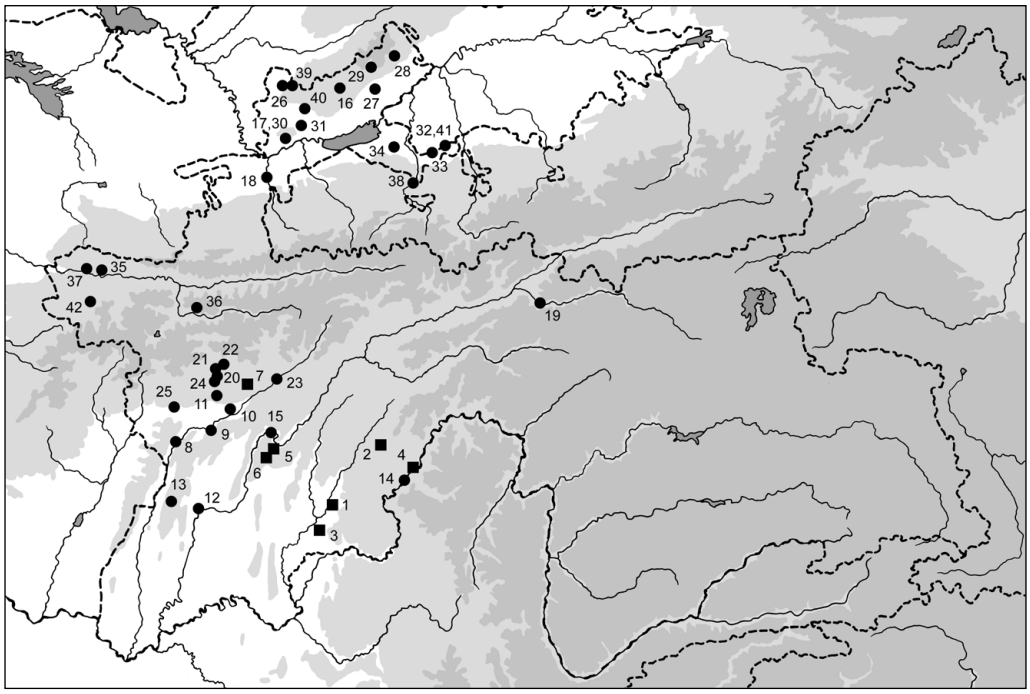


Fig. 62. Records of *Myotis blythii* (Tomes, 1857) in Tajikistan; squares – new records, circles – published records.

incl. 1 / 2 ♂♂, 1 ♀ (Habilov & Tadžibaeva 2014a, 2020a, Tadžibaeva & Habilov 2016d, Tadžibaeva 2018), 1 August 2015: obs. 19 inds., incl. 6 ♂♂, 5 ♀♀ (Tadžibaeva & Habilov 2016d, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 14 July 2012: obs. 1 ind., 23 August 2014: obs. 6 inds., incl. 3 ♂♂ (Tadžibaeva 2018), mine 4, 10 July 2014: obs. 4 inds., incl. 2 ♂♂, 1 ♀, 10 October 2014: exam. 1 ♂ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 10 April 2012: obs. 2 inds., incl. 1 ♂, 23 March 2014: obs. 6 inds., incl. 3 ♂♂, 14 September 2017: obs. 12 inds., incl. 1 ♂, 1 ♀, 7 July 2018: obs. 11 inds., incl. 4 ♂♂, 5 July 2019: obs. 7 inds., incl. 2 ♂♂ (Habilov & Tadžibaeva 2020a); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Kul′kent [= Kūlkand] [**33**], abandoned mine, 16 June 1979: exam. 1 ♂ (Habilov 1992, Habilov & Tadžibaeva 2014a, 2020c, Tadžibaeva 2018), mines 2+4, 14 July 2012: obs. 2 inds. (Habilov & Tadžibaeva 2014a, 2020c, Tadžibaeva 2018), mine 2, 21 June 2017: obs. 3 /11 inds., incl. 2 / 3 ♂♂, 5 ♀♀, mine 4, 22 June 2017: obs. 2 inds., incl. 1 ♂ (Tadžibaeva & Habilov 2017c, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine, 21 August 2014: obs. 11 inds., incl. 3 ♂♂, 5 ♀♀, 31 May 2018: obs. 4 inds., incl. 2 ♂♂, 5 June 2018: obs. 3 inds., incl. 1 ♂, 1 ♀ (Habilov & Tadžibaeva 2020c); – Belesenyk Range, near Kim [**34**], 16 May 1979: exam. 3 ♂♂ (Habilov 1992, Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, near Jory [= Ërī] kishlak [**35**], 1440 m a. s. l., Somi cave, 20 August 1978: obs. 12 inds., incl. 4 ♂♂, 6 ♀♀, 29 August 1987: exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2017a), 19 August 1977: obs. 4 inds., incl. 2 ♂♂, 1 ♀, 15 October 2015: obs. 1 ind. (Tadžibaeva & Habilov 2017a); – Zeravšanskij [= Zarafšon] Mountains, near Remond [= Remon] (Duoba site) [**36**], 17 August 1978: exam. 1 ♂ (Habilov 1992); – Majkata [= Majkatta] kishlak [**37**], cave, 21 August 1978: obs. 500–600 inds., exam. 36 ♂♂, 177 ♀♀, 20 June 1979: obs. a nursery colony of 1000 inds. (Habilov 1992, Tadžibaeva & Habilov 2017a); – Čarku [= Čorkuḫ] [**38**], 3 July 1988: 1 ♂, NMP, leg. J. Červený, A. Červená & J. Obuch (Benda et al. 2011, 2012, Benda & Gaisler 2015); – near Altyn-Topkan / Zarnisor (Kuraminskij [= Kurama] Mountains) [**39**], juniper tree zone, 1590 m a. s. l., abandoned mine, 5 February 2016: exam. 1 ♀, 15 February 2016: coll. 1 ♀, leg. A. V. Pastuhov (Tadžibaeva & Habilov 2016b, 2017b, 2018); – Kansaj [**40**], 15 April 2017: obs. 1 ind. (Tadžibaeva & Habilov 2018); – near Dahana [**41**], Guzlon Range, Isfara district, apricot orchard, water reservoir, 5 July 2019: net. 2 ♀♀ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2020a, 2021a); – near Šing [**42**], Dahoni ob mine, 3 October 2020: obs. 1 ind. (Habilov & Tadžibaeva 2020b).

Distribution. *Myotis blythii* is distributed broadly in the southern Palaearctic (Strelkov 1972, Corbet 1978, Horáček et al. 2000, Ruedi 2023); in Asia it occurs in the Mediterranean zone of the Middle East, in Transcaucasia, West and East Turkestan, Afghanistan, northern India, Kashmir, Altai Mts. of Kazakhstan and Russia, Mongolia, and northern China (Bates & Harrison 1997, Horáček et al. 2000, Benda et al. 2006, 2012, Dolch et al. 2021a). It belongs to the most common bat species in the southern and eastern regions of West Turkestan (Bobrinskoj 1925, Ognev 1928, Bogdanov 1953a, Kuzâkin 1965, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). The Tajikistani occurrence area of *M. blythii* represents the eastern part of the distribution range of this bat in West Turkestan and one of the centres of its high abundance in the region. In central Tajikistan, west and north of the Pamirs, the species reaches a part of the southern and eastern margin of its distribution in central Asia. This range margin continues from south-western Tajikistan southwards to northern Afghanistan (Benda & Gaisler 2015) and across the Hindu Kush Mts. to southern Afghanistan and the Indian range part (Bates & Harrison 1997, Benda & Gaisler 2015). From northern Tajikistan the range margin continues to southern Kirghizstan, south-eastern Kazakhstan, East Turkestan, and Mongolia (Bobrinskoj 1925, Butovskij et al. 1985, Rybin et al. 1989, Dolch et al. 2021a).

Topál (1971: 384) reported two ZIN and/or ZMMU specimens of *M. blythii* from Tajikistan as follows: "Tacht Bazar, Murgab Basin, Pamir Mts.: 38°5′, 74°". This record indicates to Tagtabazar on the Murgap river in Turkmenistan (35°57'N, 62°55'E) and to the Pamir Mts. in Tajikistan (approximate coordinates as given by Topál 1971). The Turkmenistani locality corresponds with that of a ZIN specimen collected in Tagtabazar by K. K. Flerov on 25 June 1930 and reported by

Fig. 63. *Myotis blythii* (Tomes, 1857) roosting in a mine at Magov. Photo by A. Reiter (18 May 2016).

Strelkov et al. (1978). Its assignation to the origin in Tajikistan is thus erroneous. The other specimen could be coidentified with one of the two ZIN specimens coming reportedly from Tajikistan, from Kūlob (ZIN 32277) or from near Kzyl-Tam on the northern slope of the Ḩisor Mountains (ZIN 24389). However, the latter (male) specimen, reported to originate from Tajikistan by Habilov (1992), Benda et al. (2006, 2012), and Benda & Gaisler (2015) and collected by entomologist Petr Aleksandrovič Vel′tišev on 17/18 August 1933, originates in fact from Qiziltom, Qamashi District, Qashqadaryo Province, Uzbekistan (38°45'N, 67°00'E, 2056 m a. s. l.). This site is really situated on the northern slope of the Ḩisor Mountains, but not in its Tajikistani part (a similar error was made also concerning a specimen of *Myotis davidii* coming from this locality, see below).

Our new records contribute only slightly to the depiction of the distribution of this bat in West Turkestan, but significantly to a detailed picture of its occurrence in south-western Tajikistan, namely in the Khatlon Province (Fig. 62). In this district, only two records were known, those made by Ŝerbin (1968) at Gançina and Âhčisor in the middle 1960s. The six new records show much broader occurrence of *M. blythii* in this low hilly region, the record made inside a loess cavity at Qarağoč represents the new southernmost finding of this bat in Tajikistan (37°44'N).

In Tajikistan, *M. blythii* belongs to very common bats (Fig. 62), at least 42 record sites are known, spread across the low to medium altitudes of the western section of the country (plus one site in the northern Pamirs). The available records come from a rather wide altitudinal range (1897 m); however, some three quarters of the records were made at the sites below 1300 m a. s. l., i.e. in rather low areas of Tajikistan (Fig. 10, Table 3). Our records come from a smaller range of 1270 m, however, the distribution of these record sites is very similar and only slightly higher positioned, respectively (median 1168.0 m vs. 1036.0 m; see Fig. 11, Table 4).

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Myotis blythii* are shown in Table 10. For the material examined see above.

The Tajikistani populations of *M. blythii* as well as its populations of Afghanistan, Kashmir, India, Nepal, and of the whole eastern part of West Turkestan (Tajikistan, Kirghizstan, E Kazakhstan, E Uzbekistan), have been consistently attributed to the small-sized nominotypical subspecies of this bat, *M. b. blythii*, described from northern India (Topál 1971, Strelkov 1972, 1981, Felten et al. 1977, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, Koopman 1994, Benda & Horáček 1995, Arlettaz et al. 1997, Bates & Harrison 1997, Benda et al. 2006, 2011, 2012, Dzeverin & Strelkov 2008, Evin et al. 2008, Bogdanowicz et al. 2009, Srinivasulu & Srinivasulu 2012, Furman et al. 2013, 2014, Benda & Gaisler 2015, Ruedi 2023, etc.).

However, several other opinions formerly appeared concerning the taxonomic affiliation of the West Turkestani populations of *M. blythii*; see crosses [†] below for the authors who regarded taxonomic status (also) of the populations of Tajikistan in particular. Originally, these bats were assigned to *M. myotis* (Borkhausen, 1797), a European sibling species of *M. blythii* (Radde & Walter 1889, Kaŝenko 1905, Satunin″ 1910, 1914, Bil′kevič″ 1918, Bobrinskoj 1918†, 1925†, 1926, Ogneff & Heptner 1928, Ognev 1928†, Kuzâkin 1934, Meklenburcev 1935, 1937, Vinogradov 1935†). Later on, the Turkestani bats were affiliated with *M. oxygnathus* (Monticelli, 1885), currently considered to be a name of the European subspecies of *M. blythii* (Ognev 1927†, Kuzâkin 1935, 1944†, 1950†, L′vova 1945†, Kuznecov 1948, Bogdanov 1953a, 1954†, 1956a†, 1968, Strelkov 1963†, Babaev 1965, Ŝerbin 1968†). To *M. blythii oxygnathus*, the Turkestani populations were assigned by only Ellerman & Morrison-Scott (1951†) and those of Afghanistan by Aellen (1959a).

Finally, Kuzâkin (1965) and subsequent authors (except the two mentioned above) assigned the West Turkestani bats to *M. blythii*; concerning the Tajikistani populations namely Topál (1971), Strelkov (1972, 1981), Corbet (1978), Pavlinov & Rossolimo (1987, 1998), Malinovskij (1988), Habilov (1992, 2003), Koopman (1994), Borisenko & Pavlinov (1995), Horáček et al. (2000),

Table 10. Basic biometric data on the newly collected specimens of *Myotis blythii* (Tomes, 1857), *M. emarginatus* (Geoffroy, 1806), *M. davidii* (Peters, 1869), and *Vespertilio murinus* Linnaeus, 1758 (*V.m.*). For abbreviations see p. 8

	Myotis blythii					*Myotis emarginatus*					*Myotis davidii*		*V.m.*
	n	**M**	min	max	SD	n	**M**	min	max	SD	95756	95769	95725
LC	26	**75.7**	71	78	1.853	15	**53.9**	52	57	1.407	50	48	66
LCd	26	**62.3**	59	65	1.828	15	**49.3**	46	53	2.160	49	46	49
LAt	26	**57.00**	54.1	60.5	1.623	15	**43.17**	40.8	45.1	1.236	35.5	36.4	45.3
LA	26	**24.62**	23.4	26.2	0.753	15	**18.35**	17.6	19.3	0.567	16.8	15.8	18.1
LT	26	**9.96**	8.9	10.8	0.442	15	**9.25**	8.3	9.9	0.389	7.3	7.3	6.3
G	26	**19.55**	16.0	24.5	2.093	15	**7.85**	6.7	8.9	0.624	4.6	4.3	10.2
LCr	24	**21.14**	20.46	22.04	0.365	15	**16.27**	15.66	16.62	0.266	14.14	13.95	14.93
LCb	24	**20.14**	19.51	20.76	0.305	15	**15.39**	14.92	15.89	0.284	13.44	13.26	14.81
LaZ	24	**13.72**	13.07	14.26	0.317	15	**9.86**	9.68	10.17	0.150	8.64	8.41	9.64
LaI	24	**4.98**	4.67	5.23	0.134	15	**3.56**	3.37	3.73	0.110	3.35	3.24	4.28
LaInf	24	**5.57**	2.39	6.23	0.703	15	**3.88**	3.74	4.08	0.092	3.43	3.38	5.55
LaN	24	**9.56**	9.17	9.88	0.161	15	**7.44**	7.32	7.61	0.088	6.83	6.61	7.73
LaM	24	**10.02**	9.54	10.42	0.205	15	**8.05**	7.91	8.27	0.098	7.31	7.08	8.73
ANc	24	**7.48**	7.26	7.75	0.143	15	**5.75**	5.48	5.94	0.108	4.83	4.68	5.19
LBT	24	**3.53**	3.36	3.67	0.081	15	**2.93**	2.66	3.22	0.145	2.72	2.83	3.58
CC	24	**5.80**	5.63	6.08	0.123	15	**4.12**	4.03	4.23	0.061	3.54	3.52	5.08
M^3M^3	24	**9.01**	8.72	9.41	0.181	15	**6.33**	6.17	6.47	0.087	5.44	5.32	6.11
CM^3	24	**8.90**	8.68	9.28	0.139	15	**6.63**	6.33	6.83	0.133	5.25	5.21	5.36
LMd	24	**16.09**	15.57	16.56	0.276	15	**12.03**	11.53	12.41	0.264	9.93	9.86	10.88
ACo	24	**5.16**	4.63	5.57	0.205	15	**3.58**	3.41	3.74	0.101	2.78	2.82	3.32
CM_3	24	**9.58**	9.33	9.91	0.161	15	**7.02**	6.68	7.32	0.181	5.58	5.53	5.76

Benda et al. (2011), Habilov & Tadžibaeva (2013, 2014a, 2016b, 2019a, 2020a, b, c, d, 2021a, b, c), Tadžibaeva & Habilov (2016b, 2017a, b, c, 2018, 2019a, d, c).

Records of ectoparasites. **Original data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata turkestanica*: 1 ♂ ad, 1 ♀ ad [A], from 1 ♀ (NMP 95723), Kūlob, botanical garden, 6 May 2016; – 1 ♂ ad, 1 ♀ ad [A], from 1 ♂ (NMP 95745), Qarağoč, loess cavity, 15 May 2016. – N y c t e r i b i i d a e: *Nycteribia lindbergi*: 1 ♀ ad [A], from 1 ♂ (NMP 95752), Hoça Šaqiqi Balhi, Dañgara tunnel, 17 May 2016; – 1 ♂ ad, 1 ♀ ad [A], from 8 ♂♂ (NMP 95738–95741, HSU pb6211–6214), Sariselom valley, Kalpisipar cave, 10 May 2016; – 1 ♂ ad, 1 ♀ ad [A], from 7 ♂♂ (NMP 95730–95732, HSU pb6194–6197), Qarağoč, loess cavity, 9 May 2016; – 1 ♂ ad [A], from 1 ♂ (NMP 95728), Čilduhtaron, rock overhang, 8 May 2016. – *Penicillidia dufourii*: 1 ♀ ad [A], from 1 ♂ (NMP 95752), Hoça Šaqiqi Balhi, Dañgara tunnel, 17 May 2016. – S p i n t u r n i c i d a e: *Spinturnix myoti*: 3 inds. [A], from 1 ♀ (NMP 95723), Kūlob, botanical garden, 6 May 2016; – 7 inds. [A], from 7 ♂♂ (NMP 95730–95732, HSU pb6194–6197), Qarağoč, loess cavity, 9 May 2016; – 1 ♂ ad, 3 ♀♀ ad, 6 inds. [A], from 1 ♂ (NMP 95745), Qarağoč, loess cavity, 15 May 2016; – 1 ♂ ad [P], from 5 ♂♂ (NMP 95767, 95768, HSU pb6258–6260), Magov, mine, 18 May 2016. – **Published data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata turkestanica*: 5 ♂♂, 7 ♀♀, vicinity of Uč-Tepe [= Učteppa], mine, May 1983 (Medvedev 1984, Medvedev et al. 1984); 12 inds. ad, numerous larvae, mines near Leninabad [= Huçand], May 1983 (Medvedev 1992). – N y c t e r i b i i d a e: *Nycteribia latreillii*: 2 ♂♂, 4 ♀♀, Kuraminskij khrebet [= Kurama Mts.], Adrasman [= Adrasmon], May 1978, 4 May 1979, leg. T. K. Khabilov (Hůrka 1984); – 12 ♂♂, 17 ♀♀, Mogol-Tau [= Mogoltau] mountains, Uč Tepa [= Učteppa], 19 July 1978, 22 April 1980, leg. T. K. Khabilov (Hůrka 1984); – 1 ♀, Tagojak [= Tağoâk], 25 km SW Leninabad [= Huçand], July 1979, leg. T. K. Khabilov (Hůrka 1984); – *Nycteribia lindbergi*: 5 ♂♂, 1 ♀, Kuraminskiy khrebet [= Kurama Mts.], Adrasman [= Adrasmon], 9 April 1978, 19 June 1978, 19 April 1979, leg. T. K. Khabilov (Hůrka 1984); – 1 ♂, 4 ♀♀, Mogol-Tau [= Mogoltau] mountains, Uč Tepa [= Učteppa], 19 July 1978, 22 April 1980, leg. T. K. Khabilov (Hůrka 1984); – *Penicillidia dufourii*: 2 ♂♂, 5 ♀♀, Kuraminskiy khrebet [= Kurama Mts.], Adrasman [= Adrasmon], 9 April 1978, 19 June 1978, 19 April 1979, leg. T. K. Khabilov (Hůrka 1984); – 2 ♂♂, 6 ♀♀, Mogol-Tau [= Mogoltau] Mts., Uč Tepa [= Učteppa], 19 July 1978, 22 April 1980, leg. T. K. Khabilov (Hůrka 1984). – S p i n t u r n i c i d a e: *Spinturnix myoti*: 16 ♂♂, 22 ♀♀, 11 ♀ deutonymphs, 8 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – M a c r o n y s s i d a e: *Steatonyssus periblepharus*: 1 ♂, 1 ♀,

2 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Ichoronyssus scutatus*: 1 ♀, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Myotis blythii*, a very broad variety of ectoparasites was found in Tajikistan, seven species of four families were documented in total.

The members of the genus *Rhinolophopsylla* Oudemans, 1909 are predominantly documented from cave-dwelling bats, primarily of the genera *Rhinolophus* or *Miniopterus*, although bats of the family Vespertilionidae could also be encountered (Hůrka 1963). However, Medvedev (1992) suggested *Myotis blythii* to be the principal host of the West Turkestani populations, belonging to the subspecies *R. unipectinata turkestanica* Ioff, 1953. This flea shows a high infestation level in *M. blythii* in West Turkestan and the evidence from Tajikistan conforms with such observation. Numerous records are available also from *Rhinolophus ferrumequinum*, this could be linked just to the sharing of the same underground roost, anyway. Besides these two hosts, *R. u. turkestanica* was collected also from *Rhinolophus bocharicus* and *Myotis emarginatus* in Tajikistan, and this makes it one of the most frequent flea species in the country. According to the data by Medvedev (1992) this flea occurs mostly in submontane and montane altitudes of West Turkestan, although this observation is rather a consequence of a limited selection of the inspected bat roosts.

In the western Palaearctic, typical nycteribiid parasites of the *Myotis myotis* group are the subgenera *Nycteribia* Latreille, 1796 and *Acrocholidia* Kolenati, 1857. The distribution range of *Nycteribia* (*Nycteribia*) *latreillii* (Leach, 1817) corresponds to the geographical extension of the group, its occurrence is known from the area stretching from the Maghreb in the west, across the southern part of continental Europe (up to 51–52°N) and south-western Asia to West Turkestan, the easternmost findings are known from eastern Kazakhstan (Theodor 1954, Hůrka 1964, Polkanov & Medvedev 1997). Additionally, a separate subspecies *N. l. kimaonica* Bhat et Kulkarni, 1974 was described based on the specimens from northern India (Bhat & Kulkarni 1974). *Nycteribia* (*Acrocholidia*) *vexata* Westwood, 1835 has a very similar range, only in Europe it reaches more to the north, up to 53°N, and in Asia slightly less to the east, the easternmost records being known from northern Iran and south-western Turkmenistan (Hůrka 1984). In West Turkestan and adjacent regions, *N. vexata* is replaced by a similar species, *N. lindbergi* Aellen, 1959, originally described as a subspecies of *N. vexata* from Afghanistan (Aellen 1959b; type locality: Nayak cave, west of Kabul; 35°00'N, 68°48'E). Besides Afghanistan, *N. lindbergi* was reported to occur in Tajikistan, Kirghizstan, Uzbekistan, and eastern Kazakhstan, i.e. in the West Turkestani range of *M. blythii*, but except the latter host species, also in the bats of the genus *Plecotus* (Aellen 1959b, Hůrka 1984, Polkanov & Medvedev 1997). It is a typical cave-dwelling bat fly species, in Tajikistan it was collected only from *M. blythii* at a rather high number of six sites.

Myotis blythii (along with other species of the *Myotis myotis* group) represents a principal host of the gamasoid mite *Spinturnix myoti* (Kolenati, 1856) whose distribution range corresponds with the range of the host group (Deunff et al. 2004). *Steatonyssus periblepharus* Kolenati, 1858 is a macronyssid mite species typically parasitising bats of the genus *Pipistrellus* (for details see under *Pipistrellus pipistrellus*). Besides *M. blythii*, this mite was collected from Tajikistan from *P. pipistrellus* and from a mixed collection of hosts (Chiroptera sp.).

The macronyssid mite *Ichoronyssus scutatus* (Kolenati, 1856) was traditionally considered to be a monoxenic parasite specialised on bats of the *M. myotis* group (Dusbábek 1972). A recent view by Stanyukovich (1997) and Orlova et al. (2015a) suggested its exclusive preference for the *Miniopterus schreibersii* group. However, most probably it is a polyxenic mite parasitising bats of the genera *Myotis*, *Vespertilio*, *Rhinolophus*, and *Miniopterus* (cf. Beron 1969, Radovsky 1967). It is a species distributed across the Old World, including Europe, Africa, the Middle East, and Japan (Radovsky 1967, Stanyukovich 1997).

Myotis emarginatus (Geoffroy, 1806)

Records. **Original data**: Levap [**1**], old farm (Figs. 18, 66–68), 5 May 2016: obs. a colony of ca. 120 inds. (mixed with a colony of ca. 120 inds. of *Rhinolophus bocharicus*), coll. 15 ♀♀ (NMP 95714–95719, HSU pb6164–6170 [S+A], NMP 95720, HSU pb6178 [A]; cf. Habilov & Tadžibaeva 2016b, Benda & Uvizl 2021, Uvizl & Benda 2021a), det. & rec. calls of emerging inds.; – Kūlob [**2**], botanical garden, 6 May 2016: net. 1 ♀ (NMP 95724 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda & Uvizl 2021, Uvizl & Benda 2021a); – Tuto [**3**], above a small lake, 7 May 2016: det. & rec. calls of numerous foraging inds.; – Čilduhtaron [**4**], river valley (Fig. 64), 8 May 2016: det. & rec. calls of several foraging inds.; – Kalkot [**5**], among rocks above the village, 16 May 2016: det. & rec. calls of several foraging inds.; Kalkot, Ar Arak cave (Fig. 65), 17 May 2016: coll. 1 ♂ (NMP 95754 [S+A]; cf. Habilov & Tadžibaeva 2016b, Benda & Uvizl 2021, Uvizl & Benda 2021a); Kalkot, above a small lake under the Ar Arak cave, 17 May 2016: det. & rec. calls of some foraging inds. – **Published data**: Sohta-Činar″ [= Činor] kishlak [**6**], Kafirnigan [= Kofarniḫon] river bank near the village, 30 June [= 13 July NS] 1914: shot 1 ♂, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Sohta-Činar [= Činor], 1 ind., leg. N. A. Bobrinskoj (Kuzâkin 1934); – Gandžino [= Gançina] (Vahš river valley) [**7**], fissure in an earthen hut, 31 July 1964: coll. 1 ♀ (Ŝerbin 1968); – Dagana [= Daḫana] (Dangara [= Danǧara] district) [**8**], Vahš river bank, 8 July 1966: obs. several inds., coll. 1 ♀ (Ŝerbin 1968); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**9**], abandoned mine, 23 December 1978: coll. 1 ♂, 1 ♀ (Habilov 1979, 1992, Tadžibaeva & Habilov 2018), 1 April 1979: exam. 1 ♂, 15 February 1980: exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2018), 26 May 2019: obs. 20 inds., incl. 5 ♀♀ (Tadžibaeva & Habilov 2019a); – Mogol-Tau [= Mogoltau] Mts., Uč Tepa [= Učteppa] [**10**], 6 June 1979: 1 ind. (Hůrka 1984); Mogol-Tau [= Mogoltau Mountains], near Uč-Tepa [= Učteppa] kishlak, 6 June 1979: exam. 4 ♀♀, 22 April 1980: exam. 1 ♀ (Habilov 1992); – near Varzob [**11**], mine, 23 August 1986: 1 ♀ (Malinovskij 1988, Tadžibaeva & Habilov 2019b); – between Majkata [= Majkatta] and Amondara kishlaks [**12**], mine, 20 July 1959: coll. 1 ♀, 1 ind., ZMMU, leg. O. P. Bogdanov (Habilov 1992, Benda & Uvizl 2021), mine, 6 July 1960: obs. 100 inds., leg. O. P. Bogdanov (Tadžibaeva & Habilov 2017a); – a canyon north of Nadži [= Naçi] kishlak [**13**], 10 km north-west of Honaka [= Honako], 29 July 1934: coll. 1 ♂, ZIN, leg. V. L′vova (Habilov 1992); – northern slope of the Turkestanskij [= Turkiston] Mountains, Surh [**14**], 10 April 1976: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – near Kul′kent [= Kūlkand] (Guzlon Range) [**15**], abandoned mine, 22 April 1976: exam. 1 ♀ (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), 29 April 1978: exam. 1 ♀ (Habilov & Tadžibaeva 2020c); – Ak-Su [= Aksu] river bank, Metar [= Meḫtar] kishlak [**16**], 26 July 1980: exam. 12 ♀♀

Fig. 64. Čilduhtaron, western part of the Darvoz Mountains, an area of documented occurrence of two bat species, *Myotis blythii* and *M. emarginatus*. Photo by M. Uhrin (8 May 2016).

Fig. 65. The Ar Arak cave in the rocks above the Kalkot village; two bat individuals of two species were found in this small cave, *Rhinolophus ferrumequinum* and *Myotis emarginatus*. Photo by A. Reiter (17 May 2016).

(Habilov 1992); – near Šing [**17**], abandoned building of the Taror mine, 26 May 2017: obs. 3 inds., incl. 1 ♂ (Tadžibaeva & Habilov 2017a); – Tigrovaâ balka [= Bešai Palangon] Reserve, old farm 1 km of the main gate [**1**], 30 June 2017: obs. a colony of 294 inds., incl. 4 ♂♂, 12 ♀♀ (Tadžibaeva & Habilov 2017c).

Distribution. *Myotis emarginatus* is distributed broadly in the south-western Palaearctic (Corbet 1978, Horáček et al. 2000, Benda & Uvizl 2021); in Asia it occurs in the whole Middle East except desert regions, in Transcaucasia, West Turkestan and southern Afghanistan (Horáček et al. 2000, Benda et al. 2006, 2012, Benda & Uvizl 2021). It ranks among the rather frequent bat species in the southern regions of West Turkestan (Bobrinskoj 1925, Ognev 1928, Kuzâkin 1965, Bogdanov 1953a, Strelkov et al. 1978, Habilov 1992, etc.). The Tajikistani occurrence area of *M. emarginatus* represents the south-easternmost part of the distribution range of this bat in West Turkestan and a part of the eastern margin of its distribution range in Asia. This range margin continues from south-western Tajikistan southwards (across the Hindu Kush range) to eastern Afghanistan and south-eastern Iran (Benda et al. 2012, Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan and southern Kazakhstan, where the eastern and northern limits of the species distribution in Asia are found (Butovskij et al. 1985, Dundarova et al. 2021).

Our new records from Tajikistan contribute markedly to the depiction of the eastern margin of the species range in West Turkestan; until now, *M. emarginatus* was only marginally known from the south-western section of the country (Fig. 69). In the Amudarë Basin in its broad sense, the easternmost record was available from Daḫana in the Danğara district (38°23’N, 69°18’E; Ŝerbin 1968). Three records from south-western Tajikistan lie more to the east, and the call recor-

ding made in the river valley at Čilduhtaron in the Darvoz Mountains represents the easternmost record of *M. emarginatus* in this part of the range (70°10'E). In Tajikistan, this record prolongs the known range by ca. 75 km to the east (Fig. 69).

In Tajikistan, *M. emarginatus* belongs to medium-frequent bats (Fig. 69), at least 17 record sites are known from the western section of the country. The localities are situated mainly in lowlands with only a slight coverage of medium altitudes; the available records come from a medium wide altitudinal range (1577 m), with some three quarters of the records originating from the sites below 1300 m a. s. l. (Fig. 10, Table 3). Since this bat inhabits mainly lowland areas, its range in Tajikistan is divided into three parts separated by mountain ranges, to the south-western, western, and northern sections (Fig. 69). Our records come from an identical altitudinal range as the whole site list, and the altitudinal distribution of these five sites is also very similar (median 856.0 m vs. 948.0 m; see Fig. 11, Table 4).

Echolocation. Echolocation calls of *Myotis emarginatus* were recorded at five sites during our research in Tajikistan. At four localities (Čilduhtaron, Tuto, two sites at Kalkot) the calls of foraging bats were recorded, once (Levap farm) the bats emerging from their roost were detected and recorded, in all cases they were calls of bats freely flying in an open space. The values of echolocation calls from Tajikistan were similar to those from other parts of the species range (e.g., Russo & Jones 2002, Obrist et al. 2004, Papadatou et al. 2008, Smirnov et al. 2022b, c) that were typical by the relatively high start frequency (range 57.6–107.6 kHz) as well as high peak frequency (range 46.3–53.8 kHz; Table 6, Figs. 70, 71).

Fig. 66. Portrait of *Myotis emarginatus* (Geoffroy, 1806) from Levap. Photo by A. Reiter.

Figs. 67, 68. Two groups of *Myotis emarginatus* (Geoffroy, 1806) roosting in an old abandoned farm at Levap (Fig. 18) along with a colony of *Rhinolophus bocharicus* Kašenko et Akimov, 1918 (Figs. 19, 20). Photo by A. Reiter (5 May 2016).

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Myotis emarginatus* are shown in Table 10. For the material examined see above.

Three subspecies names appeared during history concerning the taxonomic affiliation of *M. emarginatus* populations from Tajikistan and closely adjacent areas of West Turkestan as well as south-western Asia, viz. *M. e. desertorum* (Dobson, 1875) (Bobrinskoj 1918, Ogneff & Heptner 1928, Ognev 1928, Meklenburcev 1935, 1937, Vinogradov 1935, Strelkov 1963, Butovskij et al. 1985, Benda et al. 2006, 2012, Benda & Gaisler 2015); *M. e. turcomanicus* Bobrinskoj 1925 (Bobrinskoj 1925, Ognev 1927); and *M. e. saturatus* Kuzâkin, 1934 (Kuzâkin 1934, 1935, 1965, L′vova 1945, Strelkov 1981, Habilov 1992). Additionally, Kuzâkin (1944) mentioned presence of two geographical forms in West Turkestan and adjacent countries, but did not name them since he was not satisfied with the taxonomic validity of these forms. Ellerman & Morrison-Scott (1951) reported simultaneously two subspecies from Russian [= West] Turkestan, *M. e. turcomanicus* and *M. e. saturatus*, without definition of their distribution ranges.

The type localities of the three subspecies names that are regarded to come in account are situated in a relative proximity to the territory of Tajikistan (60–1152 km from the border), viz. *Vespertilio desertorum* Dobson, 1875 (type locality Jalk, Balúchistán [Jaleq, Sistan va Beluchestan, Iran; 27°36’N, 62°43’E]; Blanford 1875: 309), *Myotis emarginatus turcomanicus* Bobrins-

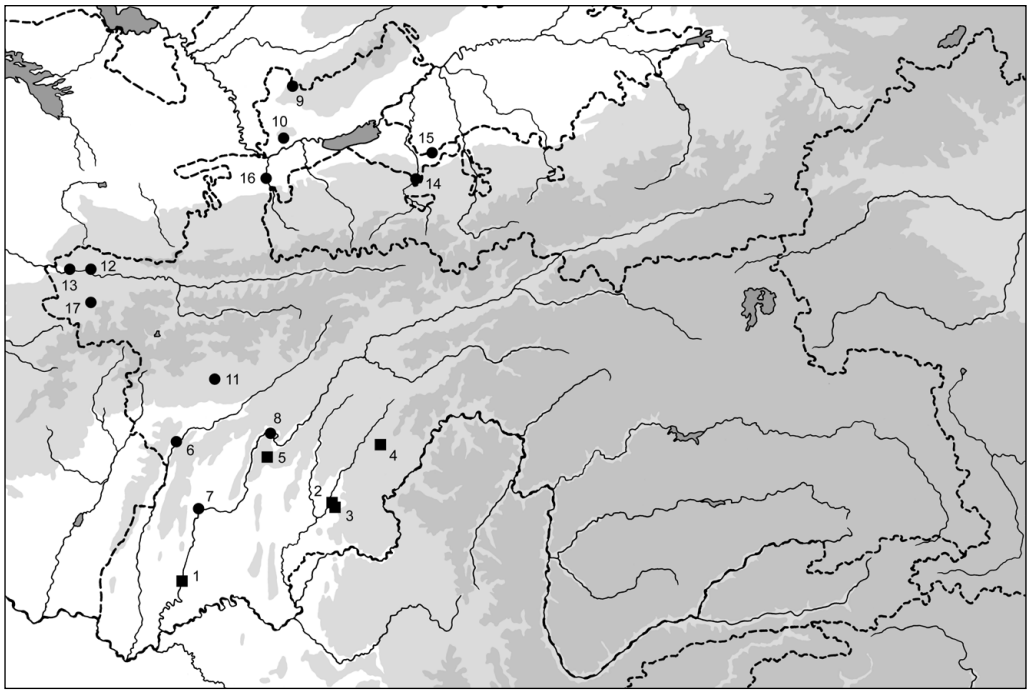


Fig. 69. Records of *Myotis emarginatus* (Geoffroy, 1806) in Tajikistan; squares – new records, circles – published records.

koj, 1925 (t.l. Valley of the river Moorghab, Turkmen-Kala [Murgap river valley, Türkmengala, Turkmenistan; 37°25'N, 62°17'E]; Bobrinskoj 1925: 359), and *M. lanaceus saturatus* Kuzâkin, 1934 (t.l. Taškent [Toshkent, Uzbekistan; 41°20'N, 69°15'E]; Kuzâkin 1934: 320). [A new name, *M. emarginatus kuzyakini* Rossolimo et Pavlinov, 1979, was proposed for *M. lanaceus saturatus* Kuzâkin, 1934 because of its pre-occupation by *M. yumanensis saturatus* Miller, 1897 (Rossolimo & Pavlinov 1979: 13).]

Originally, the intraspecific divisions of *M. emarginatus* were based on local differences in the pelage colouration and therefore this number of taxa was described. However, such traits were found extremely variable throughout the eastern part of the species range where they create a geographical mosaic (including transition forms in colouration) in accordance with the local environmental conditions – significantly paler individuals are found in more arid environments (DeBlase 1980, Benda et al. 2006). Thus, the colouration tinge was found a useless character for evaluation of the phylogenetic relations in *M. emarginatus* (see Strelkov et al. 1978, Benda et al. 2006, 2012).

Based on a detailed morphometric analysis, Benda et al. (2006) suggested that the eastern populations of *M. emarginatus*, including those of West Turkestan, Afghanistan, Iran, Caucasus region and Crimea, represent a large-sized subspecies, *M. e. desertorum*, while the western populations, occurring in the Levant, Maghreb and most of Europe, represent the nominotypical small- to medium-sized subspecies. However, more recent evaluation of morphological and molecular genetic evidence by Benda & Uvizl (2021) suggested to divide the eastern populations

into two subspecies, the south-eastern *M. e. desertorum* inhabiting Iran, Afghanistan, and Oman, and probably also Iraq, and the northern *M. e. turcomanicus*, occurring in a belt between Crimea in the west and Kirghizstan in the east (incl. the Caucasus region and northern Iran). According to this recent revision, comprising also the newly sampled specimens from Tajikistan (Benda & Uvizl 2021), the whole range of *M. emarginatus* in West Turkestan is inhabited by a single phylogenetic lineage that represents a single subspecies *M. e. turcomanicus* (despite the pelage colouration differences among populations). Hence, the names *saturatus* Kuzâkin and *kuzyakini* Rossolimo et Pavlinov represent junior synonyms of *turcomanicus* Bobrinskoj.

Interestingly, the oldest and for fifty years the only specimen of *M. emarginatus* published from Tajikistan, the male collected by L. L. Nožin at Činor (originally Sohta-Činar″ [Сохта-Чинаръ]) in the western part of the country on 13 July 1914 [NS] (Bobrinskoj 1918, see Records) was attributed by various authors to all three names that appeared concerning this species in West Turkestan. Originally, Bobrinskoj (1918) referred it to *M. e. desertorum* albeit with a question mark, as he

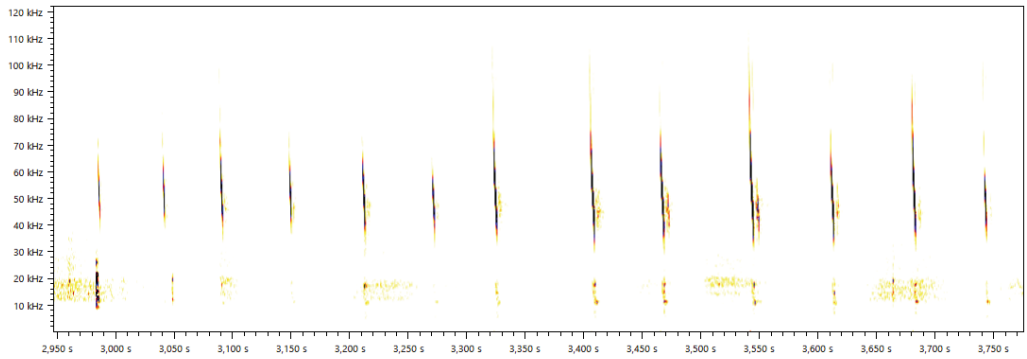


Fig. 70. Spectrogram of the echolocation calls of *Myotis emarginatus* (Geoffroy, 1806); an individual emerging from the colony roost in an old farm at Levap, 5 May 2016.

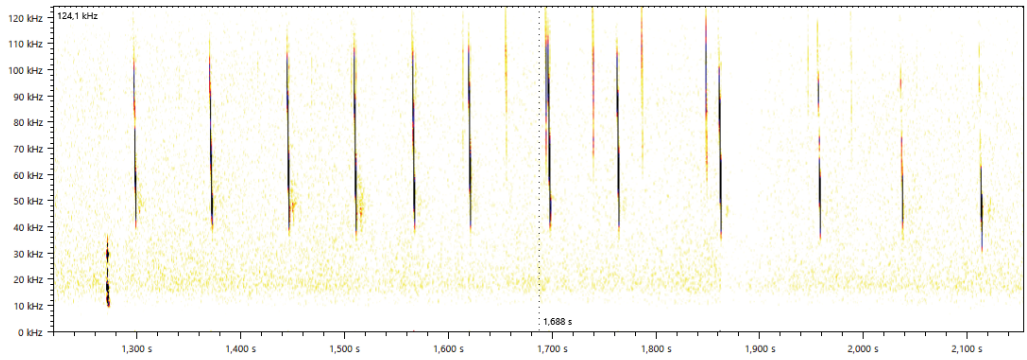


Fig. 71. Spectrogram of the echolocation calls of *Myotis emarginatus* (Geoffroy, 1806); an individual foraging over a river valley at Čilduhdaron, 8 May 2016.

regarded only some traits of the specimen fitting this form while others rather the nominotypical form. Later on, Bobrinskoj (1925), describing the new subspecies *M. e. turcomanicus*, included the Činor specimen among its representatives. Finally, Kuzâkin (1934) labelled this specimen as one of the paratypes of his new subspecies *M. lanaceus saturatus*. The latter subspecies name was then attributed to Tajikistani populations by several subsequent authors (Kuzâkin 1935, 1965, L′vova 1945, Strelkov 1981, Habilov 1992).

Kuzâkin (1934: 320) described the subspecies *M. lanaceus saturatus* based on a type series composed of seven specimens, of them the holotype and five paratypes came from Toshkent, Uzbekistan, and one paratype from Činor, Tajikistan (cf. Bobrinskoj 1918). While the holotype (female, skull and skin) is deposited in the ZMMU collection (ZMMU S-6818; Kuzâkin 1934, Rossolimo & Pavlinov 1979, Pavlinov & Rossolimo 1987, Borisenko et al. 2001, Benda et al. 2006, Benda & Uvizl 2021), the whereabouts of the paratypes are uncertain, the type catalogues of the ZMMU and ZIN collections do not list them (Rossolimo & Pavlinov 1979, Baranova et al. 1981, Borisenko et al. 2001). The SAGU collection houses several specimens of *M. emarginatus* that could have been available to Aleksandr Petrovič Kuzâkin, when he prepared the description of *saturatus* published in 1934, but they are not labelled as paratypes. The ZMMU holotype was collected by Roman Nikolaevič Meklenburcev in Toshkent on 15 June 1932, two females of *M. emarginatus* (skulls and skins, SAGU 106/4, 111/2) with the identical date, locality, and collector name as in the holotype are in the SAGU collection till recently (Kaškarov & Mitropol′skaâ 2004). Additional five specimens of the latter collection (SAGU 104/55, 105/72, 108/69, 109/73, 110/70; Kaškarov & Mitropol′skaâ 2004) were collected in Toshkent by Meklenburcev in May 1933 (see also Meklenburcev 1935). Although most of these specimens were mentioned by Kuzâkin (1935: 433, under different collection numbers, but with the identical collection circumstances) as an additional material provided by R. N. Meklenburcev after the description of *M. l. saturatus*, any of these bats could theoretically represent a part of the paratype series of *M. l. saturatus*. However, according to personal checks by the senior author (PB), the only paratype specimen from Tajikistan (Činor) is available for examination neither in the ZMMU nor ZIN collections, and according to Kaškarov & Mitropol′skaâ (2004) nor in the SAGU collection.

Records of ectoparasites. **Original data**: I s c h n o p s y l l i d a e: *Rhinolophopsylla unipectinata turkestanica*: 1 ♂ ad [A], from 1 ♀ (NMP 95724), Kūlob, botanical garden, 6 May 2016. – N y c t e r i b i i d a e: *Penicillidia dufourii*: 1 ♂ ad, 3 ♀♀ ad [A], from 15 ♀♀ (NMP 95714–95720, HSU pb6164–6170, pb6178), Levap, old farm, 5 May 2016. – S p i n t u r n i c i d a e: *Spinturnix emarginata*: 1 ♀ ad [P], from 1 ♀ (NMP 95724), Kūlob, botanical garden, 6 May 2016. – **Published data**: N y c t e r i b i i d a e: *Penicilidia dufourii*: 1 ♀, Mogol-Tau [= Mogoltau] Mts., Uč Tepa [= Učteppa], 6 June 1979, leg. T. K. Khabilov (Hůrka 1984). – S p i n t u r n i c i d a e: *Spinturnix emarginata*: Tajikistan [specimens, site, and date unlisted] (Stanyukovich 1997).

Comments on ectoparasites. In *Myotis emarginatus*, three species of ectoparasites belonging to three families were documented in Tajikistan in total.

In Tajikistan, the bat flea *Rhinolophopsylla unipectinata turkestanica* Ioff, 1953 is a taxon occurring primarily in the colonies of *Myotis blythii*, in common roosts it also frequently parasitises *Rhinolophus ferumequinum* and is considered a primary host also of the latter bat species (Medvedev & Polkanov 1997; see under both primary hosts). *Myotis emarginatus* belongs to the ecological type of cave-dwelling bats, but has not been regarded a principal host of any flea species in the great part of its distribution range. In the western Palaearctic, this bat is considered to represent a secondary host of *R. unipectinata* (Hůrka 1963), and this is apparent also from the records in Tajikistan.

The bat fly *Penicillidia dufourii* (Westwood, 1835) is a cave-dwelling species preferring to parasitise the bats of the *Myotis myotis* group (Hůrka 1964). The nominotypical subspecies of *P. dufourii* occurs in the Mediterranean and in Central Asia eastwards to eastern Kazakhstan and

the western Himalayas (Hůrka 1969, Medvedev & Polkanov 1997). Besides *M. emarginatus*, *P. dufourii* was recorded also from *Myotis blythii* in Tajikistan (see above).

Spinturnix emarginata (Kolenati, 1856) is a gamasoid mite of the *S. myoti* group. It is a form well defined by its morphology and host association, *M. emarginatus* is a principal host of this mite species. The species validity of *S. emarginata* was supported by a redescription by Dusbábek (1964b). The distribution range of *S. emarginata* is presumably identical with the range of its principal host, although its abundance could vary in accordance to the host colony size and seasonal climatic changes, sometimes resulting in absence in the mite individuals (cf. Deunff & Beaucournu 1981, Orlova & Orlov 2018). This mite was reported from Tajikistan without details by Stanyukovich (1997).

Myotis davidii (Peters, 1869)

Records. **Original data**: Kalkot [**1**], in rocks above the village (Figs. 72, 77), 16 May 2016: det. & rec. calls of several foraging inds.; Kalkot, above a small lake under the Ar Arak cave, 17 May 2016: net. 1 ♀ (Fig. 73; NMP 95756 [S+A]; cf. Habilov & Tadžibaeva 2016b); – Magov [**2**], garden, 18 May 2016: net. 1 ♂ (Figs. 75, 76; NMP 95769 [S+A]; cf. Habilov & Tadžibaeva 2016b). – **Published data**: Varzob″ i Siuma (river canyon) [**3**], 8 July [= 20 July NS] 1896: 1 ind., ZIN, leg. Barŝevskij (Satunin″ 1910); Varzob, three house attics, fissures, 4 July 1987: groups of 3–20 inds., incl. gravid ♀♀ (Malinovskij 1988); – Zeravšan″ [= Zarafšon river] [***4***], Samarkand″ [= Samarqand] province, 1892: 1 ind., ZIN, leg. Glazunov″ (Satunin″ 1910); – Kala-i-hum″ [= Qal″ai Humb] [**5**], Darvaz″ [= Darvoz Mountains], June 1897: coll. 1 ind., ZIN, Kaznakov″ (Satunin″ 1910); Kala-i-humb [= Qal″ai Humb] in Darvaz [= Darvoz Mountains] (Bogdanov 1953a); Kalaihumb [= Qal″ai Humb] on the Pândž [= Panç] river, ZIN (Strelkov 1983a); Kalaj-Humb [= Qal″ai Humb], 1 ind., IZPAN (Habilov 1986, 1992); – Karatag″ [= Qaratoğ] [**6**], 27 June [= 9 July NS] 1896: 4 inds., ZIN, leg. Barŝevskij (Satunin″ 1910); "Karatag" [= Qaratoğ] (50–60 km south-west of Dušanbe), ZIN (Strelkov 1983a); – Pendžakent″ [= Pançakent]

Fig. 72. Rocks and spring in a valley above the Kalkot village, a site of documented foraging of two bat species, *Myotis emarginatus* and *M. davidii*. Photo by A. Reiter (16 May 2016).

Fig. 73. Portrait of *Myotis davidii* (Peters, 1869) netted at a small lake at Kalkot. Photo by A. Reiter.

[**7**], 1892: 1 ind., ZIN, leg. Glazunov″ (Satunin″ 1910); Pendžekent [= Pançakent], ZIN (Strelkov 1983a); Zeravšan [= Zarafšon] river valley, near Pendžikent [= Pançakent] (in Koktaš [= Kuktoš]), 27 August 1977: coll. 1 ♀ (Habilov 1992); – Pamir, Âšil′-kul′ [= Âšilkūl] lake [**8**], 26 August 1934: coll. 1 ♀, ZMMU, leg. R. N. Meklenburcev, 27 August 1934: 1 ♀ (Kuzâkin 1935); station at the Âšil′-kul′ [= Âšilkūl] lake, August–September 1934: obs. a colony of ca. 6 inds., 26 August 1934: coll. 1 ♀, early September 1934: coll. 1 ♀ (Meklenburcev 1936); eastern Pamir, at the Âšil′-kul′ [= Âšilkūl] lake, 26–27 August 1934: coll. 2 inds., leg. R. N. Meklenburcev (Kuzâkin 1950); Âšil′kul′ [= Âšilkūl] lake, ZMMU, SAGU (Strelkov 1983a); Jašil'-Kul' [= Âšilkūl] lake, 1 ♀, ZMMU (Benda & Tsytsulina 2000); Âšil′-kul′ [= Âšilkūl] lake (Pamir), 26 August 1934: coll. 1 ♀, SAGU, leg. R. N. Meklenburcev (Kaškarov & Mitropol′skaâ 2004); Pamir Mts., Jašil' Kul' [= Âšilkūl] Lake, 27 August 1934: 1 ♀, leg. R. Meklenburcev (Benda & Karataş 2005); Âšilkul lake, Pamirs, 27 August 1934: 1 ♀, ZMMU, leg. R. Meklenburcev (Benda & Gaisler 2015, Benda et al. 2016b); – Šidharv [= Šitharv] kishlak [**9**], Pândž [= Panç] river, 1932: coll. several inds. (Rozanov 1935); Šidgrev [= Šitharv] in the Pamirs, ZIN (Strelkov 1983a); Šidgarv [= Šitharv] kishlak in the Pamirs, 8 September 1932: 1 ind. (Habilov 1986, 1992); Šidharv [= Šitharv], Pamirs, 9 September 1932: 1 ind., ZIN, leg. M. Rozanov (Benda & Gaisler 2015); – Horog [= Horuğ] [**10**], 13 June 1936: coll. 1 ind., leg. R. N. Meklenburcev (Kuzâkin 1950); Horog [= Horuğ], ZIN, SAGU (Strelkov 1983a); Horog [= Horuğ], Pamir Biological Institute, 13 June 1985: coll. 1 ♀, 15 June 1985: obs. 5 inds., coll. 1 ♀ (Habilov 1986, 1992); – Sindev kishlak [**11**], Šah-Dara [= Šahdara] river valley, 22 July 1936: coll. 2 inds., leg. R. N. Meklenburcev (Kuzâkin 1950); Šahdara river in Pamir, SAGU (Strelkov 1983a, Habilov 1986); Sindev kishlak, Šah-darâ [= Šahdara] river, Pamir, 22 June 1936: coll. 2 ♀♀, SAGU, leg. R. N. Meklenburcev (Kaškarov & Mitropol′skaâ 2004); – Stalinabad [= Dušanbe] [**12**], 12 July – 24 August 1935: coll. 11 inds., leg. A. P. Kuzâkin (Bogdanov 1956a, Tadžibaeva & Habilov 2019b); near Dušanbe, attic of a two-floor house, 15 July 1965: obs. a colony of ca. 150 inds., coll. 3 ♂♂, 7 ♀♀, 29 September 1966: obs. a colony of ca. 30 inds. (Ŝerbin 1968); Dušanbe, ZMMU (Strelkov 1983a); – Bartang river valley [**13**], Badahšan, small hole in a rock wall, 27 July 1962: obs. a colony, coll. 1 ♂ (Ŝerbin 1968); Bardara on the Bartang river in the Rušan [= Rūšon] District,

coll. S. Isakov (Strelkov 1983a); Rušan [= Rūšon] near Bogu [= Bağu] kishlak, 27 June 1962: coll. 1 ♂, IZPAN, leg. Û. V. Ŝerbin (Habilov 1986, 1992); – Leninabad [= Huçand] [**14**], ZIN (Strelkov 1983a); Leninabad [= Huçand], 14 September 1976: coll. 1 ♀ (Habilov 1992); vicinity of Khujand [= Huçand], 1 ♀ (Kuz′min et al. 2001); – "Kštut" [= Kštut river] [**15**] in the upper reaches of the Zeravšan [= Zarafšon] river, ZIN (Strelkov 1983a); – Iskanderkul′ [= Iskandarkūl] lake [**16**], ZIN (Strelkov 1983a); Pamiro-Alai Mts. [= Zarafšon Mts.], Iskandarkul [= Iskandarkūl] lake, 15 May 2013: 1 ♂ (Orlova & Zhigalin 2014); – Langar [= Sangiston] [**17**] in the Ajni [= Ajnī] district, coll. S. Isakov (Strelkov 1983a); – Ramit [= Romit] [**18**], ZMMU (Strelkov 1983a); Ramit [= Romit], house attic, in fissures of wooden rafters, 9 September 1986: obs. 80–90 inds. (coll. 2 ♂♂, 20 ♀♀), 30 March 1987: obs. inds., 13 May 1987: coll. 1 ♂, 14 ♀♀, other house attic, obs. 15–20 inds. (Malinovskij 1988); Romit, 20 July 1949: coll. 1 ind., ZMMU, leg. A. Tomin, 1 / 2 September 1986: 2 ♂♂, 20 ♀♀, leg. K. Malinovskij (Habilov 1992, Tadžibaeva & Habilov 2019b); – Šurobdara [= Šurobdar′â] river canyon [**19**], August 1984: coll. 1 ♀, September 1986: coll. 1 ♂ (Malinovskij 1988); Sary-Hosor [= Sari Hosor Reserve], 16 July 1984 & 26 September 1986: coll. 1 ♂, 1 ♀, leg. K. Malinovskij (Habilov 1992, Habilov & Tadžibaeva 2016b); – Tigrovaâ balka [= Bešai Palangon Reserve] [**20**], summer 1951: 1 ind., IZPAN (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan [= Zarnisor] [**21**], 1 April 1979: coll. 1 ♂ (Habilov 1992); – Dar-Dar kishlak [**22**], 18 August 1978: coll. 1 ♂, 1 ♀ (Habilov 1992); – near Šing kishlak [**23**], Šing river, Dahoni ob mine, Zeravšan [= Zarafšon] river valley, 22 September 2016: exam. 1 ♂, 26 May 2017: exam. 4 ♂♂ (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018, 2020b); – Guzlon mountains [**24**], 17 May 2013 (Orlova et al. 2015a); near Dahana, Guzlon Range, Isfara district, apricot orchard, water reservoir, 5 July 2019: net. 1 ♂ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2020a, 2021a).

Distribution. *Myotis davidii* is a bat whose species status in its current sense has been defined only recently (Çoraman et al. 2020). Initially, the populations of *M. davidii* were considered to be a part of *Myotis mystacinus* (Kuhl, 1817), similarly as other species of the *M. mystacinus* morpho-group (for reviews see Benda & Tsystulina 2000, Benda & Karataş 2005, Benda & Gaisler 2015).

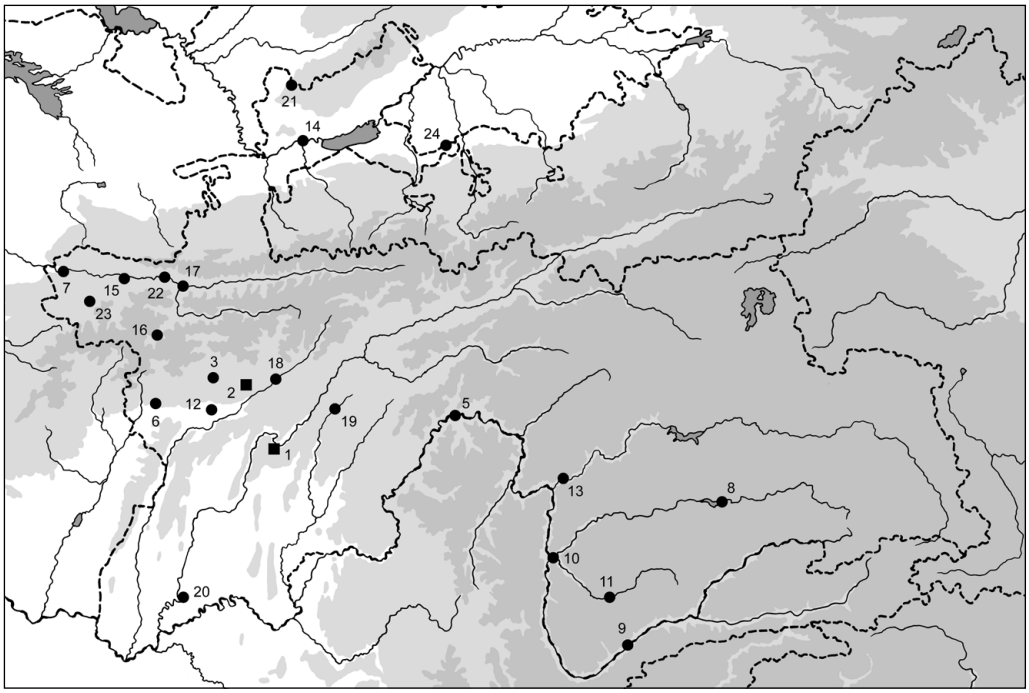


Fig. 74. Records of *Myotis davidii* (Peters, 1869) in Tajikistan; squares – new records, circles – published records.

Figs. 75, 76. *Myotis davidii* (Peters, 1869) from Magov. 75 (left) – portrait. 76 (right) – penis. Photo by A. Reiter.

In the 1980s to 2000s, a separate species status was suggested repeatedly for the populations of *M. davidii*, based on convincing results of morphological and karyological analyses (Stubbe & Chotolchu 1968, Volleth 1987, von Helversen 1989, Benda & Tsystulina 2000); at that time, several names were suggested for this bat, e.g., *M. nipalensis* (Dobson, 1871), *M. przewalskii* Bobrinskoj, 1926, and/or *M. aurascens* Kuzâkin, 1935. The latter name was then broadly used for the European populations of *M. davidii*, while the former one for its Asian populations including those of West Turkestan (sensu Benda & Tsystulina 2000). However, due to sharing of the mitochondrial genome with *M. mystacinus* s.str. in most of the Balkan populations (Mayer et al. 2007, Benda et al. 2016b), the systematic position of *M. davidii* remained unresolved until recently, when its mitochondrial and nuclear genomes were analysed and also when the type specimens of almost all concerned taxa were examined and compared (Benda et al. 2012, 2016b, Çoraman et al. 2020). However, the definition of the species rank of *M. davidii* including the nomenclatural aspects is still considered not completely elucidated, see Dzeverin (2023).

The distribution range of *M. davidii* is one of the widest among those of the Palaearctic bats, this bat lives in a belt of rather open habitats that stretches from southern Austria, Dalmatia and the Balkans, over Moldavia, Ukraine, southern Russia, Turkey, and the Caucasus, West and East Turkestan, southern Siberia, Mongolia, to eastern China and Korea (Benda & Tsystulina 2000, Benda et al. 2016b, Zhigalin 2019, Çoraman et al. 2020, Gorban′ et al. 2022, Milchram et al. 2023). This bat is the only species of the *M. mystacinus* morpho-group that occurs in West Turkestan, where it belongs to the most common bat species in the whole area (Bobrinskoj 1925, Ognev 1928, Kuzâkin 1934, 1935, 1950, 1965, Meklenburcev 1935, Bogdanov 1953a, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). In the eastern section of Kazakhstan, *M. davidii* represents the most widespread bat species at all (Strelkov & Šajmardanov 1983).

The Tajikistani part of the distribution range of *M. davidii* probably represents a segment of the south-eastern limits of the occurrence area of this bat in West Turkestan as well as in Asia. This range margin continues from southern Tajikistan southwards to northern Afghanistan and northern Iran (Benda et al. 2012, 2016b, Benda & Gaisler 2015) and from northern Tajikistan to

eastern Kirghizstan and East Turkestan (Strelkov 1983a, Rybin et al. 1989). Our new records do not contribute significantly to the extension of the species range in Tajikistan, they only make the picture of distribution more accurate (Fig. 74).

In Tajikistan, *M. davidii* ranks among rather common bats (Fig. 74), at least 24 record sites are known, spread across the complete range of altitudes of the western and southern sections of the country – the available records come from the widest altitudinal range among the bats of the country (3393 m). Most of the records were made at the sites above 1000 m a. s. l., i.e. in medium high to very high areas of Tajikistan (Fig. 10, Table 3), and our records come from similar altitudes (Fig. 11, Table 4). It is the only bat species that was more frequently recorded in the mountainous eastern section of Tajikistan (Fig. 74); the altitudinal distribution statistics show *M. davidii* to be the second most montane bat of Tajikistan, the median and mean altitudes of its Tajikistani distribution are the highest values after those of *Eptesicus gobiensis* (Table 3).

Myotis davidii is the fourth bat species reported from the Pamirs, after *Eptesicus gobiensis*, *Plecotus strelkovi*, and *Hypsugo savii*. A series of at least seven bats from four sites was collected in 1932–1936 (Fig. 74, sites 8–11; Kuzâkin 1935, 1950, Rozanov 1935, Meklenburcev 1936), an additional specimen was obtained at a fifth locality (site 13) in 1962 (Ŝerbin 1968). *Myotis davidii* is thus the most frequent bat in the south-eastern part of Tajikistan, its localities there are situated in the range of 2044–3723 m a. s. l. (median 2798 m). Although Meklenburcev (1936) mentioned a likely observation of *M. mystacinus* [s.l.; = *M. davidii*] from the Âšilkūl lake in the centre of the Pamirs by explorer N. A. Severcov already in 1878, the latter author reported only one encounter with a bat from the Pamirs in fact – he described it as follows (Sěvercov″ 1879a: 61): "*Vespertilio* sp. [s.l.] – we did not identify it more accurately; some bat was observed at late evening twilight, but not collected, near the Âšilkūl [Yashilkul] lake, at the altitude of 12,500 feet [~3,800 m] in the second half of August [1878]." [Own translation from Russian*.]

The ZIN collection houses a specimen of *M. davidii* (ZIN 24392) collected by entomologist Petr Aleksandrovič Vel′tiŝev on 21 August 1933, labelled as *M. mystacinus* [s.l.] originating from Kyzyltam, northern slope of the Gissarskij [= Ḫisor] Mountains, Tajikistan. As of the Tajikistani

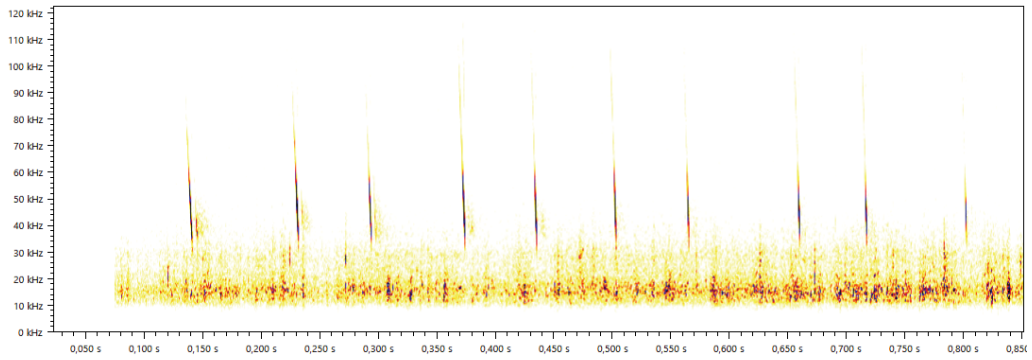


Fig. 77. Spectrogram of the echolocation calls of *Myotis davidii* (Peters, 1869); an individual foraging in rocks near Kalkot on 16 May 2016. This recording is a basis for the species evidence in the area, where an additional individual (female) was netted the following night. However, this low quality recording of *M. davidii* echolocation was not analysed properly.

* original text reads as follows (Sěvercov″ 1879a: 61): "*Vespertilio* sp. – даже ближайшій родъ не удалось опредѣлить; замѣчена въ позднія вечернія сумерки, но не добыта, какая-то летучая мышь близъ Яшиль-куля, на высотѣ 12½ тыс. фут., во второй половине августа."

origin, the specimen was published by Strelkov (1983a), Habilov (1992), Benda & Gaisler (2015), and Tadžibaeva & Habilov (2019b)†; for the first time, this bat was noted by Hanák (1965) as from an unspecified site in "Hissar-Kette" (= Ḩisor Mountains). However, this locality name refers in fact to Qiziltom, Qamashi District, Qashqadaryo Province, Uzbekistan (38°45'N, 67°00'E, 2056 m a. s. l.). This site is situated on the northern slope of the Ḩisor Mountains, but not in its Tajikistani part (a similar error was made also concerning a record of *Myotis blythii*, see above).

Variation. External and cranial dimensions of two newly collected Tajikistani specimens of *Myotis davidii* are shown in Table 10. For the material examined see above.

The systematic position of the populations of *M. davidii* in Tajikistan needs to be assessed in the context of the situation in the whole Turkestan. However, the taxonomic arrangement of the Turkestani populations of the *M. mystacinus* morpho-group remained uncertain for a long time, since *M. davidii* is extremely variable and represents several morphotypes in body and skull size, skull shape, and in pelage colouration, concerning both individual and interpopulation (geographical) aspects. Several authors tried to evaluate the systematic status of the Turkestani populations of the morpho-group (Bobrinskoj 1926, 1929, Ogneff & Heptner 1928, Ognev 1928, Kuzâkin 1934, 1935, 1950, 1965, Stubbe & Chotolchu 1968, Strelkov 1983b, Benda & Tsystulina 2000, Tsytsulina 2000, Tsytsulina et al. 2012) and several new taxa within the rank of broadly understood *M. mystacinus* were described from various parts of Turkestan and adjacent mountainous regions, viz. *M. m. przewalskii* Bobrinskoj, 1926, *M. meinertzhageni* Thomas, 1926, *M. m. transcaspicus* Ogneff et Heptner, 1928, *M. m. kukunorensis* Bobrinskoj, 1929, *M. m. sogdianus* Kuzâkin, 1934, *M. m. aurascens* Kuzâkin, 1935, *M. m. pamirensis* Kuzâkin, 1935, and *M. m. hajastanicus* Argiropulo, 1939. It is undoubtedly the largest number concerning a single species and/or species group of Palaearctic bats and this again underlines the extraordinary variability of this bat.

Of these names, the type series of *M. m. pamirensis* originates from the territory of Tajikistan, the type locality is "Pamir, oz. Âšil′-kul′" [Памир, оз. Яшиль-Куль] [= Âšilkūl / Yashilkul lake, the Pamirs; ca. 37°46'N, 72°57'E, ~3720 m a. s. l.] (Kuzâkin 1935: 431). The type series is composed of two females gathered by Roman Nikolaevič Meklenburcev, the holotype was collected on 27 August 1934, the paratype on 26 August 1934 (Kuzâkin 1935: 431); according to Meklenburcev (1936: 4) the holotype was collected in early September 1934. The holotype (skull only) is housed in the ZMMU collection (ZMMU [S-]9265; Kuzâkin 1935, Rossolimo & Pavlinov 1979, Strelkov 1983a, Pavlinov & Rossolimo 1987, Benda & Tsytsulina 2000, Borisenko et al. 2001, Benda & Karataş 2005); the paratype (skull and skin) finally survived in the SAGU collection (SAGU 92/1; Strelkov 1983a, Kaškarov & Mitropol′skaâ 2004), although originally it was also housed in the ZMMU collection according to Kuzâkin (1935) and Meklenburcev (1936).

Meklenburcev (1936) collected this type series and first presented his experiences with it (although his text was published later than the taxonomic description by Kuzâkin) as follows (pp. 3–4): "Bats occurred in a group of rocks, where they roosted in fissures. [Their] colony was very small, no more than six individuals. They emerged earlier [of an evening] than it was observed in lowlands, and they never circled above water [surface of the lake]. // Two specimens

† Strelkov (1983a) reported as follows: "Кызылтам [...] на сев. склонах Гиссарского хр." [Kyzyltam on the northern slopes of the Ḩisor Mountains]; Habilov (1992: 147) as follows: "В коллекции Зоологического института нами обнаружен экземпляр сборов Вельтищева от 21 августа 1933 г., добытый на северном склоне Гиссарского хребта в Кзыл-Таме; [...]." [= In the collection of the Zoological Institute [of the Academy of Sciences of the Soviet Union in Leningrad] we discovered a specimen from the field collection of Vel′tiŝev made on 21 August 1933, collected on the northern slope of the Ḩisor Mountains, in Kzyl-Tam]; Tadžibaeva & Habilov (2019b: 43) repeated verbatim the mention by Habilov (1992). Based on the personal examination of the specimen, Benda & Gaisler (2015: 451) mentioned as follows: "1 ind. (ZIN 24392 [S+B]), Kzyl-Tam, northern slope of the Gissarskij range [= Ḩisor Mountains], 21 August 1933, leg. Vel′tiŝev."

were collected, and they clearly differed from *M. m. transcaspicus* Ogn[ev]. by much larger size and darker [colouration of the] pelage. It is well possible that the Pamir whiskered bat will be shown as a new form. The bats collected by me were transferred to the laboratory of Professor [Sergej Ivanovič] Ognev [in ZMMU] for an exact clarification of their systematic position." [Own translation from Russian‡.] The proper description of *M. m. pamirensis* was published by Kuzâkin (1935: 431–432) and reads as follows: "Diagnosis. According to the structure of premolars, *M. m. pamirensis* belongs to the group of the whiskered bats, occurring in Middle and Central Asia, but concerning its [body] size, it is markedly larger than all other Asian forms. // Length: of body *d*–47; tail 44–40; ear 13.5–13; tragus 8.5–8; greatest length of skull 14.1–14.1; condylobasal length 13.7–13.3; zygomatic width *d*–8.3; interorbital width 3.6–3.6; skull width 7.5–7.2; upper tooth-row length 5.4–5.3. Forearm 38–36.2 mm (first, the dimensions of the holotype; second, of the paratype). // Along with the remarkable length, the skull has a narrow interorbital constriction. The braincase is not very high, it is slightly flattened, with a relatively sharp elevation in the frontal region. The cingula of P^2 and P^4 are almost in contact, and an extraordinarily small P^3 displaced [palatally] from the tooth-row and it is not visible from the side view. The lower second premolar is extraordinarily narrow, pointed; it is squeezed in a narrow space between P_2 and P_4. This tooth is twice shorter and once narrower than the first premolar. // Colouration of the holotype. The bases of all hairs are deep dark brown with a weak admixture of the cinnamon tinge. Distal parts of the dorsal hairs are pale, glossy, light-yellowish; distal parts of the hairs covering the ventral side are whitish. Ears and wing membranes are pale brownish." [Own translation from Russian**.]

Besides Kuzâkin (1935) as a descriptor, *M. m. pamirensis* was regarded to be a valid taxon also by Tate (1941a), Kuzâkin (1944, 1950, 1965), Ellerman & Morrison-Scott (1951), Aellen (1959a), and Strelkov (1963, 1981). Nevertheless, although several other authors considered the mountainous Central Asian populations of *M. mystacinus* s.l. to deserve a separate taxonomic position, they did not consider the name *pamirensis* as the prior available name for this form – they rather suggested *nipalensis* Dobson, 1871 or *przewalskii* Bobrinskoj, 1926 as the name fitting these populations (Hanák 1965, Stubbe & Chotolchu 1968, Corbet 1978, Koopman 1994, Benda & Tsystulina 2000). On the other hand, numerous authors considered all populations of *M. mystacinus* s.l. of West Turkestan, both of mountains and lowlands, to represent a single taxon – *brandtii* Eversmann, 1845, *przewalskii* Bobrinskoj, 1926, or *transcaspicus* Ogneff & Heptner,

---

‡ original text reads as follows (Meklenburcev 1936: 3–4): "Мыши держались в группе скал, где их убежищами служили расщелины. Колония была очень не велика, не более шести особей. Вылетали ночницы раньше, чем это наблюдается в низменностях, и никогда не кружились над водой. // Добыто 2 экземпляра, причем они явно отличаются от *M. m. transcaspicus* Ogn. гораздо большей величиной и темным мехом. Вполне вероятно, что памирская усатая ночница окажется новой формой. Добытые мной мыши переданы в лабораторию профессора Огнева для точного выяснения их систематического положения."

** original text reads as follows (Kuzâkin 1935: 431–432): "Диагноз. По структуре ложнокоренных зубов *M. m. pamirensis* относится к группе усатых ночниц, населяющих Среднюю и Центральную Азию, но по размерам она значительно крыпнее всех азиатских форм. // Длина: тела *d*–47; хвоста 44–40; уха 13,5–13; козелка 8,5–8; общая длина черепа 14,1–14,1; кондилобазальная длина 13,7–13,3; скуловая ширина *d*–8,3; межгл. промежуток 3,6–3,6; ширина черепа 7,5–7,2; длина верхнего ряда зубов 5,4–5,3. Предплечье 38–36,2 *мм* (сначала даны размеры типа; после него – котипа). // При значительной длине череп имеет узкий межглазничный промежуток. Мозговая коробка не очень высокая, несколько уплощенная, с довольно крутым подъемом в области лба. Cingulum Pm^1 [= P^2] и Pm_3 [= P^4] почти сомкнуты, а чрезвычайно мелккий Pm^2 [= P^3] вытеснен внутрь из зубного ряда и в профиль не виден. Нижний второй ложнокоренной зуб чрезвычайно тонкий, остроконечный; он зажат в узком промежутке между Pm^1 [= P_2] и Pm^3 [= P_4]. Этот зуб в 2 раза короче и раза в 3 тоньше первого ложнокоренного. // Окраска типа. Основания всех волос насыщенные, темнобурые со слабой примесью коричневого оттенка. Вершины спинных волос светлые, блестящие, палево-желтоватые; окончания волос, покрывающих нижнюю сторону, белесые. Уши и перепонки палево-буроватые."

1928 (Bobrinskoj 1925, Ognev 1927, 1928, Rozanov 1935, Allen 1938, Strelkov 1983b, Habilov 1986, 1992). However, of all these authors, only Kuzâkin (1935, 1944, 1950, 1965), Meklenburcev (1936), Rozanov (1935), Hanák (1965), Strelkov (1983b), Habilov (1986, 1992), and Benda & Tsystulina (2000) examined the samples from Tajikistan.

Recently, a series of papers dealing with geographical variation and taxonomy of the *Myotis mystacinus* morpho-group, based on evaluations of various character matrices – both detailed morphological and molecular genetic ones – showed a completely different picture of the taxonomic arrangement within the group (von Helversen 1989, Benda & Tsystulina 2000, Cyculina 2001, von Helversen et al. 2001, Kawai et al. 2003, Tsytsulina & Masuda 2004, Benda & Karataş 2005, Benda et al. 2012, 2016b, Kruskop et al. 2012, Tsytsulina et al. 2012, Dietz et al. 2016, Morales et al. 2019, Çoraman et al. 2020, Ruedi et al. 2021, Gorban′ et al. 2022, Milchram et al. 2023). It was demonstrated that the morpho-group, composed originally of a single species (cf. Ellerman & Morrison-Scott 1951), comprises at least six species distributed in the Palaearctic and adjacent parts of the Oriental region, viz. *M. mystacinus* (Kuhl, 1817) in the arboreal zones of Europe, North Africa and south-western Asia, *M. alcathoe* von Helversen et Heller, 2001 in the arboreal zone of Europe and in the Caucasus region, *M. brandtii* (Eversmann, 1845) in the boreal and temperate forests of Europe, Caucasus and western Siberia, *M. sibiricus* (Kaŝenko, 1905) in the forests of central and eastern Siberia and the Far East (incl. Sakhalin and Hokkaido), *M. davidii* (Peters, 1869) in the Mediterranean arboreal and eremial zones of the Palaearctic between the western Balkans and Korea, and *M. nipalensis* (Dobson, 1871) in the mountains of the northern part of the Indian Subcontinent. While majority of these species represent more or less stable and rather invariable morphotypes from the geographical point of view, *M. davidii* is extremely variable in its absolute and relative morphometric traits and in colouration (cf. Hanák 1965, Strelkov 1983b, Benda & Tsytsulina 2000, Benda et al. 2016b).

Of these taxa, *M. davidii* is the only known representative of the morpho-group that occurs in the arid steppes and mountains of the temperate central belt of Asia, between the Caspian Sea in the west and Manchuria in the east, including the whole Turkestan and north-eastern Tibet (Benda & Tsystulina 2000, Benda et al. 2012, Kruskop et al. 2012, Tsytsulina et al. 2012, Morales et al. 2019, Zhigalin 2019, Çoraman et al. 2020, Ruedi et al. 2021, Gorban′ et al. 2022). Across the whole extensive distribution range of *M. davidii*, only two basic phylogenetic lineages were revealed despite the enormous geographical variability in phenotype (Kruskop et al. 2012, Tsytsulina et al. 2012, Morales et al. 2019, Çoraman et al. 2020, Gorban′ et al. 2022). The populations of West Turkestan represent a part of the western lineage, comprising the European range and the occurrence area in western Asia west of Lake Balkhash, including northern Tajikistan ("Sughd", see Gorban′ et al. 2022), while the populations of East Turkestan, northern Tibet, southern Siberia, Mongolia, and the Far East belong to the eastern lineage. These lineages are separated deeply enough to be taxonomically distinguished as two subspecies (see Çoraman et al. 2020). The eastern lineage represents the nominotypical subspecies, the type locality of the name *Vespertilio Davidii* Peters, 1869 is "Peking (China)" (= Beijing, China; 39°54'N, 116°23'E; Peters 1869: 403); the names *Myotis mystacinus przewalskii* Bobrinskoj, 1926, *M. m. kukunorensis* Bobrinskoj, 1929, and *M. m. mongolicus* Kruskop et Borissenko, 1996 constitute its junior synonyms⁂. Apparently, the prior name for the western lineage is *Myotis mystacinus transcaspicus* Ogneff et Heptner, 1928, described from "Dorf Mikhailovskoi (Germab) im Kopetdagh, Transcaspien" (= Germaw, Aşgabat Province, Turkmenistan; 38°01'N, 57°44'E; Ogneff & Heptner 1928: 260), the subspecies name is thus *M. davidii transcaspicus*, and the names *Myotis mystacinus sogdianus* Kuzâkin, 1934, *M. m. aurascens* Kuzâkin, 1935, *M. m. pamirensis* Kuzâkin, 1935, *M. m. bulgaricus* Heinrich, 1936, *M. m. hajastanicus* Argiropulo, 1939, and *M. m. popovi* Strelkov, 1983 represent its junior synonyms⁂. For details concerning the inclusion of the names into the species rank of *M. davidii*

see Strelkov (1983b), Benda & Tsystulina (2000), Benda et al. (2012, 2016b), Tsytsulina et al. (2012), Dietz et al. (2016), and Çoraman et al. (2020).

Concerning the Tajikistani populations of *M. davidii*, there is still a possibility that the mountain (Pamir) populations of this bat are phylogenetically close to the East Turkestani populations of the nominotypical subspecies than to other West Turkestani populations (including the western Tajikistani ones). However, this alternative does not have a support in the morphological evidence, the Pamir specimens are rather similar to other West Turkestani bats (just slightly larger in the skull size than the lowland bats) than to the type series of *M. mystacinus przewalskii* and *M. m. kukunorensis* from East Turkestan and north-eastern Tibet (Benda & Karataş 2005, Benda & Gaisler 2015). Such questions concerning phylogenetic relations among particular populations of *M. davidii* of Central Asia could be resolved only with the help of molecular genetic comparisons, very detailed in their geographical coverage; however, it is not a simple task considering the high number of named forms available from the region (see above).

Records of ectoparasites. **Original data**: N y c t e r i b i i d a e: *Basilia mongolensis*: 1 ind. [A], from 1 ♀ (NMP 95756), Kalkot, at a lake near Ar Arak cave, 17 May 2016. – M a c r o n y s s i d a e: *Steatonyssus mongolicus*: 1 ♂ [P], from from 1 ♀ (NMP 95756), Kalkot, at a lake near Ar Arak cave, 17 May 2016. – **Published data**: N y c t e r i b i i d a e: *Basilia mongolensis*: 1 ♂, 1 ♀, from 1 ♂, Pamiro-Alai [= Zarafšon] Mts., Iskandarkul [= Iskandarkūl] lake, 15 May 2013 (Orlova & Zhigalin 2014). – S p i n t u r n i c i d a e: *Spinturnix myoti*: 1 ♂, 2 ♀♀, 1 ♂ deutonymph, 1 ♀ deutonymph, 1 protonymph, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Spinturnix mystacina*: 55 ♂♂, 42 ♀♀, 4 deutonymphs, 4 protonymphs Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – M a c r o n y s s i d a e: *Ornithonyssus flexus*: Tajikistan [specimens, site, and date unlisted] (Stanyukovich 1997); – *Ornithonyssus guzlonicus*: 1 protonymph, Tajikistan [site unlisted], May 2013, leg. M. V. Orlova (Orlova et al. 2015a); – *Ornithonyssus* sp.: 7 ♀♀, 5 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Macronyssus corethroproctus* (as *Macronyssus crosbyi*): 2 ♀♀, 2 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Steatonyssus mongolicus*: Tajikistan [specimens, site, and date unlisted] (Stanyukovich 1997); – *Steatonyssus periblepharus*: 1 ♂, 5 ♀♀, 1 protonymph, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – A r g a s i d a e: *Carios vespertilionis* (as *Argas vespertilionis*): 86 larvae, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Myotis davidii*, a very broad variety of ectoparasites was documented in Tajikistan, at least nine species of four families were found in total.

⁂ the type localities of the particular names are as follows (in chronological order): *Myotis mystacinus przewalskii* Bobrinskoj, 1926: Ušel′e r. Mol′dža na sev. okrajne hrebta Russkogo (Hotan-tag) [Ущелье р. Мольджа на сев. окрайне хребта Русского (Хотан-таг)] (Bobrinskoj 1926: 95) = Moldja river canyon in the northern margins of the Russkij [Russian] (Khotantag) Range (= Moleqie river canyon, central part of the Kunlun Shan Mountains, [East Turkestan / Xinjiang, China]; 37°07’N, 84°31’E, see Prževal′skij 1888); – *Myotis mystacinus kukunorensis* Bobrinskoj, 1929: Balekut-gomi (уроч. Балекут-гоми) on Huang-ho R[iver]. to the S[outh]. from lake Kuku-nor (Bobrinskoj 1929: 221) = Balekun-gomi / Kyikug [at the confluence of Qiabuqia and Huang rivers, former settlement, now flooded by Longyangxia Reservoir], on the Huang / Yellow river south of Qinghai / Kokonor lake, [NE Tibet / Qinghai Province, China]; 36°09’N, 100°45’E, see Prževal′skij 1883, Barabanov & Ananjeva 2007); – *Myotis mystacinus sogdianus* Kuzâkin, 1934: Taškent [Ташкент] (Kuzâkin 1934: 321) = Toshkent (Uzbekistan; 41°20’N, 69°15’E); – *Myotis mystacinus pamirensis* Kuzâkin, 1935: Pamir, oz. Âšil′-kul′ [Памир, оз. Яшиль-Куль] (Kuzâkin 1935: 431) = Âšilkūl lake, the Pamirs (= Yashilkul lake, Gorno-Badakhshan Region, Tajikistan; ca. 37°46’N, 72°57’E); – *Myotis mystacinus aurascens* Kuzâkin, 1935: s. Kurkužin bliz Vladikavkaza [с. Куркужин близ Владикавказа] (Kuzâkin 1935: 432) = Kurkužin village near Vladikavkaz (= Kurkužin, Kabardino-Balkaria, Russia; 43°43’N, 43°19’E); – *Myotis mystacinus bulgaricus* Heinrich, 1936: östl. von Plovdiv (Heinrich 1936: 38) = east of Plovdiv (Bulgaria; ca. 42°09’N, 24°46’E); – *Myotis mystacinus hajastanicus* Argiropulo, 1939: Selenie Šordža (Nadeždino) na vostočnom beregu Sevana, 2000 m nad u. m. [Селение Шорджа (Надеждино) на восточном берегу Севана, 2000 м над у. м.] (Argiropulo 1939: 27) = Šordža (Nadeždino) village on the eastern bank of Sevan lake, 2000 m a. s. l. (= Shoghakat [Շողակաթ], Gegharkunik Province, Armenia; 40°30’N, 45°16’E); – *Myotis mystacinus popovi* Strelkov, 1983: Krym, Kerčenskij p-ov, kamenolomni u pos. Kamenskij [Крым, Керченский п-ов, каменоломни у пос. Каменский] (Strelkov 1983b: 262) = stone mines at Kamenskoe village, Kerch Peninsula, Crimea (Ukraine; 45°17’N, 35°32’E); – *Myotis mystacinus mongolicus* Kruskop et Borissenko, 1996: Telhi, Lake Burun-Torey, Borzinskiĭ District (Borzya), Chitinskaya Region (Kruskop & Borissenko 1996: 332) = Teli / Tèli, Barun-Torej lake, Čitinskaâ [Chita] Region (Russia; 50°03’N, 115°38’E).

Only one insect parasite species was found on *M. davidii* in Tajikistan, *Basilia mongolensis* Theodor, 1966 was collected at two sites. The bat fly genus *Basilia* Miranda-Ribeiro, 1903 represents parasites of the tree-dwelling bat species. The records of this genus from Tajikistan are affiliated to the nominotypical form, *B. m. mongolensis* occurring in Central Asia s.l., while in the rest of the western Palaearctic, the subspecies *B. m. nudior* Hůrka, 1972 is reported (Kock 1984, Heddergott 2009, Ševčík et al. 2013, Benda et al. 2016c, 2019, Orlova et al. 2021c). However, the subspecies assignation of the latter population was doubted already by Kock (1984), who suggested a full species level and thus, the monotypic status of the nominotypical form. From *M. davidii*, *B.* (*m.*) *nudior* was collected in Albania (Benda et al. 2019), the nominotypical form was found on this bat in Russia (Tyva and Krasnoârsk Provinces, Orlova & Zhigalin 2014, Orlova et al. 2015a, b, Orlova et al. 2021c), Kazakhstan (Tagil′cev 1971, Hůrka 1969, Polkanov & Medvedev 1997), and Mongolia (Theodor 1966, Scheffler et al. 2010, Minář & Hůrka 1980). However, the distribution ranges of both (sub)species based on records from all host species still remain insufficiently known.

The gamasoid mite *Spinturnix myoti* (Kolenati, 1856) is a primary parasite of bats of the *Myotis myotis* group. In Tajikistan, it was found at least at five localities on *Myotis blythii* (see above), from unknown site/s on *M. davidii*, *Otonycteris leucophaea*, and on undetermined species of bat host/s (Stanûkovič & Malinovskij 1992). A gamasoid mite species was found on *M. davidii* (as *S. myoti* s.l., from *Myotis mystacinus* s.l.) also in Kazakhstan (Tagil′cev 1971), although the reported specimens could represent either *Spinturnix myoti* or *S. mystacina*. The latter mite, *S. mystacina* (Kolenati, 1857) is a pleoxenous gamasoid parasite occurring primarily on bats of the *M. mystacinus* morphological complex, but rarely also on other Palaearctic vespertilionid bats (genera *Myotis*, *Eptesicus*, *Vespertilio*, *Nyctalus*, and/or *Plecotus*). Its records are known from a very extensive range stretching from Great Britain to Japan (Rudnick 1960, Pinčuk 1971, Dusbábek 1972, Uchikawa & Wada 1979, Schmidt 1987, Senotrusova 1987, Stanûkovič 1990).

The macronyssid mite species *Ornithonyssus flexus* (Radovsky, 1967)* was described based on the material from *Myotis lucifugus* (Le Conte, 1831) collected in Michigan, USA, later it was documented from *Lasionycteris noctivagans* (Le Conte, 1831) also from Michigan (Radovsky 1967, Dood & Kurta 1988), and originally it represented an element of the Nearctic fauna. However, thirty years later, *O. flexus* was broadly reported from the Palaearctic by Stanyukovich (1997), from Crimea and Tajikistan, in both cases from *Myotis mystacinus* s.l. [= *M. davidii*] and without closer locality provided. The recent data show this mite from a variety of Palaearctic hosts (Orlova et al. 2017a, 2020), viz. *Myotis ikonnikovi*, *M. sibiricus*, *M. petax*, *Eptesicus nilssonii*, *Pipistrellus nathusii*, *Plecotus ognevi*, and *Vespertilio murinus*, its distribution indicates this mite to be a Holarctic species without a preferred host bat. Besides from *M. davidii* (Stanyukovich 1997), *O. flexus* was collected in Tajikistan also from *Barbastella caspica* (see below under this host species).

Ornithonyssus guzlonicus Orlova, 2015* was described based on the material originating from Tajikistan and remains known only from this country (Orlova et al. 2015a). It was defined by

* *Ornithonyssus flexus* and *O. guzlonicus* were referred by Radovsky (1967) and Orlova et al. (2017a, b) to the genus *Cryptonyssus*. Here we follow the taxonomic opinion by Micherdziński (1980: 14, 15) who treated the genera *Cryptonyssus* Radovsky, 1966 and *Ornithonyssus* Sambon, 1928 as synonyms. He described his view as follows: "*Cryptonyssus* Radovsky, 1966. Die Differentialmerkmale der Weibchen lauten nach dem Bestimmungsschlüssel von Radovsky (1967, S. 93): 'Anterior spur of coxa II very small and spike-like; setae on caudal margin not abruptly tapered near their tips; dorsal plate with 2 or 3 pairs of marginal setae near tip.' Folgende 5 Arten wunden dieser Gattung zugeordnet: *C. desultorius* Radovsky 1966, *C. dogieli* (Bregetova [1953]), *C. flexus* Radovsky 1967, *C. pavlovskii* (Lange 1959), *C. pipistrelli* (Oudemans 1904). Die morphologischen Merkmale rechtfertigen wohl kaum die Aufstellung eines besonderen Genus, da sie ungezwurgen, mitsamt der Chelicerenform, dem Genus *Ornithonyssus* entsprechen. Es wurden deshalb alle aufgezählten Arten in dieses Genus aufgenommen, wobei ich *Ornithonyssus pavlovskii* mit *Ornithonyssus pipistrelli* synonymisiere".

morphological traits of a female and protonymph; the holotype female was collected from *Barbastella caspica* being the type host (see below), while the protonymph from *M. davidii* (found at an unknown locality).

The mite *Macronyssus crosbyi* (Ewing et Stover, 1915) reported from Tajikistan by Stanûkovič & Malinovskij (1992) is a species distributed in the Nearctic region and its finding in West Turkestan is quite improbable (cf. Radovsky 1967). However, of the *M. crosbyi* group in the Palaearctic, *M. corethroproctus* (Oudemans, 1902) is known to parasitise *Myotis dasycneme*; females of this mite differ in morphology only slightly from the females of *M. crosbyi* (Radovsky 1967) and the two females collected by Stanûkovič & Malinovskij (1992) in Tajikistan were most probably erroneously identified as the American species.

Steatonyssus mongolicus Dusbábek, 1966 is a species whose description is based on specimens collected from *M. davidii* (under *M. mystacinus*) at two localities in western Mongolia, Šangyn-Gobi [ca. 46°15'N, 95°02'E] and Char-us-nur [Har Us Nuur lake; 47°55'N, 91°59'E] (Dusbábek 1966). These two sites remained the only known record localities of this mite species until Stanyukovich (1997) mentioned an occurrence in Tajikistan without any detail other than the host species, identical as reported by Dusbábek (1966). The newly documented male from *M. davidii* collected at Kalkot in Tajikistan thus represents another record from a known site.

The soft tick *Carios vespertilionis* (Latreille, 1802) and macronyssid mite *Steatonyssus periblepharus* Kolenati, 1858 are typical parasites of bats of the genus *Pipistrellus*. However, they also represent endophilic and nocturnal species that occur in the habitats of both migrating and sedentary populations of many different bat species (Dusbábek 1972), and the records from *M. davidii* are thus understandable. In Tajikistan, the records of *C. vespertilionis* are available also from *Pipistrellus pipistrellus* and a mixed collection of bats (see below).

Myotis bucharensis Kuzâkin, 1950

Records. **Published data**: Ajvadž [= Ajvaç] [**1**] (Kuzâkin 1944, 1965); Ajvadž [= Ajvaç], August 1915: coll. 1 ♀, leg. V. Â. Lazdin (Kuzâkin 1950, Bogdanov 1956a, Baranova et al. 1981); Aiwadj [= Ajvaç], SW Tadzhikistan, August 1915: 1 ♀, ZIN, leg. V. J. Lazdin (Tsytsulina & Strelkov 2001); – Shing [= Šing] river valley [**2**], Panjakent [= Pançakent] district, Zerafshan [= Zarafšon] basin, old mine, October 2019: coll. 1 ♂ (Kazakov et al. 2020); next to Šing kishlak, Šing river valley, Dahoni ob, abandoned mine, 5 October 2019: coll. 1 ♂, 3 October 2020: coll. 1 ♂ (Habilov & Tadžibaeva 2020b, Tadžibaeva & Habilov 2021).

Distribution. *Myotis bucharensis* belongs to the few bat endemics of West Turkestan, and of these endemics, it is the rarest species. It is know from only four sites, two in Tajikistan and two in Uzbekistan (see the review by Habilov & Tadžibaeva 2020b). On the other hand, *M. bucharensis* belongs to the few bat species described based on specimens from Tajikistan. The description of this bat was published by Kuzâkin (1950), based on a single female specimen collected at Ajvaç [Айвач; 36°59'N, 68°02'E] close to the Amudarë in the south-western corner of Tajikistan in August 1915; this holotype specimen remains deposited in the ZIN collection (Baranova et al. 1981, Tsytsulina & Strelkov 2001). After 104 and 105 years, respectively, other two individuals were discovered in an abandoned mine at Šing kishlak in the Šing river valley, Zarafšon river basin, westernmost Tajikistan (Pançakent district; Kazakov et al. 2020, Habilov & Tadžibaeva 2020b). The two Tajikistani localities (situated ca. 255 km from each other, Fig. 78) lie in the altitudinal range of ca. 1000 m (323 m and 1383 m a. s. l.) and represent also the maximum altitude span documented in this bat. The two records from Uzbekistan were made within this range, at 465 m (Toshkent) and 680 m a. s. l. (Samarqand). However, this altitude range is the third smallest among the bats of Tajikistan (Table 3).

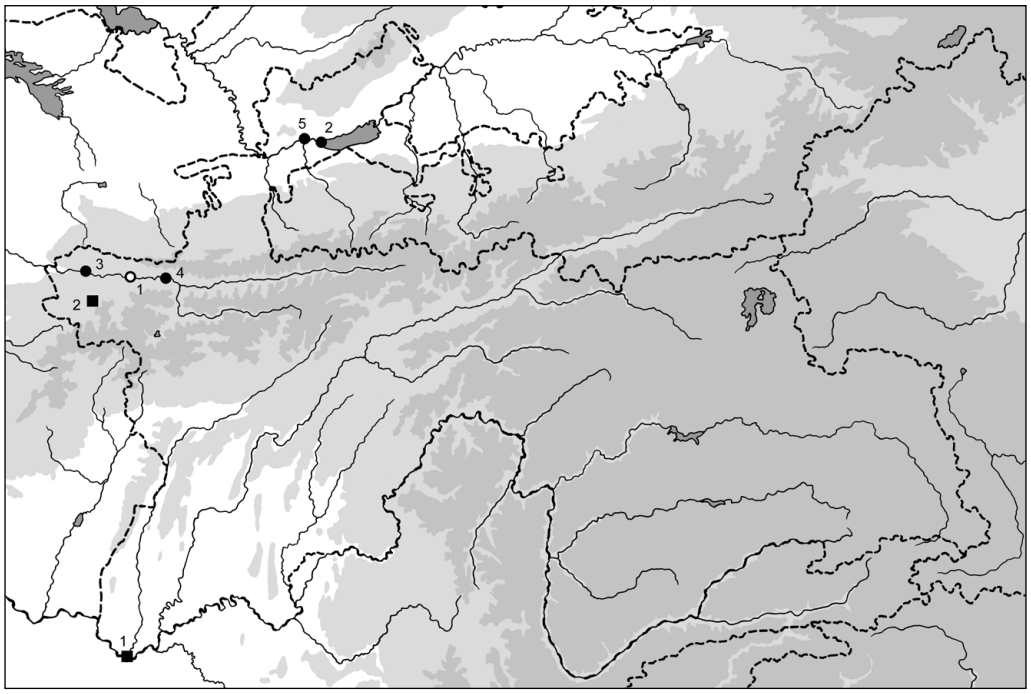


Fig. 78. Records of *Myotis bucharensis* Kuzâkin, 1950 (squares) and *Nyctalus noctula* (Schreber, 1774) (circles) in Tajikistan.

Since the previous records were made in 1963 at the latest, Horáček et al. (2000) speculated about possible extinction of *M. bucharensis*. The new records from the Zarafšon river basin confirmed continuous existence of this species (the last previous record was made also in this basin, just in its Uzbekistani part), living in a very limited geographical range, surrounding the westernmost arid reaches of the south-western Tien-Shan mountain system (Benda et al. 2011).

Variation. *Myotis bucharensis* was originally reported as *M. longicaudatus* Ognev, 1927 (see Kuzâkin 1944, 1950, Bogdanov 1956a, 1960), a species discovered in the Far East of Russia (Ognev 1927); Kuzâkin (1950) described it as a subspecies *M. longicaudatus bucharensis*. Later on, based on the suggestion by Ellerman & Morrison-Scott (1951), both these populations (West Turkestani and Far Eastern) were considered a part of another Far Eastern (Chinese) bat species, *Myotis frater* Allen, 1923, although as two separate local subspecies (Strelkov 1963, 1981, Kuzâkin 1965, Corbet 1978, Pavlinov & Rossolimo 1987, 1998, Habilov 1992, 2003, Koopman 1993, 1994, Habilov & Tadžibaeva 2016b). Finally, as a result of morphological examinations (Horáček et al. 2000, Tsytsulina & Strelkov 2001), the Turkestani populations were suggested to represent a separate species, *M. bucharensis* (see also Simmons 2005, Benda et al. 2011, Benda & Gaisler 2015, Tadžibaeva & Habilov 2017a, 2019d, 2021, Habilov & Tadžibaeva 2020b, d, 2021b) and this taxonomic rank was supported by the results of a recent molecular genetic analysis (Kazakov et al. 2020). The latter analysis was possible only thanks to the new record from western Tajikistan.

Vespertilio murinus Linnaeus, 1758

Records. **Original data**: Tuto [**1**], above a small lake (Fig. 79), 7 May 2016: net. 1 ♂ (Fig. 80; NMP 95725 [S+A]; cf. Habilov & Tadžibaeva 2016b). – **Published data**: near Stalinabad [= Dušanbe] [**2**], loess wall of the Dûšambinka [= Varzob] river bank, burrow, 24 June 1949: coll. 1 ♂, IZPAN, leg. V. I. Černyševskij [= Černyšev] (Bogdanov 1952); near Stalinabad [= Dušanbe], in an abandoned burrow of the Libyan jird, 24 June 1949: coll. 1 ♂, leg. Černyšev (Bogdanov 1953a, Černyšev 1958); – Staraâ pristan′ [= Bandari Kūḫna] [**3**] (Tigrovaâ balka [= Bešai Palangon] Reserve), under an iron roof of a living house, coll. 1 mummy (Ŝerbin 1968); – Kuraminskij [= Kurama] Mountains, near Pangaz kishlak [**4**], Mount Šurobak, abandoned mine, ceiling fissure, 20 November 1977: coll. 1 ♂ (Habilov 1980, 1992, Muratov et al. 2017); – foothills of the Turkestanskij [= Turkiston] Mountains, 11 km north-east of Isfara [**5**], Guzlon Range, abandoned mine, 18 December 1977: coll. 1 ♂ (Habilov 1980, 1992, Medvedev & Polkanov 1997, Muratov et al. 2017, Tadžibaeva 2018); – Mogol-Tau [= Mogoltau], near Čajruh-Dajron [= Čoruh-Dajron] [**6**], abandoned mine, 8 January 1978: coll. 1 ♂ (Habilov 1980, 1992, Muratov et al. 2017), 26 June 1984: exam. 1 ♀ (Habilov 1992); – near Džirgital′ [= Vaḫdat] [**7**], autumn 1978: coll. 1 ind., leg. R. Murašov / R. Muratov (Habilov 1986, 1992); – Leninabad [= Huçand] [**8**], Faculty of Fysics, window on the fourth floor, 8 January 1991: coll. 3 ♂♂, 1 ♀ (Habilov 1991); – near Majkata [= Majkatta] kishlak [**9**], above the Zeravšan [= Zarafšon] river, 5 April 1979: shot 1 ♂, leg. R. Muratov, 8 April 1979: shot 1 ♂, leg. R. Muratov (Habilov 1992, Tadžibaeva & Habilov 2017a); – south-eastern part of the Golodnaâ steppe [= Mirzacho'l], near Zafarabad [= Zafarobod] [**10**], "Leninabad" state farm, fissure of a pole, between its wooden and concrete parts, 6 October 1977: coll. 1 ♂ (Habilov 1992, Muratov et al. 2017); – Zeravšan [= Zarafšon] river valley / right bank, southern slope of the Turkestanskij [= Turkiston] Mountains, near Garibak [= Ğaribak] kishlak [**11**], laterite rock fissure, 13 February 1979: exam. 23 ♂♂, 13 ♀♀ (Habilov 1992, Medvedev & Polkanov 1997, Muratov et al. 2017); – Mogoltau Mountains, Čašme arzanak spring [**12**], 23 April 1961: coll. 1 ♀, SAGU, leg. R. N. Meklenburcev (Kaškarov & Mitropol′skaâ 2004); – Činar [= Činor] kishlak [**13**], Vose″ [= Ḫulbuk] district, ceiling fissure of a house veranda, 12 May 2017: coll. 1 ♂ (Muratov et al. 2017); – Dusti [**14**], a building under construction, ceiling fissure, 9 October 2017: coll. 1 ♀ (Muratov et al. 2017).

Distribution. *Vespertilio murinus* is distributed broadly in the temperate zone of the Palaearctic, the southernmost extension of its occurrence lies in south-western Asia (Corbet 1978, Bates & Harrison 1997, Horáček et al. 2000, Benda et al. 2012). This bat is an uncommon but regular

Fig. 79. A small lake at Tuto near Kūlob, above the Âhob river valley; a site of documented occurrence of at least seven bat species, *Myotis emarginatus*, *Vespertilio murinus*, *Eptesicus serotinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *P. kuhlii*, and *Tadarida teniotis*. Photo by A. Reiter (7 May 2016).

Fig. 80. Portrait of *Vespertilio murinus* Linnaeus, 1758 from Tuto. Photo by A. Reiter.

faunal element of the eastern part of the Middle East and of West Turkestan, the southernmost records come from northern Afghanistan, Iran, and the United Arab Emirates (Bobrinskoj 1925, Bogdanov 1953a, 1968, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, Benda et al. 2012, Benda & Gaisler 2015, Monadjem et al. 2016). The Tajikistani occurrence area of *V. murinus* represents a part of the south-eastern margin of the distribution range of this bat in West Turkestan and Palaearctic Asia as well. This range margin continues from south-western Tajikistan southwards to north-western Afghanistan (Neuhauser & DeBlase 1974) and from northern Tajikistan to southern Kirghizstan and south-eastern Kazakhstan (Butovskij et al. 1985, Rybin et al. 1989). The southern limits of the distribution range of *V. murinus* continue eastward through East Turkestan, Mongolia, to Manchuria (Dobson 1879, Bobrinskoj 1929, Wallin 1969, Dolch et al. 2007).

In Tajikistan, *V. murinus* ranks among rather uncommon bats (Fig. 81), fourteen record sites are known being spread across low to medium altitudes in the western section of the country. The available records (including that made by us) come from a medium-wide altitudinal range (1521 m); however, some three quarters of the records come from the sites below 1000 m a. s. l., i.e. from quite low areas of Tajikistan (Fig. 10, Table 3). The seasonal distribution of records indicates that *V. murinus*, a migratory bat species, occurs in Tajikistan mainly in the winter (hibernation) period, while in the warm period of a year, only few records of single males were made, no reproduction aggregation of females was found (see also Habilov 1992, Muratov et al. 2017).

Variation. External and cranial dimensions of the single newly collected Tajikistani specimen of *Vespertilio murinus* are shown in Table 10. Considering morphometry, the Tajikistani sample of *V. murinus* conforms to those from Europe or Iran (see e.g., Benda et al. 2003a, 2012, 2019). Two subspecies of *V. murinus* are recognised within its species range and the populations of south-western Asia including the Tajikistani ones were assigned to the nominotypical form (DeBlase 1980, Strelkov et al. 1978, Habilov 1992), similarly as those of most of the species distribution range, occurring from western Europe to Kashmir and the Trans-Baikal region (Wallin 1969, Corbet 1978, Koopman 1994, Horáček et al. 2000, Simmons 2005).

Records of ectoparasites. **Published data**: I s c h n o p s y l l i d a e: *Nycteridopsylla dictena*: 10 km NE of Isfara, mines at the old road to Kokand [= Qo'qon] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997); – vicinity of Pendžikent [= Pançakent] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997).

Comments on ectoparasites. In *Vespertilio murinus*, just one ectoparasite species was documented in Tajikistan, the bat flea *Nycteridopsylla dictena* (Kolenati, 1856). This flea has an Eupalaearctic range of distribution, it is known to occur in Europe, central and eastern Asia, and Japan (Medvedev & Polkanov 1997, Ohno et al. 2008). In West Turkestan, it was collected from few sites, three in Kirghizstan and two in western and northern Tajikistan (see Records of ectoparasites; Ioff et al. 1946, Ioff 1949, Ioff & Bondar′ 1956, Medvedev & Polkanov 1997). The bat hosts preferred by this bat flea are *Vespertilio murinus* (considered a primary host in Tajikistan by Medvedev 1992 and Medvedev & Polkanov 1997), *Pipistrellus pipistrellus*, and *Nyctalus noctula*, while the oc-

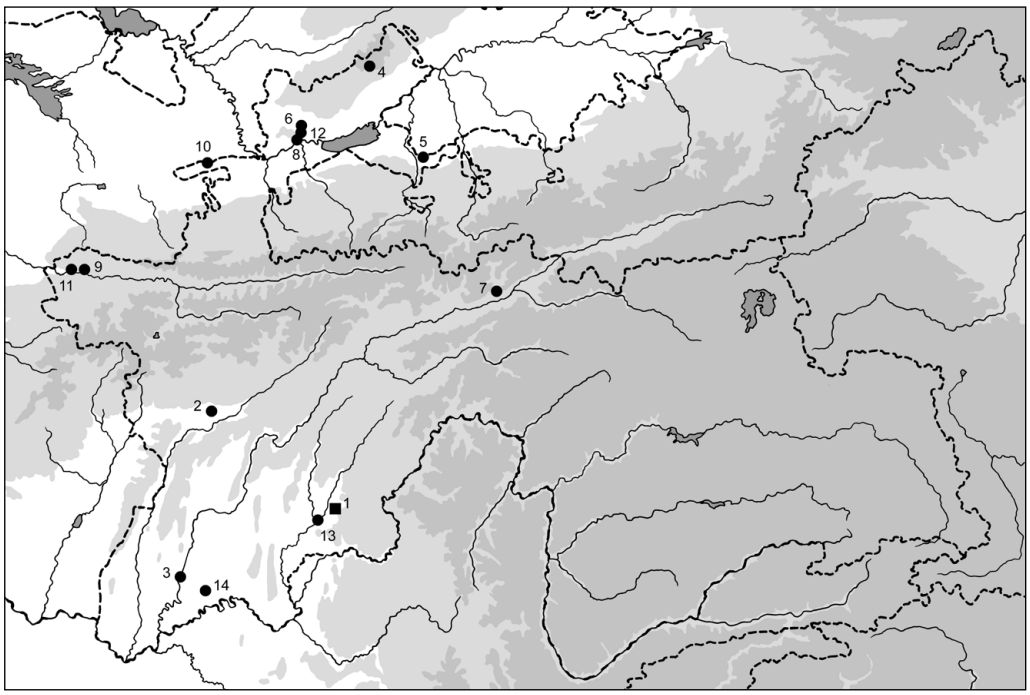


Fig. 81. Records of *Vespertilio murinus* Linnaeus, 1758 in Tajikistan; square – new record, circles – published records.

currence on bats of the genera *Barbastella* and *Plecotus* are considered rather accidental (Hůrka 1963). *Nycteridopsylla dictena* is a very rare flea and interestingly, almost all its records refer to females, while a male was reported (and described) only once (Smit 1955).

Eptesicus serotinus (Schreber, 1774)

Records. **Original data**: Levap [**1**], old farm, 5 May 2016: det. & rec. calls of several foraging inds.; – Kūlob [**2**], botanical garden (Fig. 82), 6 May 2016: det. & rec. calls of several foraging inds.; – Tuto [**3**], above a small lake, 7 May 2016: det. & rec. calls of several foraging inds.; – Host [**4**], Obihumbou river valley (Fig. 83), 13 May 2016: det. & rec. calls of 1 foraging ind. – **Published data**: Gissar″ [= Ḥisor] [**5**], May 1897: 5 inds., ZIN, leg. Kaznakov″ (Satunin″ 1910); Gissar [= Ḥisor] (Bogdanov 1953a); – Karatag″ [= Qaratoğ] [**6**], 27 June [= 9 July NS] 1896: 1 ind., ZIN, leg. Barŝevskij (Satunin″ 1910); Karatag [= Qaratoğ] Mountains (Bogdanov 1953a); – [?] Hodžent″ [= Huçand] [**7**], 1 ind. juv., ZIN, leg. Sěvercov″ (Satunin″ 1910 [as *E. serotinus isabellinus*]); Hodžent [= Huçand] (Ognev 1928, Vinogradov 1935, Bogdanov 1953a); Leninabad [= Huçand], 18 July 1909: coll. 1 ♂, leg. N. A. Zarudnyj (Habilov 1992); Leninabad [= Huçand], 19 May 1985: exam. 1 ♂ (Habilov 1992); – Fejzabad″ [= Fajzobod] kishlak [**8**], behind a beam of a house, 28 July [= 9 August NS] 1914: coll. 4 ♂♂, 6 ♀♀, leg. Nožin (Bobrinskoj 1918); Fejzabad″ [= Fajzobod] kishlak, (Karategin [= Qarotegin]), 28 July [= 9 August NS] 1914: coll. 10 ♂♂, 1 ♀, leg. L. L. Nožin (Bobrinskoj 1925); Fajzabad [= Fajzobod] (Bogdanov 1953a); – periphery of Stalinabad [= Dušanbe] [**9**], orchards, 1935: obs. foraging inds. (Kuzâkin 1950); Dušanbe, 10 April 1963: coll. 1 ♂, 3 July 1963: coll. ♀ (Ŝerbin 1968); Dušanbe, 27 May 1971: coll. 1 ♀, ZIN, leg. P. P. Strelkov (Habilov 1992, Tadžibaeva & Habilov 2019b); [Dušanbe, hotel, 2 June 1980: 1 ♀, NMP, leg. J. Gaisler & V. Hanák (Benda et al. 2006, Benda & Gaisler 2015) = an error, in fact, the locality is Taraz, Kazakhstan, see Benda et al. (2011)]; – Kurgan-Tûbe [= Bohtar] [**10**], coll. several inds. (Bogdanov 1956a); – near Dusti [**11**], 10, 27, and 28 May 1965: obs. ca. 20 foraging inds. (Ŝerbin 1968); – Šululu kishlak [**12**], near Kulâb [= Kūlob], 16 May 1965: obs. 12 foraging inds., 17 May 1965: obs. ca. 30 foraging ins., coll. 3 ♀♀ (Ŝerbin 1968); Šululu kishlak, near Kulâb [= Kūlob], 17 May 1965: coll. 1 ♂, 2 ♀♀,

Fig. 82. Botanical garden in Kūlob, at the northern outskirts of the town; a site of documented occurrence of at least seven bat species, *Rhinolophus bocharicus*, *Myotis blythii*, *M. emarginatus*, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, *Otonycteris leucophaea*, and *Tadarida teniotis*. Photo by A. Reiter (7 May 2016).

Fig. 83. The Obihumbou river valley above Host, north of Qal″ai Humb, Darvoz Mountains; the echolocation calls of three foraging bat species were documented at this site on 13 May 2016, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, and *P. kuhlii*. Photo by M. Uhrin (13 May 2016).

IZPAN, leg. Û. V. Ŝerbin (Habilov 1992); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**13**], abandoned mine, 23 December 1978: exam. 1 ♂ (Habilov 1979, Tadžibaeva & Habilov 2018), Poj-bulok mine, 1240 m a. s. l., 25 February 2016: exam. 1 ♀ (Tadžibaeva & Habilov 2017b, 2018), [mine], 4 February 2016: exam. 1 ♀ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, near Pangaz kishlak [**14**], Mount Šurobak, two abandoned mines, 26 December 1976: coll. 2 / 3 ♂♂, 1 ♀, 20 November 1977: obs. 4 / 3 ♂♂, 2 / 3 ♀♀ (Habilov 1980, 1992), 18 November 1978: exam. 2 ♂♂, 5 ♀♀ (Habilov 1992); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**15**], abandoned mine, 8 November 1977: coll. 1 ♂ / ♀, 8 January 1978: coll. 1 ♂ (Habilov 1980, 1992), 18 July 1977: exam. 3 ♂♂, 1 ♀, 17 November 1978: exam. 1 ♂, 2 ♀♀, 30 January 1979: exam. 1 ♂, 5 January 1980: exam. 1 ♂, 1 ♀, 21 January 1980: exam. 2 ♀♀, 21 April 1980: exam. 1 ♂, 1 ♀, 10 November 1984: exam. 1 ♀, 19 April 1985: exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2019a), 9 January 1989: obs. 3 inds., mine, 23 November 2012: obs. 1 ind., large mine, 11 September 2015: exam. 1 ♂, mine, 2 October 2015: exam. 1 ♂, 20 August 2016: exam. 1 ♂, large mine, 20 August 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2019a); – foothills of the Turkestanskij [= Turkiston] Mountains, near Dahana (Guzlon Range) [**16**], abandoned mine 4, 16 October 1977: coll. 1 ♂ (Habilov 1980, 1992, Habilov & Tadžibaeva 2020a), mine 4, 14/15 May 1977: exam. 1 ♂, mine, 25 March 1978: exam. 1 ♂, 1 ♀, mine 4, 11 November 1978: exam. 1 ♂, mine, 12 November 1978: exam. 1 ♂, 21 October 1979: exam. 2 ♂♂, 1 ♀ (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 10 October 2014: coll. 1 ♂ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a); – Tigrovaâ balka [= Bešai Palangon] Reserve [**17**], Central′nyj forestry, 24 April 1987: obs. 2 inds. (Malinovskij 1988); – Džilikul′ [= Çilikūl] [**18**], behind a shop sign, April 1986: obs. a colony of ca. 100 inds., exam. 62 ♀♀, 13 April 1987: coll. 1 ♀, 19 April 1987: obs. 15–18 inds. (Malinovskij 1988); – Langar kishlak [**19**], 40 km south-west of Leninabad [= Huçand], fissure of a concrete roof, 21 June – 1 July 1988: obs. a colony of 8–14 inds. (Habilov 1990); near Nau [= Nov] (Langar), 21 June – 30 July 1988: obs. a colony of 8–14 inds. (Habilov 1992); – 6 km west of Gissar [= Ḫisor] [**20**], state farm, 16 August 1934: coll. 1 ♀, ZIN, leg. V. L′vova (Habilov 1992); – Ajvadž [= Ajvaç] [**21**], border crossing, 26 June 1976:

coll. 1 ♂, IZPAN, leg. G. S. Davydov (Habilov 1992); – Kuraminskij [= Kurama] Mountains, Adrasman [= Adrasmon] [**22**], 19 July 1980: exam. 1 ♂ (Habilov 1992), Gulšan, mine, 15 January 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2018); – Surh [**23**], 7 May 1977: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – Kajrakkum [= Guliston] [**24**], 19 May 1979: exam. 1 ♂ (Habilov 1992); – Nižnyj Pândž [= Pançi Poën] [**25**], under a slate roof cover of a house, 9 October 1987: obs. a colony, exam. 1 ♂, 41 ♀♀ (Habilov 1992, Medvedev & Polkanov 1997); – ca. 70 km of the road Hudžand [= Huçand] – Istaravšan, Devaštič [= Gončī] district [**26**], small lake in steppe, 2 July 2019: net. 1 ♂ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2021a).

Distribution. *Eptesicus serotinus* is distributed broadly in the south-western Palaearctic, in most of Europe and Asia (Benda et al. 2012, Juste et al. 2013, López-Baucells & Burgin 2019); in Asia it occurs in the Mediterranean zone of the Middle East, in the Caucasus region, northern Afghanistan, whole Turkestan, and in southern Mongolia (Benda et al. 2012, Juste et al. 2013, Benda & Gaisler 2015, Dolch et al. 2021a). It belongs to the most common bat species in the central and southern parts of West Turkestan (Bobrinskoj 1925, Ognev 1928, Kuzâkin 1950, 1965, Bogdanov 1953a, 1968, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). The Tajikistani occurrence area of *E. serotinus* represents the south-easternmost part of the distribution range of this bat in West Turkestan and a part of the range margin in Palaearctic Asia. This range margin continues from south-western Tajikistan southwards to north-western Afghanistan (Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan, eastern Kazakhstan and southern Mongolia (Butovskij et al. 1985, Rybin et al. 1989, Dolch et al. 2021a).

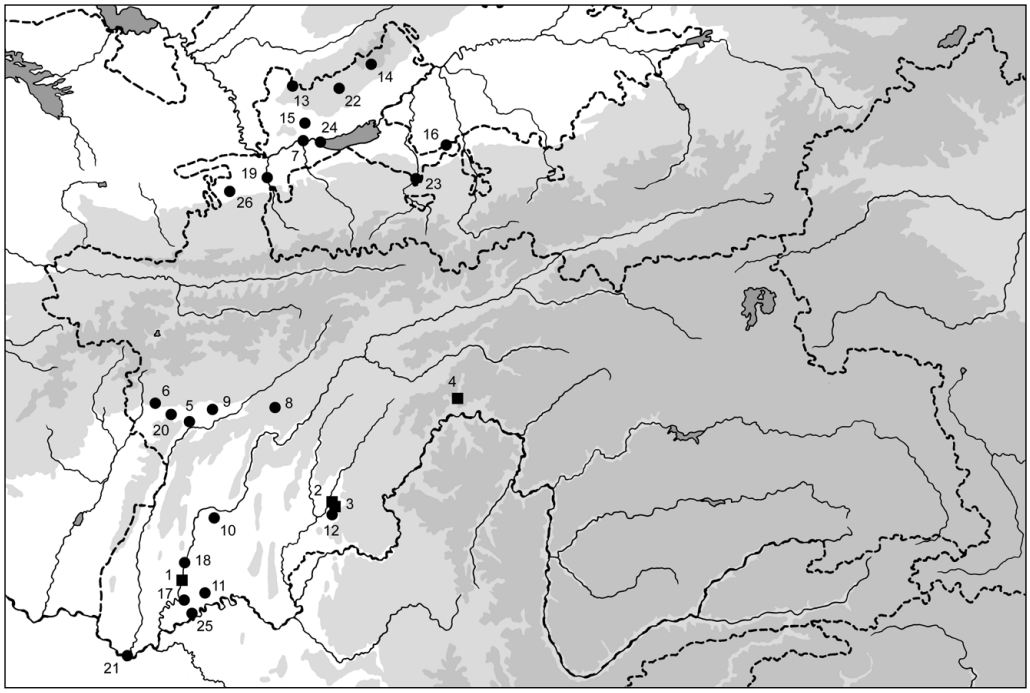


Fig. 84. Records of *Eptesicus serotinus* (Schreber, 1774) in Tajikistan; squares – new records, circles – published records.

In the first paper mentioning records of *E. serotinus* from Tajikistan, Satunin″ (1910: 282) reported a juvenile specimen of "*Eptesicus serotinus isabellinus* Blyth" from the ZIN collection, being collected by explorer N. A. Severcov in Huçand. This mention was universally accepted as a record of *E. serotinus* by subsequent authors (Bobrinskoj 1925, Ognev 1928, Vinogradov 1935, Bogdanov 1953a, 1956, Habilov 1992), since the name "*isabellinus* Blyth" (≠ *isabellinus* Temminck) is generally considered to be a synonym of *turcomanus* Eversmann. However, a possibility exists that this specimen in fact represents rather *Eptesicus ognevi* than *E. serotinus*, see below under the former species. Anyway, the occurrence of *E. serotinus* in Huçand was confirmed by several subsequent collectors (see above and Habilov 1992), the doubts concerning the oldest record thus do not affect the known occurrence of this bat in this town.

Habilov (1992: 311) reported on a ZIN specimen of *E. serotinus* collected at Kara-Kul′ on 22 April 1930 (collector name is not listed, just the Central Asian Zoological Expedition). Localities with a (currently unused) Russian name Kara-Kul′ [Кара-Куль; = Black Lake] are rather frequent in West Turkestan, in Tajikistan the name could indicate the Qarokūl lake in the Pamirs (ca. 39°03'N, 73°23'E; 3892 m a. s. l.; see Fig. 1). However, *E. serotinus* is a common element throughout the lowlands of West Turkestan, but it is absent from high mountains and the Qarokūl lake at almost 4000 m a. s. l. is quite unlikely as an occurrence area of this bat (Habilov 1992 did not mark such occurrence in the map at p. 312). Most probably, the locality of the specimen origin is Qorako'l (Kara-kul′ in Russian; 39°30'N, 63°51'E; 197 m a. s. l.), a large lowland oasis near Buxoro (Bukhara) in central Uzbekistan. A similar confusion of the site location was made in *Tadarida teniotis* collected at Qorako'l in 1936 (see below); however, its correct locality in Uzbekistan was published (Bobrinskoj & Kuzâkin 1937) and the error is clear. No similar record of *E. serotinus* in Uzbekistan was reported (cf. Bogdanov 1953a) and the explanation presented here remains unconfirmed.

Our new records from south-western Tajikistan contribute only slightly to the detailed depiction of the distribution range of *E. serotinus* and its eastern margin in Central Asia (Fig. 84); the recording of echolocation call of this bat made in the Obihumbou river valley at Host in the Darvoz Mountains (Fig. 83) represents the easternmost record of *E. serotinus* in the Amudarë Basin (70°50'E) and a new prolongation of the range by 120 km of aerial distance to the northeast from Šululu (near Kūlob) and 130 km east from Fajzobod (Èlok river valley), the closest two sites previously known to create the eastern range margin in the country (Fig. 84; Bobrinskoj 1918, Ŝerbin 1968). The call recording of at least one foraging individual at Host also constitutes the highest locality of *E. serotinus* in Tajikistan (ca. 1700 m a. s. l.).

In Tajikistan, *E. serotinus* ranks among common bats (Fig. 84), at least 26 record sites are known, spread across low to medium altitudes of the western section of the country. The available records come from a rather narrow altitudinal range (1368 m); majority of the records were made at the sites below 900 m a. s. l., i.e. in very low areas of Tajikistan, the value of the altitudinal mean in *E. serotinus* is the smallest among all bats of Tajikistan (Fig. 10, Table 3). Our records come from a similarly wide range of 1351 m and also the altitudinal distribution of these four record sites is very similar to that of all records (median 751.5 m vs. 757.5 m; see Fig. 11, Table 4).

Echolocation. While no individuals of *Eptesicus serotinus* were examined during our research in Tajikistan, echolocation calls of this bat represented the only then obtained distribution data on this bat and were detected at four sites in the southern part of the country (see Records). All recorded calls represent search calls of foraging bats, they were assigned to *E. serotinus* according to the behaviour observed and the call characteristics (Table 5, Fig. 85). All the documented parameters concord with the values documented in other parts of the species distribution range (Russo & Jones 2002, Obrist et al. 2004, Papadatou et al. 2008, Benda et al. 2012).

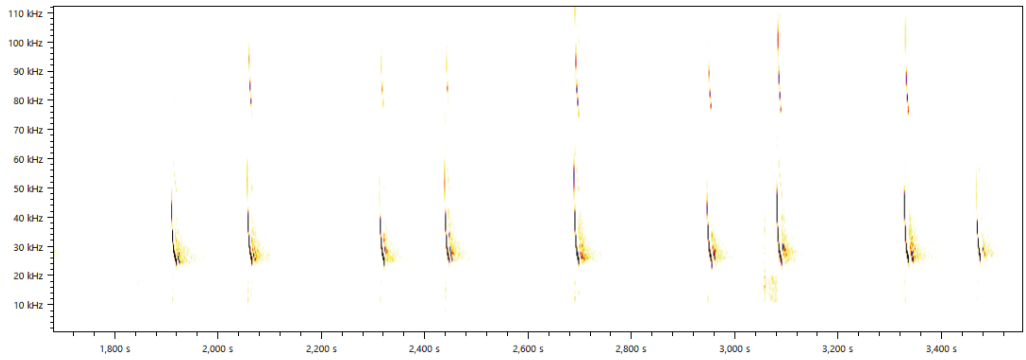


Fig. 85. Spectrogram of the echolocation calls of *Eptesicus serotinus* (Schreber, 1774); an individual foraging in the botanical garden at Kūlob, 6 May 2016.

Variation. With only few exceptions, the populations of West Turkestan, including Tajikistan, were until recently considered a pale and small-sized subspecies of *Eptesicus serotinus*; in a large majority as *E. s. turcomanus* (Eversmann, 1840) (Ognev 1927, 1928, Bobrinskoj 1926, 1929, Kuzâkin 1934, Meklenburcev 1935, Ellerman & Morrison-Scott 1951, Strelkov 1963, 1981, Corbet 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, Koopman 1994, Horáček et al. 2000, etc.), and by several elder authors in different combinations, as *Vesperugo serotinus turcomanus* (Radde & Walter 1889, Kaŝenko 1905) and *Vespertilio serotinus turcomanus* (Bobrinskoj 1925, Kuzâkin 1944, 1950, 1965, Bogdanov 1953a, 1956b). Few authors at the beginning of the 20th century (Satunin″ 1906, 1910, 1914, Bobrinskoj 1918, Bil′kevič″ 1918) used a different name, *Eptesicus serotinus isabellinus* (Temmnick, 1840), a species of the *serotinus* group, living in the western Mediterranean. However, this name under the correct authorship (Temminck 1840: 205) was mentioned only by Satunin″ (1906) and Bil′kevič″ (1918), while Satunin″ (1910, 1914) and Bobrinskoj (1918) affiliated this name erroneously to "Blyth" (= Edward Blyth, 1810–1873), hence, to a different bat in fact, *Nycticejus isabellinus* Blyth, 1851 [= *Hesperoptenus tickelli* (Blyth, 1851)], an Oriental form of the Eptesicini bats.

Moreover, Satunin″ (1910) reported two forms with two names to occur in sympatry in West Turkestan, *E. serotinus* and *E. serotinus isabellinus*. The author did not give any explanation of his opinion concerning the characters identifying these forms, one of possible reasons is an admixture of two species in his specimen series, *E. serotinus* and *E. ognevi*, and in that case, the name "*isabellinus* Blyth" was applied for a species other than *E. serotinus* (see more details under the latter species below).

Exceptional opinions considered the West Turkestani populations to represent a species separated from *E. serotinus*, viz. *Vesperugo turcomanus* (Sěvercov″ 1873a, Severtzoff 1876) and *Eptesicus turcomanus* (Bìanki 1917, Benda et al. 2011). However, recent molecular genetic analyses (Artyushin et al. 2012b, Juste et al. 2013, Artûšin et al. 2018) demonstrated the West Turkestani populations of *E. serotinus* to represent an identical taxon as the European and Caucasian populations of the species, i.e. the nominotypical form. The morphologically well characterised populations of West Turkestan and surrounding areas, traditionally named "*turcomanus*", thus represent just a distinct ecomorph of *E. s. serotinus* (Juste et al. 2013, Benda & Gaisler 2015).

Records of ectoparasites. **Published data**: I s c h n o p s y l l i d a e: *Ischnopsyllus plumatus*: Nižnyj Pândž [= Pançi Poën] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997). – M a c r o n y s s i d a e: *Steatonyssus occidentalis evansi*: 4 ♂♂, 37 ♀♀, 24 protonymphs, 1 larva, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Eptesicus serotinus*, two ectoparasite species of two families were found in Tajikistan, one flea and one mite. The bat flea *Ischnopsyllus plumatus* Ioff, 1946 has a Central Asian range of distribution, this range represents just seven localities spread across the whole West Turkestan. At two sites in southern Kazakhstan it was collected from *Myotis blythii* (Altyntau and Novotroickoe [= Töle Bi]), while in other Turkestani countries solely from *Eptesicus serotinus*, being considered a principal host (Medvedev 1992). All findings were made in synanthropic conditions, at three sites in eastern Turkmenistan (Duşak, Kuška [= Serhetabad], and Repetek), at one in south-western Kirghizstan (Kuršab), and one in southern Tajikistan (Pançi Poën) (Medvedev & Polkanov 1997). The appearance of this species is limited to the period between May and June, because of the sensitivity of adult stages to the high summer temperatures (Medvedev & Polkanov 1997).

The macronyssid mite *Steatonyssus occidentalis* (Ewing,1933) is a species described and mostly distributed in the American continent (Radovsky 1967). In the Palaearctic, *S. o. evansi* Micherdziński, 1980 occurs in Europe and West Turkestan, where it parasitises bats of the genera *Myotis*, *Eptesicus*, *Pipistrellus*, *Nyctalus*, and *Plecotus* (see the review by Lanza 1999). However, records from other bats are not unusual either (Stanyukovich 1997).

Eptesicus ognevi Bobrinskoj, 1918

Records. **Original data**: Qarağoč [**1**], above a small lake, 9 May 2016: net. 1 ♀ (Figs. 86, 87; NMP 95733 [S+A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of several foraging inds., 15 May 2016: net. 1 ♂, 2 ♀♀ (NMP 95746, HSU pb6220, 6222 [S+A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of several foraging inds.; – Kalkot [**2**], above a small lake under the Ar Arak cave (Fig. 88), 17 May 2016: net. 1 ♂ (NMP 95757 [S+A]; cf. Habilov & Tadžibaeva 2016b). – **Published data**: [?] Hodžent″ [= Huçand] [**3**], 1 ind. juv., ZIN, leg. Sěvercov″ (Satunin″ 1910 [as *E. serotinus isabellinus*]); – Fejzabad″ [= Fajzobod] kishlak [**4**], behind a beam of a house, 28 July [= 9 August NS] 1914: coll. 1 ♂, 1 ♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Fejzabad [= Fajzobod], 28 July 1914: 1 ♂, 1 ♀ (Ognev 1928); Fejzabad [= Fajzobod] (Kuzâkin 1944, 1950, 1965, Bogdanov 1953a); – Sohta-činar″ [= Činor] kishlak [**5**], in a house, 30 June [= 13 July NS] 1914: coll. 1 ♂, 1 ♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Sohta-Činar [= Činor], 30 June 1914: 1 ♂, 30 July 1914: 1 ♀ (Ognev 1928); Sohta-Činar [= Činor] (Kuzâkin 1944, 1950, 1965, Bogdanov 1953a, Tadžibaeva & Habilov 2019b); – montane canyon Kiik″-Dagan″ [= Daḫanakiik] of the Gisar [= Ḫisor] district [**6**], 2 July [= 14 July NS] 1914: coll. 1 ♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Kiik-Dagan [= Daḫanakiik], 2 July 1914: 1 ♀ (Ognev 1928); Kiik′-dagan′ [= Daḫanakiik] (Kuzâkin 1944, 1950, 1965, Bogdanov 1953a, Tadžibaeva & Habilov 2019b); – Kurgan-Tûbinskij [= Viloâti Hatlon] pass [**7**], fissure in a rock boulder, 21 June 1950: obs. a colony of ca. 30 ♀♀, coll. several ♀♀ ads. plus 6 ♂♂, 11 ♀♀ juvs. (Bogdanov 1952, 1953a, 1956a); Kurgan-Tûbinskij [= Viloâti Hatlon] pass, 21 June 1950: 1 ind., ZIN (Benda et al. 2006); – Ak-Tau [= Aktau] Mountains [**8**], at 1900 m a. s. l., obs. & coll. inds., 24 May 1964: obs. foraging inds. (Ŝerbin 1968); – Aruk-Tau [= Aruktau] Mountains [**9**], obs. & coll. inds. (Ŝerbin 1968); – Gandžino [= Gançina] kishlak [**10**], May–August 1964: obs. foraging inds., coll. 12 ♂♂, 1 ♀ (Ŝerbin 1968); – Tigrovaâ balka [= Bešai Palangon] Reserve [**11**], fissure in a wooden pole, 12 April 1987: coll. 1 ♀ (Malinovskij 1988); – Kurgan-Tûbe [= Bohtar] [**12**], 17 July 1950: coll. 1 ind., ZIN (Habilov 1992, Benda et al. 2006); – Ajvadž [= Ajvaç] [**13**], 25 May 1971: 1 ♀, ZIN, leg. P. P. Strelkov (Habilov 1992, Benda et al. 2006); – right bank of the Syrdar′â [= Sirdarë], near Kok-Kurak [= Kokkurak] [**14**], foothills of the Mahou-Tau [= Mahoutau] Mountains, 15 May 1980: coll. 1 ♂ (Habilov 1992, 1995); right bank of the Kajrakkumskoe [= Baḫri Toçik] dam, near Kok-Kurak [= Kokkurak], June–July 1990: coll. 5 ♂♂, 15 ♀♀, 1–2 July 1990: obs. 268 inds. (Habilov 1995); – Volč′e canyon, between Mahou-Tau Mountains and the Kajrakkumskoe [= Baḫri Toçik] dam [**15**], June–July 1990: obs. 5 inds., incl. 1 ♀ (Habilov 1995); – near Dahana [**16**], Guzlon Range, mine 4, 14 February 2015: exam. 1 ♀ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a, 2022c), 26 February 2022: exam. 1 ♂ (Habilov & Tadžibaeva 2022c); – ca. 70 km of the road Hudžand [= Huçand] – Istaravšan [**17**], Devaštič [= Ğončī] district, small lake in steppe, 2 July 2019: net. 1 ♂ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2021a); – near Dahana [**18**], Guzlon Range, Isfara district, apricot orchard, water reservoir, 5 July 2019: net. 3 ♀♀ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2020a, 2021a).

Fig. 86. Portrait of *Eptesicus ognevi* Bobrinskoj, 1918 from Qarağoč. Photo by A. Reiter.

Distribution. *Eptesicus ognevi* is an endemic of arid lowland steppes of West Turkestan and adjacent areas, its distribution range comprises eastern Transcaucasia, northern parts of Iran and Afghanistan, and majority of West Turkestan, one finding comes from western Inner Mongolia (Hanák & Gaisler 1971, Rybin et al. 1989, Nader & Kock 1990, Benda et al. 2011, 2012, Benda & Gaisler 2015). The Tajikistani occurrence area of *E. ognevi* represents a part the eastern fringes of the distribution range of this bat in West Turkestan and a part of the eastern margin of the whole species range. This range margin continues from southern Tajikistan southwards to northern Afghanistan (Benda & Gaisler 2015); the only (uncertain) Afghanistani finding comes from near Taliqan (36°46'N, 69°39'E), some 48 km south of the Tajikistani border (Neuhauser 1969), and constitutes the south-eastern limit of the known distribution range of *E. ognevi* (for additional discussion see Benda & Gaisler 2015: 346). Our individuals netted above a small lake near Qarağoč (37°44'N, 69°40'E) represent a record in a geographical continuation of these eastern distribution limits in the low areas of south-western Tajikistan. From northern Tajikistan, the eastern margin of the range of *E. ognevi* continues to south-western Kirghizstan and eastern Kazakhstan, the northern limits of the species distribution are situated in the central latitudes of Kazakhstan (Butovskij et al. 1985, Rybin et al. 1989, Nader & Kock 1990).

Satunin″ (1910: 282) reported a juvenile specimen of "*Eptesicus serotinus isabellinus* Blyth" from the ZIN collection, being collected by explorer N. A. Severcov in Huçand, Tajikistan (no date of collection is provided). This mention was universally accepted as a record of *E. serotinus*

by subsequent authors (Bobrinskoj 1925, Ognev 1928, Vinogradov 1935, Bogdanov 1953a, 1956, Habilov 1992), although none of them mentioned an examination of the specimen that would confirm its taxonomic identity. However, besides 13 other specimens of the form "*isabellinus* Blyth" from various parts of Turkestan (other than Tajikistan), Satunin″ (1910: 281) mentioned also 31 specimens under the name *Eptesicus serotinus* from Turkestan (besides other 45 specimens from Cis- and Transcaucasia), including a series of five bats from Ḩisor and one bat from Qaratoğ, both Tajikistan (see above). The simultaneous mentioning of two *Eptesicus* forms from one territory suggests the sympatric occurrence of these forms that could imply their taxonomic exclusivity. Although the name "*Eptesicus serotinus isabellinus* Blyth" is currently considered a synonym of *Vespertilio turcomanus* Eversmann, 1840 (= *Eptesicus serotinus* Schreber; see above), at the times when *E. ognevi* was not recognised as a proper taxon (being described in 1918), it could have covered also this bat, which is similar in colouration to, but differs in size from *E. serotinus* of the region. A specimen considered juvenile could in fact represent a small-sized (adult) bat, i.e. *E. ognevi* instead of *E. serotinus*. These two species were frequently misidentified in West Turkestan (see e.g. Strelkov & Šajmardanov 1983 concerning Kazakhstan) and their taxonomic identity confused. Since nobody revised the identity of 14 specimens of "*isabellinus* Blyth" reported by Satunin″ (1910), it is possible that all or some of them represent *E. ognevi*. However, we here added a question mark to this record, since this view cannot be confirmed or rejected for the time being and remains a mere speculation.

Fig. 87. Penis of *Eptesicus ognevi* Bobrinskoj, 1918 from Qarağoč. Photo by A. Reiter.

Fig. 88. A small lake under the Ar Arak cave near Kalkot; at this lake, three bat species were netted, *Myotis blythii*, *M. davidii*, and *Eptesicus ognevi*, and echolocation calls of two additional species were recorded on 17 May 2016, *Rhinolophus ferrumequinum* and *Myotis emarginatus*. Photo by A. Reiter (17 May 2016).

In Tajikistan, *E. ognevi* represents a medium-frequent bat (Fig. 89), at least 17 record sites are spread across low to medium altitudes of the western section of the country. The records come from a medium wide altitudinal range (1577 m) and this species represents mainly a lowland dweller in the country – a large majority of its localities lie at the altitudes below 1100 m a. s. l. (Fig. 10, Table 3). Since this bat inhabits mainly lowland areas, its range in Tajikistan is divided into two parts separated by the ranges of the south-western Tien-Shan mountain system, to its south-western and northern sections (Fig. 89). The records from higher altitudes (roughly around or above 1300 m a. s. l.) represent observations of foraging individuals in the Aktau and Aruktau Mountains surrounded by the low areas of the Amudarë Basin (Ŝerbin 1968), i.e. the lowest parts of Tajikistan (Fig. 89). Our two records come from a narrow altitudinal range of 385 m, and their distribution is situated rather to higher altitudes of the species range (median 1089.5 m vs. 800.5 m; see Fig. 11, Table 4).

Echolocation. Echolocation calls of *Eptesicus ognevi* were detected just at one site during our research in Tajikistan, calls of several foraging bats were recorded at a small lake near Qarağoč during two research sessions (see Records). However, these recordings give the first available data on the echolocation parameters of this bat (Table 5). The foraging individuals of *E. ognevi* produce calls of the FM type with peak frequencies in the range of 30.0–32.8 kHz (Figs. 90, 91). Generally, in most parameters these calls are very similar to those of the closely related species *E. bottae* from the Middle East; based on the available recordings of calls from Sinai and Jordan (Benda et al. 2008, 2010a), in the latter species the descriptive parameters of echolocation calls

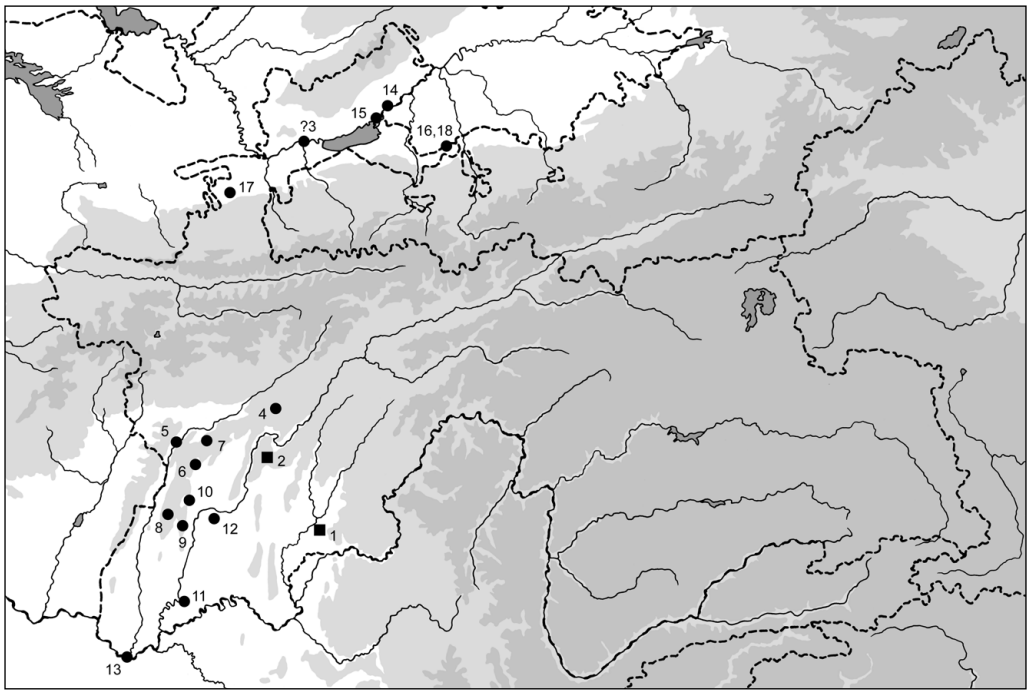


Fig. 89. Records of *Eptesicus ognevi* Bobrinskoj, 1918 in Tajikistan; squares – new records, circles – published records.

are as follows (mean, range): D 5.8 ms, 2.7–10.3 ms; SF 52.7 kHz, 37.9–83.0 kHz; EF 30.4 kHz, 27.0–33.7 kHz; PF 34.2 kHz, 29.6–39.5 kHz; IPI 128.3 ms, 52–301 ms (n=163). Most of the parameters were very similar in both species, although the start and peak frequencies of the calls in *E. ognevi* were at moderately lower values than in *E. bottae* (mean 44.1 kHz vs. 52.7 kHz,

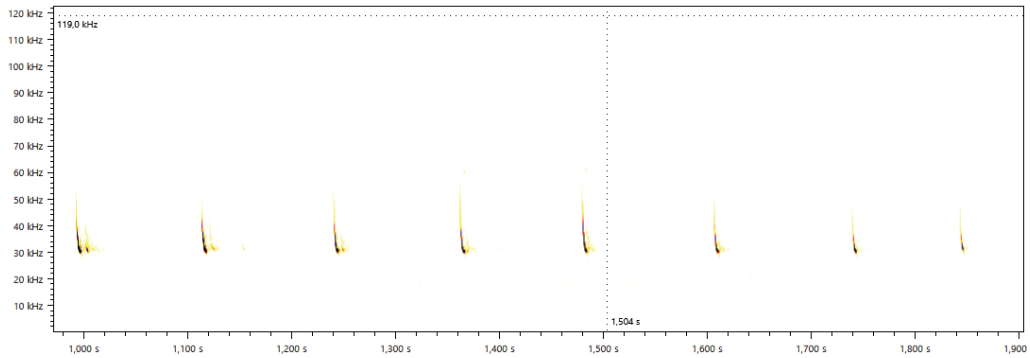


Fig. 90. Spectrogram of the echolocation calls of *Eptesicus ognevi* Bobrinskoj, 1918; an individual foraging at a small lake at Qarağoč, 9 May 2016.

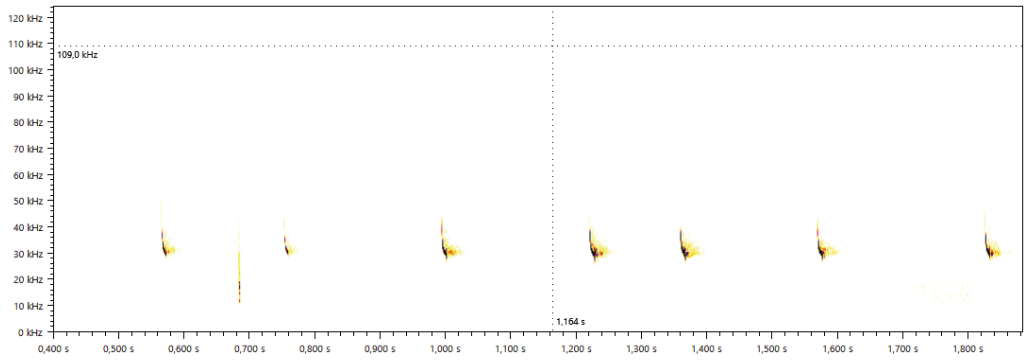


Fig. 91. Spectrogram of the echolocation calls of *Eptesicus ognevi* Bobrinskoj, 1918; an individual foraging at a small lake at Qarağoč, 15 May 2016.

and 30.8 kHz vs. 34.2 kHz, respectively), while the interpulse interval was on average larger in *E. ognevi* than in *E. bottae* (mean 162.3 ms vs. 128.3 ms).

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Eptesicus ognevi* are shown in Table 11. For the material examined see above.

Eptesicus ognevi belongs to several bat species whose description is based on a specimen from Tajikistan. The description of this bat was published by Bobrinskoj (1918: 12) and reads as follows: "*Eptesicus ognevi* sp. nov. figura similis est *Eptesico serotino* Schr[eber]., sed multo minor. Pellis colore pallido similis est *Eptesico serotino isabellino* Blyth, [= *Vespertilio turcomanus* Eversmann = *Eptesicus serotinus*] sed setae bicolores sunt, nam superiore corporis parte ab inicio ex fusco alnidae, delinde flavi paulumque cani; parte autem inferiore ab initio cani, deinde albi paulumque flavi canescentesque. // Typus: sen 30.VI/12 VII, 1914. Sochta-Sinar [= Činor], praefectura Hisariensis (vulgo dicitur «Gisarskoe bekstvo» [= Ḥisor District]), Buchara [= Emirate of Bokhara]. № 1 mihi coll. Corpus et caput 58 mm.? antibracchium 46,5 [mm], longitudo maxima cranii 17,5 mm."

The holotype specimen, female, was collected by L. L. Nožin from a house in Činor kishlak [38°22'N, 68°29'E, 665 m a. s. l.; ca. 30 km SW of Dušanbe] on 13 July 1914 [NS], during a joint expedition of the Imperial Moscow Society of Naturalists and the Department of Land Refinements that travelled across the eastern part of the Emirate of Bokhara in the summer 1914 (see Dimo 1915, Bobrinskoj 1918). It is deposited in the ZMMU collection (ZMMU S-96374, alcoholic specimen with skull extracted, skull missing), see Rossolimo & Pavlinov (1979: 14) and Borisenko et al. (2001: 171); it was examined by the senior author (PB) during his visit to the ZMMU collection in 2000, who found the following dimensions of this specimen: LAt 46.4 mm, lengths of the proximal / medial phalangi of the finger III 14.7 / 12.6 mm, finger IV 12.1 / 9.2 mm, finger V 10.0 / 6.6 mm. Although the species description mentioned a series of six specimens in total, the specimens other than the holotype were not designated as (para)types (see Bobrinskoj 1918: 12).

Although *E. ognevi* was originally described as a new species under its currently valid name (see above), during history it was assigned to several other combinations and ranks, although mostly under the subspecific name *ognevi* Bobrinskoj. This nomenclatural diversity concerns the populations of both Tajikistan *per se* and West Turkestan as a whole; see crosses [†] below for the authors who regarded taxonomic status of the Tajikistani populations in particular.

Table 11. Basic biometric data on the newly collected specimens of *Eptesicus ognevi* Bobrinskoj, 1918 and *Hypsugo savii* (Bonaparte, 1837). For abbreviations see p. 8

	Eptesicus ognevi					*Hypsugo savii*				
	n	**M**	min	max	SD	n	**M**	min	max	SD
LC	5	**65.6**	64	68	1.517	3	**54.7**	53	56	1.528
LCd	5	**54.2**	53	56	1.095	3	**44.0**	42	46	2.000
LAt	5	**44.08**	43.3	45.8	0.993	3	**35.33**	34.7	35.8	0.569
LA	5	**18.86**	18.3	19.5	0.503	3	**14.87**	14.1	16.3	1.242
LT	5	**7.46**	6.8	7.8	0.397	3	**5.03**	4.4	5.6	0.603
G	5	**13.80**	10.8	16.3	2.489	3	**7.53**	7.0	8.0	0.503
LCr	5	**16.74**	16.31	17.17	0.339	3	**13.39**	13.16	13.75	0.316
LCb	5	**16.48**	16.08	16.97	0.360	3	**12.91**	12.72	13.21	0.261
LaZ	5	**11.00**	10.81	11.24	0.186	3	**8.69**	8.51	8.98	0.254
LaI	5	**3.72**	3.54	3.93	0.169	3	**3.54**	3.43	3.63	0.103
LaInf	5	**5.39**	5.18	5.68	0.200	3	**4.43**	4.28	4.62	0.175
LaN	5	**7.80**	7.58	7.92	0.143	3	**6.87**	6.63	7.06	0.221
LaM	5	**8.87**	8.75	8.98	0.088	3	**7.40**	7.21	7.61	0.201
ANc	5	**5.71**	5.51	5.81	0.124	3	**4.49**	4.26	4.75	0.246
LBT	5	**3.47**	3.38	3.55	0.067	3	**2.90**	2.63	3.17	0.270
CC	5	**5.35**	5.18	5.58	0.147	3	**4.11**	3.98	4.18	0.110
M^3M^3	5	**7.16**	6.98	7.48	0.193	3	**5.63**	5.46	5.79	0.165
CM^3	5	**6.18**	5.93	6.33	0.165	3	**4.57**	4.46	4.71	0.129
LMd	5	**12.33**	12.02	12.67	0.260	3	**9.32**	9.17	9.46	0.145
ACo	5	**4.29**	4.18	4.38	0.098	3	**2.84**	2.63	3.06	0.215
CM_3	5	**6.80**	6.68	6.98	0.142	3	**4.86**	4.82	4.91	0.047

Two other species names were applied besides *ognevi* Bobrinskoj for the concerned populations of this bat. Shortly after the description, Bobrinskoj (1925†) himself included this bat into the taxon *Vespertilio sodalis ognevi*, and its populations were treated as *Eptesicus sodalis ognevi* in the first half of the 20th century (Bobrinskoj 1926, 1929, Ognev 1927, 1928†, Bobrinskoi 1931, Laptev 1934, Vinogradov 1935†, Tate 1942, Ellerman & Morrison-Scott 1951†). (The name *Eptesicus sodalis* Barret-Hamilton, 1910 is currently considered a junior synonym of *Vespertilio serotinus* Schreber, 1774; see e.g. Hanák & Gaisler 1971, Harrison 1976, Corbet 1978, Koopman 1993, Borisenko & Pavlinov 1995, Simmons 2005, etc.) Later on, the original opinion concerning the species rank prevailed and the name *Vespertilio ognevi* was used broadly (Kuzâkin 1944†, 1950†, 1965†, Kuznecov 1948, Bogdanov 1953a†, 1956a†, Dement′ev et al. 1955, Babaev 1965, Ŝerbin 1968†, etc.), while the combination *Eptesicus ognevi* only exceptionally (Strelkov 1963). Hanák & Gaisler (1971) suggested to include the form *ognevi* as a subspecies into the species rank of *Eptesicus bottae* (Peters, 1869), morphologically and ecologically a very similar bat from Arabia and the eremial zones of adjacent regions. This taxonomic view was accepted by numerous subsequent authors and the populations of West Turkestan were assigned to *E. bottae ognevi* (Harrison 1976, Corbet 1978, Strelkov et al. 1978, DeBlase 1980, Strelkov 1981, Butovskij et al. 1985, Rybin et al. 1989, Nader & Kock 1990, Koopman 1994, Horáček et al. 2000, Simmons 2005, Benda et al. 2006†, 2011); generally, the species name *E. bottae* was used for these bats for some forty years (see Strelkov et al. 1978, Strelkov 1980, Strelkov & Šajmardanov 1983, Pavlinov & Rossolimo 1987, 1998, Malinovskij 1988†, Corbet & Hill 1992, Habilov 1992†, 1995†, 2003†, Koopman 1993, Borisenko & Pavlinov 1995, Kaškarov & Mitropol′skaâ 2004, Gricina et al. 2013, Habilov et al. 2016, etc.).

Nevertheless, the recent molecular genetic analyses by Juste et al. (2013) and Artûšin et al. (2018) demonstrated coincidently that the populations of *ognevi* represent a separate phylogenetic lineage within the *E. bottae* species group of the genus *Eptesicus* and deserve the species status (along with *E. bottae* s.str., *E. hottentotus* (Smith, 1833), and *E. anatolicus* Felten, 1971). Thus, *E. ognevi* is currently considered a separate species, and the original taxonomic and nomenclatural views by Bobrinskoj (1918) are valid again (see Benda et al. 2012, Datzmann et al. 2012, Benda & Gaisler 2015, Habilov & Tadžibaeva 2016b†, 2020a†, d†, 2021a†, b†, 2022c†, Artûšin et al. 2018, Tadžibaeva 2018†, Burgin 2019b, Tadžibaeva & Habilov 2019b†, c†, Dundarova et al. 2021).

Although the populations of *E. ognevi* from West Turkestan are on average slightly larger in body and skull size than the populations of Transcaucasia (see Benda et al. 2006, 2011), both population groups represent an identical skull morphotype, namely in comparison with various populations of *E. bottae* s.str. (see Benda et al. 2006); hence, *E. ognevi* is considered a monotypic species (Burgin 2019b).

Records of ectoparasites. **Original data**: S p i n t u r n i c i d a e: *Spinturnix carnificina*: 1 ♂ deutonymph [P], from 1 ♀ (NMP 95733), Qarağoč, small lake, 9 May 2016; – 1 nymph, 1 protonymph [P], from 1 ♂, 2 ♀♀ (NMP 95746, HSU pb6220, 6222), Qarağoč, small lake, 15 May 2016. – M a c r o n y s s i d a e: *Steatonyssus pseudoheteroventralis*: 1 ♀ ad [P], from 1 ♂, 2 ♀♀ (NMP 95746, HSU pb6220, 6222), Qarağoč, small lake, 15 May 2016. – T r o m b i c u l i d a e: *Miyatrombicula* sp.: 1 larva [P], from 1 ♂ (NMP 95757), Kalkot, small lake at Ar Arak cave, 17 May 2016.

Comments on ectoparasites. In *Eptesicus ognevi*, a medium wide variety of ectoparasites was documented in Tajikistan, three species of three families were found in total. From the country, the ectoparasites of *E. ognevi* are here documented for the first time.

The mite *Spinturnix carnificina* (Koch, 1839) (sensu Dusbábek 1962) parasitises primarily bats of the genus *Eptesicus* in the Palaearctic. The records of this mite from Europe, Azerbaijan, Afghanistan, Mongolia, Taiwan, and Japan are associated exclusively with this bat genus (Rudnick 1960, Dusbábek 1962, 1970, Prasad 1969, Uchikawa & Wada 1979), although Dusbábek (1962, 1970) recorded it also from other bat genera used as its hosts.

The macronyssid mite collected from *E. ognevi* at Qarağoč is here referred to *Steatonyssus pseudoheteroventralis* Orlova et Anisimov, 2023. This species was described based on specimens from south-western Mongolia (type locality Zulganaj baân burd; 43°35'N, 100°04'E), additional material was collected at the Irbitej river in the Tyva Republic of Russia (50°44'N, 93°08'E), at both sites from *Eptesicus gobiensis* (Orlova & Anisimov 2023). Our new record from Qarağoč in Tajikistan represents the third known locality of this parasite (and first from West Turkestan) and the second host bat species, which in all cases are bats of the genus *Eptesicus*, i.e. litophilous fissure-dwelling bats. Nevertheless, the female of *S. pseudoheteroventralis* sensu Orlova & Anisimov (2023), originally assigned to *S. heteroventralis* Ah et Radovsky, 1967, is very similar in its morphology to the female of *Steatonyssus gaisleri* as described from Bisut, Afghanistan, by Dusbábek (1970), where it was collected from an ecologically and morphologically close host species *Rhyneptesicus nasutus* (Dobson, 1877), formerly included in the genus *Eptesicus*.

The species determination of the chigger mite (Trombiculidae) collected at Kalkot has not been confirmed, it is a member of the family Trombiculidae and according to the morphological characters (see below) it has been identified as belonging to the subgenus *Myiatrombicula* (*Miyacarus*) Vercammen-Grandjean, 1967. The mite specimen has a palpal setal formula 7B, identically as the group of morphologically closely related species of the subgenus (*M. balcanica* Kolebinova, 1969, *M. caucasica* Mulârskaâ, 1969, *M. kumadai* Takada, 1978, *M. muris* (Oudemans, 1910), *M. ramitensis* Kudrâšova, 1978, and *M. tokyoensis* Kumada, 1954), but it differs from them by 2 genualae I, vs. 3 genualae I in the group, larger size of the scutum and scutal setae (AW 94 µm, PW 113 µm, SB 39 µm, ASB 41 µm, PSB 45 µm, SD 86 µm, AP 60 µm, AM 60 µm, AL 56 µm,

PL 53 µm). The genus *Myiatrombicula* Sasa, Kawashima et Egashira, 1952 does not rank among the mites parasitising bats, and until now, no association with this host group was documented (see Zajkowska et al. 2018, Ševčík 2023). These mites are common parasites of small mammals (rodents and shrews) and rarely parasitise reptiles. The only exception concerning bats known from the Old World is a record (and description) of *Miyatrombicula barbatulus* Mulârskaâ, 1973 based on specimens collected from *Rhinolophus mehelyi* Matschie, 1901 from Azerbaijan (Mulârskaâ 1973, Gadžiev et al. 1990). Theoretically, the bats of the genus *Eptesicus* as petrophilous and also synanthropic species could be better predisposed to be infested by the *Myiatrombicula* mites switching from another host in the shared habitat.

Among other chigger mites of West Turkestan and adjacent areas, two forms of the complex *Willmannium cavus* Kudrâšova, 1992 were collected and described from *E. ognevi*, viz. *W. c. iraniensis* Kudrâšova, 1992 from Iran and *W. c. mangyshlakiensis* Kudrâšova, 1992 from Kazakhstan (Kudrâšova 1992). From broader Central Asia, i.e. from habitats similar to those of West Turkestan inhabited by *E. ognevi*, larvae (mentioned as "nymphs") of chigger mites identified only as "*Trombicula* spec." were reported from various other bat species of Mongolia (Scheffler et al. 2016).

Eptesicus gobiensis Bobrinskoj, 1926

Records. **Published data**: Fergana (Pamir?) [**1**], 1 ind., ZIN, leg. N. A. Severcov (Bobrinskoj 1926, 1929, Ognev 1928); Fergana, 1 ind., leg. N. A. Severcov (Strelkov 1986); Fergana, Uzbekistan, 1 ind., leg. N. A. Severcov (Habilov 1992); – Iskander-kul [= Iskandarkūl] [**2**], 1 ♀, ZIN, leg. Russov (Bobrinskoj 1929); Iskanderkul′ [= Iskandarkūl] lake, upper reaches of the Zaravšan [= Zarafšon] river, 1 ind. (Strelkov 1986); Iskanderkul′ [= Iskandarkūl], Gissarskij [= Ḥisor] Mountains, 1878: 1 ♀, ZIN, leg. V. F. Russov (Habilov 1992); – Pamir [**3**], 1901: 1 ind., leg. A. P. Fedčenko (Bogdanov 1956a, Habilov 1992); Pamir, 1901, leg. A. P. Fedčenko (Habilov 1986, 2003); Pamir, 1989[?]: 1 ind., leg. Muratov & Malinovskij (Habilov 1992); Pamir, "recent record", leg. R. Muratov (Habilov 2003).

Distribution. *Eptesicus gobiensis* is one of the rarest bats of the Tajikistani fauna. The number of specimens of this species really originating from the country remains somewhat enigmatic, it is not clear whether this bat was documented from Tajikistan once, twice, or more times, and whether only in the second half of the 19th century, or also more recently. Here we try to review the evidence and real or just possible records.

Originally, Bobrinskoj (1926, 1929) reported two specimens housed in the ZIN collection; a dry skin (sex undetermined) labelled to be collected at Fergana [Фергана, Farg'ona] by N. A. Severcov (no date of collection given), and a female alcoholic specimen collected by Valerian Fridrihevič Russov at the Iskandarkūl [Искандаркӯл] lake in 1878. The latter specimen seems to be the least questionable, V. F. Russov really visited the area of Iskandarkūl in 1878, where he collected zoological material; he died from smallpox shortly after his return to Saint-Petersburg in January 1879 before he managed to process and publish his collections (Anonymous 1879b). Russov's specimen thus gives a foundation to consider *E. gobiensis* as a part of the fauna of Tajikistan (see Strelkov 1986, Habilov 1992, 2003, Tadžibaeva & Habilov 2021, and also distribution maps in Kuzâkin 1944, 1950, 1965; contra Tadžibaeva & Habilov 2017a).

The former (Fergana) specimen is more problematic concerning its geographical origin, since its affiliation to the territory of Tajikistan is based on the variance between the site on its label and the usual environment of occurrence of this bat, arid montane steppes of Central Asia (see e.g. Strelkov 1986, Benda & Mashkour 2021). The site name written on the specimen's label is Fergana [Farg'ona] (see Strelkov 1986, Habilov 1992), currently the best known as a town in the easternmost part of Uzbekistan (sometimes Ferghana in English). However, the town bears this name from 1924, while originally, after its foundation, its name was Novyj Margelan″ [Новый

Маргеланъ] (1876–1907), and later, in 1907–1924, Skobelev″ [Скобелевъ]. Fergana had originally three other meanings; (1) name of the historical Fergana region covering mainly the Fergana valley [Ферганская долина / Farg‘ona vodiysi], an extensive flat basin (ca. 25,000 km^2, ca. 400–800 m a. s. l.) and partly also the surrounding western ranges of the Tien-Shan; (2) name of the Fergana Mountains [Ферганский хребет / Баргана тоо кыркасы], part of the Tien-Shan on the north and north-eastern margin of the Fergana valley; and (3) name of a division of the Russian Empire, Fergana Province [Ферганская область; Ferganskaâ oblast′] in 1876–1924 (renaming the then conquered Khanate of Kokand), covering the whole Fergana valley and the surrounding mountains slopes, but also the whole Russian part of the Pamirs (the eastern Pamirs, while the western Pamirs was then a part of the Emirate of Bukhara and Bukhara Republic, respectively, until 1924). Therefore, Bobrinskoj (1926: 97; 1929: 234) and Ognev (1928: 557) added also the note "(Pamir?)" to the specimen locality Fergana, trying to specify the possible area of origin of the bat with a confusing original labelling.

Nikolaj Alekseevič Severcov (1827–1885) was mentioned as the collector of the "Fergana" specimen of *E. gobiensis* by Bobrinskoj (1926, 1929), Ognev (1928), Strelkov (1986), and Habilov (1992), all of them examined the bat personally. Severcov was a renowned Russian explorer and zoological collector in West Turkestan and adjacent areas and travelled there several times between 1858 and 1878 (Maslova 1956, 1962). During his travels covering almost the whole then Russian section of Central Asia, he visited three times the Fergana valley and Fergana Province, respectively, in the years 1877–1878. The expeditions started in the Fergana valley, twice from Oš (at the southern margin of the Fergana valley, today southern Kirghizstan) in autumn 1877 and in summer 1878, and once from Andijon (former Andidžan, in present-day eastern Uzbekistan) in spring 1878 (Anonymous 1879a). While the two journeys starting in Oš directed southwards to the Alay and Pamir Mountains, the journey starting in Andijon directed north-eastwards to the Fergana Mountains. The 1877 southern journey concerned the Pamirs only marginally in its north-east, but the 1878 journey covered a big part of this mountain region. However, Severcov named the 1877 journey as the "Expedition to Alay and Pamir" [Экспедиція на Алай и Памиръ] (Sěvercov″ 1878), while the 1878 journey as the "Fergana Scientific Expedition" [Ферганская Ученая Экспедиція] (Sěvercov″ 1879b), perhaps because of extensive exploration of the Fergana Province. Therefore, the "Fergana" specimen of *E. gobiensis* could originate either from Severcov's second journey through the Fergana Province in spring 1878, and the name Fergana on its label could refer to the name of the mountains visited, or from Severcov's third journey in summer 1878, and the name Fergana on the label could refer to the name of the expedition.

The geographical origin of the specimen thus could be found anywhere along the 1878 journey routes, defined very roughly as follows (in current toponyms): spring 1878: Andijon (present day Uzbekistan) – Fergana Mountains (Kirghizstan) – Uzun-Ahmat valley – Andijon (Uzbekistan); summer 1878: Oš (Kirghizstan) – Gulčö – Alaj valley – Irkeštam – Kyzylart pass (Tajikistan) – Qarokūl lake – Rangkūl lake – Najzataš pass – Âšilkūl lake, and back along a similar route ending in Özgön (Kirghizstan), 50 km north-east of Oš (see Anonymous 1879a, Sěvercov″ 1879b, Maslova 1962). The former journey covered some 700 km, the latter journey some 1500 km at least, and only the latter journey by its ca. two thirds went through the Pamirs, i.e. present-day Tajikistan. However, Sěvercov″ (1879a) published a detailed review of his vertebrate collection gathered during the Pamir parts of both journeys (autumn 1877, summer 1878); he mentioned only one encounter with a bat from the Pamirs but he did not specify its species nor genus (Sěvercov″ 1879a: 61; see under *Myotis davidii* above). Thus, if the "Fergana" specimen of *E. gobiensis* really originates from Severcov's collection obtained on the journey through the Fergana Province, it most probably does not come from the Pamir sections of Severcov's routes, i.e. from the present-

day Tajikistan. The origin of this bat is more likely in the Fergana Mountains (north-east of the Fergana valley) or Alay Mountains (south of the Fergana valley), both in present-day Kirghizstan.

A mention of a possible additional specimen of *E. gobiensis* from the Pamirs was introduced by Bogdanov (1956a) and repeated again by Habilov (1986, 1992, 2003) as an evidence of the species from this mountain region. Bogdanov (1956a: 73) wrote as follows: "A. P. Fedčenko collected this bat from the Pamirs in 1901, as it was reported by S. I. Ognev (1928) and B. S. Vinogradov (1935)." [Own translation from Russian†.] However, both mentioned authors reported on Fedčenko's specimen of *Hypsugo savii* collected in 1901 (see also above), although under its synonyms – Ognev (1928: 561) as *Amblyotus caucasicus pallescens* (Bobrinskoj, 1926) and Vinogradov (1935: 27) as *Eptesicus caucasicus* (Satunin, 1901). Moreover, Vinogradov (1935) did not mention *Eptesicus gobiensis* (or *E. nilssonii* s.l.) at all, while Ognev (1928) mentioned only the "Fergana bat" concerning the occurrence of *E. gobiensis* in West Turkestan. Hence, the record mentioned by Bogdanov (1956a) represents a synonym misinterpretation and not a real record of *E. gobiensis* from the Pamirs. Bogdanov (1956a) also introduced another error, he mentioned the explorer Aleksej Pavlovič Fedčenko (1844–1873) as the collector of the bat, although it was collected by his son, botanist Boris Alekseevič Fedčenko (1872–1947). Nevertheless, such an error is understandable, since both naturalists travelled and collected in West Turkestan, just in different periods; on the other hand, Ognev (1928), Bobrinskoj (1926), Vinogradov (1935), and Ŝerbin (1968) mentioned the collector's name correctly.

The last possible record of *E. gobiensis* from Tajikistan was indirectly reported by Habilov (1992: 332), who noted as follows: "Recently (Muratov & Malinovskij 1989), a report appeared again on a finding of this species from the Pamirs." [Own translation from Russian*.] However, this very simple note remains without any additional details and the "report by Muratov & Malinovskij 1989" is not included in the reference list in Habilov (1992, 2003) or in papers by other authors, and most probably, it does not exist (it perhaps represents just a personal communication, see below). Later on, Habilov (2003: 41) reported on the occurrence of *E. gobiensis* in Tajikistan as follows: "The Gobi serotine. It was only mentioned by A. P. [!] Fedčenko from the Pamirs, but we do not have any other report [on its occurrence]. // […] // Regarding the Pamirs, it remains the least studied region of Tajikistan concerning bats. Until recently, there are undoubtedly known […] just findings of the whiskered bat (at the Âšilkūl lake) and the Gobi serotine that was recently apparently found again in the Pamirs (personal communication by R. Muratov)." [Own translation from Russian‡.] This somewhat condradictory statement suggests that a recent record of *E. gobiensis* is perhaps available from the Pamirs, on the other hand, it remains slightly mysterious, why such a significant record had not yet been properly published. Thus, we regard the presence of this bat in the Tajikistani section of the Pamirs as uncertain, until full information on the "recent record" is available. Recently, Habilov & Tadžibaeva (2020d, 2021b) and Tadžibaeva & Habilov (2021) regarded the presence of *E. gobiensis* in the Pamirs as confirmed; the latter two sources clearly reported on a single record from the Pamirs (besides that from Iskandarkūl), but it is not clear whether they consider the "Fedčenko's record" or the "recent record".

---

† original text reads as follows (Bogdanov 1956a: 73): "В 1901 г. А. П. Федченко добыл этого кожанка на Памире, о чем сообщает С. И. Огнев (1928) и Б. С. Виноградов (1935)."

* original text reads as follows (Habilov 1992: 332): "В последнее время (Муратов, Малиновский, 1989) вновь появилось сообщение о находке этого вида на Памире."

‡ original text reads as follows (Habilov 2003: 41): "Гобийский кожанок. Указан А. П. Федченко для Памира, другими сведениями мы не располагаем. // […] // Что касается Памира, то он, в плане исследования рыкокрылых, остается пока наименее изученным районом Таджикистана. До настоящего времени, отсюда достоверно известны […] лишь находки усатой ночницы (у оз. Яшилькуль) и гобийского кожанка, который недавно, кажется вновь найден на Памире (личное сообщение Р. Муратова)."

Moreover, the fixed status of *E. gobiensis* in the fauna of Tajikistan seems to be not completely accepted, this extremely rare bat is not covered by the Red Data Book of Tajikistan (Saidov et al. 2017, Tadžibaeva & Habilov 2022), where almost all bat species of the country are included except those most common. Nevertheless, *E. gobiensis* certainly represents a legitimate part of the bat fauna of Tajikistan, at least due to the old record from Iskandarkūl in the western part of the country (see above).

The Tajikistani part of the distribution range of *E. gobiensis* (in its nominotypical form) represents a part of its western margin (see the review by Benda & Mashkour 2021). This species is extremely rare in West Turkestan, it remains unknown from Turkmenistan and Uzbekistan, it is rare in Tajikistan and Kirghizstan, one specimen is known from Afghanistan. Slightly more abundantly it was recorded in eastern Kazachstan, and the centre of its distribution lies in the arid mountain plateaus of East Turkestan and southern Mongolia (Dobson 1879, Bobrinskoj 1929, Butovskij et al. 1985, Strelkov 1986, Dolch et al. 2007, Benda & Gaisler 2015).

Variation. The West Turkestani populations of *Eptesicus gobiensis* were originally assigned to *E. nilssonii* (von Keyserling et Blasius, 1839), a similar but not closely related congeneric species occurring in the boreal forest zone of the Palaearctic (Bobrinskoj 1926, 1929, Ognev 1927, 1928, Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1956a, Strelkov 1963, 1981, Corbet 1978, Strelkov & Šajmardanov 1983, Habilov 1986, Koopman 1993, 1994). However, presenting the first records of this bat in West Turkestan ("Fergana" and "Iskandarkūl" bats), Bobrinskoj (1926, 1929) affiliated them to a newly described subspecies, *Eptesicus nilssonii kashgaricus* Bobrinskoj, 1926*. This conception was accepted by Ognev (1928), but subsequent authors mostly abandoned it and for the designation of all Central Asian mountain arid steppe populations they used the name *E. nilssonii gobiensis* Bobrinskoj, 1926, with the name *kashgaricus* Bobrinskoj as a synonym (Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Strelkov 1963, 1981, Corbet 1978, Strelkov & Šajmardanov 1983, Butovskij et al. 1985, Koopman 1994). Strelkov (1986), suggested to split *E. nilssonii* and *E. gobiensis* based on morphological

* Bobrinskoj (1926: 96–97) described simultaneously three subspecies of *Eptesicus nilssonii* from Central Asia, viz. *E. n. gobiensis* based on a single male specimen collected at "Burhastej-tala (vost. okonečnost′ Gobijskogo Altaâ)" [Бурхастей-тала (вост. оконечность Гобийского Алтая)] (= NE of Cogtcècij, eastern Gobi Altai Mts., south-central Mongolia; ca. 43°50'N, 105°45'E, ~1450 m a. s. l.; see Benda & Mashkour 2021, cf. Prževal′skij 1888) by explorer and collector Nikolaj Mihajlovič Prževal′skij (also spelled Przhevalsky or Przewalski; 1839–1888) on 18 August [= 30 August NS] 1873; *E. n. centrasiaticus* based on six specimens from various sites of eastern Tibet, two males, the holotype and paratype, originating from "Uŝel′e Hatu bliz oz. Russkogo (Orin-nor)" [Ущелье Хату близ оз. Русского (Орин-нор)] (= Khatu canyon, near the Russkoe / Orin Nur / Ngoring lake, ca. 220 km SW of the Koko Nor / Qinghai lake [NE Tibet / Qinghai Province, China]; ca. 35°50'N, 97°30'E, ~3500 m a. s. l.; cf. Kozlov 1906) collected by explorer and geographer Petr Kuz′mič Kozlov (1863–1935) on 30 June [= 13 July NS] 1901 and in 'June 1901', respectively (remaining four paratypes came from three sites in the Nan Shan / Qilian Mountains and were collected by N. M. Prževal′skij in 1879 and 1884, and by P. K. Kozlov & Vsevolod Ivanovič Roborovskij (1856–1910) in 1895; for details see also Bobrinskoj 1929: 232); and *E. n. kashgaricus* based on two syntype specimens, an individual of unidentified sex from "Hrebet Russkij (Hotan-tag)" [Хребет Русский (Хотан-таг)] (= Russkij [Russian] Mountains, central part of the Kunlun Shan Mts. [East Turkestan / Xinjiang Province, China], centred to ca. 36°40'N, 83°30'E; it roughly corresponds with the locality of the following specimen) collected by N. M. Prževal′skij in May 1885, and a male from "Kara-saj, sev. skl. hreb. Russkogo" [Кара-сай, сев. скл. хреб. Русского] (= Kalasayicun/Karasay, northern slope of the Russkij [Russian] Mountains, central part of the Kunlun Shan Mts. [East Turkestan / Xinjiang Province, China]; 36°46'N, 83°49"E, ~2970 m a. s. l., cf. Pěvcov″ 1895) collected by explorer Mihail Vasil′evič Pevcov (1843–1902) in July 1890.

All above mentioned type specimens of the three names are housed in the ZIN collection (Baranova et al. 1981: 15). Besides the enumeration of the type specimens, the latter authors restricted one of the syntype specimens of *kashgaricus* Bobrinskoj as a lectotype, and besides another syntype, they mentioned also five additional specimens from Prževal′skij's and Pevcov's collections as paralectotypes (contra Bobrinskoj 1926, 1929). However, these definitions are unjustified, the type series of the name *kashgaricus* Bobrinskoj consists of two syntypes and both their collection sites remain the type locality of this name.

and ecological differences between the respective populations. This species separation was then broadly accepted, also concerning the West Turkestani populations (see Pavlinov & Rossolimo 1987, 1998, Nader & Kock 1990, Corbet & Hill 1992, Habilov 1992, 2003, Borisenko & Pavlinov 1995, Horáček et al. 2000, Simmons, 2005, Artyushin et al. 2012a, Benda & Gaisler 2015, Artûšin et al. 2018, Habilov & Tadžibaeva 2020d, 2021b, Benda & Mashkour 2021, Tadžibaeva & Habilov 2021). Based on molecular genetic and additional morphological analyses, Artyushin et al. (2012a) suggested to regard *E. gobiensis* conspecific with *E. bobrinskoi* from Kazakhstani lowland deserts, a phylogenetic relation that was suggested already by Strelkov (1986). The West Turkestani mountain populations of *E. gobiensis* are now considered a nominotypical form, *E. g. gobiensis* Bobrinskoj, 1926 (cf. Strelkov 1986, Artyushin et al. 2012a, Benda & Gaisler 2015, Benda & Mashkour 2021).

Hypsugo savii (Bonaparte, 1837)

Records. **Original data**: Tuto [**1**], above a small lake, 7 May 2016: det. & rec. calls of several foraging inds.; – Qarağoč [**2**], above a small lake, 9 May 2016: net. 1 ♀ (Fig. 92; NMP 95734 [S+A]; cf. Habilov & Tadžibaeva 2016b), 15 May 2016: net. 1 ♀ (HSU pb6223 [S+A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of several foraging inds.; – Magov [**3**], garden (Fig. 93), 18 May 2016: net. 1 ♀ (NMP 95770 [S+A]; cf. Habilov & Tadžibaeva 2016b, Tadžibaeva & Habilov 2019b). – **Published data**: Pamir [**4**], 1901: 1 ♂, ZIN, leg. B. A. Fedčenko (Bobrinskoj 1926, Ognev 1928, Vinogradov

Fig. 92. Portrait of *Hypsugo savii* (Bonaparte, 1837) from Qarağoč. Photo by A. Reiter.

Fig. 93. Abandoned gardens along the Magov stream at the Magov village, a locality of documented occurrence of four bat species, *Rhinolophus ferrumequinum*, *Myotis blythii*, *M. davidii*, and *Hypsugo savii*. Photo by A. Reiter (18 May 2016).

1935); Pamir, unspecified (Bobrinskoi 1931, Kuzâkin 1950, Bogdanov 1953a); – near Gandžino [= Gançina] [**5**] (Vahš river valley), summer 1964–1965 (incl. 20 July 1964): 2 ♂♂, 9 ♀♀, fissure in a sandstone wall, 4 July and 18 July 1964: obs. a colony 12 inds. (Ŝerbin 1968); – foothils of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Dahana kishlak [**6**], mine 4, 7 March 1976: coll. 1 ♂, 18 December 1977: coll. 2 ♀♀ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 11 December 1976: exam. 1 ♂, 1 ♀, 12 June 1977: exam. 1 ♂ in a ceiling fissure, mine, 25 March 1978: exam. 2 ♂♂, 2 ♀♀, 26 March 1978: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a); – near Tangi Surh [= Surh] [**7**], left bank of the Isfara river, mine, 22 January 1977: obs. 1 ♂, 1 ♀, coll. 1 ♀ (Habilov 1980, 1992, Tadžibaeva 2018); – foothils of the Zeravšanskij [= Zarafšon] Mountains, near Šing kishlak [**8**], abandoned mine, 23 February 1977: coll. 1 ♂, 1 ♀ (Habilov 1980, 1992); near Šing, Dahoni ob mine, 13 January 2020: exam. 1 ♀ (Habilov & Tadžibaeva 2020b); – Kuraminskij [= Kurama] Mountains, near Adrasman [= Adrasmon] [**9**], 31 October 1977: coll. 1 ♀ (Habilov 1980, 1992), 25 November 1978: exam. 2 ♂♂, 3 ♀♀ (Habilov 1992); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**10**], abandoned mine, 8 January 1978: coll. 1 ♀ (Habilov 1980, 1992), 2 December 1978: coll. 1 ♂ (Habilov 1992); mine near Čoruh-Dajron, January 1977: exam. 1 ind. (Medvedev 1992); Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron], abandoned mine, 25 November 1978: exam. 2 ♂♂, 3 ♀♀, 27 January 1980: exam. 1 ♀ (Tadžibaeva & Habilov 2019a); – Zeravšan [= Zarafšon] river valley, near Majkata [= Majkatta] kishlak [**11**], 21 & 24 March 1979: coll. 1 ♂, 1 ♀, leg. R. Muratov (Habilov 1992); – Babatag Mountains, near Čučaly [= Čužali] kishlak [**12**], 22 March 1973: coll. 1 ♂, leg. G. Zarubin (Habilov 1992); – near Kul′kent [= Kūlkand] [**13**], small mine, ceiling fissure, 24 April 1980: coll. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – 11 km north-east of Isfara [**14**], 12 November 1978: exam. 4 ♂♂, 5 ♀♀ (Habilov 1992, Tadžibaeva 2018); mines in vicinity of Isfara, January 1983: exam. 1 ♂, 1 ♀ (Medvedev et al. 1984); – Zeravšan [= Zarafšon] river valley, near Garibak [= Ğaribak] [**15**], rock fissures in the river bank, 13 February 1979: exam. 2 ♂♂, 4 ♀♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – northern slope of the Zeravšanskij [= Zarafšon] Mountains, Rudaksaj [= Padrud] [**16**], 12 February 1979: exam. 1 ♂, 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – Kuraminskij [= Kurama] Mountains, near Zarnisor [**17**], Poj-bulok mine, 1240 m a. s. l., 25 February 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2017b, 2018); – near Dahana [**18**], Guzlon Range, Isfara district, water reservoir, 5 July 2019: net. 2 ♀♀ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2020a, 2021a).

Distribution. *Hypsugo savii* is distributed mainly in the Mediterranean zone of the south-western Palaearctic (Corbet 1978, Horáček et al. 2000, Kipson et al. 2023); in Asia it occurs in the Mediterranean part of the Middle East, in Transcaucasia, Turkestan, and Afghanistan (Bobrinskoj 1926, Benda et al. 2006, 2012, Benda & Gaisler 2015). It belongs to medium-frequent bat species in the southern and eastern regions of West Turkestan (Kuzâkin 1965, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). The Tajikistani occurrence area of *H. savii* forms the eastern and southern margin of the distribution range of this bat in West Turkestan and in Asia as well. This range margin continues from southern Tajikistan southwards to central Afghanistan and north-eastern Iran (Benda et al. 2012, Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan, eastern Kazakhstan, and western East Turkestan, where the northern and eastern limits of the species distribution in Asia are found (Bobrinskoj 1929, Butovskij et al. 1985, Rybin et al. 1989).

Our new records from Tajikistan contribute to the depiction of the eastern margin of the species range in West Turkestan rather significantly; until now, only three records of *H. savii* were known from the southern half of the country (Fig. 94). In the Amudarë Basin in its broad sense, the southernmost site was available from near Gançina (37°55'N, 68°41'E; Ŝerbin 1968). The new record from Qarağoč (37°44'N, 69°40'E) represents the southernmost locality in Tajikistan and also in the whole West Turkestan (Fig. 94, see also Bobrinskoj 1918, Strelkov et al. 1978); however, this is just a minute prolongation of the range to the south from the former southernmost site, Gurşun Magdan Känı in eastern Turkmenistan (formerly Svincovyj Rudnik [Свинцовый

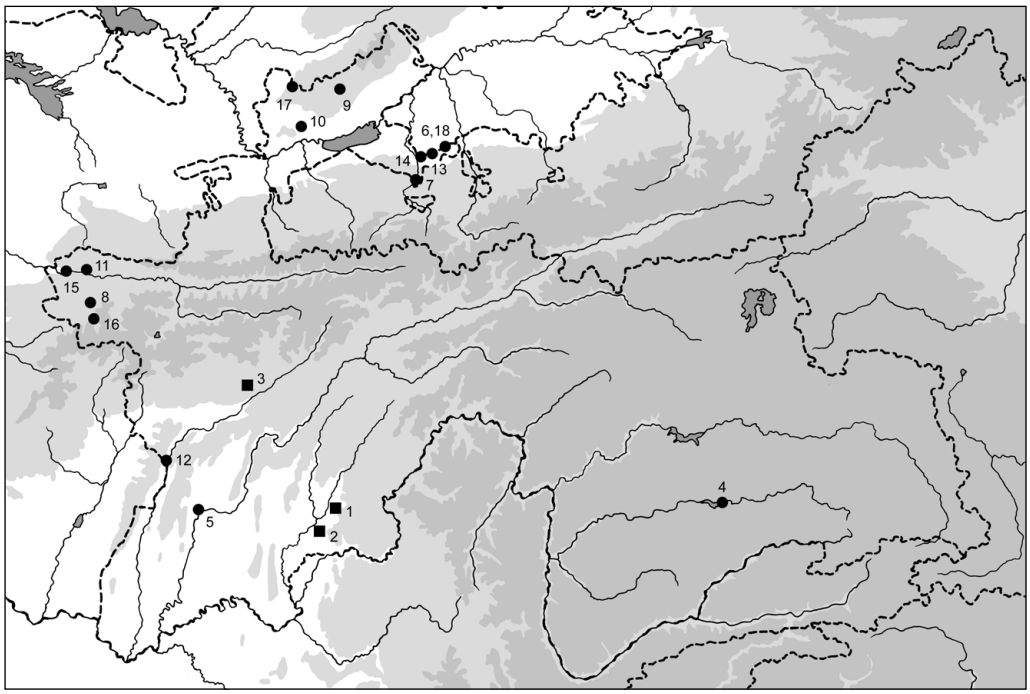


Fig. 94. Records of *Hypsugo savii* (Bonaparte, 1837) in Tajikistan; squares – new records, circles – published records.

Рудник], 37°52'N, 66°27'E; Strelkov et al. 1978), representing a distance of about 15 km in the latitudinal direction.

In Tajikistan, *H. savii* ranks among medium-frequent bats (Fig. 94), at least 18 record sites are known mainly from the western section of the country. The localities are situated mostly in medium-high areas with only a slight coverage of high altitudes; the available records of *H. savii* come from a very wide altitudinal range of around 3300 m, with some three quarters of the records originating from the sites above 900 m a. s. l. (Fig. 10, Table 3). Since this bat inhabits mainly the low mountains in the altitude span of 900–1300 m a. s. l., its range in Tajikistan is divided into four spots separated by high mountain ranges (Fig. 94). Our records come from a very small altitudinal range compared to the whole site list (589 m), despite this, the statistics of the altitudinal distribution of these three sites are very similar to those of all sites (Fig. 11, Table 4).

Bobrinskoj (1926: 98) first reported on a male specimen of *Eptesicus caucasicus* (= *Hypsugo savii*) collected by Boris Alekseevič Fedčenko (1872–1947) during his travel to the Pamirs. This specimen under the same species name was mentioned again by Ognev (1928: 561), Bobrinskoj (1929: 231), Bobrinskoi (1931: 267), and Vinogradov (1935: 270), and their reports of this bat (under the currently valid species name) by several subsequent authors (Kuzâkin 1950, Bogdanov 1953a, Ŝerbin 1968, Habilov 1986, 1992, 2003). On the other hand, Bogdanov (1956a) and again Habilov (1986, 1992, 2003) erroneously assigned the Fedčenko's specimen to *Eptesicus gobiensis* (as *E. nilssonii* s.l.), perhaps being confused by the genus names used for this bat by the previous authors (cf. Bobrinskoj 1926, 1929, Ognev 1928, Bobrinskoi 1931, Vinogradov 1935). Interestingly, the same authors (Bogdanov 1953a, Habilov 1986, 1992, 2003) reported this specimen parallelly also under its correct identification (for details see under *E. gobiensis* above). Nevertheless, all authors mentioned the specimen to originate just from the Pamirs, without any close geographical specifications.

The bat fauna of the Pamirs is poor, only few species were documented from this mountain complex and records of two species from the Pamirs remain uncertain, of *Eptesicus gobiensis* and of *Hypsugo savii*. In both these species, the published data do not allow to determine with certainty the geographical origin of the specimens reportedly coming from the Pamirs. For a review concerning the finding/s of *E. gobiensis* see above. The evidence on the possible provenance of the specimen of *H. savii* from the Pamirs could be reconstructed as follows.

The botanist B. A. Fedčenko travelled to the Pamirs for the first time as a fellow-traveller of his mother, botanist Ol′ga Aleksandrovna Fedčenko (1845–1921) in the summer 1901. A year later he published a travel report (Fedčenko 1902), while the first scientific results of the trip were published by his mother two years later (Fedčenko 1903). Fedčenko (1902) described mainly traveller's impressions from the trip, a rough botanical review of the visited landscapes, and gave only few notes on the observed and/or collected animals. He reported on collections of various insects and other invertebrates made several times during the travel, twice on the collections of reptiles and once on bats. However, Fedčenko (1902: 277) mentioned the collected bats only concerning the several-day stay of in Oš (in present-day Kirghizstan) at the beginning of the trip (before 25 June [= 8 July NS] 1901). This report indicates that the concerned specimen of *H. savii* from "the Pamirs" in fact originates from the Oš Province of Kirghizstan and not from Tajikistan. However, this problem could be solved only by a detailed check of the travelling diaries of B. A. Fedčenko (if they still exist).

The specimen labelling as from "the Pamirs" may be linked with two meanings; either referring to the real origin of the bat from the Pamirs, i.e. from the easternmost part of Tajikistan (see below), or just to the name of the research trip, which was generally mentioned as the "Fedčenko Pamir Expedition", and the geographical area of the potential origin of the specimen may thus be wider. If the locality concerns the whole visited route of the trip, the most probable origin of the

H. savii specimen is Oš, mentioned by Fedčenko (1902) as a site of bat collection, although the whole route of the trip between Oš and Iškošim could be taken into consideration. This route* (ca. 850 km of direct distance, without turns-off) followed almost exactly the course of the present-day "Pamir Highway" between Oš (southern Kirghizstan; 40°32'N, 72°48'E) and Horuǧ (south-eastern Tajikistan; 37°29'N, 71°33'E) and along the Panç river valley it continued southward to Iškošim (36°44'N, 71°37'E).

However, if the provenance of the *H. savii* specimen in "the Pamirs" really refers to the Pamirs, the origin of the bat lies within the Tajikistani area. Fedčenko (1903: 239–240) described the route of the research trip in 1901 day by day*, she exactly differentiated between the Pamir territory s.str. and other passed territories. The Pamir territory is described with most accuracy, while other territories, namely the Alay Mountains in the north-east and the Shughnan county (the part of the Pamirs belonging at that time to the quasi-independent Emirate of Bokhara) in the south-west just briefly. As the Pamirs she designated the part of the visited area of extreme altitudes between the Kyzylart pass (39°23'N, 73°19'E , 4282 m a. s. l.) in the north-east and the Kojtezek pass (37°29'N, 72°47'E, 4275 m a. s. l.) in the south-west, i.e. about 345 km of direct distance (without numerous turns-off)†. The expedition passed this route between 3 and 20 July [= 16 July – 2 August NS] 1901 and again on 1–9 August [= 14–22 August NS] 1901 on the way back. Fedčenko (1903) reported altogether 12 sites on this route*, at the altitude range of 3650–4250 m a. s. l. (median 3926 m); however, some of these sites were still covered by snow during the way to the Kojtezek pass according to Fedčenko's (1902) description. (The whole route – 21 sites visited between 25 June and 16 August 1901 – was made in the approximate altitude range of 980–4250 m a. s. l. with the median of 3720 m.) One of the 12 stops on the route through

---

* Fedčenko (1903: 239–240) described the course of the Pamir journey as follows (current state territory: date: original site name [current site name (if differs); coordinates, altitude]): Kirghizstan: 25 June [= 8 July NS] 1901: Oš″ [Ошъ = Oš; 40°32'N, 72°48'E, 985 m a. s. l.]; – [26 June [= 9 July NS] 1901:] pereval″ Čigirčik″ [перевалъ Чигирчикъ = Čyjyrčyk / Ak-Örge pass; 40°15'N, 73°19'E, 2402 m a. s. l.]; – 27 June [= 10 July NS] 1901: Gul'ša [Гульша = Gulčö; 40°19'N, 73°27'E, 1548 m a. s. l.]; – 1 July [= 14 July NS] 1901: Taldyk″ [Талдыкъ = Taldyk pass; 39°46'N, 73°10'E, 3590 m a. s. l.], Sarytaš″ [Сарыташъ = Sary-Taš; 39°44'N, 73°15'E, 3162 m a. s. l.]; – 2 July [= 15 July NS] 1901: Bordaba [Бордаба; 39°32'N, 73°16'E, 3395 m a. s. l.]. Tajikistan: 3 July [= 16 July NS] 1901: Markansu [Маркансу; 39°17'N, 73°22'E, 3980 m a s l.]; – 4–5 July [= 17–18 July NS] 1901: ozero Kara-kul′ [озеро Кара-куль = Qarokūl lake; ca. 39°03'N, 73°23'E; 3892 m a. s. l.]; – 6 July [= 19 July NS] 1901: Muskol″ [Мусколъ = Muzkol, Tajikistan; 38°44'N, 73°32'E, 4095 m a s l.]; – 7 July [= 20 July NS] 1901: podošva perevala Ak″-Bajtal″ [подошва перевала Акъ-Байталъ = foots of the Okbajtal pass; ca. 38°36'N, 73°32'E, ca. 4250 m a. s. l.]; – 8 July [= 21 July NS] 1901: uročiše Gurumdy [урочищѣ Гурумды = Gurumdy; 38°30'N, 73°51'E, 3997 m a s l.]; – 9 July [= 22 July NS] 1901: uročiše Čičikty [урочищѣ Чичикты = Čečekty; 38°20'N, 74°01'E, 3795 m a s l.]; – 10–14 July [= 23–27 July NS] 1901: Pamirskij post″ [Памирский постъ = Murǧob; 38°10'N, 73°58'E, 3650 m a. s. l.]; – 15 July [= 28 July NS] 1901: Karasu [Карасу; 38°01'N, 73°56'E, 3765 m a s l.]; – 16 July [= 29 July NS] 1901: uročiše Čatyr″-taš″ [урочищѣ Чатыръ-ташъ = Čatyrtaš rock; 37°49'N, 73°38'E, 3960 m a. s. l.]; – 17 July [= 30 July NS] 1901: ozero Sassyk″-kul′ [озеро Сассыкъ-куль = Sasyqkūl lake; 37°42'N, 73°12'E, 3820 m a. s. l.]; – 18 July [= 31 July NS] 1901: ozero Âšil′-kul′ [озеро Яшиль-куль = Âšilkūl / Yashilkul lake; ca. 37°46'N, 72°57'E, ca. 3720 m a. s. l.]; – 19 July [= 1 August NS] 1901: uročiše Hadža-Nazar″ [урочищѣ Ходжа-Назаръ = now an unnamed site at the confluence of the Gurumdy and Sulu-Tagarkaki rivers; ca. 37°32'N, 72°55'E, 4030 m a. s. l.]; – 20–31 July [= 2–13 August NS] 1901: pereval″ Koj-tezek″ [перевалъ Кой-тезекъ = Kojtezek pass; 37°29'N, 72°47'E, 4275 m a. s. l.] – ušel′e Uč″-kol″ [ущелье Учъ-колъ = Učkol canyon; ca. 37°33'N, 72°39'E, ca. 3650 m a. s. l.] – Horog″ [Хорогъ = Horuǧ; 37°29'N, 71°33'E, 2105 m a s l.]; – Iškašim″ [Ишкашимъ = Iškošim; 36°44'N, 71°37'E, 2525 m a s l.]; – 1–9 August [= 14–22 August NS] 1901: way back across the Pamirs along the same route (Sasyqkūl – Čatyrtaš – Karasu – Murǧob – Gurumdy – Qarokūl). – Kirghizstan: 10–16 August [= 23–29 August NS] 1901: Bordaba – Oš.

† Fedčenko (1909: 457–458) described the Pamir journey of the explorer and botanist Fedor Nikitič Aleksčenko (1882–1904) made in 1901 and delimited it by the Kyzylart pass in the north and Pamir river in the south (the journey in its first third overlapped with the journey of B. A. Fedčenko & O. A. Fedčenko), while the other parts of the route were not described as they did not concern the Pamirs s.str.

the Pamirs thus could have been the locality of collection of the *H. savii* specimen. In the map of *H. savii* records in Tajikistan (Fig. 94), we depicted the area of the Âšilkūl lake, situated at ca. 3720 m a. s. l., close to the median altitude of the whole route of the Fedčenko Pamir journey.

Echolocation. Echolocation calls of foraging individuals of *Hypsugo savii* were recorded at two sites during our research in Tajikistan, above small water bodies (Qarağoč and Tuto). The echolocation characteristics of this bat are rather conservative throughout the distribution range and without significant geographical variation in the peak frequency, which lies in the range of 32.0–40.1 kHz in the European and Middle Eastern populations (Zingg 1988, Russo & Jones 2002, Obrist et al. 2004, Benda et al. 2006, 2012, Papadatou et al. 2008, Javanbakht & Shahabi 2015, Benda & Uhrin 2017, our own data). Although we recorded this species acoustically at two sites in Tajikistan, only one sequence with three particular pulses was suitable for measuring (Fig. 95). The pattern of the calls conforms to those registered in other parts of the species range (see references above) and allowed us to attribute these calls to this species (Table 5); this was confirmed also by the simultaneous netting of two individuals at one site of call detection (Qarağoč).

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Hypsugo savii* are shown in Table 11. For the material examined see above.

The West Turkestani populations of *H. savii*, including those of Tajikistan, are considered to be a part of the Asian subspecies of this bat, *H. s. caucasicus* (Satunin, 1901) (Kuzâkin 1944, 1950, 1965, Bogdanov 1953a, Strelkov 1963, 1981, Corbet 1978, Baranova et al. 1981, Butovskij et al. 1985, Horáček & Hanák 1986, Rybin et al. 1989, Habilov 1992, Koopman 1994, Horáček et al. 2000, Horáček & Benda 2004, López-Baucells 2019a). Although Benda et al. (2006) doubted the validity of this subspecies based on the revision of morphological characters that were used for its separation from the nominotypical European form, results of a recent molecular genetic analysis (Balog 2023) conform with the separate position of the eastern Mediterranean / Asian populations. The subspecific status of *H. s. caucasicus* thus seems to be justified. This form was originally described as *Vesperugo* (*Vesperus*) *caucasicus* by Satunin (1901: 462) based on two specimens from Tiflis [= Tbilisi, Georgia; 41°41’N, 44°48’E) as a sister species to European *Hypsugo savii*, occurring in the Caucasus (for the number and origin of the type specimens see Satunin 1896 and Satunin″ & Radde 1899).

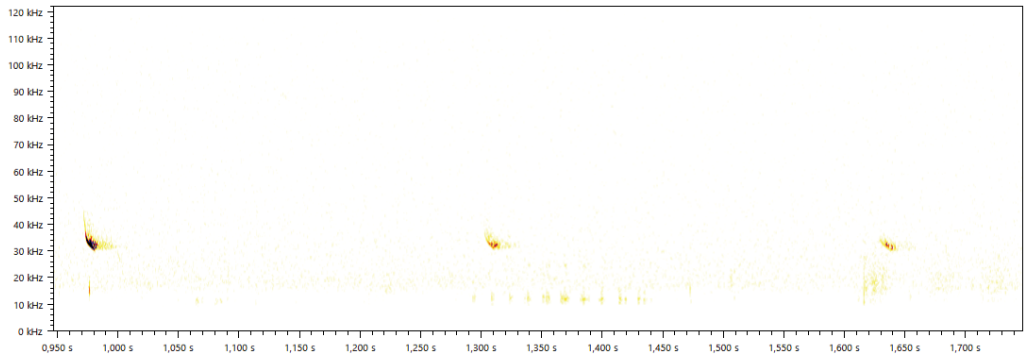


Fig. 95. Spectrogram of the echolocation calls of *Hypsugo savii* (Bonaparte, 1837); an individual foraging at a small lake in Tuto, 7 May 2016.

However, two other names that are included within the synonymy of *H. savii* were created for the Turkestani populations of this bat, at least one of them was considered valid also for the Tajikistani populations of *H. savii*. The older of these names is *Eptesicus tamerlani* Bobrinskoj, 1918, its description is based on four specimens collected by Nikolaj Alekseevič Bobrinskoj in "Augustiae Tamerlani, praefectura Baisunensis (vulgo dicitur «Baisunskoe bekstvo»), Buchara" (= Tamerlan's canyon, Boysun district, Emirate of Bokhara [Uzbekistan]; ca. 38°18'N, 67°15'E) on 9 June [22 June NS] 1914 (Bobrinskoj 1918: 13). The holotype and paratypes are housed in the ZIN collection (Baranova et al. 1981: 15), the type locality is situated about 70 km west of the western border of Tajikistan, however, it was never mentioned concerning the Tajikistani bats. Bobrinskoj (1918: 13) described it as a bat very similar in body size to *Eptesicus caucasicus* (Satunin, 1901) (= *H. savii*), but differing from it by a much paler colouration of the pelage. This species was considered valid (although in combination with three different genus names) besides Bobrinskoj (1918) also by Bobrinskoj (1925) as *Vespertilio tamerlani* and by Ognev (1927) as *Amblyotus tamerlani*.

Another name is *Eptesicus caucasicus pallescens* Bobrinskoj, 1926, it was described based on a series of five syntypes collected by two famous Russian explorers in the south-western part of East Turkestan (Bobrinskoj 1926: 97), by Nikolaj Mihajlovič Prževal′skij in "Uŝel′e r. Mol′dža na sev. okr. hreb. Russkogo" [Ущелье р. Мольджа на сев. окр. хреб. Русского] (= Moldja river canyon at the northern margins of the Russkij Mountains [= Moleqie river canyon in the central part of the Kunlun Shan Mountains, East Turkestan / Xinjiang Province, China]; 37°07'N, 84°31'E, ca. 2335 m a. s. l.; see Prževal′skij 1888) on 4 May [16 May NS] 1885, and by Mihail Vasil′evič Pevcov at "Uročiŝe Tohta-hon v ûžnokašgarskih gorah" [Урочище Тохта-хон в южнокашгарских горах] (= Tohtahon in the South-Kashgarian Mountains [= cf. Yasi Pulong, Kargilik District, Kashgar Prefecture, East Turkestan / Xinjiang Province, China]; 37°04'N, 77°06'E, ca. 3050 m a. s. l.; see Pěvcov″ 1895) in the late summer 1889. Later on, Bobrinskoj (1929: 227) specified two specimens (male? and male) coming from the former site, and three males coming from the latter site; he also defined one specimen (♂?, ZIN 13901, coll. Prževal′skij) as a lectotype and the four remaining specimens thus represent paralectotypes (see also Baranova et al. 1981: 14). Hence, the Moleqie river canyon became the type locality of this name, and this site is situated ca. 830 km east of the Tajikistani eastern border.

Besides the type series from south-western East Turkestan (Moleqie river canyon, Yasi Pulong region), Bobrinskoj (1926, 1929) and Ognev (1928) affiliated to this subspecies an additional specimen from Subaš [Субаш], central East Turkestan (= Subashi temple, oasis of Kuqa, Aksu Prefecture, East Turkestan / Xinjiang Province, China; 41°51'N, 83°03'E; 1240 m a s l.), collected by traveller and ornithologist Mihail Mihailovič Berezovskij (1848–1912), and mainly, the Fedčenko's bat from the Pamirs; all these specimens are housed in the ZIN collection (Bobrinskoj 1929). Thus, *Eptesicus caucasicus pallescens* is the first name given to the Tajikistani populations of *H. savii*.

Describing *E. c. pallescens*, Bobrinskoj (1926: 98) added a note on *E. tamerlani* as follows: "After the comparison of the cotypes [= type series] of *Ept. tamerlani* Bobr[inskoj,]. 1918 with the cotypes [= syntypes] of *Ept. caucasicus* Sat[unin,]. 1901, it seems to be clear that the Bokharan form [= *E. tamerlani*] is very closely related, or even identical, to the Caucasian one (it is possible that *tamerlani* is slightly paler than *caucasicus*, but this is hard to elucidate from the alcoholic specimens)." [Own translation from Russian*.]

---

* original text reads as follows (Bobrinskoj 1926: 98): "Как удалось выяснить из сравнения типов *Ept. tamerlani* Bobr. 1918 с котипами *Ept. caucasicus* Sat. 1901, бухарская форма очень близка, если не тождественна, с кавказской (возможно, что *tamerlani* несколько светлей *caucasicus*'а, но выяснить это по спиртовым экземпл. трудно)."

A more complex view of the Asian forms currently considered *H. savii* was given by Bobrinskoj (1929: 227–228), he noted as follows: "The inaccuracy of Satunin's description of *E. caucasicus* led me to make in 1918 a mistake in describing as a new species *E. tamerlani* from Central Bokhara. Possessing at present two cotypes [= syntypes] of *E. caucasicus* (original label, written in Satunin's own hand "*Vesperus borealis caucasicus* Satunin. Tiflis. XI 95"), I can assert that the Bokharian form [= *E. tamerlani*] is very similar, if not identical, to the Caucasian one (it is possible that the *tamerlani* is somewhat lighter in colour, but as specimens are in alcohol, a solution is most difficult). To my description of 1918 I can add that in *E. caucasicus* (I mean all three subspecies): 1) the last caudal vertebra and the distal half of penultimate vertebra (sometimes the whole of it) are free, so that the end of tail projects beyond membrane for 1.5–2.5 *mm*, 2) fourth finger exceeds the combined length of metacarpal and first phalanx of fourth finger by 0.5–2 *mm*, 3) in all specimens of *caucasicus* and *pallescens* examined the tragus possesses but one lobe on the base of outer border, so that two basal lobes in some specimens of *tamerlani* is not characteristic for the species, 4) seventh palatal ridge divided, 5) teeth as in *E. nilssoni* and apex of outer incisor reaching level of secondary cusp of inner one. // Range. […] this essentially mountainous species ranges from Central Transcaucasia through Russian [= West] Turkestan into East-Turkestan, where it appears to be rather common."

So, Bobrinskoj (1926, 1929) unified his descriptions of "small-sized *Eptesicus*" (= *Hypsugo*) into one broadly distributed Asian species, *E. caucasicus*, with three subspecies. This conception was accepted by some authors (Ognev 1928, Bobrinskoi 1931, Vinogradov 1935). However, all the subsequent authors considered the names *caucasicus* Satunin, *tamerlani* Bobrinskoj, and *pallescens* Bobrinskoj to be junior synonyms of *Vespertilio savii* Bonaparte, 1837 (= *Hypsugo savii*); concerning the populations of Tajikistan and West Turkestan, this is absolutely valid, just various authors used various genus names for this bat, viz. *Vespertilio*, *Pipistrellus*, or *Hypsugo* (Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, Strelkov 1963, 1981, Ŝerbin 1968, Corbet 1978, Habilov 1980, 1986, 1992, 2003, Strelkov & Šajmardanov 1983, Horáček & Hanák 1986, Pavlinov & Rossolimo 1987, 1998, Rybin et al. 1989, Koopman 1993, 1994, Borisenko & Pavlinov 1995, Horáček et al. 2000, Simmons 2005, Benda et al. 2011, Butovskij et al. 1985, Habilov & Tadžibaeva 2016b, 2020a, b, d, 2021a, b, c, Habilov et al. 2016, Tadžibaeva & Habilov 2017a, b, 2018, 2019a, d, c, Dundarova et al. 2021). The only different and rather obscure opinion was presented by Tate (1942), who considered almost all Asian names of *Hypsugo* (in the current taxonomy, i.e. *caucasicus*, *pallescens*, *tamerlani*, *velox* Ognev, 1927, with the only exception of *alashanicus* Bobrinskoj, 1926) to be a part of the species rank of *Eptesicus nilssonii* s.l. However, this view was not followed at all.

Records of ectoparasites. **Original data**: S p i n t u r n i c i d a e: *Spinturnix nobleti*: 1 ♂ deutonymph [P], from ♀ (NMP 95734), Qarağoč, small lake, 9 May 2016; – 2 ♀♀ ad [P], from 1 ♀ (HSU pb6223), Qarağoč, small lake, 15 May 2016; – 1 ♂ ad [P], from ♀ (NMP 95770), Magov, garden, 18 May 2016. – **Published data**: I s c h n o p s y l l i d a e: *Ischnopsyllus petropolitanus*: 1 ♂, mine near Čoruh-Dajron, January 1977 (Medvedev 1992); – *Nycteridopsylla oligochaeta*: 1 ♂ ad, 10 ♀♀ ad, from 1 ♂, 1 ♀, mines in vicinity of Isfara, January 1983 (Medvedev et al. 1984).

Comments on ectoparasites. In *Hypsugo savii*, at least three ectoparasite species were collected in Tajikistan, two bat fleas and one gamasoid mite. Additionally, Medvedev (1992) and Medvedev & Polkanov (1997) reported on the records of *Nycteridopsylla calceata* made in four countries of West Turkestan including Tajikistan and collected from four bat species including *H. savii*, but without a direct link between locality and the host bat species. Theoretically, the latter parasite could be collected from *H. savii* also in Tajikistan.

The flea species *Ischnopsyllus petropolitanus* (Wagner, 1898) is distributed in mountains of the central-southern part of the Palaearctic (Medvedev & Polkanov 1997, Scheffler et al. 2010).

In West Turkestan, the principal host of this parasite is *Plecotus strelkovi* (Medvedev & Polkanov 1997), see under the latter bat species for details (it was recorded also from *Barbastella caspica*).

The principal host of the bat flea *Nycteridopsylla oligochaeta* Rybin, 1961 is *Barbastella caspica* (Medvedev et al. 1984, Medvedev 1992), its finding in *H. savii* could be considered as exceptional, caused by a horizontal transfer during hibernation of both hosts in a shared winter roost (old mine). See below under *B. caspica* for details.

The bat flea *Nycteridopsylla calceata* (Ioff et Labunec, 1953) was discovered in Toshkent, Uzbekistan, and later it was collected in the Bektau-ata Mts., north of Lake Balkhash, Kazakhstan (Ioff et al. 1953, Medvedev & Polkanov 1997). Until now, this flea was documented from five localities in four countries of West Turkestan, besides Uzbekistan and Kazakhstan, also in Kirghizstan (Oš) and Tajikistan (Dobita near Adrasman [= Adrasmon] and vicinity of Pendžikent [= Pançakent]) (Medvedev & Polkanov 1997). The Central Asian distribution range is reported for this flea species, with the principal host being *Barbastella caspica*, other hosts including *Pipistrellus pipistrellus*, *Hypsugo savii*, and *Plecotus strelkovi*. As in other species of the genus *Nycteridopsylla* Oudemans, 1906, whose adult stages infest the hosts during their hibernation, within our research trip in May 2016 it was not possible to collect this species. The findings reported by Medvedev (1992) and Medvedev & Polkanov (1997), despite the real host species identity, represent the only records of *N. calceata* from Tajikistan.

Three records of the gamasoid mite *Spinturnix nobleti* Deunff, Volleth, Keller et Aellen, 1990 were made from *H. savii* in Tajikistan, from both localities of collection of this bat, although in a very small abundance. This mite species occurs principally in the Palaearctic bat species of the genus *Hypsugo*, *H. savii* and *H. alashanicus*, and the distribution range of this recently described mite presumably corresponds with the range of its host species; however, the number of its records is still rather limited (Deunff et al. 1990, Stanyukovich 1997, Scheffler et al. 2012, Benda et al. 2019, Orlova et al. 2021a, b). The natural history as well as the limits of distribution of this gamasoid mite remain unknown, although the high temperature in the anthropogenic roost of their host could be regarded. The type material of *S. nobleti* contains also the nymphal stages (see Deunff et al. 1990), but until now they have not been described.

Pipistrellus pipistrellus (Schreber, 1774)

Records. **Original data**: Dušanbe [**1**], city centre, hotel garden (Fig. 96), 2 May 2016: det. & rec. calls of several foraging inds.; – Bešai Palangon Reserve, Tarzan forestry [**2**], 4 May 2016: net. 5 ♂♂ (coll. 4 spec., Fig. 97; NMP 95705, 95706, HSU pb6147, 6148 [S+A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of numerous foraging inds.; – Levap [**3**], old farm, 5 May 2016: obs. a colony of ca. 100 inds. (Figs. 17, 99), net. 4 ♂♂ (Figs. 100, 101; NMP 95721, HSU pb6179, 6180 [S+A], NMP 95722 [A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of numerous foraging inds.; – Kūlob [**4**], botanical garden, 6 May 2016: det. & rec. calls of numerous foraging inds., 14 May 2016: det. & rec. calls of several foraging inds.; – Tuto [**5**], above a small lake, 7 May 2016: net. 4 ♀♀ (NMP 95726, HSU pb6187, 6188 [S+A], NMP 95727 [A]; cf. Habilov & Tadžibaeva 2016b), det. & rec. calls of numerous foraging inds.; – Qarağoč [**6**], above a small lake, 9 May 2016: det. & rec. calls of numerous foraging inds.; – Qal″ai Humb [**7**], in rocks above the village (Fig. 102), 11 May 2016: det. & rec. calls of numerous foraging inds.; – Zingroğ [**8**], at a rock above the village, 12 May 2016: det. & rec. calls of min. 1 foraging ind.; – Host [**9**], Obihumbou river valley, 13 May 2016: det. & rec. calls of 1 foraging ind. – **Published data**: Hodžent [= Huçand] [**10**] (Sěvercov″ 1873a); Hodgent [= Huçand] (Severtzoff 1876); Hodžent [= Huçand], 1 ind., ZMMU (Tihomirov″ & Korčagin″ 1889); Hodžent″ [= Huçand], 5 inds., ZIN, leg. Sěvercov″ (Satunin″ 1910); Leninabad [= Huçand], coll. inds., 15 May 1979: coll. 1 ♂, loft of a two-storeyed house, 10 July 1979: exam. 5 ♂♂, 2 ♀♀, Kyzyl-Yulduz [= Kzil Ûlduz] state farm, 11 June 1979: obs. a nursery colony of 51 inds., exam. 41 ♀♀ (Khabilov 1989a, Habilov 1992); Leninabad [= Huçand], Faculty of Fysics, window on the fourth floor, 8 January 1991: exam. 244 ♂♂, 457 ♀♀ (Habilov 1991); Leninabad [= Huçand], 28 September 1976: coll. 1 ♂, 19 June 1977: coll. 1 ♂, 4 April 1977: coll. 1 ♂, 4 May 1977: coll. 1 ♂, 24–26 March, 1 April, 17 April, 11 May 1978: coll. 6 ♂♂, 2 ♀♀, 19 April 1984: coll. 3 ♀♀, 6 January 1986: coll. 1 ♂, 1 ♀ (Habilov 1992); Hudžand [= Huçand], 33 district, autumn 1990–1991, 13 district, spring 1991–1992, autumn 1992–1993, 12 district, spring 1994, obs. emerging inds. (Habilov & Zyrânova

Fig. 96. Hotel garden in the city centre of Dušanbe, a foraging area of numerous individuals of *Pipistrellus pipistrellus*. Photo by A. Reiter (3 May 2016).

1995); – Pendžakent″ [= Pançakent] [**11**], 25 May [= 6 June NS] 1892: 2 inds., ZIN, leg. Glazunov″ (Satunin″ 1910); Pendžikent [= Pançakent] (Habilov 1992); – Varzaminar″ [= Ajnī] [**12**], 24 August [= 5 September NS] 1892: 1 ind., ZIN, leg. Glazunov″ (Satunin″ 1910); – Fejzabad″ [= Fajzobod] kishlak [**13**], behind a beam of a house, 28 July [= 9 August NS] 1914: coll. 10 ♂♂, 1 ♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Fejzabad [= Fajzobod] kishlak, 28 July 1914: 3 ♂♂, leg. L. L. Nožin (Ognev 1928); – Sohta-činar″ [= Činor] kishlak [**14**], in a house, 30 June [= 13 July NS] 1914: coll. 1 ♂, 2 ♀♀, leg. L. L. Nožin (Bobrinskoj 1918, 1925); Sohta-činar [= Činor] kishlak, leg. L. L. Nožin (Ognev 1928); – Kurgan-Tûbe [= Bohtar] [**15**], Vahš state farm, house No. 3, 10 August 1930: coll. 1 ♂ (Laptev 1937); – Ângi-Bazar [= Vaḫdat] [**16**], obs. inds. (Laptev 1937); – Stalinabad [= Dušanbe] [**1**], obs. inds. (Laptev 1937); Stalinabad [= Dušanbe], 31 July 1935: coll. 2 ♂♂, 24 ♀♀ (Kuzâkin 1950); Stalinabad [= Dušanbe], under boards of a wall of a living house, 8 July 1944: obs. a colony, coll. 1 ♀, ZIN, leg. B. S. Vinogradov & S. U. Stroganov (Kiričenko 1952, Tadžibaeva & Habilov 2019b); Stalinabad [= Dušanbe], fissures between bricks and in a fissure of a telegraphic pole, obs. inds. (Bogdanov 1956a); Dušanbe and near Dušanbe (Ŝerbin 1968); Dušanbe, 20 July 1965: obs. a colony, incl. 30 juvs. and 3 ♂♂ ad (Ŝerbin 1968); Dušanbe, June 1987: obs. a colony (Malinovskij 1988); Stalinabad [= Dušanbe], 1935: coll. 2 ♂♂, 3 ♀♀, ZIN, leg. A. P. Kuzâkin, 8 July 1944: coll. 1 ♀, ZIN, leg. B. S. Vinogradov & S. U. Stroganov, July–August 1935: coll. 27 inds., ZMMU, leg. A. P. Kuzâkin (Habilov 1992); Dušanbe, coll. series of inds., IZPAN (Habilov 1992); Dušanbe, more records (Habilov 1992, Tadžibaeva & Habilov 2019b, Medvedev & Polkanov 1997); Dušanbe, 22 April 1979: 1 ind., NMP (Benda et al. 2011); – Gissarskaâ [= Ḥisor] fortress building [**17**], obs. a colony (Kuzâkin 1950); Gissar [= Ḥisor], garage, 26 June 1987: obs. a colony, coll. 7 ♀♀, 6 juvs. (Malinovskij 1988); – Kurgan-Tûbe [= Bohtar] [**18**], attic of a house, 20 June 1949: obs. a colony (Kiričenko 1952); Kurgan-Tûbe [= Bohtar], numerous inds., leg. Potopol′skij (Bogdanov 1956a); – Novabad [= Navobod] kishlak [**19**], Zeravšan [= Zarafšon] river valley, obs. inds. (Bogdanov 1956a); – Ura-Tûbe [= Istaravšan] [**20**] (Bogdanov 1956a, Habilov 1992); – Tigrovaâ balka [= Bešai Palangon] Reserve, Central′nyj forestry area [**2**], 1956: several inds., leg. M. A. Gulâeva (Černyšev 1958); Kumsangir district, July 1974 (L′vov et al. 1984); Tigrovaâ balka [= Bešai Palangon] Reserve, fissure in a wooden pole, 12 April 1987: coll. 4 inds. (Malinovskij 1988); Kumsangir district, Tigrovaâ balka [= Bešai Palangon] Reserve, 7 July 1977: coll. 45 inds., ZMMU, leg. Malûkov (Habilov 1992); Tigrovaâ balka [= Bešai Palangon Reserve], coll. series of inds., IZPAN (Habilov 1992); – Gandžino [= Gançina] [**21**], Vahš river valley (Ŝerbin 1968); – Hodža-Beh-Ob [**22**], Vahš river valley (Ŝerbin 1968); – near Dusti [**23**],

Vahšskaâ dolina (Ŝerbin 1968); Dusti, a building under construction, ceiling fissure, 9 October 2017: obs. a colony of 35 inds. (Muratov et al. 2017); – Staraâ pristan′ [= Bandari Kūḫna] (Tigrovaâ balka [= Bešai Palangon] Reserve) [**3**], under an iron roof of a living house, obs. numerous mummified and living inds. (Ŝerbin 1968); – Kulâb [= Kūlob] [**4**], 17 May 1965: obs. a colony of ca. 60 inds. (Ŝerbin 1968); – Âgid [= Ëged] kishlak [**24**] (Darvazskij [= Darvoz] Mountains) (Ŝerbin 1968); Kalaj-humb [= Qal″ai Humb], Âgid [= Ëged] kishlak, 28 July 1963: coll. 1 ♂, 3 ♀♀, IZPAN, leg. Û. V. Ŝerbin (Habilov 1986); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**25**], two abandoned mines, 8 November 1977: obs. 6 / 10 ♂♂, 12 / 6 ♀♀, 8 January 1978: obs. 1 ♂ (Habilov 1980, Tadžibaeva & Habilov 2019a), 5 April 1978: exam. 2 ♂♂, 1 ♀, 26 June 1984: exam. 2 ♂♂, 10 November 1984: obs. 18 inds., incl.. 3 / 2 ♂♂, 1 / 2 ♀♀, 13 January 1985: obs. 7 inds., incl. 1 ♂, 23 February 1985: exam. 1 ♂, 18 April 1988: exam. 1 ♂, 23 October 1989: exam. 3 ♂♂, 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2019a), 17 November 1978: exam. 10 ♂♂, 4 ♀♀, 2 December 1978: exam. 3 ♂♂, 3 ♀♀, 5 January 1980: obs. 3 inds., incl. 2 ♂♂, 4 December 1980: obs. 8 inds., incl. 4 ♂♂, 3 ♀♀, 3 January 1981: exam. 3 ♂♂, 3 ♀♀, 3 March 1985: obs. 7 inds., 16 December 1985: obs. 8 inds., 1 November 1986: obs. 4 inds., 30 September 1987: exam. 1 ♂, 27 October 1988: obs. 8 inds., 21 November 1988: obs. 29 inds. (Tadžibaeva & Habilov 2019a); – Nižnyj Pândž [= Pançi Poën] [**26**], under a beam above house entrace & roof fissure, September 1982, June 1983: obs. two colonies (Medvedev et al. 1984, Medvedev 1992, cf. Medvedev & Polkanov 1997); Nižnyj Pândž [= Pançi Poën], during the 1970s: coll. 1,500 inds., Tajikistani Ministry of Health, leg. M. A. Kostûkov (Habilov 1992); Nižnyj Pândž [= Pançi Poën], 9 October 1987: exam. 7 ♂♂, 4 ♀♀ (Habilov 1992); – Džilikul′ [= Çilikūl] [**27**] (Malinovskij 1988); – Džilikul′ [= Çilikūl] district, Kalinin farm [**28**], April 1987: obs. a disperged colony of ca. 1,500 inds., 18 April 1987: coll. 1 ♂, 39 ♀♀ (Malinovskij 1988); – Varzob [**29**] (Malinovskij 1988); Gissarskij [= Ḥisor] Mountains, Varzob-Ali canyon, 22 April 1961: coll. 3 inds., ZMMU, leg. P. L. Beme (Habilov 1992); – Samgar [= Somğor] [**30**], 25 km north-west of Leninabad [= 20 km north-east of Huçand], obs. two colonies, coll. inds., 22 May 1979: coll. 2 ♂♂, 28 May 1979: obs. a colony of 14 inds, incl. 1 ♂, 10 ♀♀, coll. 1 ♀, school building, 8 June 1979: obs. a nursery colony of 104 inds., net. 1 ♂, 89 ♀♀ (Khabilov 1989a, Habilov 1992); Samgar [= Somğor], April 1963: coll. 1 ♀ + juvs., ZIN, leg. I. A. Hotenovskij (Habilov 1992); – Kajrakkum [= Guliston] [**31**], building of a tourist complex, obs. a colony, 20 May 1979: coll. 1 ♂, 1 ♀, 27 May 1979: exam. 2 ♂♂, 13 ♀♀, coll. 2 ♀♀, building of a fishing farm, 12 June 1979: obs. a nursery colony, exam. 22 ♂♂, 65 ♀♀ (Khabilov 1989a); Kajrakkum [= Guliston], 19 & 27 May 1979: coll. 5 inds. (Habilov 1992); – Tagoyak [= Tağoâk] [**32**], Nau [= Nov] district, 15 July 1979: exam. 5 inds. (Khabilov 1989a); – Ajvadž

Fig. 97. Portrait of *Pipistrellus pipistrellus* (Schreber, 1774) netted at the Tarzan forestry in the Bešai Palangon Reserve. Photo by A. Reiter.

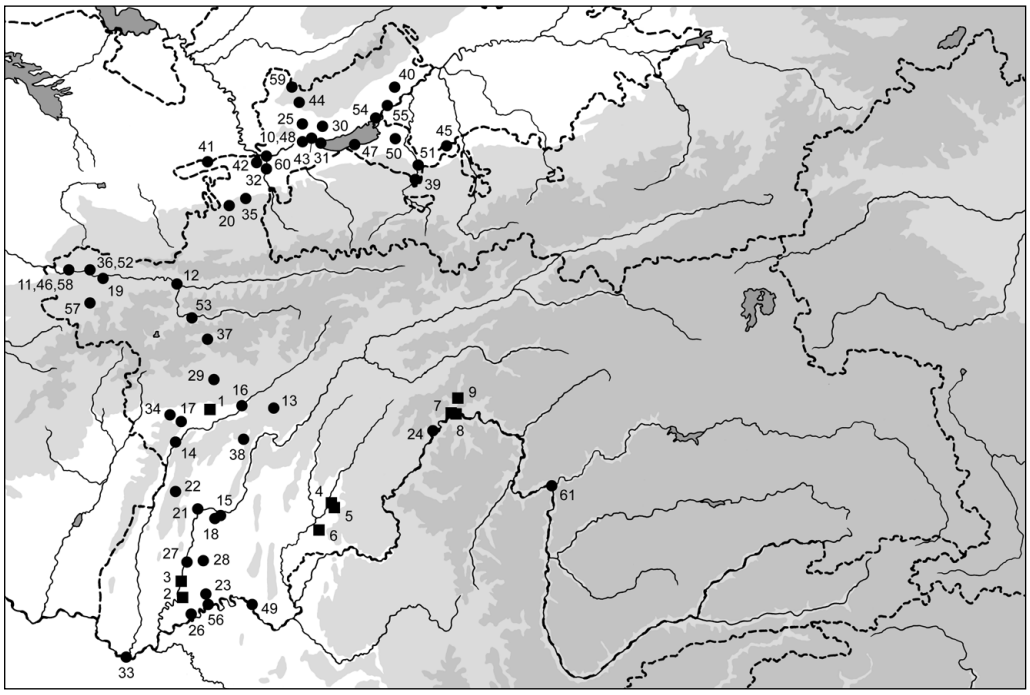


Fig. 98. Records of *Pipistrellus pipistrellus* (Schreber, 1774) in Tajikistan; squares – new records, circles – published records.

[= Ajvaç] [**33**], 1971: coll. 1 ♂, 7 ♀♀, 1 ind., ZIN, leg. P. P. Strelkov (Habilov 1992); – 6 km of Gissar [= Ḥisor] [**34**], state farm, 28 August 1934: coll. 1 ♂, ZIN, leg. V. L′vova (Habilov 1992); – Ganči [= Ǧončī] district [**35**], coll. series of inds., IZPAN (Habilov 1992); – Majkata [= Majkatta] kishlak [**36**], near Pendžikent [= Pançakent], 24 March 1979: coll. 1 ♀, leg. R. Š. Muratov (Habilov 1992, Tadžibaeva & Habilov 2017a); – southern slope of the Gissarskij [= Ḥisor] Mountains, Kamadon [= Kamodon = Ziddī] kishlak [**37**], 7 July 1970: coll. 1 ♂, leg. R. Š. Muratov (Habilov 1992); – Âvanskaâ [= Ëvonsu] river valley, Gurgon kishlak [**38**], 16 October 1972: coll. 1 ♂, leg. R. Š. Muratov (Habilov 1992); – Tangi Surh [= Surh] [**39**], 23 June 1976, 12–14 June 1977, 26–28 June 1977, 1 July 1977: coll. 12 ♂♂ (Habilov 1992); – Ašt [= Šajdon] district, near Bulak [= Bulok/Qaḥramon] [**40**], July 1977: coll. 3 ♂♂, 6 ♀♀ (Habilov 1992, cf. Medvedev & Polkanov 1997); – near Zafarabad [= Zafarobod] [**41**], south-eastern part of the Golodnaâ steppe [= Mirzachoʻl], 4, 6, 11 October 1977: coll. 4 ♂♂ (Habilov 1992); Zafarabad [= Zafarobod], 21 June 1978: coll. 1 ♂ (Habilov 1992); – near Kurkat kishlak [**42**], 23 June 1977: coll. 1 ♂, 27 November 1977: coll. 1 ♂, 16 December 1977: coll. 1 ♂, 26 March 1978: coll. 1 ♂ (Habilov 1992); – Palas [= Palos] [**43**], Agrobiological Station of the HSU, 6 July 1978: coll. 2 ♀♀, 17 April 1979: coll. 1 ♀ (Habilov 1992); – Tabošar [= Istiqlol] [**44**], 2 April 1978: coll. 1 ♂ (Habilov 1992); – near Dahana [**45**], Guzlon Range, mine 4, 11 November 1978: coll. 1 ♂, 1 ♀ (Habilov 1992, Habilov & Tadžibaeva 2020a); – Garibak [= Ǧaribak] kishlak [**46**], Zeravšan [= Zarafšon] river valley, rock fissure, 13 February 1979: obs. a colony of 50 inds., coll. 1 ♂, 1 ♀ (Habilov 1992, Tadžibaeva & Habilov 2017a); – Karakčikum [= Qarakčiqum] kishlak [**47**], 27 April 1980: coll. 7 ♀♀ (Habilov 1992); – Rumon [= Rūmon] [**48**] (near Leninabad [= Huçand]), 19 April 1984: coll. 1 ♀ (Habilov 1992); – Pândž [= Panç] [**49**], 17 September 1987: exam. 5 ♂♂, 6 ♀♀ (Habilov 1992); – Kanibadam [= Konibodom] [**50**] (Habilov 1992); – Isfara [**51**] (Habilov 1992, Medvedev & Polkanov 1997); – Amondara [**52**] (Habilov 1992); – Zeravšan [= Zarafšon] [**53**], northern slope of the Zeravšanskij [= Zarafšon] Mountains (Habilov 1992); – Volčʼe canyon, between Mahou-Tau Mountains and the Kajrakkumskoe [= Baḥri Toçik] dam [**54**], June–July 1990: coll. 1 ♂ (Habilov 1995); – right bank of the Kajrakkumskoe [= Baḥri Toçik] dam, near Kok-Kurak [= Kokkurak] [**55**], June–July 1990: coll. 6 ♂♂, 36 ♀♀, 1 ind., 1–2 July 1990: obs. 409 inds. (Habilov 1995); – Dusti [**56**], Pânž [= Panç] river valley, June 1989: 4 ♀♀, NMP, leg. B. Pražan (Benda et al. 2011); – Šing [**57**], 22 September 2016: obs. foraging inds. (Tadžibaeva

& Habilov 2017a); – Koktaš [= Kuktoš] [**58**] (near Pendžikent [= Pançakent]), 23 May 2017: obs. inds. (Tadžibaeva & Habilov 2017a); – Kuraminskij [= Kurama] Mountains, near Zarnisor [**59**], at Poj-bulok mine, 1240 m a. s. l., 25 February 2016: obs. 1 foraging ind. (Tadžibaeva & Habilov 2017b); – near Kuštegirmon [= Kūštegirmon] [**60**], Spitamen district, near the Syr-Dar′â [= Sirdarë] right bank, pool in a former sport camp, 8 August 2019: net. 1 ♂ (Tadžibaeva & Habilov 2019c, Habilov & Tadžibaeva 2021a); – Rušan [= Rūšon] [**61**], central street, 22 July 2022: obs. ca. 20 foraging inds. (Habilov & Tadžibaeva 2022a).

Distribution. *Pipistrellus pipistrellus* is distributed broadly in the temperate zone of the western Palaearctic, from the Maghreb and western Europe to the western and central parts of Asia (Horáček et al. 2000, Mathews et al. 2023); in Asia it occurs in the Mediterranean zone of the Middle East, in the Caucasus region, West Turkestan, western East Turkestan, and marginally it occurs also in the Oriental region, in south-eastern Afghanistan, northern Pakistan, and Kashmir (Bobrinskoj 1929, Bates & Harrison 1997, Benda & Gaisler 2015, Liu et al. 2018). It belongs to the most common bat species in the central and southern regions of West Turkestan (see the review of distribution by Benda et al. 2011). The Tajikistani occurrence area of *P. pipistrellus* represents the easternmost part of the distribution range of this bat in West Turkestan and a part of the range margin in Palaearctic Asia. This range margin continues from south-western Tajikistan southwards to northern Afghanistan (Benda & Gaisler 2015) and from northern Tajikistan to southern Kirghizstan, south-eastern Kazakhstan, and western East Turkestan, where the northern limits of the species distribution in Asia are found (Butovskij et al. 1985, Rybin et al. 1989, Benda et al. 2011, Abduriyim et al. 2022).

Our new records from Tajikistan contribute only slightly to the detailed depiction of the eastern margin of the species range in Central Asia, until now, the species remained undocumented from

Fig. 99. Part of a colony of *Pipistrellus pipistrellus* (Schreber, 1774) composed of ca. 100 individuals in total roosting in a ceiling fissure of an abandoned farm building in Levap (see Fig. 17). Photo by A. Reiter (5 May 2016).

Figs. 100, 101. *Pipistrellus pipistrellus* (Schreber, 1774) from Levap (left – portrait, right – penis). Photos by A. Reiter.

the eastern parts of the Hatlon Province (Surhob river valley; Fig. 98). Additionally, the calls of foraging bats recorded in Zingroğ in the Darvoz Mountains represent the second easternmost records of *P. pipistrellus* in the Amudarë Basin (70°49'E; Fig. 98), after the recent observation in Rūšon (Habilov & Tadžibaeva 2022a).

Fig. 102. Qal″ai Humb, Panç river valley; echolocation calls of numerous foraging individuals of *Pipistrellus pipistrellus* were recorded in the town on 11 May 2016. Photo by A. Reiter (12 May 2016).

In Tajikistan, *P. pipistrellus* is an extremely common bat (Fig. 98), at least 61 record sites are known, spread mostly across the low to medium altitudes of the western part of the country. It is the most common bat species of Tajikistan, by one fifth of the record number more frequent than the second species, *Rhinolophus ferrumequinum* (Table 1). The available records come from a rather wide altitudinal range of 1956 m; however, some three quarters of the records were made at the sites below 1100 m a. s. l., i.e. in rather low areas of Tajikistan, the altitude median (734.0 m a. s. l.) is the second lowest among Tajikistani bats (Fig. 10, Table 3). Our records come from a much smaller range of 1361 m, however, the altitude distribution of these record sites remains similar to that of the whole available material (mean 900.2 m vs. 828.2 m; see Fig. 11, Table 4).

Echolocation. Echolocation calls of *Pipistrellus pipistrellus* were recorded at nine sites during our research in Tajikistan. In all sites they were foraging bats, at one site (Levap) individuals emerging from a day roost were mixed with the bats that were foraging around. The typical call of this species is frequency-modulated in the initial phase and has a quasi-constant frequency in the final part of the pulse. According to the available data, the echolocation characteristics of *P. pipistrellus* have a significant geographical variation showing a trend of increasing peak frequencies of the calls from the west to the east. In the European and Maghrebian populations, these frequencies were found to lie in the range of 42–52 kHz, on average around 45 kHz (see Jones & van Parijs 1993, Kalko 1995, Vaughan et al. 1997, Barlow & Jones 1999, Parsons & Jones 2000, Russo & Jones 2002, Obrist et al. 2004, Papadatou et al. 2008, Benda et al. 2010b, etc.), while in the Middle Eastern populations they were recorded to be higher, e.g. 46–54 kHz (mean 50.0 kHz) in Syria, 46–50 kHz (51.2 kHz) in Jordan, or 44–54 kHz (48.6 kHz) in Iran (Benda et al. 2006, 2010a, 2012). The data gathered from Tajikistan (Figs. 103–105) conform to this geographical pattern, the echolocation calls showed values of the peak frequencies similar to those in the Middle East populations, in the range of 45.4–56.6 kHz with the mean 49.1 kHz (Table 5). Additionally, in some foraging individuals presumably of *P. pipistrellus*, the echolocation parameters showed high values resembling the calls of the European species *P. pygmaeus* (Leach, 1825) in which an average peak frequency is around 55 kHz (Table 5; see the above references). These calls were detected at four sites of Tajikistan, Dušanbe, Levap, Qal″ai Humb, and Zingroğ; in the former three sites these call sequences were recorded syntopically along with the regular calls of *P. pipistrellus* (Figs. 103, 105). Most probably, these calls represent just an extremely high vocalisation of

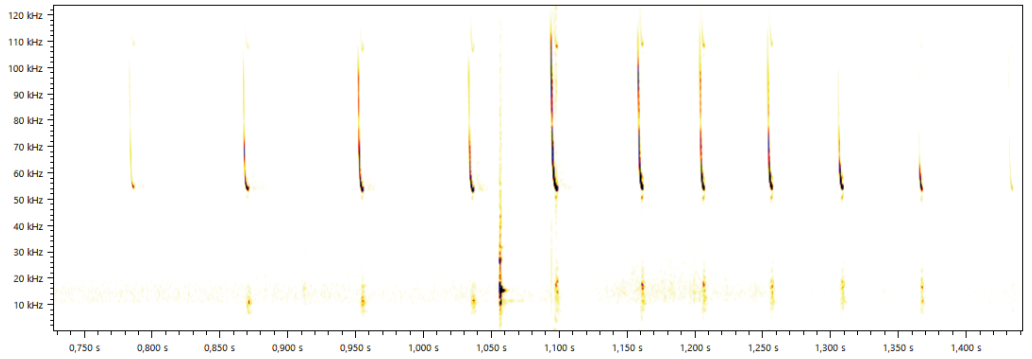
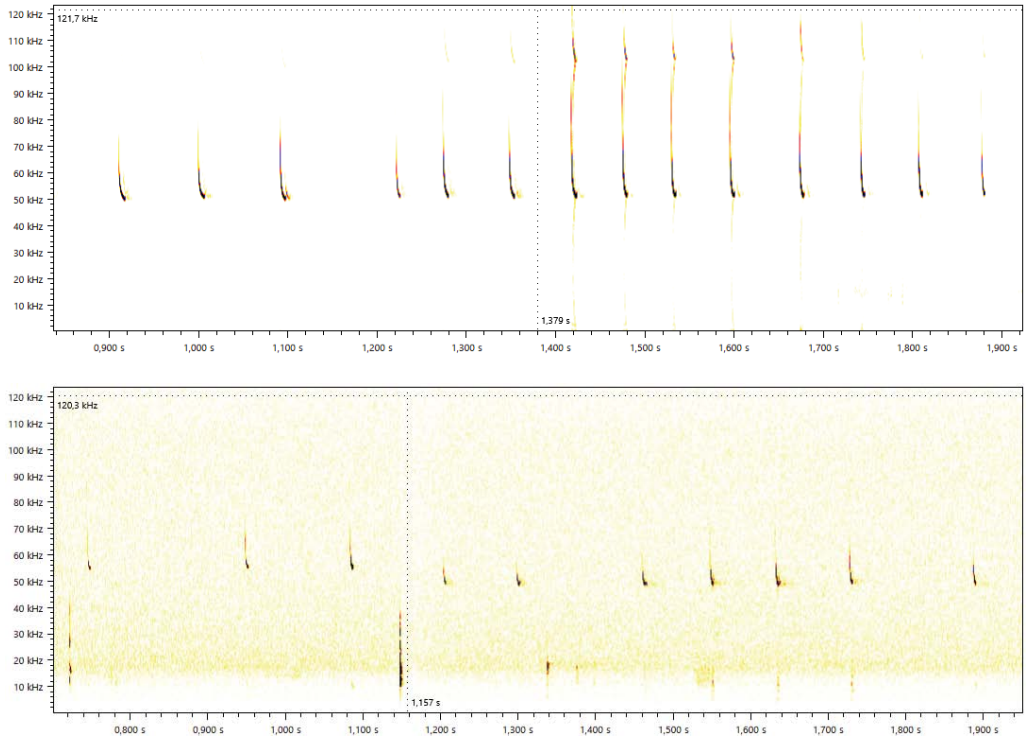


Fig. 103. Spectrogram of the echolocation calls of *Pipistrellus pipistrellus* (Schreber, 1774); an individual foraging in a hotel garden in the city centre of Dušanbe, 2 May 2016.



Figs. 104, 105. Spectrograms of the echolocation calls of *Pipistrellus pipistrellus* (Schreber, 1774). 104 (top) – an individual foraging at the Tarzan forestry in the Bešai Palangon Reserve, 4 May 2016. 105 (bottom) – individuals foraging at an old farm in Levap – simultaneous production of the regular call type and high-frequency type, 5 May 2016.

P. pipistrellus at the eastern limits of the distribution range, i.e. at the eastern margin of the increasing cline of the frequency values. Moreover, the peak frequencies of these unusually high calls are still within the range of the regular calls of *P. pipistrellus*, see Table 5. Thus, we attribute these calls to *P. pipistrellus* rather than to any other species despite their extreme parameter values. On the other hand, they represent an unusual call type that certainly deserves to be noted.

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Pipistrellus pipistrellus* are shown in Table 12. For the material examined see above. The sequences of a mitochondrial marker obtained from these new samples showed a close affiliation of the Tajikistani populations of *P. pipistrellus* to other populations of the species from central parts of Asia, namely the eastern Middle East and northern East Turkestan, with very minute differences between regions (Table 13; Hulva et al. 2004, 2007, Abduriyim et al. 2022). The populations of Tajikistan thus do not represent a distinct haplotype group and are an integral component of the Eurasian populations of this bat (see below).

The *P. pipistrellus* populations of the eastern part of the species distribution range – approximately to the east of the Caucasus – were considered to represent a subspecies of its own, separated from the nominotypical European form. This separation was supported by the differences in

Table 12. Basic biometric data on the newly collected specimens of *Pipistrellus pipistrellus* (Schreber, 1774), *Otonycteris leucophaea* (Severcov, 1873), and *Barbastella caspica* Satunin, 1908. For abbreviations see p. 8

	Pipistrellus pipistrellus					*Otonycteris*	*Barbastella caspica*				
	n	**M**	min	max	SD	*leucophaea*	n	**M**	min	max	SD
LC	12	**45.3**	42	48	1.960	88	12	**59.4**	57	65	2.575
LCd	12	**36.8**	36	38	0.754	61	12	**57.4**	50	62	3.397
LAt	12	**31.43**	30.1	32.9	0.778	62.4	12	**42.81**	41.4	45.2	1.184
LA	12	**12.25**	10.1	13.4	0.868	38.8	12	**19.91**	18.5	21.3	0.749
LT	12	**4.95**	4.3	5.4	0.436	16.6	12	**9.43**	8.9	9.9	0.299
G	12	**4.30**	3.8	5.1	0.411	24.9	12	**10.24**	7.9	14.4	2.391
LCr	10	**11.72**	11.52	11.95	0.145	23.37	10	**15.09**	14.68	15.67	0.330
LCb	10	**11.27**	11.12	11.42	0.091	21.81	10	**14.17**	13.75	14.62	0.332
LaZ	9	**7.61**	7.46	7.73	0.101	15.58	10	**7.95**	7.74	8.22	0.146
LaI	10	**3.31**	3.07	3.41	0.098	4.52	11	**3.68**	3.58	3.76	0.062
LaInf	10	**3.59**	3.44	3.68	0.088	6.28	11	**4.24**	4.17	4.39	0.073
LaN	10	**6.22**	6.03	6.42	0.130	10.28	10	**7.62**	7.31	8.83	0.446
LaM	10	**6.76**	6.63	6.89	0.084	11.83	10	**8.79**	8.61	9.14	0.154
ANc	9	**4.27**	4.12	4.44	0.110	7.47	10	**5.51**	5.24	5.67	0.134
LBT	10	**2.90**	2.72	3.21	0.155	4.93	10	**3.27**	2.97	3.98	0.281
CC	10	**3.55**	3.44	3.73	0.081	6.61	11	**3.96**	3.73	4.12	0.141
M^3M^3	10	**4.96**	4.82	5.17	0.098	9.97	11	**5.83**	5.55	6.07	0.149
CM^3	10	**4.19**	4.07	4.33	0.089	8.33	11	**4.92**	4.81	5.08	0.090
LMd	10	**8.23**	8.11	8.37	0.092	16.63	10	**9.71**	9.48	10.03	0.171
ACo	10	**2.35**	2.18	2.47	0.091	7.24	10	**2.66**	2.58	2.76	0.063
CM_3	10	**4.45**	4.31	4.63	0.090	9.39	10	**5.36**	5.27	5.48	0.068

the pelage and wing membrane colouration – while in the most of the European and Caucasian representatives of *P. pipistrellus* the pelage is dark brown and the membranes are uniformly dark greyish brown, in the Central Asian populations of this bat the pelage is pale brown and the wing membranes have a variably wide pale (creamy or whitish) posterior margin. This colouration difference led to the descriptions of several taxa, see below and Ellerman & Morrison-Scott (1951), Strelkov (1981), Pavlinov & Rossolimo (1987), and Benda et al. (2011). However, all continental Eurasian populations of *P. pipistrellus* were demonstrated to represent a single genetic lineage

Table 13. Percent pairwise uncorrected genetic distances among and within reconstructed phylogroups of the *Pipistrellus pipistrellus* complex based on analysis of the cytochrome *b* gene sequences; for the new sequences from Tajikistan and for the published comparative data see Appendix II

haplogroup	1	2	3	4	5	6	7
1 *pipistrellus* Tajikistan	0.00–0.82						
2 *pipistrellus* E Middle East	0.00–2.36	0.25–2.49					
3 *pipistrellus* W Middle East	1.30–5.17	0.25–3.48	0.00–2.49				
4 *pipistrellus* Europe	1.82–4.31	0.75–3.60	0.25–2.40	0.00–1.49			
5 *pipistrellus* North Africa*	4.78–9.48	4.23–6.22	3.98–5.72	3.73–5.47	0.25–4.48		
6 *pygmaeus* Iran	10.34–11.95	10.70–12.44	11.19–12.44	11.44–12.19	10.20–12.12	0.25	
7 *pygmaeus* Europe	9.99–11.95	10.23–12.44	10.95–12.47	9.54–12.22	9.95–12.47	0.25–1.00	0.25–1.00
8 *pygmaeus* Cyprus	11.04–13.51	11.36–13.43	11.94–13.43	10.83–13.43	11.44–12.63	2.74–3.48	2.65–3.99
9 *hanaki* Libya & Crete	9.48–10.91	9.95–10.95	9.95–11.69	10.20–11.44	9.70–11.44	6.22–6.97	6.22–7.48

* including haplotypes from Corsica and Sardinia (see Hulva et al. 2007)

(Hulva et al. 2004, 2007, 2010, Benda et al. 2010a, 2012), therefore, all these populations should be referred to a single taxon (Benda et al. 2011, Mathews et al. 2023), since the pale Asian form is just an ecomorph of the arid environment (cf. Benda et al. 2011, 2012).

For the populations of *P. pipistrellus* that occur in West Turkestan, several other names were used besides that currently valid (*Vespertilio pipistrellus* Schreber, 1774 in original combination), namely *Vespertilio lacteus* Temminck, 1840 (type locality: unknown, but probably South America; Temminck 1840: 246), *Vesperugo Blythi* Wagner, 1855 (t.l. Calcutta [= Kolkata, West Bengal, India; 22°34'N, 88°22'E]; Wagner 1855: 742), *Vesperugo akokomuli almatensis* Severcov, 1873 (t.l. Věrnyj [= Almaty, Kazakhstan; 43°14'N, 76°57'E]; Sěvercov″ 1873a: 79), *Vesperugo oxianus* Bogdanov, 1882 (t.l. hivinskij oazis [= Oasis of Xiva, Xorazm, Uzbekistan; 41°23'N, 60°22'E]; Bogdanov″ 1882: 78), *Pipistrellus aladdin* Thomas, 1905 (t.l. Derbent, 50 mi. W. of Isfahan [= Darband, Isfahan Prov., Iran; 33°22'N, 50°02'E]; Thomas 1905: 521), *Pipistrellus bactrianus* Satunin, 1905 (t.l.: Tedžen″ [= Tejen, Turkmenistan; 37°23'N, 60°31'E]; Satunin″ 1905: 67), *Vespertilio pipistrellus kusjakini* Korelov, 1947 (t.l. reka Ili niže ust′â reki Čaryn & Sary-Čagan [Ile river valley near the Șarın river estuary, Kazakhstan & Sarıșağan, Kazakhstan; 43°55'N, 79°23'E & 46°07'N, 73°37'E]; Korelov 1947: 118), and *Vespertilio pipistrellus fulvus* Korelov, 1947 (t.l. predgor′â Tân-Šana ot Samarkanda do Alma-Ata [foothils of the Tien-Shan Mts. between Samarqand, Uzbekistan and Almaty, Kazakhstan]; Korelov 1947: 118).

Since the name *lacteus* Temminck remains a nomen dubium (see the detailed review by Benda et al. 2011), and *blythi* Wagner represents a junior synonym of *coromandra* Gray, 1838 (= currently *Pipistrellus* [*Alionoctula*] *coromandra*; see Ellerman & Morrison-Scott 1951, Corbet & Hill 1992, Koopman 1993, Borisenko & Pavlinov 1995, Simmons 2005), and *akokomuli* Temminck, 1840 a junior synonym of *abramus* Temminck, 1840 (= currently *Pipistrellus* [*Alionoctula*] *abramus*; see Ellerman & Morrison-Scott 1951, Corbet 1978, Borisenko & Pavlinov 1995, Simmons 2005), the prior name applicable to the populations of the eastern part of the species distribution range is *almatensis* Severcov. However, this name was for a long time considered erroneously a nomen nudum (Ognev 1928, Ellerman & Morrison-Scott 1951, Pavlinov & Rossolimo 1987, Borisenko & Pavlinov 1995, Simmons 2005), and although it could be potentially available for nomenclature (see Benda et al. 2011), it currently represents a nomen oblitum. On the other hand, another name, *oxianus* Bogdanov, which really is a nomen nudum, was attributed to this category correctly by the previous authors (Ognev 1928, Ellerman & Morrison-Scott 1951, Rossolimo & Pavlinov 1987, Borisenko & Pavlinov 1995, Simmons 2005). Thus, Central Asian populations were affiliated most frequently either to *P. p. aladdin* or *P. p. bactrianus*.

The oldest mention of *P. pipistrellus* from Tajikistan comes from Sěvercov″ (1873a), who attributed the specimens from Huçand to *Vesperugo Blythii*. One of these bats from the ZMMU collection was examined by Tihomirov″ & Korčagin″ (1889), who identified it as *Vesperugo pipistrellus* (this name was mentioned also by Radde & Walter 1889 and Kaŝenko 1905 concerning the Sěvercov's bats), and five of them from the ZIN collection by Satunin″ (1910), who named them as *Pipistrellus bactrianus*. The next records of *P. pipistrellus* from Tajikistan made in 1914 were mentioned by Bobrinskoj (1918) as *Pipistrellus lacteus*. All subsequent authors attributed the Tajikistani populations to *P. pipistrellus* (Bìanki 1917, Bobrinskoj 1925, 1929, Ognev 1927, 1928, Vinogradov 1935, Laptev 1937, Kuzâkin 1944, 1950, 1965, L′vova 1945, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, 1956a, Strelkov 1963, 1981, Ŝerbin 1968, Corbet 1978, Habilov 1980, 1986, 1991, 1992, 2003, Pavlinov & Rossolimo 1987, 1998, Malinovskij 1988, Koopman 1993, 1994, Horáček et al. 2000, Benda et al. 2011, Tadžibaeva & Habilov 2017a, b, 2019a, d, Habilov & Tadžibaeva 2019a, 2020a, d, 2021b, c).

Concerning the subspecies of *P. pipistrellus* that occurs in Tajikistan as well as the whole Central Asia, two opinions and four names appeared. A view prevailing till present has differentiated the

Turkestani bats as a form separated from the European nominotypical subspecies (see above), and three names were used to assign this form, viz. *P. p. lacteus* (Bìanki 1917), *P. p. bactrianus* (Bobrinskoj 1925, 1926, 1929, Ognev 1927, 1928, Meklenburcev 1935, 1937, Vinogradov 1935, Laptev 1937, Kuzâkin 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, Dement′ev et al. 1955, Strelkov 1963, 1981, Meyer-Oehme 1965, Butovskij et al. 1985, Habilov 1992), and *P. p. aladdin* (Neuhauser & DeBlase 1971, Corbet 1978, Rybin et al. 1989, Corbet & Hill 1992, Koopman 1994, Bates & Harrison 1997, Horáček et al. 2000, Simmons 2005, López-Baucells 2019b). The opinion supported by a molecular genetic analysis that considers the concerned populations to be an identical subspecies as in Europe is still very rare (Hulva et al. 2010, Benda et al. 2011, 2012, Benda & Gaisler 2015, Mathews et al. 2023).

Records of ectoparasites. **Original data**: I s c h n o p s y l l i d a e: *Ischnopsyllus octactenus*: 4 ♂♂ ad, 1 ♀ ad [A], from 4 ♀♀ (NMP 95726, 95727, HSU pb6187, 6188), Tuto, small lake, 7 May 2016. – M a c r o n y s s i d a e: *Steatonyssus periblepharus*: 6 protonymphs [P], from 4 ♂♂ (NMP 95721, 95722, HSU pb6179, 6180), Levap, old farm, 5 May 2016; – 6 ♀♀ [P] from 4 ♀♀ (NMP 95726, 95727, HSU pb6187, 6188), Tuto, small lake, 7 May 2016. – **Published data**: C i m i c i d a e: *Cimex pipistrelli* (as *Cacodmus vicinus*): 42 inds. ad, 8 larvae, Stalinabad [= Dušanbe], living house, 8 July 1944, Kurgan-Tûbe [= Bohtar], house attic, 20 June 1949 (Kiričenko 1952). – I s c h n o p s y l l i d a e: *Ischnopsyllus octactenus*: 52 inds. + 14 ♀♀, numerous larvae, Nižnyj Pândž [= Pançi Poën], living houses, September 1982, June 1983 (Medvedev 1984, 1992, Medvedev et al. 1984, Medvedev & Polkanov 1997); – 20 km NE of Isfara, mines [specimen numbers and collection dates unlisted] (Medvedev & Polkanov 1997); – Bulak [specimen number and collection date unlisted] (Medvedev & Polkanov 1997); – Dušanbe [specimen number and collection date unlisted] (Medvedev & Polkanov 1997). – A r g a s i d a e: *Carios vespertilionis* (as *Argas vespertilionis*): 2 larvae, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – M a c r o n y s s i d a e: *Steatonyssus periblepharus*: 9 ♂♂, 105 ♀♀, 83 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992); – *Laelaps multispinosus*: 1 ♀, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Pipistrellus pipistrellus*, a broad variety of ectoparasites was documented in Tajikistan, at least five species of four families were found in total.

Pipistrellus pipistrellus is the only host bat species in which a member of the family Cimicidae, *Cimex pipistrelli* Jenyns, 1839, was found in Tajikistan. Kiričenko (1952) referred his two findings of bugs to *Cacodmus vicinus* Horváth, 1934 and noted them as the first evidence of this species in West Turkestan and Eurasia as well. However, the known occurrence range of *C. vicinus* covers northern Africa and the Levant (Péricart 1972), and only rarely it was also found in southern Europe (Quetglas et al. 2012). Usinger (1966) corrected the species identification of the Tajikistani record as follows: "[…] a single male sent by R. Linnavuori seems to agree with typical [*Cimex*] *pipistrelli*. It is a specimen recorded by Kiritchenko [= Kiričenko] (1952) as *Cacodmus vicinus* from Kurgantube [= Bohtar], Tadzhikistan." Simultaneously, Kiričenko (1952) mentioned *Cimex pipistrelli* as a species potentially occurring in Tajikistan, but still unconfirmed. The Usinger's (1966) re-identification of this record as *C. pipistrelli* is mentioned also by Péricart (1972), who considered the West Turkestani populations to be similar to those of Scandinavia, showing characters transitional between *C. pipistrelli* and *C. dissimilis*. The assignation of Kiričenko's specimens to *Cimex dissimilis* (Horváth, 1910) is later given in the check-list of bugs of Tajikistan by Aukema & Rieger (1996). However, the latter species name is considered a synonym of *C. pipistrelli*; this was first suggested by Povolný (1957) and confirmed by the results of a molecular genetic comparison (Balvín et al. 2013). Currently, a single species of the *C. pipistrelli* complex is recognised.

Our new record and four published findings confirmed the occurrence of the bat flea *Ischnopsyllus octactenus* (Kolenati, 1856) in Tajikistan. This species is distributed mostly in the western Palaearctic (southern part of Europe, northern Morocco, and south-western Asia). In West Turkestan, *I. octactenus* was recorded in southern Turkmenistan, eastern Uzbekistan, south-western Kirghizstan, south-eastern Kazakhstan, and in the whole western part of Tajikistan (Medvedev & Polkanov 1997, own data) and in the adjacent regions of Afghanistan and Iran (Peus 1957,

Klein et al. 1963, Lewis 1973, Smit & Rosický 1973). This bat flea occurs on bats throughout the year and its reproduction is limited by high summer temperatures in the synanthropic bat roosts. Most probably, this flea species is distributed all over the Tajikistani range of *P. pipistrellus*, its principal host (Fig. 98).

The soft tick *Carios vespertilionis* (Latreille, 1802) occurs over the part of the Old World southward of 60°N, including southern Africa and Australia, and parasitises a large variety of hosts (Kolonin 2007). The bats of the genus *Pipistrellus* represent the principal host group of this tick species, which is an endophilic and nocturnal form that inhabits the habitats of both migrating and sedentary populations of various bat species, both synanthropic and exoanthropic, both litophilous and petrophilous (Arthur 1963, Dusbábek 1972). Its records made from *P. pipistrellus* are rare in Tajikistan, more frequently it is found on *Myotis davidii* (see above and Stanûkovič & Malinovskij 1992).

The macronyssid mite *Steatonyssus periblepharus* Kolenati, 1858 is a typical parasite of dendrophilous bat species, particularly of the genus *Pipistrellus* (Radovsky 1967, Dusbábek 1973, Lanza 1999); despite this preference, it is a polyxenic species parasitising also other species of the Vespertilionidae and Rhinolophidae families across the whole Palaearctic (Till & Evans 1964, Teng 1980, Rybin et al. 1989, Stanyukovich 1997, Lanza 1999). From Tajikistan, besides *P. pipistrellus* it was found additionally from *Myotis blythii*, *M. davidii* and from undetermined bat species.

The original distribution range of another macronyssid mite found on *P. pipistrellus* in Tajikistan, *Laelaps multispinosus* Banks, 1909 lies in North America. This species was introduced to Eurasia along with its principal host, *Ondatra zibethicus* (Linnaeus, 1766), and since its appearance in the Palaearctic, it inhabited most of this region, in correspondence with the range of the principal host (Nikulina 2004). The collection of *L. multispinosus* from *P. pipistrellus* in Tajikistan is thus an evidence of accidental transition of parasite to a secondary host, perhaps in the shared habitat of alluvium forest.

Pipistrellus kuhlii (Kuhl, 1817)

Records. **Original data**: Tuto [**1**], above a small lake, 7 May 2016: det. & rec. calls of several foraging inds.; – Qarağoč [**2**], above a small lake, 9 May 2016: det. & rec. calls of several foraging inds., 15 May 2016: det. & rec. calls of numerous foraging inds.; – Host [**3**], Obihumbou river valley, 13 May 2016: det. & rec. calls of several foraging inds. – **Published data**: [**4**] Hisor [= Ḥisor], Hisor Fortress (Fig. 106), space between beams, 9 August 2007: obs. 8 inds., coll. 1 ♀ (Kłys & Lis 2022).

Distribution. *Pipistrellus kuhlii* is the newest member of the bat fauna of Tajikistan, it was found in the country for the first time in 2007, when a small colony of this bat was discovered roosting in the fortress of Ḥisor in south-western Tajikistan (Kłys & Lis 2022). Here, we add three other records of foraging bats from the southern part of the country (Fig. 107), based on the recordings of their echolocation calls.

Pipistrellus kuhlii is a Mediterranean bat species distributed in the south-western part of the Palaearctic (Simmons 2005, Amichai & Korine 2023); in Asia it occurs in the Mediterranean zone of the Middle East, in the Caucasus region, southern Urals, southern West Turkestan, Afghanistan, and Pakistan (Harrison & Bates 1991, Benda et al. 2006, 2012, Snit′ko & Snit′ko 2019). It ranks among the rarest bat species in West Turkestan, until recently it was known only from few sites in western Turkmenistan, an old record was available from western Uzbekistan (Bìanki 1918, Strelkov 1973, Strelkov et al. 1978, 1985, Strelkov & Sosnovceva 1994). However, the distribution range of *P. kuhlii* changed dramatically in the last decades, an increase of the occurrence area has been documented mainly in certain parts of Europe, including the northern Caucasus region and eastern European steppes (Strelkov et al. 1985, Sachanowicz et al. 2006, Ancilloto et al. 2016). In western

Fig. 106. Reconstructed Ḥisor fortress in which the first individuals of *Pipistrellus kuhlii* in Tajikistan were found on 9 August 2007 (Kłys & Lis 2022). Photo by A. Reiter (20 May 2016).

Asia, where the eastern limits of the distribution range of *P. kuhlii* are situated, no changes of the known range margins were observed except for the recent records from Tajikistan. The newly documented shift of the range limits to Tajikistan represents the first evidence of spreading of

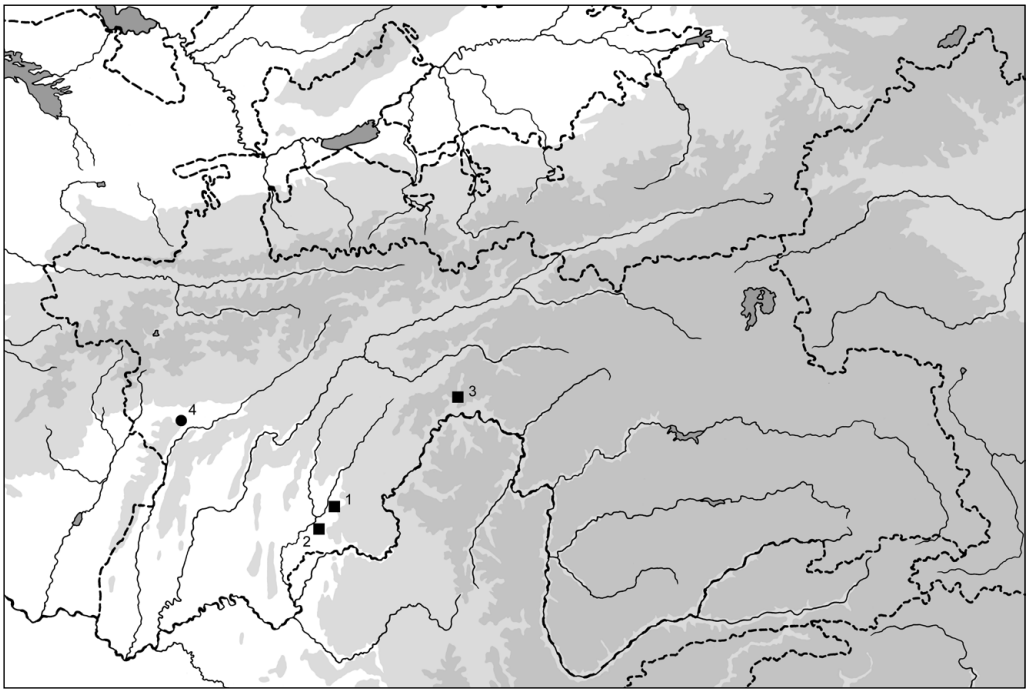


Fig. 107. Records of *Pipistrellus kuhlii* (Kuhl, 1817) in Tajikistan; squares – new records, circles – published records.

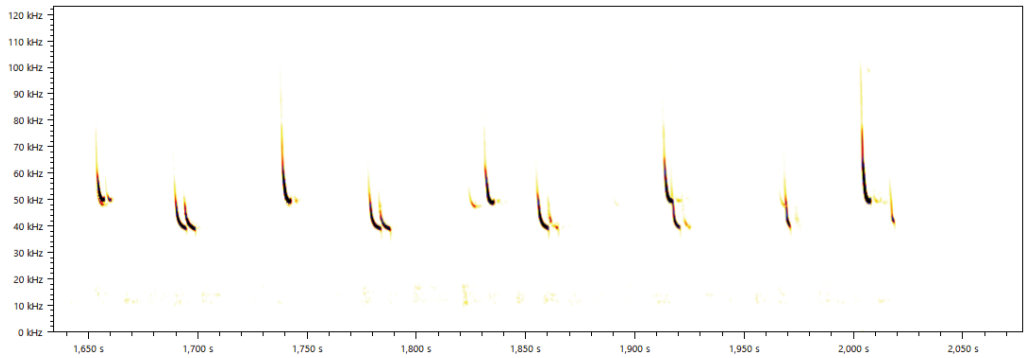


Fig. 108. Spectrogram of the echolocation calls of *Pipistrellus kuhlii* (Kuhl, 1817) and *P. pipistrellus* (Schreber, 1774); individuals foraging at a small lake in Tuto, 7 May 2016.

P. kuhlii in its Asian distribution area east of the Caucasus. In Afghanistan, this bat was recorded only in the areas south of the Hindu Kush (Benda & Gaisler 2015), while from Iran, records of *P. kuhlii* are known from the whole territory of the country, including its north-eastern section (Benda et al. 2012). Perhaps from the southern Karakum Desert of Iran (first records in 2006) this bat spread to the east, to south-eastern Turkmenistan, then to northern Aghanistan and/or southern Uzbekistan before it reached southern Tajikistan (first record in 2007). The Tajikistani occurrence area of *P. kuhlii* represents the north-easternmost projection of the species distribution range, as it is known at present. Currently, this range part represents an isolated occurrence spot, continuing (theoretically) only to north-eastern Iran (shortest distance between the record sites is 740 km), or across the Hindu Kush to south-eastern Afghanistan (365 km). A historical isolated record (made in 1873) is available from Khiva [Xiva, Хива] in western Uzbekistan (770 km; Bianki 1918).

In Tajikistan, *P. kuhlii* still belongs to rare bats, only four record sites are known and three of them were newly documented during our research in 2016 (Fig. 107). The records of this bat come

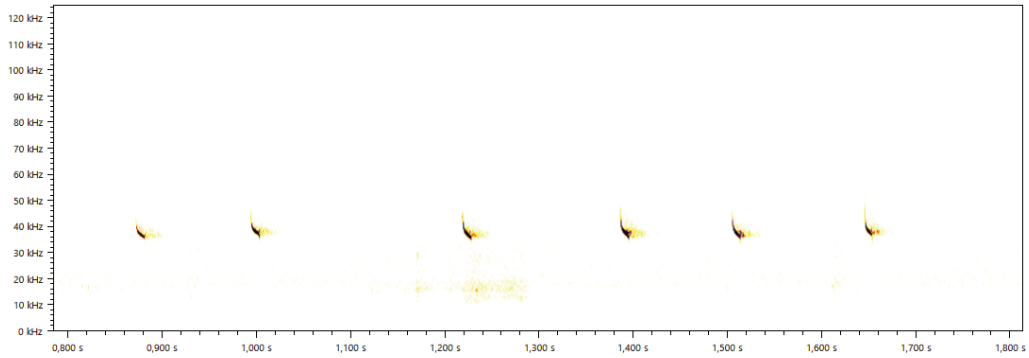


Fig. 109. Spectrogram of the echolocation calls of *Pipistrellus kuhlii* (Kuhl, 1817); an individual foraging at a small lake at Qarağoč, 9 May 2016.

from a limited part of the country, the south-western section of medium-altitude areas bordered by the high ranges of the Darvoz Mountains in the east and the Ḩisor Mountains in the north. The available records of *P. kuhlii* from Tajikistan – including those made by us – come from a small altitudinal range (953 m), the localities lie in medium high areas of Tajikistan, in the altitude range of 738–1691 m a. s. l. (median 876.5 m a. s. l.; Table 3, Fig. 10).

Echolocation. Echolocation calls of the foraging individuals of *Pipistrellus kuhlii* were recorded at three sites during our research in Tajikistan, whereas no individual was caught. We analysed in total 68 search pulses of five call sequences recorded (Figs. 108, 109), all parameters are given in Table 5. The data obtained from Tajikistan support the observations from other parts of the distribution range of *P. kuhlii* that the echolocation characteristics of this bat are rather conservative and uniform throughout the whole occurrence area, including Europe and the Middle East (see Schnitzler et al. 1987, Obrist et al. 2004, Benda et al. 2006, 2008, 2010a, 2012, Papadatou et al. 2008, Razgour et al. 2010, Hackett et al. 2016, Benda & Uhrin 2017, 2019, etc.).

Variation. The taxonomic affiliation of the Tajikistani populations of *Pipistrellus kuhlii* was never examined properly. Only Kłys & Lis (2022) examined external characters of the sole Tajikistani individual from Ḩisor before its release, and they did not find a satisfying conclusion concerning its classification (cf. Sachanowicz et al. 2017). The pelage colouration of this female bat was darker than in the bats referred to the eastern subspecies *P. k. lepidus* Blyth, 1845 and resembled that of the western, nominotypical subspecies. On the other hand, the morphometry and the wing membrane colouration of the bat indicated rather *P. k. lepidus* than *P. k. kuhlii*. Based on these findings, Kłys & Lis (2022) speculated about a possibility of another and still unnamed subspecies of *P. kuhlii* in Tajikistan, although they stressed a necessity of further investigation of this topic.

The populations of *P. kuhlii* living in the areas adjacent to Tajikistan were most frequently assigned to *P. k. lepidus*, see the reviews by Benda et al. (2006, 2012) and Benda & Gaisler (2015). The only other recently known West Turkestani populations of *P. kuhlii*, i.e. those of western Turkmenistan, were also affiliated to the later taxon (Strelkov et al. 1978).

Nyctalus noctula (Schreber, 1774)

Records. **Published data**: Zarevšan″ [= Zarafšon] [**1**], Samarkand [= Samarqand] Province, June 1892: 1 ind., ZIN, Glazunov″ (Satunin″ 1910); Zeravšan [= Zarafšon] river valley, somewhere in the Pendžikent [= Pançakent] district, leg. D. K. Glazunov (Bogdanov 1956a, cf. Satunin″ 1910); near Pendžikent [= Pançakent], Zeravšan [= Zarafšon] river valley, 22 June [= 4 July NS] 1892: 1 ind., leg. D. K. Glazunov (Habilov 1992, Tadžibaeva & Habilov 2017a); – Kajrakkum [= Guliston] [**2**] (Syrdar'â [= Sirdarë] river valley), 30 May 1908: coll. 1 ♂, leg. Zarudnyj (Habilov 1992); – near Majkata [= Majkatta] kishlak [**3**], Zeravšan [= Zarafšon] river valley, on the river bank, 23 March 1979: coll. 1 ♀, leg. R. Muratov (Habilov 1992); – Dar-Dar kishlak [**4**], near Ajni [= Ajnī], unconfirmed (Habilov 1992); – near Leninabad [= Huçand] (Rumon [= Rūmon]) [**5**], spring, coll. 1 ♀ (Habilov 1992).

Distribution. *Nyctalus noctula* is a rare bat in Tajikistan, only five records were reported from the country, and moreover, some of them remain unclear. In Tajikistan, this bat reaches the southern margin of its range in West Turkestan. The east-west directed course of the Zarafšon river valley (Tajikistan–Uzbekistan) or its southern border, the Zarafšon Mountains, represent the southern limit of the West Turkestani distribution range of *N. noctula*. South of this line, the species is distributed on the southern slopes of the chain of high mountains of the northern part of the Indian Subcontinent, stretching from eastern Afghanistan via Kashmir to West Bengal (see the review by Benda & Gaisler 2015), and the gap between the closest sites, Meta Khan in Afghanistan and Zaravšon valley in Tajikistan, is ca. 700 km across high mountains. On the other hand, the

species range continues from Tajikistan to the north, *N. noctula* is more common in Kirghizstan, the eastern parts of Uzbekistan and Kazakhstan, and the range continues northwards up to the Altai Mountains of Russia and western Mongolia (Bogdanov 1953a, Butovskij et al. 1985, Dolch et al. 2021a). Rather numerous records are available also from southern Kirghizstan, from low mountains of the eastern edge of the Farg'ona valley (Bejšebaev 1966, Rybin 1980).

Two spots of occurrence of *N. noctula* are known from Tajikistan, the southern one in the Zarafšon river valley and the northern one on the Sirdarë (Figs. 10, 78). Three localities in the southern spot are points of zoogeographical importance (see above), and continue in the west to Uzbekistan (see Thomas 1909). However, only one of the southern records seems to be well substantiated, that of the female collected at Majkatta in 1979 (Habilov 1992). Two remaining findings from the Zarafšon river valley are unclear, the record from Dar-Dar kishlak was reported as "not proven" already by Habilov (1992), the old record labelled as from Zarafšon is problematic concerning its origin in Tajikistan.

The latter specimen was collected by Dmitrij Konstantinovič Glazunov (1869–1913), a Russian entomologist, in June 1892. The specimen, deposited in the ZIN collection, Saint-Petersburg (ZIN 5722), was published by Satunin″ (1910: 283) as originating from Zarafšon, Samarqand Province [Заревшанъ, Самаркандская. обл[асть].; Zarefšan″, Samarkandskaâ oblast′]. At that time, the term Zarevšan named the river, its valley, and the mountain creating the southern slope of this valley (although for the mountain, slightly different variant of the Russian word is used), the settlements of these names did not exist yet. The Zaravšon river is more than 800 km long, it runs initially (in the east) for ca. 325 km through present-day Tajikistan, the rest in the west is in Uzbekistan; the eastern ca. 460 km of the river, between the spring in Tajikistan and Kattaming in central Uzbekistan, was situated in the former Samarqand Province of the Russian Empire; this is the locality of *N. noctula* given by Glazunov and published by Satunin″ (1910), respectively. However, Bogdanov (1956a) selected the area of the Pançakent district in western Tajikistan as the actual locality of the ZIN specimen – this restriction is interesting regarding the former view of this author, since Bogdanov (1953a) placed the same record to Uzbekistan. Bogdanov's (1956a) site identification as Pançakent district was accepted by Habilov (1992) and Tadžibaeva & Habilov (2017a, 2021), although the previous authors dealing with Glazunov's record of *N. noctula* did not suggest a more accurate locality and only repeated the original data by Satunin″ (Bobrinskoj 1925, Ognev 1928, Vinogradov 1935, Strelkov et al. 1978). Tadžibaeva & Habilov (2017a) additionally specified the date of collection as 22 June [= 4 July NS] 1892.

For indication of the particular site of *N. noctula* collection, Bogdanov (1956a) may be used the only Glazunov's publication on his travel to West Turkestan in 1892 (Glasounow 1893), where he presented just one site (but not date) – the type locality of a new species of whirligig beetle – situated in the valley of the Moğiëndarë river, which reaches its mouth to the Zarafšon river some 10 km above Pançakent (and the type locality itself lies in the Pançakent district). Nevertheless, for the specification of the collection site, the route of Glazunov's 1892 expedition can be partly reconstructed according to the collection dates of his other ZIN specimens mentioned by Satunin″ (1910). Chronologically, they could be ordered as follows: 24 April – Nuratau Mountains, 9 May – Kattaqo'rg'on, 25 May – Pançakent, June – Zarafšon, 23 August – Ajnī. This simple schedule suggests that the June collecting locality Zaravšon was visited after leaving Pançakent in late May and before reaching Ajnī in August, i.e. along the section of the river valley ca. 80 km long (~100 km along the river). Therefore, the most likely area of collection of the first specimen of *N. noctula* from Tajikistan could be restricted to the section of the Zarafšon river valley between Pançakent and Ajnī (Fig. 78). This specification, however, shifts the estimation by Bogdanov (1956a) only slighty from the geographical point of view and confirms the most probable origin of the *N. noctula* specimen in Tajikistan.

The northern spot of occurrence of *N. noctula* in Tajikistan is represented by two records from the short Tajikistani section of the Sirdarë Valley – along this river the occurrence continues directly to the west to Chinoz (Severtzoff 1876) and Toshkent (Bobrinskoj 1925, Kuzâkin 1934, Meklenburcev 1935, Bogdanov 1953a). A record without date (only "spring" is given) of a female from Rūmon, nowaday a part of Huçand (Habilov 1992), and an old finding of a male from Guliston (former Kajrakkum) made by Nikolaj Alekseevič Zarudnyj, a renowned Ukrainian explorer and ornithologist, in 1908 (Habilov 1992, see also Tadžibaeva & Habilov 2021). However, concerning the latter record, Habilov (1992) did not give the source of his information, although it should originate either from a publication or from a collection examination. Majority of Zarudnyj's collection (more than 13,000 specimens, see Kaškarov & Mitropol′skaâ 2012) is housed in the SAGU collection, Toshkent, but Kaškarov & Mitropol′skaâ (2004), publishing the catalogue of bats of the SAGU collection, did not mention this specimen. This record was not mentioned by any author dealing with Zarudnyj's collections (Bobrinskoj 1925, Ognev 1928, Bobrinskoi 1931, Kuzâkin 1934, Meklenburcev 1935, Strelkov et al. 1978). Although the maps of distribution of *N. noctula* in the Soviet Union by Kuzâkin (1944, 1950, 1965) indicate a record along the Tajikistani section of the Sirdarë Valley, it is not clear whether it is the Rūmon record or the Guliston record (or some other). For the time being, this question remains unresolved.

Variation. The Tajikistani populations of *Nyctalus noctula* were not evaluated concerning their taxonomic position within the species rank (Habilov 1992). However, besides the old views by Bobrinskoj (1925), Ognev (1927, 1928), and Vinogradov (1935), who considered the Turkestani populations a part of the eastern European form *Nyctalus noctula princeps* Ognev, 1923 (currently considered a synonym of the nominotypical west-Palaearctic subspecies, see Benda et al. 2006 for a review), the populations of the eastern part of West Turkestan – i.e. living east of the Aral Sea, including those of Tajikistan – are generally regarded to belong to *N. n. meklenburzevi* Kuzâkin, 1934 (Kuzâkin 1934, 1944, 1950, 1965, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, Strelkov 1963, 1981, Corbet 1978, Rybin et al. 1989, Koopman 1994, Horáček et al. 2000, Benda et al. 2006, 2011, etc.).

Otonycteris leucophaea (Severcov, 1873)

Records. **Original data**: Kūlob [**1**], botanical garden, 6 May 2016: det. & rec. calls of minimum 2 foraging inds.; – Qarağoč [**2**], above a small lake (Fig. 110), 15 May 2016: net. 1 ♂ (Figs. 111, 112; NMP 95747 [S+A]; cf. Habilov & Tadžibaeva 2016b, Tadžibaeva & Habilov 2016a). – **Published data** [as of *O. hemprichii*]: near Džan-bulak [= Būston] [**3**], at the southern base of the Kuraminskij [= Kurama] Mountains, between Taškent [= Toshkent] and Hodžent [= Huçand], 1 ind., ZMMU (Sěvercov″ 1873a); at Djan-bulak [= Būston], on the southern side of the Kuraminsk [= Kurama] mountain-chain, between Tashkent [= Toshkent] and Hodgent [= Huçand], 1 ind. (Severtzoff 1876); Taškent [= Toshkent, Uzbekistan], 1 ♂, ZMMU, leg. N. A. Severcov (Bobrinskoj 1925); near Djan-Bulak [= Būston] at the southern foot of the Kuraminsk [= Kurama] Mountains, between Tashkent [= Toshkent] and Chodgent [= Huçand], 1 ind., ZMMU (Ognev 1927); – near Ajvadž [= Ajvaç], at the mouth of the Kafirnigin [= Kofarniḫon] river [**4**], 5 August [= 18 August NS] 1915: coll. 1 ♂, ZIN, leg. Lazdin (Bobrinskoj 1925, Ognev 1928); Ajvadž [= Ajvaç], lower reaches of the Kafirnigin [= Kofarniḫon] river (Kuzâkin 1944, 1950, 1965); – Horog [= Horuğ] [**5**], a canyon at the confluence of the Šah-Dar′â [= Šahdara] and Gunt [= Ğund] rivers, summer 1937: remains of 7 skulls in *Bubo bubo* pellets (Kornev 1941); Horog [= Horuğ] in the western Pamirs (Kuzâkin 1944, 1950, 1965); – Stalinabad [= Dušanbe] [**6**], fissure of a window frame on the second floor of the university building, 5 June 1950: obs. a colony, coll. 1 ♀, 2 July 1950: coll. 1 ♀, leg. O. P. Bogdanov & I. I. Lindt, 1 June 1951: coll. 18 ♀♀, leg. S. U. Stroganov, 12 July 1951: coll. 1 ♀, leg. V. D. Potopol′skij (Bogdanov 1953a, b, 1956a); Dušanbe (Kuzâkin 1965); Dušanbe, living house, 7 September 1987: 1 ♂ flew into a flat (Malinovskij 1988); – Gandžino [= Gançina] (Vahš river valley) [**7**], fissures in limestone and sandstone outcrops, May–August 1964 (incl. 19 May, 4 June, 4 July, 13 July, 24 July, 27 August), obs. emerging inds., shot 5 ♂♂, 26 July 1964: shot 1 ♀, 23 August 1964: shot 1 ♂ (Ŝerbin 1968); – Zeravšan [= Zarafšon] river valley, between Majkata [= Majkatta] and Amondara [**8**], mine, 6 July 1960: coll. 1 ♂, leg. O. P. Bogdanov (Habilov 1992, Tadžibaeva & Habilov 2017a); – proportionatelly between the Vahš river and Šaartuz [= Šaḫritus] [**9**], 1 ind., ZIN, leg. P. P. Strelkov & G. N. Sapožnikov (Habilov 1992); – Moskovskij [=

Fig. 110. A small lake and surrounding loess slopes of the Mount Ḩoça Mū″min at Qarağoč; during two visits of this locality, on 9 May & 15 May 2016, nine bat species were documented. At the lake three species were netted, *Eptesicus ognevi*, *Hypsugo savii*, and *Otonycteris leucophaea*, echolocation calls of three other species were detected, *Pipistrellus pipistrellus*, *P. kuhlii*, and *Tadarida teniotis*; in the underground cavities and corridors in the loess slopes, individuals of *Rhinolophus ferrumequinum*, *R. bocharicus*, *Myotis blythii*, and *Barbastella caspica* were documented. Photo by A. Reiter (15 May 2016).

Maskav] district, Hozratišo [= Ḩazrati Šoḩ] [**10**], 1 ind., ZIN, leg. P. P. Strelkov & G. N. Sapožnikov (Habilov 1992); – Bah [= Bahorak?] (25 km of Čubek) [**11**], Montane Bukhara (Pamir-Alay), 1 ♂, SAGU, leg. L. Molčanov (Kaškarov & Mitropol′skaâ 2004); – Barušon [**12**], 22 July 2022: obs. 1 foraging ind. (Habilov & Tadžibaeva 2022a).

Distribution. *Otonycteris leucophaea* is an endemic of West Turkestan and adjacent areas, its distribution range stretches from southern Kazakhstan to southern Turkmenistan, north-eastern Iran, northern parts of Afghanistan and Pakistan, and to Kashmir (Bates & Harrison 1997, Benda et al. 2011, 2012, Benda & Gaisler 2015). The Tajikistani occurrence area of *O. leucophaea* represents the easternmost part of the distribution range of this bat in West Turkestan and a part of the eastern margin of the whole species range. This range margin continues from southern Tajikistan southwards to central Afghanistan and to Kashmir (Benda & Gvoždík 2010, Benda & Gaisler 2015) and from northern Tajikistan to western Kirghizstan and southern Kazakhstan, where the northern limits of the species distribution are situated (Butovskij et al. 1985, Rybin et al. 1989). In the Afghanistani provinces of Herat and Lowgar, *O. leucophaea* reaches the southernmost points of its distribution range (Benda & Gaisler 2015).

In Tajikistan, *O. leucophaea* represents a rather uncommon bat (Fig. 113), 12 record sites are spread across low to medium altitudes of the western section of the country. The records come from a medium wide altitudinal range (1780 m) and this species represents mainly a lowland dweller in the country – a large majority of its localities lie at the altitudes below 900 m a. s. l.

Fig. 111. Portrait of *Otonycteris leucophaea* (Severcov, 1873) from Qarağoč. Photo by A. Reiter.

(median 751.5 m a. s. l.; Fig. 10, Table 3). The only record from an altitude above 2000 m a. s. l. (a river valley near Horuğ, Badakhshan, at 2103 m a. s. l.) constitutes a finding of bone remains of seven individuals in owl pellets (Kornev 1941), the real occurrence of the bats thus could be situated much lower than the site of their bone finding.

Fig. 112. Penis of *Otonycteris leucophaea* (Severcov, 1873) from Qarağoč. Photo by A. Reiter.

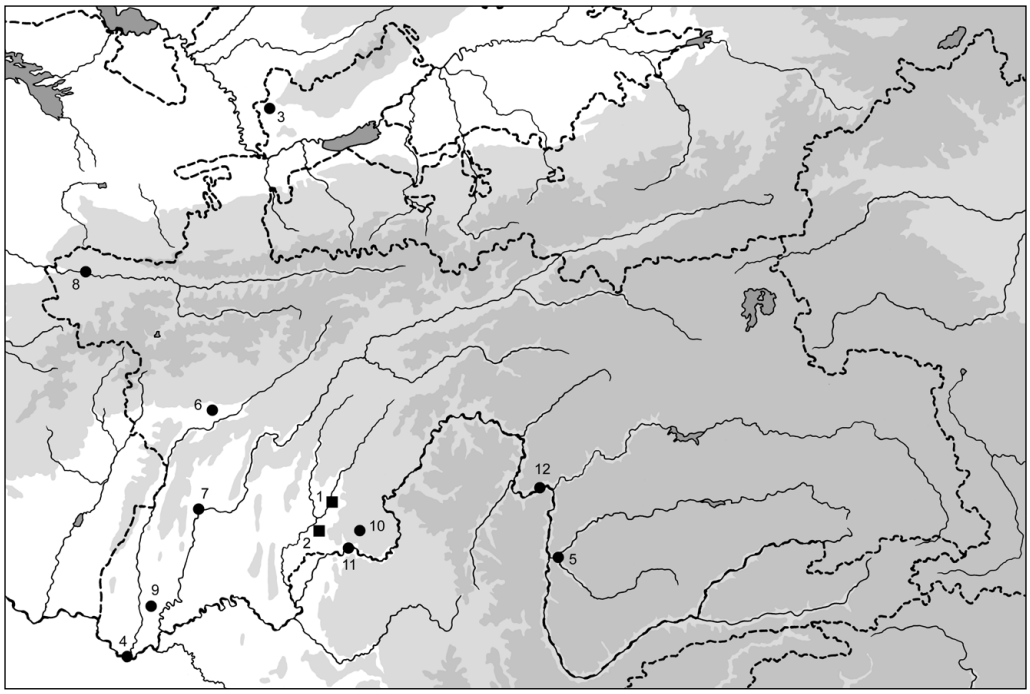


Fig. 113. Records of *Otonycteris leucophaea* (Severcov, 1873) in Tajikistan; squares – new records, circles – published records.

Echolocation. Echolocation calls of *Otonycteris leucophaea* were detected just at one site during our research trip to Tajikistan, calls of at least two foraging bats were recorded in the botanical garden in Kūlob. We measured only five pulses of a single sequence (Fig. 114, Table 5). These limited data give an opportunity for a simple description of the echolocation parameters of *O. leucophaea*, although the first information on the echolocation of this bat was given by Horáček (1991) based on observations from a heterodyning detector used in Kirghizstan. Horáček (1991) described these calls as a short series of low-frequency clicks with a regular low repetition rate increasing when approaching a prey and terminating with feeding, he mentioned the call range of 18–40 kHz with the peak frequency at 30–32 kHz. However, these data on peak intensity refer to the span of the highest acoustic resolution in the heterodyne record, not to the end frequency of a call (see Benda et al. 2008). Based on the record from Tajikistan, the call parameters of *O. leucophaea* resemble those of the only congener *O. hemprichii* Peters, 1859 as described by Benda et al. (2008) and later characterised by Benda et al. (2010a, 2012), Razgour et al. (2010), and Benda & Uhrin (2019). The echolocation calls of *O. leucophaea* are very short, broadband frequency-modulated signals with the peak frequency (produced by a foraging bat) in the range of 21.1–21.5 kHz, mean 21.3 kHz (Table 5). This is a slightly lower value compared to those found in *O. hemprichii*, where the call parameters are reported as follows (mean, range): D 5.6 ms, 4.9–6.6 ms; SF 45.2 kHz, 43.6–47.5 kHz; EF 18.7 kHz, 18.0–19.6 kHz; PF 22.2 kHz, 20.4–24.3 kHz; IPI 106.9 ms, 69.6–146.4 ms (Sinai, n=13; Benda et al. 2008); D 7.2 ms, 2.9–11.9 ms; SF 46.8 kHz, 34.2–68.3 kHz;

EF 20.4 kHz, 15.0–25.6 kHz; PF 26.8 kHz, 19.4–31.8 kHz; IPI 142.7 ms, 72.0–302.0 ms (Jordan, n=66; Benda et al. 2010a); D 3.7 ms, 3.4–4.1 ms; SF 38.8 kHz, 28.6–32.8 kHz; EF 22.1 kHz, 21.9–22.3 kHz; PF 22.9 kHz, 16.9–29.9 kHz; IPI 157.9 ms, 143.0–190.1 ms (Iran, n=10; Benda et al. 2012). The difference is perhaps a consequence of the differences in body size, *O. leucophaea* is a bat somewhat larger than *O. hemprichii* and thus, it produces on average lower frequencies of echolocation calls than the latter species.

Variation. External and cranial dimensions of the newly collected Tajikistani specimen of *Otonycteris leucophaea* are shown in Table 12.

All published records of the bats of the genus *Otonycteris* from Tajikistan as well as West Turkestan until 2010 were referred to *O. hemprichii* Peters, 1859 (see Radde & Walter 1889, Kaŝenko 1905, Satunin″ 1906, 1914, Bìanki 1917, Bil′kevič″ 1918, Bobrinskoj 1918, 1925, 1929, Ognev 1927, 1928, Ogneff & Heptner 1928, Laptev 1934, Kuzâkin 1935, 1944, 1950, 1965, Vinogradov 1935, Kornev 1941, Ellerman & Morrison-Scott 1951, Bogdanov 1953a, b, 1956a, b, 1968, 1974, Strelkov 1963, 1981, Babaev 1965, Ŝerbin 1968, Ânuševič et al. 1972, Corbet 1978, Strelkov et al. 1978, Strelkov & Šajmardanov 1983, Butovskij et al. 1985, Habilov 1986, 1992, 2003, Pavlinov & Rossolimo 1987, 1998, Malinovskij 1988, Khabilov 1989b, Rybin et al. 1989, Horáček 1991, Zima et al. 1991, 1992b, Koopman 1993, 1994, Strelkov & Sosnovceva 1994, Borisenko & Pavlinov 1995, Horáček et al. 2000, Borisenko et al. 2001, Kaškarov & Mitropol′skaâ 2004, Simmons 2005, Benda et al. 2006, etc.). However, the taxonomic revision by Benda & Gvoždík (2010), based on the results of morphological and molecular genetic analyses, demonstrated the content of the genus *Otonycteris* to consist of two species, *O. hemprichii*, distributed in North Africa and the Middle East, and *O. leucophaea*, occurring in West Turkestan and parts of adjacent countries.

Otonycteris leucophaea belongs to the few bat species whose description is based on a specimen from Tajikistan. The description of this bat under *Plecotus leucophaeus* was published by Sěvercov″ (1873a: 18) based on "a single specimen found at the altitude no less than 2000' [~610 m], but not in the steppe, in fact in the lower part of a montane canyon, between Taškent [= Toshkent] and Hodžent [= Huçand], near Džan-bulak [= Būston; 40°31'N, 69°20'E]". [Own translation from Russian*.] The type specimen (male, see Bobrinskoj 1925) was collected most

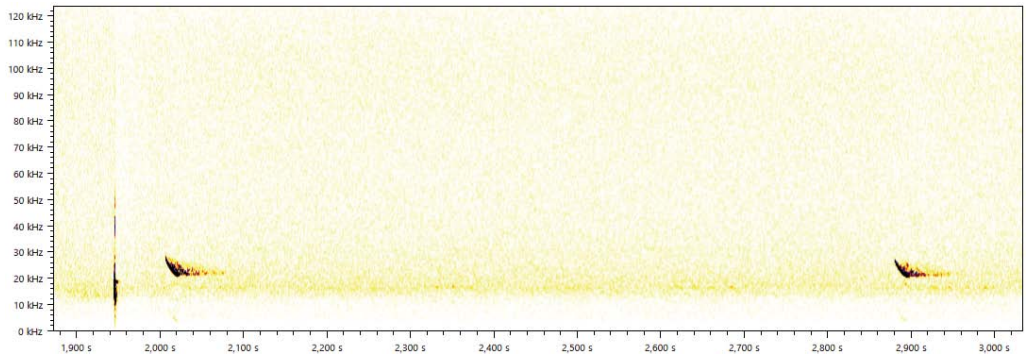


Fig. 114. Spectrogram of the echolocation calls of *Otonycteris leucophaea* (Severcov, 1873); an individual foraging in the botanical garden at Kūlob, 6 May 2016.

* original text reads as follows (Sěvercov″ 1873a: 18): "Единственный экземпляръ найденъ на высотѣ менѣе 2000', но не въ степи, а въ нижней части горнаго ущелья, между Ташкентомъ и Ходжентомъ, у Джан-булака."

probably in 1868, when N. A. Severcov (1827–1885; see under *Eptesicus gobiensis* above) travelled between Toshkent and Huçand and collected zoological materials in the broader vicinity of Huçand, although he did not mention the type locality (Džan-bulak / Būston) directly (Sěvercov″ 1873b, see also Maslova 1956). Since Sěvercov″ (1873a) reported the altitude of the type locality at 2000 feet at least, i.e. above 600 m a. s. l., the site should be within the Kurama Mountains in a certain distance from the city of Būston that is situated around 330 m a. s. l.

In the book containing the description of *O. leucophaea*, Sěvercov″ (1873a: 79) referred the type specimen of the new species also to '*Plecotus auritus* var[ietas] *brevimana* Bonap[arte, 1837]', i.e. he synonymised the name *leucophaeus* with *brevimana*. Despite the clear Sěvercov″'s (1873a) indication of an existing name mentioning Bonaparte as its author, the name '*brevimana* Severcov' was erroneously considered a junior synonym of *Otonycteris hemprichii* Peters or *O. leucophaea* Severcov by a series of authors (see Kaŝenko 1905, Bobrinskoj 1925, Ognev 1928, Kuzâkin 1950, Ellerman & Morrison-Scott 1951, Corbet 1978, Strelkov 1981, Borisenko & Pavlinov 1995, Simmons 2005). However, when Bonaparte (1837: [59]) mentioned *Plecotus brevimanus*, he clearly indicated Jenyns (1828) as the author of this name. Currently, *brevimanus* Jenyns is considered a junior synonym of *Vespertilio auritus* Linnaeus, 1758 [= *Plecotus auritus* (Linnaeus, 1758)], this is apparent also from the detailed species description by Jenyns (1828: 55–58; see also Van Bree & Dulić 1963, Corbet 1964, 1978, Strelkov 1981, Koopman 1993, Borisenko & Pavlinov 1995, Simmons 2005). In fact, Sěvercov″ (1873a) referred the type specimen of *O. leucophaea* simultaneously to a common bat, *Plecotus auritus*, besides to the newly described species.

Due to the immediate synonymisation of the names *leucophaeus* and *brevimanus* by Sěvercov″ (1873a) that was supported again by the use of the latter name on the first place in the English translation of the original description by Severtzoff (1876: 42), and mainly due to confusion of the genera, *Plecotus* instead of *Otonycteris*, the Sěvercov″'s (1873a) original combination remained in use for a long time, see Tihomirov″ & Korčagin″ (1889) or Kaŝenko (1905). The currently valid combination of the name *leucophaeus* Severcov with the genus *Otonycteris* was first proposed almost simultaneously by Bobrinskoj (1925) and Ognev (1927).

The name *Plecotus leucophaeus* was for a long time considered a synonym of *Otonycteris hemprichii* s.str. (for discussions of the opinions concerning the intraspecific variation in this species see Nader & Kock 1983, Horáček 1991, or Horáček et al. 2000), only exceptionally it was regarded a name for a local Turkestani subspecies of the latter species (Corbet 1978, Koopman 1994). Since Benda & Gvoždík (2010) suggested the separate species status for *O. leucophaea*, this taxonomic view was subsequently and (perhaps) universally followed (Benda et al. 2011, 2012, Benda & Gaisler 2015, Rosina 2015, Ashrafi et al. 2016, Habilov & Tadžibaeva 2016b, 2019a, 2020d, 2021b, Tadžibaeva & Habilov 2016a, 2017a, 2018, 2019d, Saidov et al. 2017, Loumassine et al. 2019, Burgin 2019c, Yusefi et al. 2019, Dundarova et al. 2022, Orlova et al. 2023, etc.).

Records of ectoparasites. **Published data**: S p i n t u r n i c i d a e: *Spinturnix myoti*: 2 ♂♂, 1 ♀, 1 protonymph, from 1 ind., Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Otonycteris leucophaea*, only one ectoparasite species was documented in Tajikistan, a gamasoid mite *Spinturnix myoti* (Kolenati, 1856). A finding of four specimens from one bat individual (originally under *O. hemprichii*) was reported by Stanûkovič & Malinovskij (1992). This gamasoid permanent mite of the *S. myoti* group is a primary parasite of bats of the *M. myotis* group. In the Palaearctic, it was reported from a variety of other host species of the families Vespertilionidae and Rhinolophidae, all these records are regarded as accidental transfers from the main host group (Rudnick 1960, Uchikawa et al. 1994). It could be caused by sharing of the roost by several bat species including those of the *M. myotis* group. In

our catch from Tajikistan, this mite was collected from an individual of *Myotis blythii* examined at Magov (see above).

From *O. leucophaea*, a new species of the gamasoid mite was recently described from southern Kazakhstan, *Spinturnix otonycterisi* Dundarova et Orlova, 2022, based on the material of 15 specimens (Dundarova et al. 2022). This material was collected at two sites on the northern limits of the host distribution range (see Butovskij et al. 1985), the type locality is the Ak-Mečet′ cave near Almaly, western part of the Karatau Mts., ca. 80 km north of Šimkent (cf. Dundarova et al. 2022).

Dundarova et al. (2022: 451) complemented the description of *S. otonycterisi* by a note as follows: "The phylogenetic position of *Otonycteris* is still unresolved […], 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." On the other hand, it is worth mentioning that the available records of *O. leucophaea* in its whole range (see above) did not give any record of the *Spinturnix* mites, except those few by Stanûkovič & Malinovskij (1992) and Dundarova et al. (2022). Rybin et al. (1989) examined 15 specimens of *O. leucophaea* (under the name *O. hemprichi*) from Kirghizstan for ectoparasites and did not find any specimen of *Spinturnix*, identical results were reported by Benda et al. (2012) from Iran. This suggests certain doubts concerning the real parasite-host association of *S. otonycterisi* with *O. leucophaea*. The species of the genus *Spinturnix* do not create endemic populations and are distributed broadly, this could rather indicate a transfer of parasites between hosts (e.g. in a common roost) and the principal host of *S. otonycterisi* thus could be a member of a different bat species.

A similar situation could be observed in *Pipistrellus pipistrellus* and *P. kuhlii* and the *Spinturnix* mites. Findings of *Spinturnix acuminata* (s.str. or s.l.) and undescribed mite species of the *S. acuminata* group on these bats were registered only in marginal parts of their ranges in Libya, Turkey, Israel, Iran, and/or Afghanistan (Shulov 1957, Costa 1966, Dusbábek 1970, Karataş & Çakır 2004, Benda et al. 2012, 2014). Although both bat species are widely distributed in the Middle East (Benda et al. 2006, 2010, 2012, 2016c, Benda & Gaisler 2015, etc.), the *Spinturnix* mites were collected from them only exceptionally. This again indicates that local (marginal) populations were accidentally infested by a parasite without direct association with these bat species – both are common bats within their whole ranges, but only a few records of mites are available at all (see Stanyukovich 1997). Anyway, such infestation of a certain bat species by the (species-specific) *Spinturnix* mites only at the distribution range margin of such species remains an unresolved question.

Barbastella caspica Satunin, 1908

Records. **Original data**: Qarağoč [**1**], inside of a loess cavity (Figs. 115–117), 9 May 2016: net. 5 ♂♂ (Fig. 118; NMP 95735–95737, HSU pb6205, 6206 [S+A]; cf. Habilov & Tadžibaeva 2016b), at a loess cave, 15 May 2016: net. 3 ♂♂, 2 ♀♀ (NMP 95749, HSU pb6226–6228 [S+A], NMP 95748 [A]; cf. Habilov & Tadžibaeva 2016b), rec. calls of three handled inds.; – Hoça Šaqiqi Balhi [**2**], Dangara tunnel, 17 May 2016: obs. 3 roosting inds., coll. 1 ♂, 1 ♀ (NMP 95753, HSU pb6235 [S+A]; Habilov & Tadžibaeva 2016b). – **Published data**: Kurgan-Tûbinskij [= Viloâti Hatlon] pass [**3**], fissure in a rock boulder, 21 June 1950: coll. 1 ♂ (Bogdanov 1952); – Mindona [= Mingdona] kishlak [**4**], cave, 4 December 1953: coll. 1 ♂, 1 ♀ (Bogdanov 1956a, b); – foothills of the Turkestanskij [= Turkiston] Mountains, between Majkota [= Majkatta] and Amandora [= Amondara] [**5**], narrow rock fissure, 2 December 1953: coll. 6 ♂♂, 4 ♀♀ (Bogdanov 1956a, b); – right bank of the Zeravšan [= Zarafšon] river [**6**], 5–6 km upstream of Pendžikent [= Pançakent], mines, 3 December 1953: coll. 1 ♂, 1 ♀ (Bogdanov 1956a, b); vicinity of Pendžikent [= Pançakent], exam. inds. (Medvedev & Polkanov 1997); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**7**], abandoned mine, 17 December 1978: exam. 3 ♂♂, 1 ♀ (Habilov 1979), juniper tree zone, 1590 m a. s. l., 5 February 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2016b, 2017b, 2018), 2 April 1977: exam. 1 ♂, 23 December 1978: exam. 4 ♂♂, 2 ♀♀, 1 April 1979: exam.

Fig. 115. Eroded loess slopes of the Mount Ḥoça Mū″min at Qarağoč; inside loess cavities in these slopes (entrance of one of them is visible on the right side of the picture), four bat species were found roosting, *Rhinolophus ferrumequinum*, *R. bocharicus*, *Myotis blythii*, and *Barbastella caspica* (see also Fig. 110). Photo by A. Reiter (9 May 2016).

1 ♂, 15 February 1980: obs. 15 inds., 1 April 1980: obs. 4 inds., incl. 1 ♂, 1 ♀, 14 March 1981: obs. 5 inds., 21 February 1986: exam. 1 ♀ (Tadžibaeva & Habilov 2018), mine 29 January 2022: obs. 2 inds. (Habilov & Tadžibaeva 2022c); – northern slope of the Turkestanskij [= Turkiston] Mountains, near Dahana [**8**], Guzlon Range, 1020 m a. s. l., two abandoned mines (incl. mine 4), 2 January 1976: obs. 56 and 24 inds., exam. 7 ♂♂, 5 ♀♀ (Habilov 1980, 1992, Habilov & Tadžibaeva 2020a), 18 January 1976: obs. 44 inds., 25 January 1976: obs. 42 inds., 15 February 1976: obs. 41 inds., mine 4, 7 March 1976: obs. 28 inds., incl. 3 ♂♂, 1 ♀, mine, 9 March 1976: obs. numerous inds., mine 4, 10 December 1977: obs. 16 ♂♂, 9 ♀♀, mine, 17–18 December 1977: obs. 14 ♂♂, 6 ♀♀ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 13 March 1976: obs. 20 inds., incl. 1 ♀, 23 January 1977: obs. 27 inds., incl. 18 / 17 ♂♂, 8 ♀♀, coll. 1 ♂, 16 October 1977: exam. 2 / 3 ♂♂, 2 ♀♀, coll. 1 ♂ (Habilov 1980, 1992, Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 18 April 1976: obs. 7 inds., incl. 2 / 3 ♀♀, coll. 1 ♀, 22 May 1976: obs. 20 inds., incl. 3 ♂♂, 4 / 5 / 7 ♀♀, 13 June 1976: obs. 6 inds., incl. 1 / 2 ♂♂, 1 ♀, 23 June 1976: obs. 6 inds., incl. 2 ♂♂, 11 July 1976: exam. 1 ♂, 26 September 1976: obs. 13 inds., incl. 6 ♂♂, 5 ♀♀, 8 May 1977: exam. 1 ♂ / ♀, mine, 14 May [1977]: exam. 2 ♀♀, mine 4, 15 May 1977: obs. 7 inds., incl. 2 / 3 ♂♂, 3 ♀♀, 25 March 1978: exam. 1 ♂, 8 May 1978: exam. 1 ♂, 1 ♀, 10 June 1978: exam. 2 ♂♂, 3 ♀♀, 11 November 1978: exam. 1 ♀ (Habilov 1992, Habilov & Tadžibaeva 2013, 2020a, Tadžibaeva 2018), mine 4, 6 July 2012: obs. 10 inds., incl. 2 ♂♂, 13 July 2012: obs. a colony of 15–20 inds., incl. 1 / 3 ♂, 2 ♀♀, mine 6, 6 July 2012: obs. 1 ind., mine 13, 7 July 2012: exam. 3 ♂♂, 8 inds. juvs. (Habilov & Tadžibaeva 2013, Tadžibaeva 2015, 2018), mine 4, 21 April 2013: obs. 21 inds., 17 May 2013: obs. 30 inds., 9 September 2013: obs. 23 inds., incl. 5 ♂♂, 7 ♀♀, 22 November 2013: obs. 4 inds., incl. 1 ♀, mine 6, 22 November 2013: obs. 3 inds., mine 4, 24 January 2014: exam. 3 ♂♂, 5 ♀♀ (Orlova et al. 2015a, Tadžibaeva 2015, 2018, Habilov & Tadžibaeva 2020a), mine 4, 13 May 2012: obs. 10 inds., mine 14, 15 July 2012: obs. 4 inds., 14 February 2015: exam. 2 ♀♀ (Tadžibaeva 2018), mine 4, 12 April 2012: obs. 6 inds., incl. 1 ♂, 1 ♀, 18 April 2014: obs. 1 ind., 10 July 2014: obs. 1 ind., 23 August 2014: obs. 7 inds., incl. 4 ♀♀, 10 October 2014: obs. 15 inds., incl. 7 ♂♂, 3 ♀♀, 2 November 2014: obs. 3 inds., incl. 2 ♂♂, 1 August 2015: obs. 2 inds., incl. 1 ♀, 13 November 2015: exam. 1 ♂, 22 January 2016: exam. 5 ♀♀, 8 April 2016: obs. 10 inds., incl. 3 ♂♂, 6 ♀♀ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 21 March 1976: obs. 9 inds., 11 April 1976: obs. 7 inds., incl. 2 ♀♀, 17 April 1976: exam. 2 ♂♂, 24 April 1976: obs. 9 inds., 30 May 1976: obs. 6 inds., incl. 1 ♂, 2 ♀♀, 26 June 1976: exam. 2 ♂♂, 16 September 1976: obs. 7 inds., incl. 3 ♂♂, 18 December 1976: exam. 16 ♂♂,

9 ♀♀, 27 February 1977: obs. 18 inds., 12 March 1977: obs. 1 ind., 10 April 1977: exam. 2 ♂♂, 2 ♀♀, 13 March 1978: exam. 6 ♂♂, 4 ♀♀, 3 April 1979: obs. 3 inds., incl. 1 ♂, 1 ♀, 15 March 1980: obs. 16 inds., incl. 8 ♂♂, 4 ♀♀, 23 November 1980: obs. 20 inds., incl. 2 ♂♂, 6 ♀♀, 20 December 1980: obs. 22 inds., incl. 4 ♂♂, 4 ♀♀, 18 January 1981: obs. 20 inds., 10 January 1982: obs. 17 inds., 8 November 1983: obs. 3 inds., incl. 1 ♂, 5 January 1986: exam. 7 ♂♂, 7 ♀♀, 22 February 1986: obs. 3 inds., incl. 1 ♂, 12 November 1986: obs. 6 inds., incl. 1 ♂, 1 ♀, 19 June 1987: exam. 4 ♂♂, 1 ♀, 14 September 2017: obs. 15 inds., incl. 1 ♀, 7 July 2018: exam. 2 ♂♂, 1 ♀, 10 March 2019: exam. 1 ♂, 1 ♀, 30 March 2019: exam. 2 ♀♀, 5 July 2019: obs. 1 ind., 28 March 2020: exam. 1 ♀ (Habilov & Tadžibaeva 2020a), mine 4, 26 February 2022: exam. 1 ♂, 1 ♀ (Habilov & Tadžibaeva 2022c); – foothills of the Turkestanskij [= Turkiston] Mountains, near Voruh kishlak [**9**], right bank of the Isfara river, small mine, 21 January 1977: coll. 1 ♂, 1 ♀ (Habilov 1980); – foothils of the Zeravšanskij [= Zarafšon] Mountains, near Šing [**10**], 1600 m a. s. l., abandoned mine, 23 February 1977: obs. 31 inds., incl. 16 ♂♂, 14 ♀♀ (Habilov 1980), 22 June 1979: exam. 1 ♂ (Habilov 1992), 12 February 1977: exam. 13 inds., 12 February 1979: obs. 26 inds., incl. 9 ♂♂, 4 ♀♀, 16 October 2015: exam. 1 ♀, Dahoni ob mine, 30 January 2016: obs. 1 ind., leg. R. Oblokulov (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2020b), 22 September 2016: obs. 2 inds. (Tadžibaeva & Habilov 2017a, Habilov & Tadžibaeva 2018, 2020b), 5 October 2019: exam. 1 ♂, 3 October 2020: obs. 1 ind. (Habilov & Tadžibaeva 2020b); – Kuraminskij [= Kurama] Mountains, near Adrasman [= Adrasmon] [**11**], 1610 m a. s. l., mines, 26 December 1976: obs. several inds. (Habilov 1980), 26 May 1979: exam. 1 ♂ (Habilov 1992); Dobita near Adrasman [= Adrasmon], exam. inds. (Medvedev & Polkanov 1997); Kuraminskij [= Kurama] Mountains, near Adrasman [= Adrasmon], 1610 m a. s. l., mines, 2 January 1977: exam. 2 ♀♀, 25 November 1977: exam. 1 ♂, Koni-Mansur cave, 25 November 1977: exam. 2 ♂♂, 1 ♀, 30 November 1988: obs. 1 ind., Gulšan, mine, 15 January 2016: exam. 2 ♂♂, 1 ♀ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, Kara-Mazara Range, Kandžol

Figs. 116, 117. 116 (left) – an individual of *Barbastella caspica* Satunin, 1908 roosting in a loess cavity at Qarağoč. 117 (right) – an interior of a loess cavity at Qarağoč. Photos by A. Reiter (9 May 2016).

Fig. 118. Portrait of *Barbastella caspica* Satunin, 1908 from Qarağoč. Photo by A. Reiter.

[= Istiqlol] [**12**], 1350–1600 m a. s. l., mine, 16 January 1977: exam. 2 ♂♂ (Habilov 1980, 1992); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**13**], two abandoned mines, 8 November 1977: obs. 5 ♂♂, 2 ♀♀, coll. 1 ♂, 1 ♀, 8 January 1978: obs. 4 ♂♂, 1 ♀ (Habilov 1980, 1992), 19 June 1984: exam. 1 ♂, 13 January 1985: obs. 7 inds., incl. 1 ♂, 1 ♀, 15 April [1985]: exam. 1 ♂, 19 April [1985]: exam. 1 ♀, 29 September 1985: obs. 11 inds., incl. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2019a); near Čaruh-Dajron [= Čoruh-Dajron], exam. inds. (Medvedev & Polkanov 1997); Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron], two abandoned mines, 17 November 1978: exam. 4 ♂♂, 4 ♀♀, 2 December 1978: obs. 6 inds., incl. 1 ♂, 10 January 1979: obs. 2 inds., 5 January 1980: obs. 10 inds., incl. 5 ♂♂, 2 ♀♀, two mines, 21 January 1980: obs. 6+1 inds., ine, 16 February 1980: obs. 8 inds., incl. 3 ♂♂, 21 April 1980: obs. 8 inds., incl. 3 ♂♂, 8 September 1980: obs. 3 inds., 4 December 1980: obs. 2 inds., 16 December 1984: obs. 3 inds., 30 June 1986: obs. inds., 1 November 1986: obs. 3 inds., 30 September 1987: obs. 6 inds., 12 October 1988: obs. 9 inds., 27 October 1988: obs. 1 ind. (Tadžibaeva & Habilov 2019a); – Kuraminskij [= Kurama] Mountains, near Pangaz kishlak [**14**], abandoned mine, 20 November 1977: coll. 3 ♂♂, 1 ♀ (Habilov 1980), 26 December 1976: exam. 1 ♂ (Habilov 1992), 18 November 1977: exam. 3 ♀♀, 16 December 1979: obs. 5 inds. (Tadžibaeva & Habilov 2018); – mines near Isfara [**15**], January 1983: exam. 16 ♂♂, 20 ♀♀ (Medvedev et al. 1984, Medvedev 1992); foothils of the northern slope of the Turkestanskij [= Turkiston] Mountains, 40°04’N, 70°35’E [= near Isfara], abandoned mine, May 2013: exam. 1 ind. (Orlova & Kazakov 2016); – near Horog [= Horuğ] [**16**], Pamir Biological Institute, 15 June 1985: coll. 3 / 4 ♀♀, 1 ind. (Habilov 1986, 1992); – Takob [= Tagob] river canyon [**17**], mine, 13 October 1986: coll. 1 ♀ (Malinovskij 1988); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Kul′kent [= Kūlkand] [**18**], abandoned mine, 14 June 1978: exam. 1 ♂, 16 June 1979: exam. 1 ♂, 1 ♀, 24 April 1980: exam. 1 ♂,

1 / 4 ♀♀ (Habilov 1992, Habilov & Tadžibaeva 2020c), mine 5, 14 July 2012: exam. 1 ♀ (Habilov & Tadžibaeva 2013, 2020c, Tadžibaeva 2015), mine 2, 14 July 2012: obs. 6 inds., incl. 1 ♀, mine 3, 14 July 2012: exam. 8 ♀♀ (Habilov & Tadžibaeva 2013, 2020c, Tadžibaeva 2015, 2018), mine 2, 9 July 2013: obs. 3 inds., incl. 2 ♀♀, mine 3, 9 July 2013: obs. 1 ind. (Tadžibaeva 2015, Habilov & Tadžibaeva 2020c), mine 2, 21 June 2017: obs. 1 ind., mine 3, 21 June 2017: exam. 1 ♀, mine 5, 22 June 2017: obs. 21 inds., incl. 3 ♂♂, 12 / 16 / 18 ♀♀ (Tadžibaeva & Habilov 2017c, Habilov & Tadžibaeva 2020c), mine 5, 20 February 2015: exam. 1 ♂ (Tadžibaeva 2018), mine 2, 21 August 2014: obs. 5 inds., 3 ♂♂, 1 ♀ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine, 29 April 1978: obs. 21 inds., incl. 5 ♂♂, 1 ♀, 5 May 1979: exam. 1 ♀, 1 July 1979: exam. 1 ♂, 21 June 1980: exam. 2 ♂♂, 17–18 April 1982: exam. 1 ♀, 17 May 1983: obs. 2 inds., 17 June 1986: exam. 1 ♀, 31 May 2018: obs. 8 inds., incl. 7 ♀♀, 5 June 2018: exam. 10 ♀♀ (Habilov & Tadžibaeva 2020c, cf.); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near DÈU-50 [**19**], 9 April 1977: exam. 1 ♂, 1 ♀, 1 August 1980: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018), abandoned mine, 1 August 1980: exam. 1 ♂, 1 ♀ (Habilov & Tadžibaeva 2013); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, near Kim (Belesenyk Range) [**20**], 4 February 1979: exam. 1 ♂, 6 May [1979]: exam. 1 ♂ (Habilov 1992, Tadžibaeva 2018); – southern slope of the Turkestanskij [= Turkiston] Mountains, near Majkata [= Majkatta] kishlak [**21**], deep vertical cleft, 20 June 1979: obs. 1 ind. (Habilov 1992, Tadžibaeva & Habilov 2017a); – Zeravšanskij [= Zarafšon] Mountains, near Pančrud [= Pançrud] [**22**], 2000–2500 m a. s. l., two mines, 21 August 1977: obs. 1 ind., exam. 1 ♂ (Habilov 1992, Tadžibaeva & Habilov 2017a); – Zeravšanskij [= Zarafšon] Mountains, Vagaždon [= Vağašton] [**23**] (Habilov 1992); – Zeravšanskij [= Zarafšon] Mountains, Rašna [= Rašnai Poën] [**24**], five mines, 22 June 1979: exam. 2 ♂♂ (Habilov 1992, Tadžibaeva & Habilov 2017a); – Zeravšanskij [= Zarafšon] Mountains, Džilau [**25**], 2000 m a. s. l., two mines, 14 February [1979]: obs. 5+30 inds. (Habilov 1992, Tadžibaeva & Habilov 2017a); – Volč′e canyon, between Mahou-Tau [= Mahoutau] Mountains and the Kajrakkumskoe [= Baḫri Toçik] dam [**26**], June–July 1990: exam. 2 ♂♂ (Habilov 1995); – Čarku [= Čorkuḫ] [**27**], mine, 3 July 1988: 4 ♂♂, NMP, leg. J. Červený, A. Červená & J. Obuch (Benda et al. 2011); – Šingdar′â [= Šing] river right bank, 10 km above Šing [**28**], mine, 12 February 1979: obs. 18 inds., incl. 10 ♂♂, 5 ♀♀ (Tadžibaeva & Habilov 2017a); – Kuraminskij [= Kurama] Mountains, Kansaj [**29**], 9 November 1977:

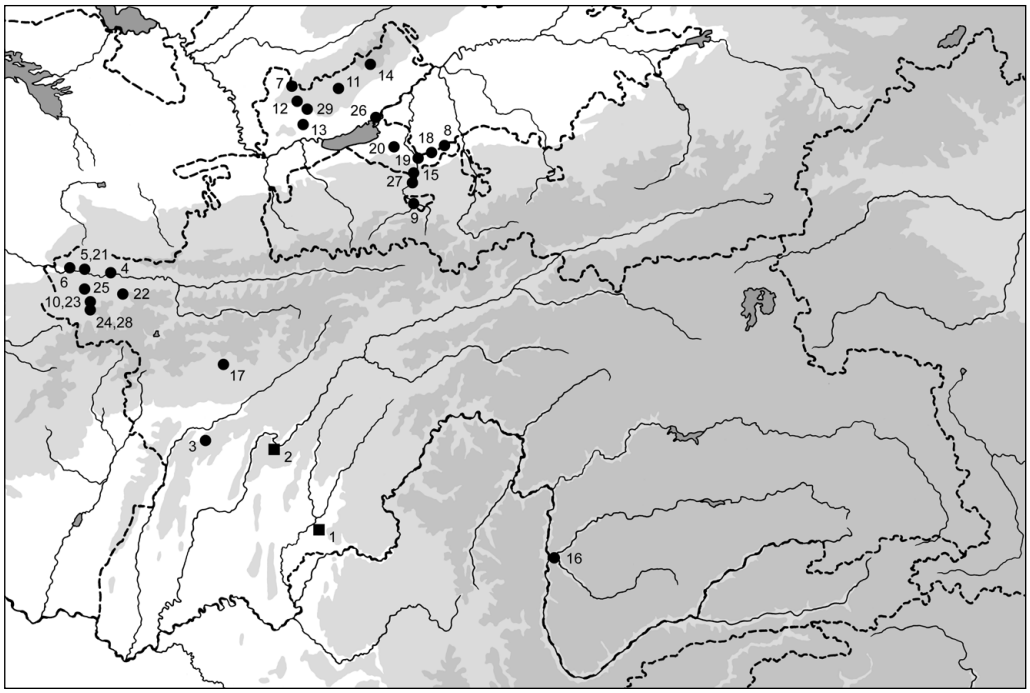


Fig. 119. Records of *Barbastella caspica* Satunin, 1908 in Tajikistan; squares – new records, circles – published records.

exam. 1 ♂ (Tadžibaeva & Habilov 2018); – Tadžikistan [= Tajikistan, no exact loc.], 1943: 6 inds., ZIN (Habilov 1992); Tajikistan, [no exact loc.], 2 ♂♂, 2 ♀♀, 5 inds., ZIN, ZMMU (Kruskop 2015).

Distribution. *Barbastella caspica* is an endemic of arid steppes and mountain plateaus of southern West Turkestan, western East Turkestan, south-eastern Transcaucasia, and the central and northern parts of Iran (Bobrinskoj 1925, 1929, Kuzâkin 1965, Butovskij et al. 1985, Rybin et al. 1989, Benda et al. 2012, Smirnov et al. 2021). The Tajikistani occurrence area of *B. caspica* represents a part of the southern margin of the whole distribution range of the species, this bat is not known from Afghanistan (although its occurrence there is very likely; Benda & Gaisler 2015). This range margin continues from southern Tajikistan westwards to southern Turkmenistan and northern Iran and north-eastwards to southern Kirghizstan and western East Turkestan. The south-western Tien-Shan mountain system of northern Tajikistan and southern Kirghizstan (sensu Merzlyakova 2002) is the part of the distribution range of *B. caspica* with most densely documented occurrence (see Smirnov et al. 2021). The northernmost localities of this bat are known from south-eastern Kazakhstan (Butovskij et al. 1985).

Our new records from Tajikistan contribute slightly to the depiction of the eastern margin of the species range in West Turkestan; until now, *B. caspica* was only marginally known from the south-western section of the country (Fig. 119). In the Amudarë Basin in its broad sense, this bat remained almost unknown, only a single record from its northern margin was available – from the Viloâti Hatlon pass (Bogdanov 1952). Our two records of *B. caspica* from south-western Tajikistan represent the first findings of this bat from low to medium altitudes (around 900 m a. s. l.) of the southern part of the country (Fig. 119) where only one record was available so far, from more than 2000 m a. s. l. near Horuğ (Habilov 1986).

In Tajikistan, *B. caspica* ranks among common bats (Fig. 119), at least 29 record sites are known mostly from the western section of the country. The Tajikistani range of *B. caspica* is divided into two parts, the northern and central-southern sections (Fig. 119). However, the geographical gap between these sections seems to be rather an artificial result of less effort in the search of roosts of this bat than a real absence of its occurrence; *B. caspica* is known solely from its roosts in Tajikistan and two thirds of these roosts represent hibernacula. The localities are situated mainly in the medium and high altitudes of the country; the available records come from a rather wide altitudinal range of 1843 m, some two thirds of the records were made at the sites above 1000 m a. s. l. (Fig. 10, Table 3). Our two records comprise a very small altitudinal range of just 35 m, the altitudinal distribution of these sites is relatively low, considering the whole distribution range of *B. caspica* in Tajikistan (median 914.5 m vs. 1189.0 m; see Fig. 11, Table 4).

Echolocation. The echolocation calls of *Barbastella caspica* were recorded at one site during our research in Tajikistan. In total, 49 echolocation pulses of three handled bats collected inside a day roost, a loess cavity at Qarağoč, were measured and these recordings gave the first data on the echolocation parameters in this species. The bats of the genus *Barbastella* are typical in production of two call types, commonly named type A and type B (Denzinger et al. 2001, Seibert et al. 2015, Young et al. 2018). Since the call type B is emitted only during the searching flight of a bat, we were able to record just the call type A in the handled bats. The recorded calls of *B. caspica* are represented usually by two harmonics with the first harmonic having the peak frequency in the range of 27.1–39.8 kHz (Table 5, Figs. 120, 121). This frequency range differs from the pattern of the call type A observed in other species of the genus. Two small-sized species of *Barbastella* produce calls of slightly higher values; in the European bat, *B. barbastellus* (Schreber, 1774), the peak frequencies in the range of 29.2–44.7 kHz were reported (Vaughan et al. 1997, Denzinger et al. 2001, Russo & Jones 2002, Obrist et al. 2004, Smirnov et al. 2022c), in the Levantine species *B. leucomelas* (Cretzschmar, 1830), the peak frequencies of the call type A were reported to

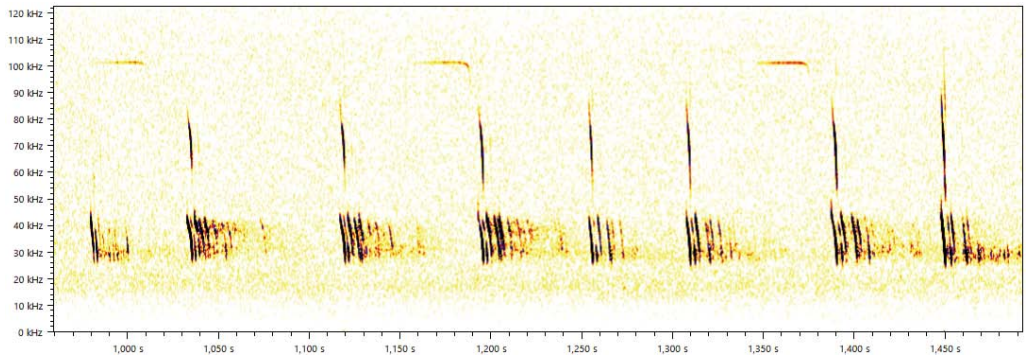


Fig. 120. Spectrogram of the echolocation calls of *Barbastella caspica* Satunin, 1908 and *Rhinolophus bocharicus* Kašenko et Akimov, 1918; individuals foraging at a small lake at Qarağoč, 9 May 2016.

be in a much narrower range of 32.4–37.2 kHz (Benda et al. 2008, 2010a, Hackett et al. 2016). The *Barbastella* species distributed in a geographical proximity to the West Turkestani range of *B. caspica*, the Himalayan species *B. darjelingensis* (Hodgson, 1855), has a slightly higher mean value of the peak frequency (34.8 kHz, mean of pulse duration 5 ms; Chakravarty et al. 2021) than *B. caspica* (mean 31.2 kHz; see Table 5). The last species of the genus with known echolocation parameters, *B. beijingensis* Zhang, Han, Jones, Lin, Zhang, Zhu, Huang et Zhang, 2007 showed the peak frequency at around 39.4 kHz (Zhang et al. 2007), also at values higher than in *B. caspica*.

Variation. External and cranial dimensions of the newly collected Tajikistani specimens of *Barbastella caspica* are shown in Table 12. For the material examined see above.

The taxonomic affiliation of the Central Asian populations of the genus *Barbastella* remained rather enigmatic and unresolved for a long time and there still are some uncertainties concerning these bats at present. In West Turkestan, they were originally attributed to *B. barbastellus* (Schreber, 1774), see Radde & Walter (1889) and Tihomirov″ & Korčagin″ (1889), a species currently regar-

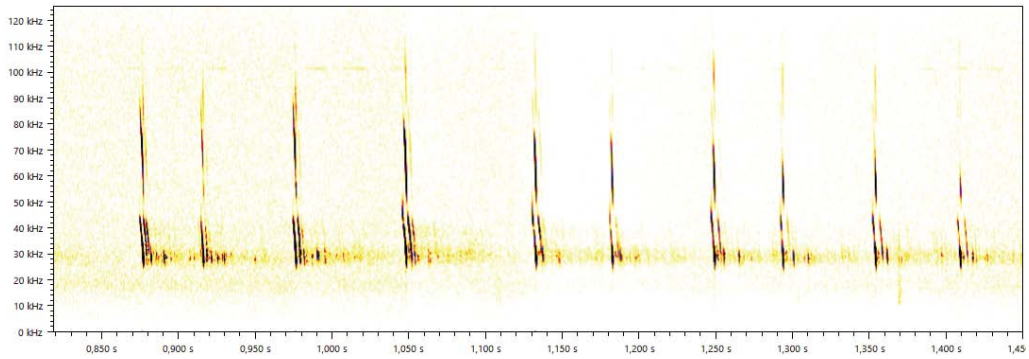


Fig. 121. Spectrogram of the echolocation calls of *Barbastella caspica* Satunin, 1908; an individual foraging at a small lake at Qarağoč, 15 May 2016.

ded to be confined to the temperate forest zone of Europe, the Maghreb, Caucasus region, and Canary islands (Russo et al. 2023). However, exceptionally also some later authors affiliated the Central Asian populations to this name (e.g. Rybin et al. 1989).

For most of the first half of the twentieth century, the name *B. darjelingensis* (Hodgson, 1855) was applied for the populations of West Turkestan (Kaŝenko 1905, Satunin″ 1914, Bil′kevič″ 1918, Kuzâkin 1944, 1950, Bogdanov 1952†, 1953a, 1956a†, b†, Strelkov 1963†, Babaev 1965), less frequently, the name *B. caspica* Satunin, 1908 was used (Bobrinskoj 1925, 1926, 1929, Ognev 1927, 1928, Kuzâkin 1934, Meklenburcev 1935), and just as an irregularity, the name *B. blanfordi* Bìanki, 1917 appeared (Bìanki 1917). However, since the first *Barbastella* was documented from Tajikistan in 1950 (Bogdanov 1952; see above), at that time the taxonomic opinions also concerned the Tajikistani populations *per se* (see crosses [†] for the authors who regarded taxonomic status of the Tajikistani populations in particular). Based on the taxonomic review by Tate (1942), Ellerman & Morrison-Scott (1951) suggested the name *B. leucomelas* (Cretzschmar, 1830) for the Asian populations of the genus and this opinion was generally accepted by subsequent authors also for the populations of West Turkestan and Tajikistan, respectively (Kuzâkin 1965†, Corbet 1978†, Strelkov et al. 1978, Habilov 1979†, 1980†, 1986†, 1992†, 1995†, 2003†, Strelkov 1981†, Strelkov & Šajmardanov 1983, Butovskij et al. 1985, Pavlinov & Rossolimo 1987†, 1998†, Malinovskij 1988†, Koopman 1993†, 1994†, Borisenko & Pavlinov 1995†, Kaškarov & Mitropol′skaâ 2004, Simmons 2005†, Habilov & Tadžibaeva 2013†, Tadžibaeva 2015†, Habilov et al. 2016, Saidov et al. 2017†).

However, based on the results of morphological and molecular genetic analyses, Benda et al. (2008) demonstrated the name *B. leucomelas* to be applicable only for the *Barbastella* populations of a limited region of the southern Levant, Sinai, and adjacent areas on both sides of the Red Sea, while they found the European and Central Asian populations to represent two separate species. They suggested the latter populations, living from Transcaucasia to the eastern Himalayas, to be named *B. darjelingensis*, applying a name that was in use several decades ago. However, this name remained in use for the populations of West Turkestan and adjacent areas only for several years (Benda et al. 2011†, 2012, Orlova et al. 2015a†, Tadžibaeva & Habilov 2016b†, Habilov & Tadžibaeva 2018†), until Kruskop (2015) presented morphometric and genetic differences between the Indian and Turkestani *Barbastella* populations. These results showed the name *B. darjelingensis* unassignable to the Turkestani bats, which instead have to bear the name *B. caspica*. This taxonomic opinion was then broadly accepted, namely concerning the West Turkestani populations (Habilov & Tadžibaeva 2016b†, 2019a†, 2020a†, b†, c†, d†, 2021a†, c†, Tadžibaeva & Habilov 2017a†, b†, c†, 2018†, 2019a†, d†, López-Baucells 2019c, Yusefi et al. 2019, Dundarova et al. 2021) and is followed also here. According to this taxonomic view, *B. caspica* is a monotypic species, inhabiting a limited range of the arid regions of Central Asia (Kruskop 2015, López-Baucells 2019c), extent of this range corresponds roughly to the range of *Eptesicus ognevi* (see above).

An additional taxonomic opinion has been suggested recently, when Smirnov et al. (2020) and Zarei et al. (2022) compared the *Barbastella* samples from eastern Russian Caucasus (Dagestan) and north-western Iran (Qazvin Province) and found them to differ in their genetic traits from the Turkestani samples, but not in their morphometric characters. While Zarei et al. (2022) only stated that the Iranian populations are related more closely to *B. leucomelas* than to *B. caspica*, Smirnov et al. (2020) suggested to split the contents of *B. caspica* sensu Kruskop (2015) into two species and to name the West Turkestani populations *B. walteri* Bìanki, 1917 and the Caucasian populations *B. leucomelas* (with *B. caspica* as a junior synonym). Since *B. caspica* was described by Satunin″ (1908: 43) based on a specimen from eastern Azerbaijan (type locality: dolina r. Pirsagat″, sel. Kubaly = Pirsaat river valley, Qubalıbalaoğlan village, Hacıqabul District; 40°07'N, 49°03'E), in the area neighbouring Dagestan, Smirnov et al. (2020) concluded that the Turkestani populations

has to be named *B. walteri*, based on a specimen collected in eastern Turkmenistan (Bìanki 1917: lxxv) with the type locality Tahta-Bazar (= Tagtabazar, Mary Province; 35°58'N, 62°54'E). This view was followed by Habilov & Tadžibaeva (2021b†) and Smirnov et al. (2021†).

However, we consider these conclusions as premature, since none of the type specimens (nor topotype samples) were examined to support them, the differences were found only in a small portion of the mitochondrial marker (609 bp of the cytochrome *b* gene) and the available morphological evidence does not support these conclusions. It is not clear whether the differences found among few specimens consider the whole populations, and mainly the topotype populations, and thus, whether such a finding has any taxonomic relevance. Although it cannot be excluded that the given populations indeed represent two different taxa, now we do not regard this opinion as well supported. A more complex additional research is necessary to support this conclusion. Therefore, we accept here the opinion by Kruskop (2015) about the taxonomic affiliation of the Tajikistani populations of the *Barbastella* bats.

Records of ectoparasites. **Original data**: N y c t e r i b i i d a e: *Basilia mongolensis*: 1 ind. [A], from 3 ♂♂, 2 ♀♀ (NMP 95748, 95749, HSU pb6226–6228), Qarağoč, loess cavity, 15 May 2016; – S p i n t u r n i c i d a e: *Spinturnix punctata*: 1 ♀ ad, 1 ♂ ad, 2 inds. damaged [P, A], from 3 ♂♂, 2 ♀♀ (NMP 95748, 95749, HSU pb6226–6228), Qarağoč, loess cavity, 15 May 2016. – M a c r o n y s s i d a e: *Macronyssus barbastellinus*: 1 ♀ from 1 ♂, 1 ♀ (NMP 95753, HSU pb6234–6235), Hoça Šaqiqi Balhi, Danğara tunnel, 17 May 2016. – *Ornithonyssus flexus*: 1 ♀, 2 protonymphs [P], from 1 ♂, 1 ♀ (NMP 95753, HSU pb6234–6235), Hoça Šaqiqi Balhi, Danğara tunnel, 17 May 2016. – **Published data**: I s c h n o p s y l l i d a e: *Ischnopsyllus petropolitanus*: 1 ♀, mines near Isfara, January 1983 (Medvedev 1992); – *Nycteridopsylla oligochaeta*: 35 ♂♂ ad, 31 ♀♀ ad, mines near Isfara, January 1983 (Medvedev et al. 1984, Medvedev 1992); – near Čaruh-Dajron [= Čoruh-Dajron] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997); – Dobita near Adrasman [= Adrasmon] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997); – vicinity of Pendžikent [= Pançakent] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997). – S p i n t u r n i c i d a e: *Spinturnix punctata*: 2 ♂ ad, 1 ♀ ad, 1 nymph, foothils of the northern slope of the Turkestanskij [= Turkiston] Mountains, 40°04'N, 70°35'E [= near Isfara], abandoned mine, May 2013, leg. M. V. Orlova (Orlova & Kazakov 2016).

Comments on ectoparasites. In *Barbastella caspica*, a medium broad variety of ectoparasites was documented in Tajikistan, at least five species of four families were found in total.

The flea species *Ischnopsyllus petropolitanus* (Wagner, 1898) is distributed in mountains of the central-southern part of the Palaearctic (Medvedev & Polkanov 1997, Scheffler et al. 2010). In West Turkestan, the principal host of this parasite is *Plecotus strelkovi* (Medvedev & Polkanov 1997), see under the latter bat species for details (it was recorded also from *Hypsugo savii*).

The bat flea *Nycteridopsylla oligochaeta* Rybin, 1961 is an endemic of Central Asia, its records are available from Uzbekistan (Toshkent), northern Tajikistan (four sites, see above), southern Kirghizstan (Oš), and eastern Afghanistan (Hůrka 1970, Medvedev et al. 1984, Medvedev & Polkanov 1997). The principal host of this flea is *B. caspica* (Medvedev 1992), although we did not collect any flea from this bat in Tajikistan (this could have been caused by the period of the research trip, since the adult stages occur only in hibernating bats). From this host species, also the type series of *Nycteridopsylla singula* Rybin, 1991 was collected in Kirghizstan (Kan-i-Gut cave; Rybin 1991).

The bat fly genus *Basilia* Miranda-Ribeiro, 1903 represents parasites of the tree-dwelling bat species, its nominate species *Basilia mongolensis* Theodor, 1966 was collected at two sites in Tajikistan from *Myotis davidii* and at one site from *Barbastella caspica*, both these bat species are regarded principal hosts of this bat fly. The distribution range of this species as well as its other host potential is not well studied.

One species of mesostigmatic mite was recorded from *B. caspica* in Tajikistan, *Spinturnix punctata* (Sundevall, 1833). It represents an Eupalaearctic oligoxenic species associated with bats of the genus *Barbastella* (Uchikawa et al. 1994, Deunff et al. 1997, Orlova & Kazakov

2016) and its records were made in western Europe, the Baltic states, Caucasus, West Turkestan (Kirghizstan, Tajikistan), and the Russian Far East (Rudnick 1960, Dusbábek & Pinčuk 1971, Rybin 1983, Stanûkovič 1990, Medvedev et al. 1991).

The bats of the genus *Barbastella* are reported to be principal hosts of an oligoxenous dermanysoid mite species of the family Macronyssidae, *Macronyssus barbastellinus* Dusbábek et Pinčuk, 1971. Its distribution is known from central Europe, Moldavia, and southern Kirghizstan (Dusbábek & Pinčuk 1971, Haitlinger 1978, Rybin 1983), our new record from Tajikistan is thus confirmation of the host preference, and it also demarcates the south-eastern limits of the known distribution range.

Another macronyssid mite species *Ornithonyssus flexus* (Radovsky, 1967) was documented from Tajikistan from *B. caspica* (our data) and from *Myotis davidii* (Stanyukovich 1997; see above). The genus *Barbastella* is a new host genus of this mite, till now collected from the bat genera *Myotis*, *Eptesicus*, *Pipistrellus*, *Plecotus*, and *Vespertilio* (see Stanyukovich 1997).

Plecotus strelkovi Spitzenberger, 2006

Records. **Published data**: Darvaz″ [= Darvoz Mountains], Teharf [= Teharv] kishlak [**1**], Vanč [= Vanç] river, 23 July [= 4 August NS] 1889: coll. 4 ♀♀, ZIN, leg. B. Grombčevskij (Satunin″ 1910, Bobrinskoj 1925, Habilov 1986); Darvaz [= Darvoz Mountains] (Bogdanov 1953a); Darvaz [= Darvoz Mountains], 1889: 2 inds., ZIN, leg. Grombčevskij (Spitzenberger et al. 2006, Benda & Gaisler 2015); Vanch [= Vanç] river, S Tekharv, 1 ind., ZIN (Spitzenberger et al. 2006); – near Stalinabad [= Dušanbe] [**2**], 1932, leg. Parasitological Section of the Tajikistan Complex Expedition (Vinogradov 1935); near Stalinabad [= Dušanbe] (Bogdanov 1953a); Dushanbe [= Dušanbe], 22 April 1932: 1 ♂, ZIN (Spitzenberger et al. 2006, Benda & Gaisler 2015); – Horog [= Horuğ] [**3**], a canyon at the confluence of the Šah-Dar′â [= Šahdara] and Gunt rivers, summer 1937: remains of 3 skulls in *Bubo bubo* pellets (Kornev 1941); – Kuraminskij [= Kurama] Mountains, near Altyn-Topkan / Zarnisor [**4**], abandoned mine, 17 December 1978: coll. 1 ♂ (Habilov 1979, 1992, Tadžibaeva & Habilov 2018), 2 April 1977: exam. 1 ♀ (Habilov 1980), juniper tree zone, 1590 m a. s. l., abandoned mine, 5 February 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2016b, 2017b, 2018), 17 June 1979: exam. 1 ♂ (Tadžibaeva & Habilov 2018); – northern slope of the Turkestanskij [= Turkiston] Mountains, Guzlon Range, near Dahana [**5**], 1020 m a. s. l., abandoned mines, mine 4, 21 March 1976: coll. 1 ♂, 4 April 1976: coll. 1 ♂, mines 13+14, 18 April 1977: coll. 2 ♂♂ (Habilov 1980, 1992, Habilov & Tadžibaeva 2014b, 2020a, Tadžibaeva 2018), mine 13, 8 May 1977: obs. 30 inds., incl. 3 ♂♂, 23 ♀♀ (Habilov 1982, 1992, Habilov & Tadžibaeva 2014b, 2020a), mine 6, 8 May 1978: obs. 30 inds., incl. 2 ♂♂, 22 ♀♀ (Habilov 1992, Habilov & Tadžibaeva 2014b, 2020a), mine 4, 25 July 1976: obs. 30 inds., incl. 4 / 5 ♂♂, 13 / 14 ♀♀, 14 / 15 May 1977: obs. 40 inds., incl. 1 / 2 ♂♂, 3 / 31 ♀♀, 12 June 1977: obs. 2 colonies, incl. 1 / 3 ♂♂, 6 / 13 ♀♀, mine 6, 13 June 1976: exam. 2 ♂♂, 1 ♀, mine 4, 6 July 1976: obs. 30 inds., incl. 4 ♂♂, 9 ♀♀, mine 13, 11 July 1976: obs. 35 inds., incl. 4 / 7 ♂♂, 1 / 10 ♀♀, mine 13, 25 July 1977: exam. 1 / 9 ♂♂, 1 / 12 ♀♀ (Habilov 1982, 1992, Habilov & Tadžibaeva 2014b, 2020a, Tadžibaeva 2018), mine 4, 8 May 1978: obs. 40 inds., incl. 1 / 4 ♂♂, 32 ♀♀, mine 4, 10 June 1978: exam. 2 ♂♂, 3 ♀♀, 19 June 1978: exam. 1 ♀ (Habilov 1992, Habilov & Tadžibaeva 2014b, 2020a, Tadžibaeva 2018), mine 14, 13 July 2012: obs. a colony of ca. 20 inds., incl. 1 ♂, 3 ♀♀ (Habilov & Tadžibaeva 2013, 2014b, Khabilov & Tadzhibaeva 2013, Tadžibaeva 2018), mine 4, 24 April 1976: obs. 4 inds. incl. 1 ♂, 2 ♀♀, 19 September 1976: exam. 4 ♂♂, 3 ♀♀, 10 April 1977: exam. 1 ♂, 1 ♀, 11 November 1978: exam. 1 ♂, 21 October 1979: exam. 1 ♂, 1 ♀, 19 June 1980: obs. 18 inds., incl. 5 ♂♂, 11 ♀♀, 20 October 1980: exam. 1 ♀, 18 January 1981: obs. 1 ind., 12 June 1987: obs. 18 ♀♀, mine 6, 22 May 1977: obs. 8 inds., incl. 2 ♂♂, 1 ♀, mine 4, 16 October 1977: exam. 1 ♂, mine 6, 16 October 1977: exam. 1 ♂, 19 June 1980: obs. 8 inds., incl. 4 ♀♀, mine 13, 1 August 1980: obs. 70 inds., incl. 18 ♂♂, 39 ♀♀ (Habilov & Tadžibaeva 2014b, 2020a, Tadžibaeva 2018), mine 4, 21 April 2013: obs. 6 inds., 17 May 2013: obs. 10 inds., 9 September 2013: obs. 5 inds., incl. 1 ♂, 2 ♀♀, mine 14, 15 July 2012: obs. 2 inds. (Habilov & Tadžibaeva 2014b, 2020a), mine 6, 2 November 2014: exam. 1 ♂ (Tadžibaeva 2018), mine 4, 23 August 2014: exam. 1 ♀, 10 October 2014: exam. 1 ♂, 1 August 2015: exam. 1 / 2 ♀♀ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020a), mine 4, 18 April 1976: exam. 2 ♂♂, 13 June 1976: exam. 2 ♂♂, 1 ♀, 11 July 1976: exam. 1 ♂, ♀, 8 May 1977: exam. 2 ♂♂, 3 ♀♀, 25 July 1977: exam. 1 ♂, ♀, 14 September 2017: exam. 2 ♀♀, 5 July 2019: exam. 1 ♂ (Habilov & Tadžibaeva 2020a); – Kuraminskij [= Kurama] Mountains, near Pangaz kishlak [**6**], abandoned mine, 26 December 1978: coll. 1 ♀ (Habilov 1980, 1992), 20 November 1977: exam. 1 ♂, 1 ♀, 17 June 1979: exam. 1 ♂ (Habilov 1992), 18 November 1978: exam. 2 ♂♂, 27 January 1980: exam. 1 ♀19 October 2015: exam. 2 ♂♂ (Tadžibaeva & Habilov 2018); – Kuraminskij [= Kurama] Mountains, near Adrasman [= Adrasmon] [**7**], 2 January 1977: coll. 1 ♂ (Habilov 1980), 26 May 1979: exam. 1 ♂ (Habilov 1992), 20 November 1977: exam. 1 ♂, 1 ♀, Gulšan, mine, 15 January 2016: exam. 1 ♂ (Tadžibaeva & Habilov 2018); – [northern] slope of the Zeravšan [= Zarafšon] Mountains, near Šing [**8**], abandoned mine, 1700 m a. s. l., 23 February

1977: coll. 1 ♂, 30 April 1977: coll. 1 ♂, 1 ind. / 2 ♂♂ (Habilov 1980, 1992, Tadžibaeva & Habilov 2017a); – foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, Guzlon Range, near Kul′kent [= Kūlkand] [**9**], mine 3, 26–28 June 1977: exam. 1 ♂, 14 ♀♀ (Habilov 1982, 1992, Habilov & Tadžibaeva 2014b, 2020c), mine 1, 28 June 1977: obs. 12 inds., incl. 1 ♂, 3 ♀♀, mine 2, 28 June 1977: exam. 1 ♂ (Habilov 1992, Habilov & Tadžibaeva 2014b, 2020c), mine 1, 29 April 1978: obs. 50 / 71 inds., incl. 1 ♂, 1 / 43 / 63 ♀♀, 14 June 1978: obs. 40 inds., incl. 1 / 3 / 4 ♂♂, 7 / 31 / 20 ♀♀ (Habilov 1992, Habilov & Tadžibaeva 2014b, 2020c, Tadžibaeva 2018); mines near Isfara, May 1983: obs. a colony, exam. 267 inds. (Medvedev et al. 1984, Medvedev 1992); foothills of the northern slope of the Turkestanskij [= Turkiston] Mountains, Guzlon Range, near Kul′kent [= Kūlkand], mine 3, 14 July 2012: obs. 6 inds., incl. 2 ♂♂, 2 ♀♀, mine 4, 14 July 2012: exam. 1 ♀, mine 5, 14 July 2012: obs. a colony of 55–60 inds., incl. 9 / 10 ♂♂, 28 / 29 ♀♀ (Habilov & Tadžibaeva 2013, 2014b, 2020c, Khabilov & Tadzhibaeva 2013, Tadžibaeva 2018), mine 5, 19 June 1978: exam. 2 ♂♂, 22 ♀♀, mine 1, 29 August 1978: obs. 28 inds., incl. 4 ♂♂, 16 ♀♀, mine 2, 29 August 1978: obs. 30 inds. incl. 10 ♂♂, 13 ♀♀, mine 1, 5 May 1979: exam. 2 ♂♂, 41 ♀♀, mine 2, 5 May 1979: obs. 50 inds., incl. 1 ♂, 36 ♀♀, mine 3, 5 May 1979: obs. 60 inds., incl. 2 ♂♂, 48 ♀♀, mine 1, 16 June 1979: obs. 20 inds., incl. 2 ♂♂, 12 / 13 ♀♀, mine 2, 1 July 1979: obs. 15 inds., incl. 4 ♂♂, 4 ♀♀, mine 3, 1 July 1979: obs. 10 inds., incl. 3 ♀♀, mine 4, 1 July 1979: exam. 2 ♂♂, 17 ♀♀, mine 1, 24 April 1980: obs. 30 inds., incl. 1 ♂, 7 ♀♀, mine 2, 24 April 1980: exam. 1 ♂, 33 ♀♀, mine 3, 24 April 1980: obs. a colony of 30 ♀♀, mine 4, 24 April 1980: obs. a colony of 40 ♀♀, mine 5, 24 April 1980: exam. 2 ♂♂, 28 ♀♀, mine 1, 17 April 1982: exam. 1 ♂, 8 ♀♀, mine 2, 18 April 1982: obs. 25 inds., incl. 1 ♂, 19 ♀♀, mine 1, 8 June 1982: obs. 26 inds., incl. 20 ♀♀, 17 May 1983: exam. 17 ♀♀, mine 2, 17 May 1983: exam. 4 ♂♂, 44 ♀♀, mine 3, 17 May 1983: obs. a colony of 47 ♀♀, mine 4, 25 May 1983: exam. 1 ♂, 9 ♀♀, mine 5, 25 May 1983: obs. 12 inds., incl. 1 ♂, 7 ♀♀, mine 1, 17 June 1986: obs. 6 inds., incl. 3 ♀♀, mine 2, 17 June 1986: obs. 3 inds., incl. 2 ♂♂, mine 4, 17 June 1986: obs. 10 ♀♀, mine 5, 21 June 1986: obs. 9 inds., incl. 4 ♂♂, 4 ♀♀, mine 2, 17 June 1987: obs. 6 ♀♀ (Habilov & Tadžibaeva 2014b, 2020c), mine 2, 9 July 2013: exam. 2 ♂♂, 2 / 3 ♀♀ (Habilov & Tadžibaeva 2014b, 2020c, Tadžibaeva 2018), mine 3, 21 June 2017: exam. 5 ♂♂, 27 ♀♀, mine 4, 22 June 2017: obs. 10 inds., incl. 2 ♀♀

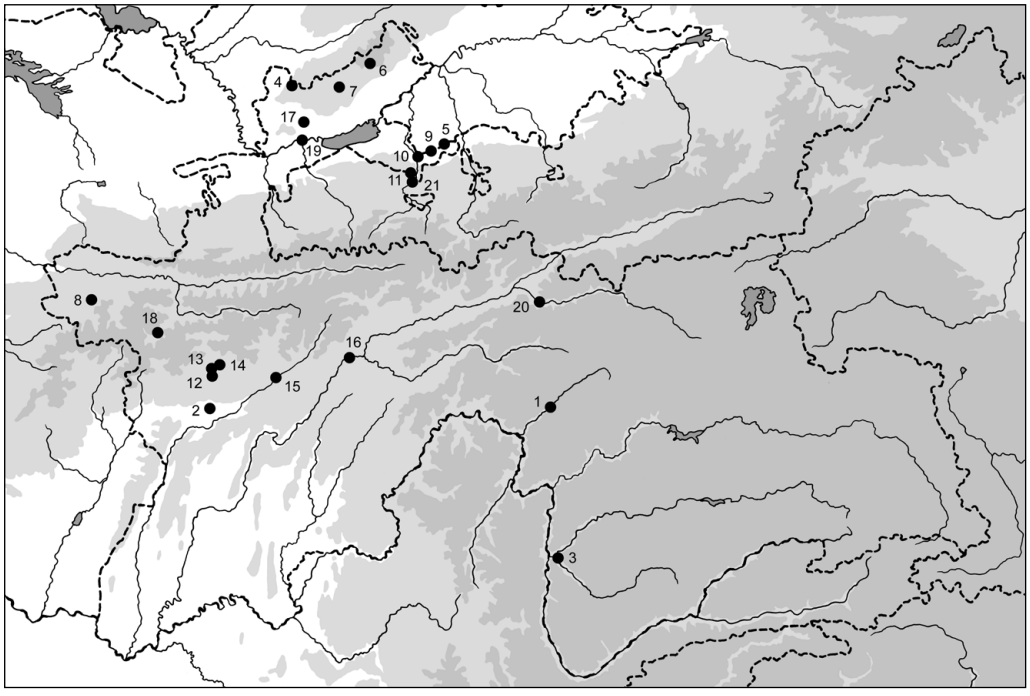


Fig. 122. Records of *Plecotus strelkovi* Spitzenberger, 2006 in Tajikistan.

(Tadžibaeva & Habilov 2017c, Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine, 21 August 2014: exam. 1 ♂ (Tadžibaeva 2018, Habilov & Tadžibaeva 2020c), mine, 25 May 1985: obs. 43 inds., incl. 4 ♂♂, 31 ♀♀, 31 May 2018: obs. 15 inds., incl. 1 ♂, 1 ♀, 5 June 2018: obs. 49 inds., incl. 12 ♂♂, 29 ♀♀ (Habilov & Tadžibaeva 2020c); – 11 km north-west [= north-east] of Isfara / near DÈU-50 [**10**], 9 April 1977: obs. 53 inds., incl. 1 / 3 ♂♂, 2 / 30 ♀♀, 26 July 1977: exam. 1 ♂ / 1 ♀ (Habilov 1982, 1992, Tadžibaeva 2018); mines near Isfara, August 1982: exam. 51 inds. (Medvedev et al. 1984, Medvedev 1992); 11 km north-west [= north-east] of Isfara / near DÈU-50, 4 May 1979: exam. 1 ♀, 24 August 1982: exam. 1 ♀, 30 August 1982: exam. 1 ♀ (Habilov 1992, Tadžibaeva 2018); – near Šurab [**11**], near Isfara, abandoned mine, 5 June 1977: exam. 1 ♀ (Habilov 1982); – Varzob river valley [**12**] (Malinovskij 1988); – Kondara river valley [**13**] (Malinovskij 1988); – Takob [= Tagob] river valley [**14**] (Malinovskij 1988); – Sardaimiena river valley [**15**] (Malinovskij 1988); – 150 km east of Dušanbe, Komsomolabad [= Darband] district [**16**], March 1979: net. 1 ind., leg. R. Muratov (Habilov 1992, Habilov & Tadžibaeva 2014b, Tadžibaeva & Habilov 2019b); – Mogol-Tau [= Mogoltau] Mountains, near Čajruh-Dajron [= Čoruh-Dajron] [**17**], in the 1970s, 1 ind. (Habilov 1992, Tadžibaeva & Habilov 2019a); near Čaruh-Dajron [= Čoruh-Dajron], exam. inds. (Medvedev & Polkanov 1997); – Gissarskij [= Ḩisor] Mountains, near Iskanderkul′ [= Iskandarkūl lake] [**18**], 1 ind., leg. Û. V. Ŝerbin (Habilov 1992); – Khudshand [= Huçand] [**19**], 2 inds., ZIN (Spitzenberger et al. 2006); near Khudshand [= Huçand], 1976: 2 inds., ZIN (Spitzenberger et al. 2006); northern Tajikistan, 1976: 1 ♂, 1 ♀, ZIN, leg. T. Habilov (Benda & Gaisler 2015); – Muk [**20**], 1 ind., ZIN (Spitzenberger et al. 2006); Petra Pervogo [= Pëtri Âkim] Mountains, 6 July 1974: 1 ind., ZIN, leg. S. Isakov (Benda & Gaisler 2015); – Čorkuh [= Čorkuḩ] [**21**], Isfara district, April 1963: 1 ♂, ZIN (Benda & Gaisler 2015).

Distribution. *Plecotus strelkovi* ranks among medium-frequent bats of Tajikistan (Fig. 122), 21 record sites are known from the country. It is the only species of rather common bats of Tajikistan that was not documented during our research. This species is distributed in the mountainous regions of Central Asia, from Iran and Afghanistan through Turkestan to western Mongolia (Spitzenberger et al. 2006). It is the only *Plecotus* species that is known to occur in the eastern part of West Turkestan – in Tajikistan, Kirghizstan, south-eastern Uzbekistan, and south-eastern Kazakhstan. The Tajikistani part of the distribution range of *P. strelkovi* thus represents a central segment of the belt of its occurrence stretching from the south-west to the north-east, along the western slopes of the highest mountains of Central Asia (Bobrinskoj 1925, 1926, Ognev 1928, Habilov 1992, Dolch et al. 2007, 2021b, Benda & Gaisler 2015). The mountain systems of the Tien-Shan and Pamirs represent the geographical centre of the distribution range of *P. strelkovi* and its records are most abundant there.

In Tajikistan, *P. strelkovi* was found in two areas separated by high altitudes of the Turkiston Mountains, in the lowlands and rather low mountains of the north-western part of the country adjacent to the Sirdarë river basin, and in rather elevated mountainous parts of the central and south-eastern parts of the country, in the Zarafšon and Ḩisor Mountains and in the western Pamirs (Fig. 122). The available records come from a rather wide altitudinal range of 1871 m, most of the records were made at the sites above 1000 m a. s. l., i.e. in medium high to high areas of Tajikistan (Fig. 10, Table 3). Along with *Myotis davidii*, *P. strelkovi* is the only bat species that was recorded repeatedly and from several sites in the mountainous eastern section of Tajikistan (Fig. 122), the median and mean altitudes show *P. strelkovi* to be one of the most montane bat of Tajikistan (1252 m and 1316.5 m a. s. l.; see Table 3, Fig. 10). In 1889, *P. strelkovi* was as the second bat species documented from the Pamirs, after *Eptesicus gobiensis* (Satunin″ 1910, as *P. auritus*); a series of at least eight bats from three sites was collected in these mountains (Fig. 122; Satunin″ 1910, Kornev 1941, Spitzenberger et al. 2006, Benda & Gaisler 2015).

Variation. *Plecotus strelkovi* is currently considered a monotypic species endemic to the semi-arid mountains of Central Asia (Spitzenberger et al. 2006, Benda & Gaisler 2015, López-Baucells 2019c). After its description by F. Spitzenberger (in Spitzenberger et al. 2006), the separate species status of this bat was accepted perhaps universally (see crosses [†] below for the authors who regarded taxonomic status of the Tajikistani populations in particular), and for the *Plecotus* populations of the eastern part of West Turkestan exclusively (Srinivasulu et al. 2010, Benda et al. 2011†, 2012, Datzmann et al. 2012, Srinivasulu & Srinivasulu 2012, Habilov & Tadžibaeva

2013†, 2014b†, 2016b†, 2019a†, 2020a†, c†, d†, 2021a†, b†, c†, Khabilov & Tadzhibaeva 2013†, Benda & Gaisler 2015, Habilov et al. 2016, Tadžibaeva & Habilov 2016b†, 2017a†, b†, c†, 2018†, 2019a†, d†, López-Baucells 2019c, Yusefi et al. 2019, Kruskop et al. 2020, Dolch et al. 2021b, Dundarova et al. 2021, etc.).

However, two other species names were applied besides *strelkovi* Spitzenberger for the latter populations. Originally, most of the Palaearctic populations of the genus *Plecotus*, including those of West Turkestan, were assigned to *P. auritus* (Linnaeus, 1758) (Kaŝenko 1905, Satunin″ 1910†, 1914†, Bobrinskoj 1925†, 1929, Ognev 1927†, 1928†, Bobrinskoi 1931, Kuzâkin 1935, 1944†, 1950†, 1965†, Vinogradov 1935†, Kornev 1941†, Ellerman & Morrison-Scott 1951†, Bogdanov 1953a†, 1956a†, Strelkov 1963†, Babaev 1965, Babaev & Dmitrieva 1966, Habilov 1979†, 1980†, 1982†, Kaškarov & Mitropol′skaâ 2004). Later, they were assigned to one of two recognised species of the Palaearctic defined morphologically, namely to *P. austriacus* (Fischer, 1829) (Hanák 1966†, Corbet 1978†, Strelkov et al. 1978, Strelkov 1980†, 1981†, 1988†, Butovskij et al. 1985, Habilov 1986†, 1992†, 2003†, Pavlinov & Rossolimo 1987†, 1998†, Malinovskij 1988†, Rybin et al. 1989, Koopman 1993†, 1994†, Borisenko & Pavlinov 1995†, Horáček et al. 2000†, Simmons 2005). However, concerning the subspecies level, solely the name *wardi* Thomas, 1911 is used, either earlier as *P. auritus wardi* (Bobrinskoj 1925†, 1929, Ognev 1927†, 1928†, Bobrinskoi 1931, Vinogradov 1935†, Kornev 1941†, Kuzâkin 1944†, 1950†, 1965†, Ellerman & Morrison-Scott 1951†, Bogdanov 1953a†, Strelkov 1963†, Babaev & Dmitrieva 1966), or later as *P. austriacus wardi* (Hanák 1966†, Strelkov 1980†, 1981†, 1988†, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992†, Koopman 1994†, Horáček et al. 2000†). Nevertheless, none of these authors suggested a separate species status for these populations except for Kuzâkin (1935†), who suggested the occurrence of *P. wardi* or an unnamed species in West Turkestan and the Caucasus region, and Aellen (1959a), who considered *P. wardi* to occur in Afghanistan. The opinion on the existence of an endemic species was finally validated by the results of the thorough taxonomic analysis by Spitzenberger et al. (2006†), who however, demonstrated the separate positions of *P. wardi* s.str. occurring in northern Pakistan, Kashmir, northern India, and Nepal, and *P. strelkovi* of eastern West Turkestan, Afghanistan and adjacent areas.

Records of ectoparasites. **Published data**: I s c h n o p s y l l i d a e: *Ischnopsyllus petropolitanus*: 11 inds., mines near Isfara, from 51 inds., August 1982, from 267 inds., May 1983 (Medvedev et al. 1984, Medvedev 1992, Medvedev & Polkanov 1997); – near Čaruh-Dajron [= Čoruh-Dajron] [specimen number and collection date unlisted] (Medvedev & Polkanov 1997). – S p i n t u r n i c i d a e: *Spinturnix plecotina*: 11 ♂♂, 9 ♀♀, 3 protonymphs, Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992). – M a c r o n y s s i d a e: *Steatonyssus* sp.: 1 ind., Tajikistan [site and date unlisted] (Stanûkovič & Malinovskij 1992).

Comments on ectoparasites. In *Plecotus strelkovi*, three species of ectoparasites of three families were documented in Tajikistan.

The flea species *Ischnopsyllus petropolitanus* (Wagner, 1898) is distributed in mountains of the central-southern part of the Palaearctic, in the area from the Caucasus and the lower part of the Volga region in the west to Mongolia in the east (Medvedev & Polkanov 1997, Scheffler et al. 2010). In West Turkestan, this flea occurs in the montane regions up to 2000–3000 m a. s. l. of northern Turkmenistan, northern Tajikistan, eastern Uzbekistan, southern Kirghizstan, and southern and eastern Kazakhstan (Hůrka 1970, 1997, Medvedev & Polkanov 1997). In Tajikistan, the principal host of this flea is *Plecotus strelkovi*, on this species the fleas reproduce, while in the hibernation period it occurs also on *Myotis davidii*, *Hypsugo savii*, and *Barbastella caspica* (Kunickaâ 1968, Medvedev et al. 1984, Medvedev 1992). The records of this flea were made in two mines in the northern part of the country, in both of them from *P. strelkovi*, in one also from *H. savii* and in the other from *B. caspica*. From the latter two species it was collected only during

the hibernation period, while from *P. strelkovi* from maternal colonies roosting in these mines in summer, and this situation again indicates the latter bat as the principal host. The altitude of the sites is rather low, below 900 m a. s. l.

The gamasoid permanent mite *Spinturnix plecotina* (Koch, 1839) represents a well defined species concerning its Palaearctic populations (Rudnick 1960, Uchikawa & Wada 1979, Medvedev 1992). The distribution range of *S. plecotina* corresponds with those of the bat genus *Plecotus* and covers Europe, and central and eastern Asia (Rudnick 1960, Uchikawa et al. 1994). Although the *Plecotus* bats are considered to be a principal host group of *S. plecotina*, its records are reported also from other bat genera, viz. *Rhinolophus*, *Eptesicus*, *Barbastella*, and *Nyctalus* (Rudnick 1960, Uchikawa et al. 1994, Stanyukovich 1997, Uchikawa & Wada 1979).

Stanûkovič & Malinovskij (1992) reported a finding of a mite on the *Plecotus* bat from Tajikistan, belonging to the genus *Steatonyssus* without the species identification. In the Palaearctic, the bat genus *Plecotus* is reported to be a host of the following *Steatonyssus* species: *S. periblepharus* Kolenati, 1858, *S. occidentalis* (Ewing, 1933), *S. spinosus* Wilmann, 1936, and *Ornithonyssus pipistrelli* (Oudemans, 1904) (Radovsky 1967, Stanyukovich 1997). These species have a cosmopolitan type of distribution, any of them could be a candidate for coidentification with *Steatonyssus* sp. by Stanûkovič & Malinovskij (1992).

Miniopterus cf. *pallidus* Thomas, 1907

Records. **Published data**: Ura-Tûbe [= Istaravšan], 21 July 1946: 3 ♂♂, ZIN, leg. V. B. Dubin (Habilov 1983, 1992).

Distribution. The occurrence of bats of the genus *Miniopterus* Bonaparte, 1837 in Tajikistan is based only on specimens discovered in the ZIN collection, Saint-Petersburg, in the early 1980s (Habilov 1983). Three alcoholic specimens were reportedly collected at Istaravšan, northern Tajikistan, in the 1940s.

This only available record from the country is geographically very isolated concerning the known distribution range of *Miniopterus* bats in Asia, it is the northernmost in the central part of Asia and far distant from the regular distribution range. The closest areas of occurrence of these bats in West Turkestan lie in the Kopetdagh Mts. of south-western Turkmenistan and north-eastern Iran (Strelkov et al. 1978, Benda et al. 2012); the aerial distance between Istaravšan and the closest record site in the eastern Kopetdagh Mts. (Mozduran Cave, Iran; Etemad 1967, DeBlase 1980, Steiner & Gaisler 1994, Benda et al. 2012) is ca. 850 km across the Karakum desert. Only slightly more closely situated are the localities in south-western and south-eastern Afghanistan; the closest Afghanistani locality (old town of Jalalabad) is situated ca. 630 km south of Istaravšan, across the highest ranges of the Hindu Kush. The localities known from the lowlands of south-western Afghanistan (Farah, Helmand, Kandahar and Zabol Provinces; see Benda & Gaisler 2015) lie in the minimum aerial distance of 900 km across the Hindu Kush from Istaravšan.

The Tajikistani occurrence of the *Miniopterus* bats was not confirmed by a record in the wild, despite the enormous research effort in bat roosts, namely in northern Tajikistan (see the reviews by Habilov 1992, 2003, Habilov & Tadžibaeva 2021b). Moreover, Habilov (1992: 302) indicated a possible uncertain origin of the ZIN specimens, he mentioned as follows: "These specimens arrived to the collection of the Zoological Institute from a secondary person in 1958 and their original labels did not survive; anyway, I consider necessary to remind such data." [Own translation from Russian*.] On the other hand, Tadžibaeva & Habilov (2021) did not express any doubts concerning

* original text reads as follows (Habilov 1992: 302): "Эти экземпляры поступили в коллекцию Зоологического института в 1958 г. от другого лица, не сохранена также оригинальная этикетка; тем не менее, мы считаем необходимым упоминать эти даные."

the origin of the ZIN specimens of *Miniopterus* (reportedly) from Tajikistan. However, the fixed status of *Miniopterus* in the fauna of Tajikistan seems to be not completely accepted, this bat is not covered by the Red Data Book of Tajikistan (Saidov et al. 2017, Tadžibaeva & Habilov 2022).

Variation. Taxonomic status of the possible Tajikistani populations of the *Miniopterus* bats remains uncertain. Habilov (1983, 1992, 2003) assigned the respective ZIN specimens to *M. schreibersii* (Kuhl, 1817), which was for a long time considered a polytypic bat species, widely distributed across the Old World (Tate 1941b, Ellerman & Morrison-Scott 1951, Corbet 1978, Strelkov 1981, Koopman 1994, Simmons 2005, etc.). However, based on detailed morphometric and molecular genetic analyses, this conception is currently abandoned and four separate species instead of one are recognised only in western Asia (see Šrámek et al. 2013, and the review by Benda & Gaisler 2015). Occurrence of two species is reported from the territories surrounding Tajikistan, *M. fuliginosus* (Hodgson, 1835) from south-eastern Afghanistan and the areas eastwards (Pakistan to Japan), and *M. pallidus* Thomas, 1907 from south-western Afghanistan, whole Iran, south-western Turkmenistan and several regions situated westwards (up to central Turkey and eastern Levant); see the reviews by Benda et al. (2012) and Benda & Gaisler (2015).

Following the revised taxonomy of the genus *Miniopterus*, Habilov & Tadžibaeva (2020d, 2021b) and Tadžibaeva & Habilov (2021) affiliated the reportedly Tajikistani populations to *M. pallidus*. Such a name selection is perhaps based on the species identification of the only other populations of the West Turkestan, i.e. those from Turkmenistan. However, the populations living closest to the reported spot of occurrence in Tajikistan (SE Afghanistan, see above) belong to *M. fuliginosus*. Based solely on the geographical grounds, both mentioned species of *Miniopterus* thus can be met in Tajikistan. Nevertheless, the real species affiliation of the respective populations is possible only after a profound examination of the concerned ZIN specimens.

Tadarida teniotis (Rafinesque, 1814)

Records. **Original data**: Bešai Palangon Reserve (Fig. 123), Tarzan forestry [**1**], 4 May 2016: det. & rec. calls of several foraging inds. (cf. Habilov & Tadžibaeva 2016b); – Levap [**2**], at an old farm, 5 May 2016: det. calls of 2 foraging inds.; – Kūlob [**3**], botanical garden, 6 May 2016: det. calls of several foraging inds., 14 May 2016: det. calls of 1 foraging ind. (cf. Habilov & Tadžibaeva 2016b); – Tuto [**4**], at a small lake, 7 May 2016: det. & rec. calls of 2–3 foraging inds.; – Qarağoč [**5**], at a small lake, 9 May 2016: det. calls of 1–2 foraging inds.; – Sariselom valley, at the Kalpisipar cave [**6**], 10 May 2016: det. & rec. calls of several inds. (cf. Habilov & Tadžibaeva 2016b). – **Published data**: near Stalinabad [= Dušanbe] [**7**], October 1950: coll. 1 ♂, leg. I. D. Ivanenko (Bogdanov 1952, 1953a); – Anzobskij [= Anzob] pass [**8**] in the Gissarskij [= Ḥisor] Mountains, ca. 3000 m a. s. l., rock fissure, July 1959: coll. 1 ind. (Ŝerbin 1968); – Rubanol′ canyon [**9**] (near Tavil′-Dara [= Tavildara]), ca. 1800 m a. s. l., September 1962: heard typical calls of several inds. (Ŝerbin 1968); – Garavak [= Agaravak] [**10**] (near Kzyl-Kala [= Qizilqala]), fissure in a sandstone outcrop, 29 May 1964: obs. a colony of ca. 40 inds., coll. 1 ♀, 7 June 1964: obs. 2 inds., plus 5 inds. and 3 inds. in two fissures 5 km and 6 km far (Ŝerbin 1968); – Ok-Bulak [**11**], Ak-Tau [= Aktau] Mountains, ca. 1800 m a. s. l., fissure in a limestone wall, 13 August 1964: obs. a colony (Ŝerbin 1968); – near Džilikul′ [= Çilikūl], Staraâ pristan′ [= Bandari Kūḫna] [**12**], 20–21 April [1965?]: heard typical calls of several foraging inds. (Ŝerbin 1968); – near Dašti-Džum [= Daštiçum], Âhči-Sor [= Âhčisor] [**13**] (Darvazskij [= Darvoz] Mountains), fissure under a rock ledge, 23 September 1965: obs. 1 roosting ind., 5 emerging inds. (Ŝerbin 1968).

Distribution. *Tadarida teniotis* is a Mediterranean bat species distributed in the south-western part of the Palaearctic (Kock & Nader 1984, Horáček et al. 2000, Simmons 2005); in Asia it occurs in the Mediterranean zone of the Middle East, in the Caucasus region, southern West Turkestan, and Afghanistan (Harrison & Bates 1991, Benda et al. 2006, 2012). It ranks among the rarest bat species in West Turkestan, its scarce records are widespread across the whole southern part of the region from south-western Turkmenistan to southern Kirghizstan (Bogdanov 1953a, Babaev & Dmitrieva 1966, Strelkov et al. 1978, Butovskij et al. 1985, Rybin et al. 1989, Habilov 1992, etc.). The Tajikistani occurrence area of *T. teniotis* represents a part of the eastern margin of the

Fig. 123. The alluvium habitats of the Bešai Palangon Reserve, near the Tarzan forestry, where echolocation calls of numerous foraging individuals of *Pipistrellus pipistrellus* and *Tadarida teniotis* were detected. Photo by M. Uhrin (4 May 2016).

species distribution range, as it is currently considered (Simmons 2005, Taylor 2019). This range margin continues from south-western Tajikistan southwards to eastern Afghanistan, where only one record is available (Kabul; Meyer-Oehme 1965, Benda & Gaisler 2015), southern Iran (Benda et al. 2012), and north-western India (Chakravarty 2017). Northwards and north-eastwards of Tajikistan, the eastern margin of the range continues to southern Kirghizstan, eastern Uzbekistan, and south-eastern Kazakhstan, where the northern limits of the species distribution in Asia are situated (Bogdanov 1953a, Butovskij et al. 1985, Rybin et al. 1989).

In Tajikistan, *T. teniotis* belongs to rather rare bats, only 13 record sites are known and six of them (46.2%) were newly documented during our research in 2016 (Fig. 124). The records of this bat come from a limited area of the country, the south-western section of lowlands and medium-altitude slopes bordered by the high ranges of the Darvoz Mountains in the east and the Ḩisor Mountains in the north. Surprisingly, no finding of *T. teniotis* was made in the northern part of Tajikistan (Suğd Province), although in the adjacent parts of Kirghizstan this bat does not seem to be an extermely rare species (see Rybin et al. 1989, Dundarova et al. 2021).

Additionally, Habilov (1992) reported a specimen found in the ZMMU collection being labelled "Kara-Kul′, Tadžikistan (?)". Such writing suggests the origin of the bat from the Qarokūl lake in the Pamirs (Kara-Kul′ in Russian; ca. 39°03'N, 73°23'E; 3892 m a. s. l.), north-eastern corner of Tajikistan; however, such localisation (or the labelling) is most probably erroneous, and the locality of the specimen origin in fact is Qorako'l (Kara-kul′ in Russian; 39°30'N, 63°51'E; 197 m a. s. l.), a large oasis in central Uzbekistan, where a male specimen of *T. teniotis* was collected in May 1936 (Bobrinskoj & Kuzâkin 1937).

However, despite the relatively high number of our new records made after a half of century from the country, they come from a region where a rather dense occurrence of *T. teniotis* was confirmed previously (Fig. 124) – south-western Tajikistan and an adjacent part of Uzbekistan. In the Babatag [Bobokūḥ / Bobotog‘] Mountains of southern Uzbekistan, four roost sites of *T. teniotis* were discovered in a belt of rocks some 10–12 km long in May–August 1949* (Bogdanov 1950, 1953a); it was the second finding of this bat in West Turkestan. Now, the area between the Uzbekistani part of the Babatag Mountains and the Darvoz Mountains of Tajikistan represents a zone with the highest abundace of records of *T. teniotis* in Central Asia (besides the records depicted in the map in Fig. 124 only some ten sites are available from other parts of West Turkestan).

The available records of *T. teniotis* from Tajikistan come from a medium-wide altitudinal range (1766 m); however, some three quarters of the records were made at the sites below 1200 m a. s. l., i.e. in rather low areas of the country (Fig. 10, Table 3). Our records come from a much

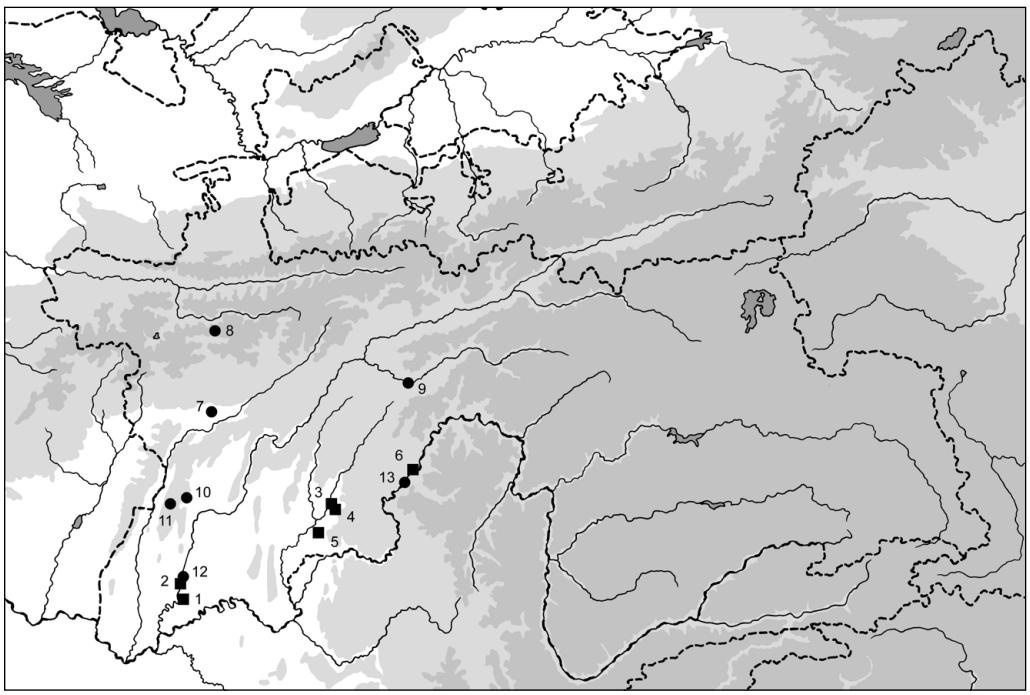


Fig. 124. Records of *Tadarida teniotis* (Rafinesque, 1814) in Tajikistan; squares – new records, circles – published records.

* Bogdanov (1950: 129) reported on the observation of four colonies of *Tadarida teniotis* found on the western (Uzbekistani) slopes of the Bobokūḥ Mountains as follows: (1) in the canyon between Kaška-bulak and Gul′baj springs [ущелье [...] от родника Кашка-булак к роднику Гульбай; 37°46’N, 68°00’E], a colony observed in a vertical rock fissure on 26 May 1949, 9 ♀♀ collected there on 23 May 1949; (2) between Bol′šaâ Turanga and Patally springs (3 km from the previous locality) [между родниками Большая Туранга и Паталлы], a colony observed in a vertical rock fissure on 27 May 1949, 1 ♂ and 18 ♀♀ collected; (3) in Patally-saj (2 km from the previous site) [Паталлы-сай; 37°46’N, 68°01’E], a colony of unknown size was found under a sandstone ledge, date not provided; (4) at the Bies-simas spring, 3 km from Patally-saj [у родника Биес-симас, в 3 км от Паталлы-сая; 37°48’N, 68°02’E], a colony observed in a vertical rock fissure on 23 August 1949. These sites are situated 2.8–4.0 km west of the Tajikistani state border.

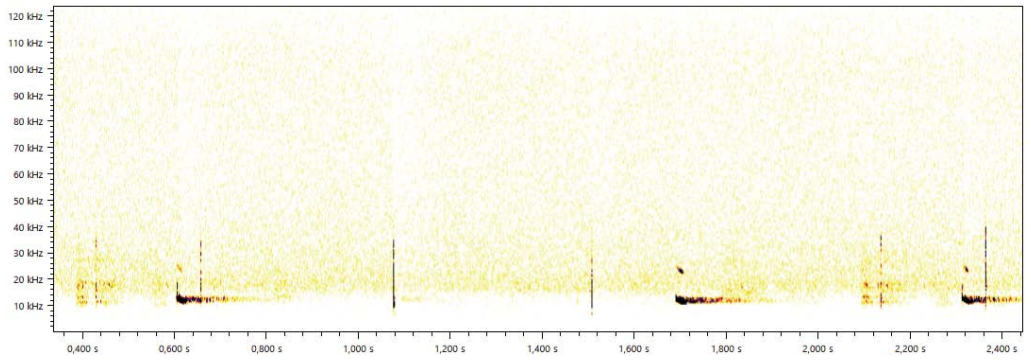


Fig. 125. Spectrogram of the echolocation calls of *Tadarida teniotis* (Rafinesque, 1814); an individual foraging at the Tarzan forestry in the Bešai Palangon Reserve, 4 May 2016.

smaller range of 838 m, although the distribution of these record sites remains very similar to the whole range (median 751 m vs. 897 m a. s. l.). The majority of the sites come from the lowland altitudes below 800 m a. s. l. (see Fig. 11, Table 4).

Echolocation. Echolocation calls of the foraging individuals of *Tadarida teniotis* were recorded at six sites during our research in Tajikistan, whereas no individual was caught. In total, we analysed twelve pulses of this bat from four call sequences recorded in the Bešai Palangon Reserve (Fig. 125). Basic echolocation characteristics with peak frequency in the range of 11.2–15.9 kHz, with a long lasted pulse (up to 15.4 ms) and with typically variable and very long interpulse intervals (Table 5) resemble well the pattern known from the European and Middle Eastern populations of this bat (Zbinden & Zingg 1986, Russo & Jones 2002, Obrist et al. 2004, Ciechanowski et al. 2005, Benda et al. 2006, 2008, 2010a, 2012, Bayefsky-Anand et al. 2008, Papadatou et al. 2008, Georgiakakis et al. 2010, Razgour et al. 2010, Smirnov et al. 2022c, our own data). We did not record any atypical call type previously reported from Crimea, Ukraine (Uhrin et al. 2009), or any atypical frequency level as published from Uttarakhand, north-western India (Chakravarty 2017).

Variation. The taxonomic affiliation of the Tajikistani populations of *Tadarida teniotis* was never examined. Several authors suggested to assign taxonomically only the populations of West Turkestan as a whole, based just on geographical grounds, to the nominotypical subspecies, *T. t. teniotis* (Ellerman & Morrison-Scott 1951, Strelkov 1981, Koopman 1994, Horáček et al. 2000). On the other hand, Gubar′ov (1941) identified the only specimen then known from West Turkestan (from Qorako'l, central Uzbekistan; see above, and Bobrinskoj & Kuzâkin 1937) as a part of his newly described subspecies *T. t. cinerea* Gubar′ov, 1941 (type locality: Šuša [= Şuşa, Dağlıq Qarabağ], Azerbaijan; ca. 39°46'N, 46°46'E). However, this name is considered to be a synonym of the name of the nominotypical form (Corbet 1978, Pavlinov & Rossolimo 1987, 1998), although Simmons (2005), really uncommonly, regarded it a synonym of *T. insignis* (Blyth, 1861), a bat occurring in eastern China, Korea, and Japan.

The problematics of the intraspecific variation in the Asian populations of *T. teniotis* were assessed and broadly discussed by Benda et al. (2008, 2012, 2014). Benda & Gaisler (2015: 409) concluded about this topic as follows: "[the evaluation of morphological traits across most of the species range] suggests that the variability in body size and pelage colouration represents rather

local and individual variations than any clear geographical and phylogenetic trends. In other words, the morphometric and colouration characters do not help in taxonomic evaluation of the intraspecific variation in *T. teniotis*, while the real description of its geographical variation has to be based on a molecular genetic analysis of the samples representing its whole range. Hence, until a new evidence suggesting a subspecific division is available, it is appropriate to consider *T. teniotis* a monotypic species." This conclusion was accepted by Taylor (2019).

Nevertheless, Amorim et al. (2020) carried out a molecular genetic analysis of the Mediterranean populations of *T. teniotis*, very detailed concerning the geographical sampling. Considering the above findings, they rather surprisingly discovered a geographical structure in phylogenetic relations of these populations, suggesting an existence of two basic lineages within the species in the mitochondrial DNA, the Euro-Maghrebian and Middle Eastern. However, Amorim et al. (2020) included only samples from Turkey and the Levant describing the Middle Eastern lineage, whereas the populations of the remaining parts of the Asian range of *T. teniotis* were not covered by the analysis. The most important discovery concerning the West Turkestani populations was made by these authors regarding the relations of the samples from Kirghizstan (that otherwise were not included in the phylogenetic analysis), which they found to be almost identical with the samples identified as *T. latouchei* Thomas, 1920 from Indochina, a form very similar to *T. teniotis* in morphology (formerly a part of its species rank), but significantly distant in the genetic traits (ca. 13% of genetic distance in the COI gene, cf. Mata et al. 2017). Moreover, this result corroborates the findings by Kock (1999), who compared the structure of lower molars in several Asian populations of *Tadarida*. In a specimen from Kirghizstan (of the same SMF series examined by Amorim et al. 2020), he found the reduced hypoconulids in a similar way as in the eastern Asian samples that he identified as *T. insignis*. On the other hand, the molars of the European as well as the Afghanistani specimens of *T. teniotis* did not show such a reduction of hypoconulids according to Kock's (1999) comparison.

These results indicate an unexpected phylogenetic variation in the populations of West Turkestan traditionally assigned to *T. teniotis* and call for a more detailed analysis, using both the molecular genetic and morphological approaches. The question arises whether these findings (Kock 1999, Amorim et al. 2020) concern all populations of the eastern part of West Turkestan, or whether a mixture of morpho- and haplotypes occurs there that comprises both forms mentioned from the area, *T. teniotis* s.str. and *T. insignis/latouchei*. Thus, a new broad comparative research of the populations of *T. teniotis* s.l. from the whole range has to be carried out, which will include also the populations of eastern Asia and precisely define the differences (including the phylogenetic ones) between *T. insignis*, *T. latouchei*, and *T. coecata* Thomas, 1922 (i.e. the eastern Asian taxa of the *T. teniotis* complex; see Funakoshi & Kunisaki 2000). Last but not least, a question remains how this unexpected variation affects the phylogenetic positions of the populations of *T. teniotis* s.l. of Tajikistan and other parts of Central Asia.

DISCUSSION AND CONCLUSIONS

Bat fauna and zoogeography

The present review summarises at least 416 records (species vs. locality) of 20–21 bat species from the territory of Tajikistan (Table 1). Our research brought in total 59 records of 16 species, i.e. 14.2% of all records available from the country and 78% of the species spectrum of the Tajikistani bat fauna. Since we applied methods rather rarely used for bat research in Tajikistan till now, such as netting and detectoring, we were able to record also several rather rare or medium frequent species. The inspection of bats in their roosts (mainly underground spaces) has been the dominant method of bat research in the country till recently (see Bogdanov 1956a, Ŝerbin 1968,

Malinovskij 1988, Habilov 1992, Habilov & Tadžibaeva 2021c). Our new records are valuable namely concerning the extent of the bat distribution ranges – mainly of *Rhinolophus bocharicus*, *Myotis emarginatus*, *Eptesicus serotinus*, *Hypsugo savii*, *Pipistrellus kuhlii*, *Barbastella caspica*, and *Tadarida teniotis*, but in a certain aspect also of common species like *Rhinolophus ferrumequinum*, *Myotis blythii*, and *Pipistrellus pipistrellus* (see the distribution maps above). *Otonycteris leucophaea* was confirmed from Tajikistan after 45 year by our new record, *Tadarida teniotis* after more than 50 years. However, we were also able to gather new data on echolocation characteristics of Tajikistani bats, in five species for the first time (*Rhinolophus bocharicus*, *R. kirghisorum* sp. nov., *Eptesicus ognevi*, *Otonycteris leucophaea*, and *Barbastella caspica*).

In comparison with the previous review of the bat fauna of Tajikistan by Habilov (1992), the number of species has increased by two species, *Rhinolophus kirghisorum* sp. nov. and *Pipistrellus kuhlii*. The former bat was recorded from five localities in medium to high altitudes of western Tajikistan, the latter bat from four sites of the south-western part of the country. The total number of bat records from Tajikistan has increased by more than a half (152–154%) and the number of records per species by 137–325% (on average 160%) in comparison with the previous review (Table 1). The highest enlargements of the country record numbers were documented in *Tadarida teniotis* (325%), *Myotis bucharensis* (200%), and *Eptesicus ognevi* (189%), while in three bat species the number of records did not change in the last thirty years (*Eptesicus gobiensis*, *Nyctalus noctula*, *Miniopterus* sp.).

Considering the area of the country and the number of bat records, the bat fauna of Tajikistan is relatively well known among the countries of West Turkestan as well as south-western Asia (comp. e.g. Strelkov et al. 1978, Strelkov 1983c, Rahmatulina 2005, Benda et al. 2006, 2010, 2012, Benda & Gaisler 2015). The number of bat records available from Tajikistan is 1.5 times larger (147%) than that from Turkmenistan, a country 3.5 times larger than Tajikistan (cf. Strelkov et al. 1978), almost twice larger (185%) than that from Afghanistan, a country 4.5 times larger (cf. Benda & Gaisler 2015), or, the number of Tajikistani bat records is almost a half (46%) of such number from Iran, which is, however, a more than eleven times larger country (cf. Benda et al. 2012). In all surrounding south-west Asian countries included in Table 14, the average number of records per bat species is smaller than in Tajikistan, where it is 20.1 records/species (Turkmenistan, 13.5; Iran, 18.0; Afghanistan, 5.6; Syria, 10.8; Jordan, 11.1). Among the countries of a similar size and research effort made, a larger average number of records per bat species is known only from Azerbaijan (26.6 records/species; cf. Rahmatulina 2005).

Only a third of the species number of the fauna of Tajikistan can be considered as more or less abundant (*Rhinolophus ferrumequinum*, *R. bocharicus*, *Myotis blythii*, *M. davidii*, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, and *Barbastella caspica*), they are known from more than 23 records each (24–59) and the sum of their records represents almost two thirds (62.6%) of the total number of bat records from Tajikistan (Table 1). Only in two of these species (*Myotis blythii*, *Pipistrellus pipistrellus*), however, the number of records increased significantly (more than 1.5 times) in comparison with the previous review, i.e. in the last thirty years (Habilov 1992; Table 1). Ten species (48.8% of the whole bat fauna, 14.9% of the total number of bat records) are known from Tajikistan from less than fifteen records, and five species (23.8%, 3.2%) can be considered as very rare, they are known only from five records or even less. *Eptesicus gobiensis* and *Miniopterus* sp. represent two rarest bats of Tajikistan, the former one is known from only one indubitable record from the country (but maybe, three records could be considered in total) and the latter one is an enigmatic member of the fauna, being known only from old museum preparations of an uncertain origin (Habilov 1983).

The occurrence pattern of the particular species in Tajikistan mostly did not change much by the recent surveys (both our own and that by Habilov, Tadžibaeva et al. in 2013–2022), the new

Table 14. Composition of the bat fauna of Tajikistan and adjacent countries of Central Asia (arranged from north anti-clockwise). Country acronyms: TJK = Tajikistan, KRG = Kirgizstan, KZH = Kazakhstan, UZB = Uzbekistan, TKM = Turkmenistan, IRN = Iran, AFG = Afghanistan, PK+KS = Pakistan and Kashmir, ETS = East Turkestan. Based on the data by Bobrinskoj (1925, 1926), Bogdanov (1953a), Borovskij & Voroncov (1970), Strelkov et al. (1978), Strelkov (1980, 1986, 1988), Butovskij et al. (1985), Kovaleva & Ŝerbak (1990), Bates & Harrison (1997), Matveev et al. (2005), Spitzenberger et al. (2006), Wilson (2008), Mahmood-ul-Hassan et al. (2009), Benda & Gvoždík (2010), Benda et al. (2012, 2022), Kruskop et al. (2012), Gricina et al. (2013), Juste et al. (2013), Benda & Gaisler (2015), Mahmood-ul-Hassan & Salim (2015), Naderi et al. (2017), Liu et al. (2018), Tu et al. (2018), Khajeh et al. (2021), Ruedi et al. (2021), Uvizl & Benda (2021b), and the data summarised in this review

species \ country	TJK	KRG	KZH	UZB	TKM	IRN	AFG	PK+KS	ETS
Pteropus medius Temminck, 1825	–	–	–	–	–	–	–	+	–
Cynopterus sphinx (Vahl, 1797)	–	–	–	–	–	–	–	+	–
Rousettus aegyptiacus (Geoffroy, 1810)	–	–	–	–	–	+	–	+	–
Rousettus leschenaultii (Desmarest, 1820)	–	–	–	–	–	+	–	+	–
Rhinopoma microphyllum (Brünnich, 1782)	–	–	–	–	–	+	+	+	–
Rhinopoma muscatellum Thomas, 1903	–	–	–	–	–	+	+	+	–
Rhinopoma hardwickii Gray, 1831	–	–	–	–	–	+	+	+	–
Lyroderma lyra (Geoffroy, 1810)	–	–	–	–	–	–	+	+	–
Rhinolophus ferrumequinum (Schreber, 1774)	+	+	+	+	+	+	+	+	–
Rhinolophus bocharicus Kašenko et Akimov, 1918	+	+	–	+	+	–	+	–	–
Rhinolophus euryale Blasius, 1853	–	–	–	–	+	+	–	–	–
Rhinolophus mehelyi Matschie, 1901	–	–	–	–	–	+	–	–	–
Rhinolophus blasii Peters, 1866	–	–	–	–	+	+	+	+	–
Rhinolophus macrotis Blyth, 1844	–	–	–	–	–	–	–	+	–
Rhinolophus kirghisorum sp. nov.	+	+	–	+	–	–	+	–	–
Rhinolophus hipposideros (André, 1797)	+	+	+	+	+	+	+	+	–
Rhinolophus midas Andersen, 1905	–	–	–	–	–	+	–	–	–
Hipposideros fulvus Gray, 1838	–	–	–	–	–	+	+	+	–
Hipposideros cineraceus Blyth, 1853	–	–	–	–	–	–	–	+	–
Asellia tridens (Geoffroy, 1813)	–	–	–	–	–	+	+	+	–
Triaenops persicus Dobson, 1871	–	–	–	–	–	+	–	+	–
Taphozous perforatus Geoffroy, 1818	–	–	–	–	–	+	–	+	–
Taphozous nudiventris Cretzschmar, 1830	–	–	–	–	–	+	+	+	–
Myotis blythii (Tomes, 1857)	+	+	+	+	+	+	+	+	+
Myotis bechsteinii (Kuhl, 1817)	–	–	–	–	–	+	–	–	–
Myotis schaubi Kormos, 1934	–	–	–	–	–	+	–	–	–
Myotis tschuliensis Kuzâkin, 1935	–	–	–	–	+	+	–	–	–
Myotis emarginatus (Geoffroy, 1806)	+	+	+	+	+	+	+	–	–
Myotis formosus (Hodgson, 1835)	–	–	–	–	–	–	+	+	–
Myotis mystacinus (Kuhl, 1817)	–	–	[+]	–	–	+	–	–	–
Myotis ikonnikovi Ognev, 1912	–	–	+	–	–	–	–	–	–
Myotis hyrcanicus Benda, Reiter et Vallo, 2012	–	–	–	–	–	+	–	–	–
Myotis davidii (Peters, 1869)	+	+	+	+	+	+	+	–	+
Myotis nipalensis (Dobson, 1871)	–	–	–	–	–	–	–	+	–
Myotis bucharensis Kuzâkin, 1950	+	–	–	+	–	–	–	–	–
Myotis dasycneme (Boie, 1825)	–	–	+	–	–	–	–	–	–
Myotis daubentonii (Kuhl, 1817)	–	–	+	–	–	–	–	–	–
Myotis petax Hollister, 1912	–	–	+	–	–	–	–	–	+
Myotis capaccinii (Bonaparte, 1837)	–	–	–	+	–	+	–	–	–
Myotis longipes (Dobson, 1873)	–	–	–	–	–	–	+	+	–
Myotis brandtii (Eversmann, 1845)	–	–	+	–	–	–	–	–	–
Myotis sibiricus Kašenko, 1905	–	–	+	–	–	–	–	–	–
Submyotodon caliginosus (Tomes, 1859)	–	–	–	–	–	–	+	+	–
Vespertilio murinus Linnaeus, 1758	+	+	+	+	+	+	+	+	+
Eptesicus serotinus (Schreber, 1774)	+	+	+	+	+	+	+	–	+
Eptesicus pachyomus (Tomes, 1857)	–	–	–	–	–	+	+	+	–

Table 14. (continued)

species \ country	TJK	KRG	KZH	UZB	TKM	IRN	AFG	PK+KS	ETS
Eptesicus anatolicus Felten, 1971	–	–	–	–	–	+	–	–	–
Eptesicus bottae (Peters, 1869)	–	–	–	–	–	+	–	–	–
Eptesicus ognevi Bobrinskoj, 1918	+	+	+	+	+	+	+	[+]	[+]
Eptesicus nilssonii (von Keyserling et Blasius, 1839)	–	–	+	–	–	[+]	–	–	–
Eptesicus gobiensis Bobrinskoj, 1926	+	+	+	[+]	–	+	+	+	+
Rhyneptesicus nasutus (Dobson, 1877)	–	–	–	–	–	+	+	+	–
Hypsugo savii (Bonaparte, 1837)	+	+	+	+	+	+	+	–	+
Hypsugo arabicus (Harrison, 1979)	–	–	–	–	–	+	–	–	–
Pipistrellus pipistrellus (Schreber, 1774)	+	+	+	+	+	+	+	+	+
Pipistrellus pygmaeus (Leach, 1825)	–	–	–	–	–	+	–	–	–
Pipistrellus nathusii (von Keyserling et Blasius, 1839)	–	–	+	–	–	+	–	–	–
Pipistrellus kuhlii (Kuhl, 1817)	+	–	+	+	+	+	+	+	–
Alionoctula coromandra (Gray, 1838)	–	–	–	–	–	–	+	+	–
Alionoctula tenuis (Temminck, 1840)	–	–	–	–	–	–	+	+	–
Alionoctula javanica (Gray, 1838)	–	–	–	–	–	–	–	+	–
Alionoctula paterculus Thomas, 1915	–	–	–	–	–	–	–	+	–
Alionoctula ceylonica (Kelaart, 1852)	–	–	–	–	–	–	–	+	–
Nyctalus noctula (Schreber, 1774)	+	+	+	+	+	+	+	+	+
Nyctalus lasiopterus (Schreber, 1780)	–	–	–	+	–	+	–	–	–
Nyctalus leisleri (Kuhl, 1817)	–	–	+	–	–	+	+	+	–
Nyctalus montanus (Barrett-Hamilton, 1906)	–	–	–	–	–	–	+	+	–
Otonycteris hemprichii Peters, 1859	–	–	–	–	–	+	–	–	–
Otonycteris leucophaea (Severcov, 1873)	+	+	+	+	+	+	+	+	–
Barbastella barbastellus (Schreber, 1774)	–	–	–	–	–	+	–	–	–
Barbastella caspica Satunin, 1908	+	+	+	+	+	+	+	[+]	+
Plecotus auritus (Linnaeus, 1758)	–	–	+	–	–	+	–	–	–
Plecotus macrobullaris Kuzâkin, 1965	–	–	–	–	[+]	+	–	–	–
Plecotus wardi Thomas, 1911	–	–	–	–	–	–	–	+	–
Plecotus kozlovi Bobrinskoj, 1926	–	–	–	–	–	–	–	–	+
Plecotus ognevi Kishida, 1927	–	–	+	–	–	–	–	–	–
Plecotus strelkovi Spitzenberger, 2006	+	+	+	+	–	+	+	–	+
Plecotus turkmenicus Strelkov, 1988	–	–	+	+	+	–	–	–	–
Plecotus homochrous Hodgson, 1847	–	–	–	–	–	–	–	+	–
Scotozous dormeri Dobson, 1875	–	–	–	–	–	–	–	+	–
Scotoecus pallidus (Dobson, 1876)	–	–	–	–	–	–	–	+	–
Scotophilus heathii (Horsfield, 1831)	–	–	–	–	–	–	+	+	–
Scotophilus kuhlii Leach, 1821	–	–	–	–	–	–	+	+	–
Murina tubinaris (Scully, 1881)	–	–	–	–	–	–	–	+	–
Murina huttonii (Peters, 1872)	–	–	–	–	–	–	–	+	–
Kerivoula furva Kuo, Soisook, Ho, Csorba, Wang et Rossiter, 2017	–	–	–	–	–	–	–	+	–
Miniopterus pallidus Thomas, 1907	[+]	–	–	–	+	+	+	–	–
Miniopterus fuliginosus (Hodgson, 1835)	–	–	–	–	–	–	+	+	–
Tadarida teniotis (Rafinesque, 1814)	+	+	+	+	+	+	+	–	–
Nyctinomus aegyptiacus Geoffroy, 1818	–	–	–	–	–	+	+	+	–
total	20–21	18	29–30	22–23	21–22	52–53	40	49–51	12–13
congruence [%] TJK vs. local	–	88	53	95	83	88	98	51	51
congruence [%] local vs. TJK	–	100	58	87	79	34	50	20	84
area [thousands km^2]	143	200	2725	447	491	1648	653	983	1665

records roughly conform to the ranges delineated already by Habilov (1992). Five exceptions include *Rhinolophus bocharicus*, *Myotis emarginatus*, *M. bucharensis*, *Eptesicus ognevi*, and *Hypsugo savii*, whose occurrence area has been modified most significantly; *M. bucharensis* was

documented for the first time from the north-western part of Tajikistan (Kazakov et al. 2020), other species from the southern part of the country (this review), except *E. ognevi* that was newly found as a regular element in northern Tajikistan (Habilov 1995, Tadžibaeva 2018). Special cases are *Rhinolophus hipposideros* s.str. and *R. kirghisorum* sp. nov., documented properly from Tajikistan as newly defined species and currently being known from 5–6 records per species (see above and Table 1), and *Pipistrellus kuhlii* discovered as a quite new member of the fauna from four sites.

The relative distribution of particular faunal elements over Tajikistan shows a clear pattern, the country's area is divided into two natural regions, differing from each other in various aspects (see Introduction), but mainly in the hypsometric and vegetation characters – the western part is relatively low (ca. 300–5500 m a. s. l.) and dominated by arid steppes, the eastern part is represented by the mountain plateaus of the Pamirs (ca. 1200–7500 m a. s. l.), covered mostly by the mountain tundra. This division corresponds also with the political division of the country, the eastern elevated part almost perfectly conforms to the area of autonomous Badakhshan, politically separated from the rest of the country. In comparison with the fauna composition of the western part of Tajikistan, the known bat fauna of the Pamirs is very poor, partly naturally, because of the harsh continental montane climate of the region, and partly artificially, because this mountain ranges are the least studied section of the Tajikistani territory concerning its biota (see Habilov 1986, 1992, 2003). Only two species of bats were documented from more than one site in this mountain system and represent regular faunal elements there (*Myotis davidii*, *Plecotus strelkovi*), the other three just from one site in the western slopes of the Pamirs (*Rhinolophus hipposideros*, *Otonycteris leucophaea*, *Barbastella caspica*). The records of two bat species from the Pamirs remain uncertain (*Eptesicus gobiensis*, *Hypsugo savii*). In both these species, the published data do not allow to determine with certainty the geographical origin of the specimens reportedly coming from Tajikistan, although their presence in the mountains could be naturally anticipated. On the other hand, the fauna of western Tajikistan comprises all bat species known from the country, and 13 species are known only from this area. Five species, *Vespertilio murinus*, *Eptesicus serotinus*, *E. ognevi*, *Pipistrellus pipistrellus*, and *Otonycteris leucophaea* are the most lowland dwelling bats of Tajikistan (see Fig. 10) distributed only or mainly in western Tajikistan. Despite that the bone remains of *O. leucophaea* were found also near Horuğ, Badakhshan (2103 m a. s. l.; Fig. 113) and this bat is thus a part of the Pamir fauna, the median value of its record altitudes is the third lowest among the Tajikistani bats (751.5 m a. s. l.; Table 3) and three quarters of its records were made at altitudes below 900 m a. s. l., i.e. quite in lowlands considering the overall conditions of Tajikistan. Although the western part of Tajikistan shows a considerable geographical variability, being divided by high mountain ranges of the south-western Tien-Shan into three lowland sections (Sirdarë, Zarafšon, and Amudarë valleys), there is no obvious present faunal trend in bat distribution among the three lowlands. Several species were not found in all three valleys (*Myotis bucharensis* in the Sirdarë valley, *Eptesicus serotinus* and *E. ognevi* in the Zarafšon valley, *Nyctalus noctula* in the Amudarë valley, and *Pipistrellus kuhlii* and *Tadarida teniotis* in Zarafšon and Sirdarë valleys), but this mostly seems to be just a result of a low research effort, since these species do occur in the adjacent parts of the valleys out of the Tajikistani territory. There are only two exceptions, *Nyctalus noctula*, which perhaps really does not occur southward of the Zarafšon Mountains, and *Pipistrellus kuhlii*, which lives only in and southwards of the Amudarë valley; both facts are clear in the whole range trends in these bats (see Bogdanov 1953a, Bejšebaev 1966, Strelkov 1973, Strelkov et al. 1978, 1985, Rybin 1980, Butovskij et al. 1985, Strelkov & Sosnovceva 1994, etc.).

The bat fauna of Tajikistan currently comprises 20 undoubtedly documented species plus one uncertain species (*Miniopterus* sp., see above). It is the second smallest fauna of West Turkestan, after the bat fauna of Kirghizstan, composed of 18 species (Table 14). All 18 bat species of the Kirghizstani fauna live also in Tajikistan, where 2–3 more species occur – the rarest bats of the

country – *Myotis bucharensis*, *Pipistrellus kuhlii*, and (possibly) *Miniopterus* sp. The second most similar fauna to that of Tajikistan among the countries of West Turkestan is the fauna of Uzbekistan, composed of 22–23 species (Table 14); 87% of the Uzbekistani bat species occur also in Tajikistan (only *Myotis capaccinii*, *Nyctalus lasiopterus*, and *Plecotus turkmenicus* are missing in Tajikistan – they are known from a single record each, made in the westernmost section of the country), while 95% of Tajikistani species live also in Uzbekistan, where only *Miniopterus* sp. is absent. The congruence of the Tajikistani bat fauna with the faunas of two remaining countries of West Turkestan (Kazakhstan, Turkmenistan) is much smaller than with the former two countries (see Table 14), on the other hand, 98% and 88% of species of the Tajikistani fauna co-occur in Afghanistan and Iran, respectively. A relatively high congruence of faunas is also between Tajikistan and East Turkestan – 84% of species of the fauna of the latter country composed only of 12–13 species live also in Tajikistan, while only two species of the East Turkestani fauna have not yet been documented from Tajikistan (*Myotis petax*, *Plecotus kozlovi*; Table 14). Similar relative congruences among national faunas of West Turkestan and adjacent countries were shown already by Rybin et al. (1989), although the taxonomic compositions of the particular faunas differed considerably.

The known composition of the bat fauna of Tajikistan seems to be rather complete for the time being. The fauna of nine countries bordering or closely adjacent to Tajikistan, occupying a part of Asia almost nine million of square kilometres in size (8,955.200 km^2, which is, for comparison, almost exactly a half of the area of Russia, 52.4%), where Tajikistan represents just 1.6% of the area, comprises 90 species of bats (Table 14). However, almost none of these species – besides those already discovered from Tajikistan – occurs in areas in close proximity to Tajikistan and thus, could theoretically enrich the fauna of Tajikistan when further research is carried out.

Perhaps only two exceptions could be envisaged, *Plecotus kozlovi* and *Myotis capaccinii*. The former bat is considered an endemic of the arid mountain plateaus of Central Asia, its occurrence was confirmed from East Turkestan, Tibet, Inner Mongolia, and [Outer] Mongolia (Spitzenberger et al. 2006). It was described from the north-eastern part of Tibet (Qaidam Basin; Bobrinskoj 1926*), where the largest number of records of this bat is currently available (Wilson 2008). However, the type specimen of *Plecotus mordax* Thomas, 1926, a junior synonym of *P. kozlovi* (see Spitzenberger et al. 2006), originates from Kashgar in the Taklamakan Desert in western East Turkestan, situated some 160 km from the Tajikistani eastern border, and represents the westernmost known record of this species. Thus, it is possible that this bat occurs also in the Alay Valley in south-eastern Kighizstan and adjacent mountain regions of Tajikistan. Only a detailed bat research in the eastern parts of Tajikistan that is generally needed to improve the insufficient knowledge of the local fauna could help to confirm such a premise.

Another bat species that could theoretically enrich the fauna of Tajikistan, *M. capaccinii*, is a Mediterranean faunal element. It occurs in southern Europe and the Maghreb, and in western Asia it is known only from the north-western parts of the Middle East, from western and southern Anatolia, Cyprus, and the Levant through the Mesopotamian lowland to south-western Iran (Benda et al. 2006, 2012). It was documented only once from West Turkestan, a single individual was collected in Nókis, Karakalpakstan [Qaraqalpaqstan], western Uzbekistan, in 1875; this record was first mentioned briefly by Kuzâkin (1944) and its circumstances were simply described by Kuzâkin (1950: 262) as follows: "In the collection of the Zoological Institute of the Academy of Science, there is […] one specimen from Nukus [= Nókis] in the Amu Darya [= Amudarë] lowland.

* type localities of the names from the species rank of *P. kozlovi* are as follows: *Plecotus auritus kozlovi* Bobrinskoj, 1926: Hyrma Barun Zasaka (bl. Hyr. Dzun Zasaka, vost. Cajdam) [Хырма Барун Засака (бл. Хыр. Дзун Засака, вост. Цайдам)] (= Barun fort, eastern Qaidam [NE Tibet / Qinghai Province, China]; 36°03'N, 97°30'E; Bobrinskoj 1926: 98); *Plecotus mordax* Thomas, 1926: Kashgar [East Turkestan / Xinjiang Province, China]; 39°28'N, 75°59'E; Thomas 1926: 306).

This [specimen] represents the only record of this form in the limits of the western part of our country [= Soviet Union]. // The specimen, collected by Darant [= Dorandt] in Nukus in 1875, differs from the Mediterranean samples of this species by its deeper pale "desert" colouration." [Own translation from Russian†.] The bat was collected – perhaps accidentally – by Ferdinand Bogdanovič Dorandt (1846–1878), a meteorologist, during his participation in the Amu Darya Expedition of the Imperial Russian Geographical Society, led by Nikolaj Grigor′evič Stoletov (1831–1912) in 1874–1875 (see Dorandt″ 1877, Maslova 1962). This old and quite isolated record of *M. capaccinii* was accepted without any doubts by subsequent Russian/Uzbekistani authors concerning both geographical origin and species identification (Bogdanov 1953a, Strelkov 1963, 1981, Kuzâkin 1965, Rejmov 1982, 1985, Pavlinov & Rossolimo 1987, 1998, Žumarov 2014, etc.). On the other hand, some authors questioned the correct species identification / geographical origin of the Nókis bat (Rejmov 1982, Rybin et al. 1989) and Benda et al. (2006: 133) speculated as follows: "we suggest rather a different affiliation of the record, which could be geographically more reasonable, e.g. *M. longipes* […]. [… The] location of the respective Uzbek[istani] specimen [is] in the ZIN collection and therefore the revision of the species assignation should be relatively simple." Eventually, Sergej V. Kruskop (ad verb.) examined the respective ZIN specimen and confirmed the identification made by Kuzâkin (1944); thus, *M. capaccinii* remains a member of the West Turkestani fauna. Since no sufficient research in the western part of Uzbekistan was performed till now and only very occasionally it was made in the eastern part of the country (cf. Bogdanov 1953a, 1960, 1968, Gricina et al. 2013), the occurrence of this bat in the oases along the lower reaches of the Amudarë could be really possible but remained overlooked apart from the old single finding. If *M. capaccinii* really represents a regular part of the fauna of the Uzbekistani part of the Amudarë lowland, it could be found also in its Tajikistani part, which also represents a less studied section of the country concerning the bat fauna (see above). After all, a very similar case was recently shown in *Pipistrellus kuhlii*; this bat remained known from Uzbekistan only from a historical finding made in Khiva [Xiva], 135 km SE of Nókis, in 1873 (Bìanki 1918) and recently has been discovered in south-western Tajikistan, 770 km away (Kłys & Lis 2022; see above). Although *P. kuhlii* is a species experiencing a dramatical changes of its distribution range limits – a case unknown in *M. capaccinii* – from the biogeographical point of view, a certain similarity could be expected in both species.

However, all other bat species occurring in the countries adjacent to Tajikistan and still not being a part of the Tajikistani fauna represent faunal elements quite distinct from those present in the eastern section of West Turkestan and thus, they can hardly enrich the Tajikistani fauna (Table 14). Many of these species are either Oriental or Palaearctic eremial faunal elements, all representatives of Pteropodidae, Rhinopomatidae, Megadermatidae, Hipposideridae, Rhinonycteridae, and Emballonuridae families, plus numerous other bats (*Rhinolophus macrotis*, *R. blasii*, *R. midas*, *Myotis formosus*, *M. longipes*, *Eptesicus pachyomus*, *E. bottae*, *Rhyneptesicus nasutus*, *Hypsugo arabicus*, *Alionoctula* spp., *Scotozous dormeri*, *Scotoecus pallidus*, *Scotophilus* spp., *Otonycteris hemprichii*, *Miniopterus fuliginosus*, *Murina tubinaris*, *M. huttoni*, *Kerivoula furva*, and *Nyctinomus aegyptiacus*), altogether 38 species (42.2% of the fauna) distributed only in the southern parts of Iran, Afghanistan, and/or in Pakistan (*R. blasii* also in westernmost Turkmenistan). In northern Kazakhstan and the westernmost parts of Uzbekistan, Turkmenistan, and Iran, the fauna of the Eurasian arboreal zone enters into the picture, comprising 20 species (22.2% of the fauna; *Rhinolophus euryale*, *R. mehelyi*, *Myotis bechsteinii*, *M. tschuliensis*, *M. mystacinus*,

† the original text reads as follows (Kuzâkin 1950: 262): "В коллекции Зоологического института Академии наук есть […] 1 экз. – из Нукуса в низовьях Аму-Дарьи. Последний является единственной находкой этой формы в пределах западной половины нашей страны. // Экземпляр, добытый в 1875 г. Дарантом в Нукусе, отличается от среднеземноморских особей этого вида более бледной, «пустынной» окраской."

M. ikonnikovi, *M. dasycneme*, *M. daubentonii*, *M. petax*, *M. brandtii*, *M. sibiricus*, *Eptesicus nilssonii*, *Pipistrellus pygmaeus*, *P. nathusii*, *Nyctalus lasiopterus*, *N. leisleri*, *Barbastella barbastellus*, *Plecotus auritus*, *P. macrobullaris*, and *P. ognevi*). Another group includes five bat species endemic to the belt of southern slopes of the Hindu Kush and Himalayas (*Myotis nipalensis*, *Submyotodon caliginosus*, *Nyctalus montanus*, *Plecotus wardi*, and *P. homochrous*) and the last group is composed also of four species, endemic to the Middle East and adjacent areas with limited distribution ranges (*Myotis schaubi*, *M. hyrcanicus*, *Eptesicus anatolicus*, *Plecotus turkmenicus*). These faunal elements (67 species in total) deeply differ in their biogeographical affinities from those occurring in eastern West Turkestan.

On the other hand, fourteen bat species (*Rhinolophus ferrumequinum*, *R. hipposideros* s.str., *Myotis blythii*, *M. emarginatus*, *M. davidii*, *Vespertilio murinus*, *Eptesicus serotinus*, *E. ognevi*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *Nyctalus noctula*, *Otonycteris leucophaea*, *Barbastella caspica*, *Tadarida teniotis*) represent a common fauna of the western part of Central Asia, all were documented in five countries of West Turkestan, plus in Iran and Afghanistan (Table 14). Most of these bats are widespread western Palaearctic / Mediterranean faunal elements, but three of them are endemic to West Turkestan and adjacent regions (*Eptesicus ognevi*, *Otonycteris leucophaea*, *Barbastella caspica*). Eighteen bat species, i.e. the above series plus four Central Asian endemics, *Rhinolophus bocharicus*, *R. kirghisorum* sp. nov., *Eptesicus gobiensis*, and *Plecotus strelkovi*, represent a core fauna of the eastern part of West Turkestan, they compose the complete fauna of Kirghizstan and majority of the faunas of Tajikistan and Uzbekistan; in all these countries this series is present completely. *Plecotus turkmenicus* is the only endemic species of West Turkestan that does not occur in the eastern part of the region, on the other hand, *Rhinolophus kirghisorum* sp. nov., *Myotis bucharensis*, and *Plecotus strelkovi* are the endemics or nearly endemics of the eastern part of West Turkestan and all three are a part of the Tajikistani fauna. In addition, four of Turkestani endemic bat species were described based on specimens from Tajikistan (*Rhinolophus kirghisorum* sp. nov., *Myotis bucharensis*, *Eptesicus ognevi*, *Otonycteris leucophaea*).

The region with variable landscape of hilly arid steppes and extremely high mountains in the east of West Turkestan represents a unique region of bat distribution and a zoogeografical unit of its own. Although this uniqueness is caused by the common occurrence of several endemic species representing about one quarter of the fauna, the primary ground for its existence is the extreme physical formation of the geographical circumstances in the contact zone of several countries – isolation by high mountains and isolation by harsh deserts, with extreme climatic conditions in both marginal environments.

In conclusion, the number of 20–21 species of bats in the fauna of Tajikistan is almost final, it could be complemented only by one or two species that are not primarily local elements. The number of species in the Tajikistani fauna corresponds to the situation in the neighbouring countries/regions of Central Asia with similar physical geography and vegetation (Table 14). Further faunal research of bats should be focused mainly on the mountains of southern regions of Tajikistan and particularly, on the greatly unstudied mountainous areas of Badakhshan.

Bat ectoparasites

The papers reporting bat ectoparasites from Tajikistan were published primarily in the 20th century, in the period of 1952–1997. With an exception of one paper, all of them represent faunal reports of particular species. The survey of bat ectoparasite diversity has been made thoroughly in Tajikistan, the data concerning particular arthropod groups can be summarised as follows, Kiričenko (1952) gathered data on the bug family Cimicidae, his records were mentioned (and corrected) by Usinger (1966) and Péricart (1972); Medvedev et al. (1984), Medvedev (1992), and Medvedev & Polkanov (1997) reported on the bat fleas, Ischnopsyllidae, Hůrka (1984) and

Polkanov & Medvedev (1997) on the bat flies, Nycteribiidae. The group of parasitic mites could represent a high amount of species belonging up to about twenty families, some of these species are rather difficult to collect. Despite this, a number of permanently parasitic and some phased mite species were documented on bats from Tajikistan, Filippova (1972) reviewed records of the hard ticks of the family Ixodidae, Stanûkovič & Malinovskij (1992) the families Argasidae, Spinturnicidae, and Macronyssidae. These papers were supplemented by two recent studies concerning limited parasite collections of Nycteribiidae and Spinturnicidae (Orlova & Zhigalin 2014, Orlova & Kazakov 2016).

Besides our new records, at least 36 species of arthropod ectoparasites belonging to seven families were previously documented from Tajikistan in total; Cimicidae (1 species): *Cimex pipistrelli*; Ischnopsyllidae (7): *Ischnopsyllus petropolitanus*, *I. plumatus*, *I. octactenus*, *Rhinolophopsylla unipectinata*, *Nycteridopsylla dictena*, *N. calceata*, and *N. oligochaeta*; Nycteribiidae (7): *Nycteribia latreilii*, *N. lindbergi*, *Phthiridium biarticulatum*, *P. simile*, *P. khabilovi*, *Basilia mongolensis*, and *Penicillidia dufourii*; Spinturnicidae (8): *Eyndhovenia euryalis*, *Paraperiglischrus rhinolophinus*, *Spinturnix acuminata*, *S. emarginata*, *S. myoti*, *S. mystacina*, *S. punctata*, and *S. plecotina*; Macronyssidae (11+): *Ornithonyssus flexus*, *O. guzlonicus*, *Ornithonyssus* sp., *Macronyssus crosbyi* [= *M. corethroproctus*], *M. ellipticus*, *M. rhinolophi*, *Macronyssus* sp., *Steatonyssus mongolicus*, *S. periblepharus*, *S. occidentalis*, *S. superans*, *Steatonyssus* sp., *Ichoronyssus scutatus*, and *Laelaps multispinosus*; Argasidae (1): *Argas vespertilionis* [= *Carios vespertilionis*]; and Ixodidae (1): *Ixodes vespertilionis*. These parasites were collected from at least 13 host species of bats, viz. *Rhinolophus ferrumequinum*, *R. bocharicus*, *R. hipposideros* s.l., *Myotis blythii*, *M. emarginatus*, *M. davidii*, *Vespertilio murinus*, *Eptesicus serotinus*, *Hypsugo savii*, *Pipistrellus pipistrellus*, *Otonycteris leucophaea*, *Barbastella caspica*, and *Plecotus strelkovi*, plus a number of records from unidentified bat species (Chiroptera sp.).*

Our research, analysing the bat parasite collection made in May 2016, added records of 20 species of ectoparasites belonging to six families, viz. *Rhinolophopsylla unipectinata* and *Ischnopsyllus octactenus* (Ischnopsyllidae), *Nycteribia lindbergi*, *Penicillidia dufourii*, *Phthiridium biarticulatum*, *P. szechuanum*, and *Basilia mongolensis* (Nycteribiidae), *Eyndhovenia euryalis*, *Spinturnix myoti*, *S. emarginata*, *S. carnificina*, *S. nobleti*, and *S. punctata* (Spinturnicidae), *Macronyssus barbastellinus*, *Steatonyssus mongolicus*, *S. periblepharus*, *S. pseudoheteroventralis*, and *Ornithonyssus flexus* (Macronyssidae), *Miyatrombicula* sp. (Trombiculidae), and Sarcoptiformes fam. sp. These parasites were collected from ten bat species, *Rhinolophus ferrumequinum*, *R. bocharicus*, *R. kirghisorum* sp. nov., *Myotis blythii*, *M. emarginatus*, *M. davidii*, *Eptesicus ognevi*, *Hypsugo savii*, *Pipistrellus pipistrellus*, and *Barbastella caspica*.

Among these new records, the findings of *Phthiridium szechuanum*, *Spinturnix carnificina*, *S. nobleti*, *Macronyssus barbastellinus*, *Steatonyssus pseudoheteroventralis*, *Miyatrombicula* sp. and Sarcoptiformes fam. sp. were made from bats in Tajikistan for the first time. Simultaneously,

---

* Records of ectoparasites from undetermined species of bats (Chiroptera sp.) and unspecified localities of Tajikistan. All of them are mentioned as originating in Tajikistan without information on the site and date of collection, and with the data on specimens published by Stanûkovič & Malinovskij (1992), without data on specimens by Stanyukovich (1997). S p i n t u r n i c i d a e: *Spinturnix myoti*: 6 ♂♂, 20 ♀♀, 1 ♂ deutonymph, 2 ♀ deutonymps, 5 protonymps; – *Spinturnix plecotina*: 1 ♂, 1 deutonymph, 1 protonymph; – *Paraperiglischrus rhinolophinus*: 1 ♀, 1 protonymph; – *Spinturnix acuminata* [no data]. – M a c r o n y s s i d a e: *Ornithonyssus* sp.: 2 ♀♀, 10 protonymphs; – *Macronyssus corethroproctus* (as a *Macronyssus crosbyi*): 5 ♀♀, 2 protonymphs; – *Macronyssus ellipticus* [no data]; – *Macronyssus* sp.: 1 protonymph; – *Steatonyssus periblepharus*: 4 ♂♂, 23 ♀♀, 12 protonymphs; – *Steatonyssus superans* [no data]; – *Steatonyssus* sp.: <22 inds. – A r g a s i d a e: *Carios vespertilionis* (as *Argas vespertilionis*): 10 larvae. For comments on particular mite species see under their hosts above and in Rudnick (1960), Evans & Till (1964), Ah & Radovsky (1967), Dusbábek (1972), Uchikawa et al. (1994), and Stanyukovich (1997); for the data from Tajikistan also Stanûkovič & Malinovskij (1992).

ectoparasites were documented for the first time from the Tajikistani populations of *Rhinolophus kirghisorum* sp. nov. and *Eptesicus ognevi*.

According to the revision of the family Cimicidae Latreille, 1802 by Usinger (1966), the genus *Cimex* Linnaeus, 1758 includes four species groups, of them the *C. pipistrelli* group has a trophic preference for bats. It occurs across the whole Palaearctic and comprises eleven species (Akhoundi et al. 2020). However, the assignation of populations to particular species is rather problematic and requires a use of sophisticated methods, even the position of European populations is still uncertain. Since the only record of *Cimex* from Tajikistan has been reported by Kiričenko (1952), who found *Cimex pipistrelli* [group] (under *Cacodmus vicinus*) in a colony of *Pipistrelus pipistrellus* and his material is currently unavailable, the revision of these populations cannot be carried out without a new research and findings of these parasites.

The species of the bat flea family Ischnopsyllidae Wahlgren, 1907 occurring in Tajikistan could be sorted out to several groups based on their biogeographic relations. The group of Eupalaearctic species is represented by *Nycteridopsylla dictena* (collected from *Vespertilio murinus*); the group of western Palaearctic species comprises faunal elements of Europe and south-western Asia, in Tajikistan it is represented by *Ischnopsyllus octactenus* (collected from *Pipistrellus pipistrellus*); the largest group is composed of species distributed in West Turkestan and adjacent regions, it includes *Ischnopsyllus plumatus* (from *Eptesicus serotinus*), *I. petropolitanus* (mainly from *Plecotus strelkovi*), *Nycteridopsylla calceata* (from (?) *Hypsugo savii*), *N. oligochaeta* (from *Barbastella caspica*), and *Rhinolophopsylla unipectinata turkestanica* (from *Rhinolophus ferrumequinum*, *R. bocharicus*, *Myotis blythii*, and *M. emarginatus*). Medvedev & Polkanov (1997), in their review of ischnopsyllid fleas of West Turkestan, mentioned the *Myotis* bats to be the principal hosts of the latter flea subspecies in this region, our findings show the host preference of this flea to be much broader.

The summary of species of the bat fly family Nycteribiidae Samouelle, 1819 of West Turkestan was given by Polkanov & Medvedev (1997). The fauna of the region comprises 16 species, of them eight were confirmed from the territory of Tajikistan, based on literature and own new data, viz. *Nycteribia latreillii*, *N. lindbergi* (both collected from *Myotis blythii*), *Phthiridium biarticulatum* (from *Rhinolophus ferrumequinum* and *R. bocharicus*), *P. szechuanum* (from *Rhinolophus kirghisorum* sp. nov.), *P. simile* (from *Rhinolophus hipposideros* s.l.), *P. khabilovi* (from *R. ferrumequinum*), *Basilia mongolensis* (from *Myotis davidii* and *Barbastella caspica*), and *Penicillidia dufourii* (from *Myotis blythii* and *M. emarginatus*). Seven of these species represent cave-dwelling bat flies, only the genus *Basilia* Miranda-Ribeiro, 1903 is a parasite of dendrophilous and litophilous fissure-dwelling bats (Hůrka 1980). Similarly as in Ischnopsyllidae, the Nycteribiidae flies include several biogeographical types. The Eupalaearctic elements are represented by *Penicillidia dufourii*, while *Nycteribia latreilii*, *N. lindbergi*, *Phthiridium biarticulatum*, *P. simile*, and *P. khabilovi*, are common components of the southern regions of the western and central Palaearctic. Some Central Asian species of bat flies inhabit habitats and hosts occurring in Tajikistan, although still missing in the fauna of the country. Two additional nycteribiid species can be present in Tajikistan, although still unconfirmed; *Nycteribia quasiocellata* Theodor, 1966 is a species distributed in northern Asia, from western Siberia to the Russian Far East (including Kuril islands), in eastern Kazakhstan, Mongolia, and northern China (Hůrka 1969, 1970, Minář & Hůrka 1980, Orlova et al 2021c, Reeves et al. 2024). It was newly collected in southern Kirghizstan, from a mixed collection composed of *Rhinolophus ferrumequinum*, *R. kirghisorum* sp. nov. and *Myotis blythii* (own unpubl. data), its occurrence in (northern) Tajikistan is very probable. The genus *Nycteribia* is primarily a parasite of bats of the genus *Myotis*, which has a very broad distribution in Tajikistan, including also the Pamirs. Another species, *Phthiridium orientale* (Hůrka, 1976) was documented from *Rhinolophus ferrumequinum* and *R. hipposideros* in Afghanistan and

southern Kirghizstan (most probably representing two distinct forms; Hůrka 1976), the territory of Tajikistan lies in between these two countries of confirmed occurrence and is very likely that this parasite is distributed also in the latter country (where both known hosts are present widely).

The cosmopolitan soft tick species *Carios vespertilionis* (Argasidae Koch, 1844) has been confirmed to occur in several countries of West Turkestan besides Tajikistan (Filippova 1966, L′vov et al. 1984). In Tajikistan, it was found to parasitise *Myotis davidii*, *Pipistrellus pipistrellus* and an undetermined species (Stanûkovič & Malinovskij 1992). Its primary host is *Pipistrellus pipistrellus*, the most common bat of the country, the distribution of *C. vespertilionis* and its secondary parasitation of other bats probably covers a large part of Tajikistan and a variety of bat species.

Another argasid soft tick has been reported from Central Asia, *Secretargas transgariepinus* (White, 1846). It is primarily an African faunal element, distributed in both subtropic zones of this continent and individual records are known from southern Europe (see the review by Ševčík et al. 2024); a single record was reported from eastern Afghanistan, a region belonging to the Oriental realm (Jalalabad, from *Eptesicus pachyomus* [as *E. serotinus* s.l.]; Dusbábek 1970). However, it is a litophilous species of tick (cf. Hoogstraal 1957, Pienaar et al. 2018) and in other regions of south-western Asia it could be found associated with the ecologically corresponding hosts (e.g., bats of the genera *Eptesicus*, *Hypsugo*, *Pipistrellus*, *Otonycteris*, *Barbastella*, *Plecotus*, etc.) and thus, it could be present also in Tajikistan. Similar faunal elements could be found among other soft ticks of the genus *Chiropterargas* Hoogstraal, 1955, *C. boueti* (Roubaud et Colas-Belcour, 1933) and *C. confusus* (Hoogstraal, 1955). These two species are distributed throughout the African continent, but reach the Middle East and Central Asia. *Chiropterargas boueti* is known from Afghanistan, Turkmenistan, and Uzbekistan (Nemenz 1960, Dusbábek 1962, Filippova & Čunihin 1969), *C. confusus* from Afghanistan (Nemenz 1960, Travassos Santos Dias 1961).

The hard tick family Ixodidae Dugès, 1834 comprises one species of bat parasite inhabiting West Turkestan, *Ixodes vespertilionis* Koch, 1844. Besides Tajikistan, it was documented from Turkmenistan and Kirghizstan (Dubinin & Bregetova 1952, Rybin et al. 1989, Fedorova 2012). Among other Palaearctic members of the family, this species is typical by the largest variety of bat hosts and also hosts of other mammal groups (Szentiványi et al. 2024). From Tajikistan, Filippova (1972) reported it from *Rhinolophus ferrumequinum*, a bat species ranking among the principal hosts of this tick. Other species of the genus *Rhinolophus* as well as the vespertilionid bats of the Tajikistani fauna represent potential hosts of this hard tick (Beaucournu 1966, Filippova 1977) and thus, its wide occurrence in the country is well possible. Another hard tick species potentially occurring in Tajikistan is a monoxenous species *Ixodes simplex* Neumann, 1906. It can be found usually on the *Miniopterus* bats, but also on other bat species present in proximity to the colonies of the principal host (Beaucournu 1967). In Asia its records were made in *Miniopterus pallidus* from Azerbaijan (Filippova 1972). The possible occurrence of the genus *Miniopterus* in Tajikistan could indicate also a presence of this tick in the country.

The mesostigmatic mites of two families were documented from Tajikistan, Spinturnicidae Oudemans, 1902 and Macronyssidae Oudemans, 1936. The former family represents permanent highly specialised parasites of bats, parasitising attached to the wing membrane. The life cycle of these mites is extremely shortened as an adaptation to protection of their juveniles (Bregetova 1956), so their specificity has an extreme level, in the form of monoxeny, polyxeny, or oligoxeny (Dusbábek 1973). Despite the changes of their abundance during the year cycle, the extent of their distribution ranges is expected to be in accordance with the range of the specific host species. The bat fauna of Tajikistan is composed mainly of the western Palaearctic elements, whose parasitic fauna of the family Spinturnicidae is well studied and known. Therefore, we meet a known parasite fauna from a series of studied hosts, part of them published by Stanûkovič & Malinovskij (1992) and Orlova & Kazakov (2016), with our addition it represents 10 species of three genera collected

from two bat host families, Rhinolophidae and Vespertilionidae. An exception is a vespertilionid bat *Otonycteris leucophaea*, from which a species of spinturnicid mite was collected that is reported to be geographically limited only to the distribution range of this host bat (Dundarova et al. 2022). However, it covers a relatively very small area and this would represent an unusual situation for a spinturnicide mite, see also the discussion above, under the host species. Anyway, additional data on this host and its parasites are necessary for final assessment of the host-parasite relations. In another bat host family of Tajikistan, Molossidae, the spinturnicid mites are not expected to occur as a link between these parasites and the genus *Tadarida* has never been documented (Rudnick 1960, Dusbábek 1973). Since the occurrence of the family Miniopteridae in Tajikistan is uncertain (see above), the presence of the specific primary parasite of the genus *Miniopterus*, *Spinturnix psi* (Kolenati, 1856) has not been confirmed from the country and is not expected either.

In the other mesostigmatid family, Macronyssidae, the knowledge of the fauna in Tajikistan is rather limited, similarly as in the next group, the prostigmatid mites of the family Trombiculidae (see below). For a responsible research of the macronyssid parasites, examinations of host bats must cover several seasons of the year. The occurrence of this group does not correspond directly with the activity period of the host bat, they represent endophilic parasites with a transition from periodical to permanent parasitism and obligatory hematophagy, which are limited by trophic relations to the host and by habitat preferences. The studies from other regions of the Palaearctic, namely central and southern Europe, showed higher abundances during the hibernation period in some cave-dwelling species (e.g., *Macronyssus ellipticus* and *M. cyclaspis*; Dusbábek 1972, Haitlinger 1978). On the other hand, the polyxenic species of the genus *Steatonyssus*, *S. superans* and *S. periblepharus*, prefer the migratory bat species as their hosts and the abundance peak occurs in the summer and autumn, i.e. in the reproduction periods of the hosts (Rybin 1983). In other species the year cycle still remains unknown, namely in the recently described *Ornithonyssus guzlonicus* or *Steatonyssus pseudoheteroventralis* (see Orlova et al. 2015a, 2017b). The literature data by Stanûkovič & Malinovskij (1992) and Orlova et al. (2015a), and our new records indicate the presence of at least twelve species of macronyssid mites in Tajikistan (plus one species that does not parasitise bats).

In accordance with the divisions by Orlova et al. (2017b), the fauna of both families of mesostigmatic mites occuring in Tajikistan could be sorted as follows: European subboreal species: *Eyndhovenia euryalis* and *Paraperiglischrus rhinolophinus*; European-West Siberian boreal species: *Spinturnix carnificina* and *Macronyssus corethroproctus*; Eurasian (trans-Palaearctic) subboreal species: *Spinturnix acuminata*, *S. punctata*, *Ornithonyssus flexus*, *Steatonyssus periblepharus*, and *Ichoronyssus scutatus*; European-Central Asian taxa: *Spinturnix mystacina*, *S. emarginata*, *S. nobleti*, *Macronyssus rhinolophi*, *M. barbastellinus*, and *Steatonyssus occidentalis evansi*; Central Asian species: *Ornithonyssus guzlonicus*, *Steatonyssus mongolicus*, and *S. pseudoheteroventralis*; Pan-Eurasian species: *Spinturnix myoti*, *S. plecotina*, and *Macronyssus ellipticus*; and Ural-Siberian-Far Eastern boreal-subboreal species: *Steatonyssus superans*.

The chigger mites of the family Trombiculidae Ewing, 1929 are phased parasites whose life cycle in the temperate zone represents just a single generation (contrary to tropical conditions). Their larvae are found mainly in the autumn period and primarily in the cave-dwelling bat species

† several authors (e.g. Haitlinger & Ruprecht 1985, Lanza 1999, Haitlinger & Łupicki 2008, Moniuszko & Mąkol 2014, Zajkowska et al. 2018, 2024) reported an occurrence of *Oudemansidium musca* (Oudemans, 1906) in Tajikistan. All these reports are perhaps based on a review by Vercammen-Grandjean & Langston (1976), who misinterpreted the data by Tagil′cev (1970). Tagil′cev (1970) reported this species from the Soviet Union without a closely specified locality (just with a vague link to eastern Kazakhstan). Thus, we do not consider *O. musca* to represent a part of the known fauna of Tajikistan (see also Kudrâšova 1991), although its occurrence is well posible considering the wide presence of its hosts.

(Shatrov & Kudryashova 2008, Zajkowska & Mąkol 2021). During our research trip conducted in May, only a single specimen of chigger mite of the genus *Miyatrombicula* Sasa, Kawashima et Egashira, 1952 (subgenus *Miyacarus* Vercammen-Grandjean, 1967) was collected. The species identification was not possible, for details see Records of ectoparasites under *Eptesicus ognevi*. It is an accidental record of the mite genus parasitising rodents and insectivores and rarely reptiles (Kudrâšova 1978). In the Palaearctic, only a single record of this genus from a bat was reported; *Miyatrombicula barbatulus* Mulârskaâ, 1973 from *Rhinolophus mehelyi* (Mulârskaâ 1973, Gadžiev et al. 1990), otherwise the genus does not show an association with bats.

The Palaearctic is typical by an occurrence of several species complexes of trombiculid mites, *Leptotrombidium russicum* (Oudemans, 1902), *Oudemansidium komareki* (Daniel et Dusbábek, 1959), *O. musca* (Oudemans, 1906), *Willmannium cavus* Kudrâšova, 1992 (see Kudrâšova 1991, 1992, Zajkowska et al. 2024). One of these groups†, *L. russicum*, was found in Tajikistan, but in rodents and not in bats (Vercammen-Grandjean & Langston 1976: 285). In *Eptesicus ognevi*, the complex *Willmannium cavus* was found, distributed along the southern limits of the Palaearctic, from North Africa to Mongolia (Benda et al. 2014, Stekolnikov et al. 2022, Zajkowska et al. 2024). In Tajikistan, like in other parts of West Turkestan, the trombiculid fauna is very poorly known, only few reports from bats in two countries were published, viz. *Trombigastia splendida* Šluger et Amanguliev, 1972 from *Miniopterus pallidus* in Turkmenistan (Šluger & Amanguliev 1972); *Myotrombicula hexasternalis* Šluger et Kudrâšova, 1969, *Odontacarus naumovi* Kudrâšova et Rybin, 1974, *Pantagonaspis aravani* Kudrâšova et Rybin, 1983, *Leptotrombidium* sp., *Chiroptella* sp. and Trombiculidae sp. from a variety of hosts in Kirghizstan (Šluger & Kudrâšova 1969, Kudrâšova & Rybin 1974, 1983, Rybin et al. 1989). The genus assignations in some species of this group of chigger mites has been suggested for a revision (Ševčík et al. 2021). Regarding the diversity of their bat hosts in West Turkestan, such a revison takes a significant effort, on the other hand, the discovered diversity could be as wide as in other regions with a similarly diverse bat fauna.

Acknowledgements

We thank Tolibdžon Habilov for his logistic help during our research trip, including driving of the expedition car, and Dilbar Tadžibaeva for her casual preparation of food during the trip, namely the delicious pilaf. We are also grateful to Heliana Dundarova (Sofia, Bulgaria) who kindly provided us with tissue samples of bats collected by her in Kirghizstan that were used in the molecular genetic analysis, and Gabor Csorba (HNHM), †Vladimír Hanák (CUP), †John E. Hill (BMNH), Sergej V. Kruskop, Igor′ Â. Pavlinov, and †Ol′ga L. Rossolimo (ZMMU), Maria Mostadius (MZLU), Manuel Ruedi (MHNG), †Christiaan Smeenk (RMNH), †Gerhard Storch (SMF), and †Petr P. Strelkov (ZIN), who allowed to examine the collection specimens under their care. We thank Gabor Csorba (Budapest, Hungary) also for his notes on morphology of *Rhinolophus macrotis topalius*, Luděk Bufka (Kašperské Hory, Czech Republic) for his help in the field of Kirghizstan and providing his photos from Kirghizstan, Stanislav Kalúz (Bratislava, Slovakia) for his help with determination of the Trombiculidae mite, Sergej G. Medvedev (Sankt-Peterburg, Russia) for kind providing several literature sources, and last but not least, Vlasta Pachtová (Library of the Faculty of Sciences, Charles University, Prague, Czech Republic) for her outstanding help in obtaining rather odd literature sources, necessary for reviewing the bat fauna of Tajikistan and adjacent countries. The preparation of this study was supported by the Ministry of Culture of the Czech Republic (# DKRVO 2024–2028/6.I.a, 00023252).

REFERENCES

Abduriyim S., Kasimu T., Lan J.-K., Pu Z.-L., Bai J.-L. & Wang Y.-C. 2022: Morphological and molecular confirmation of the common pipistrelle bat, Pipistrellus pipistrellus Schreber, 1774 (Vespertilionidae: Chiroptera), in Xinjiang, China. *Mammalia* **86**: 298–302.

Aellen V. 1959a: Contribution à l'étude de la faune d'Afghanistan 9. Chiroptères. *Revue Suisse de Zoologie* **66**: 353–386.

Aellen V. 1959b: Contribution à l'étude de la faune d'Afghanistan 21. Diptères Pupipares parasites de Chiroptères. *Revue Suisse de Zoologie* **66**: 555–567.

Ah H.-S. & Radovsky F. J. 1967: Notes on Steatonyssus Kolenati in Korea with description of a new species (Acarina: Macronyssidae). *Journal of Parasitology* **53**: 419–431.
Akhoundi M., Sereno D., Durand R., Mizraei A., Bruel C., Delaunay P., Marty P. & Izri A. 2020: Bed bugs (Hemiptera, Cimicidae): Overview of classification, evolution and dispersion. *International Journal of Environmental Research and Public Health* **17**(12; 4576): 1–20.
Allen G. M. 1938: *The Mammals of China and Mongolia*. *Natural History of Central Asia*. *Vol. XI*, *Part 1*. American Museum of Natural History, New York, xxv+620 pp.
Amichai E. & Korine C. 2023: Kuhl's pipistrelle Pipistrellus kuhlii (Kuhl, 1817). Pp. 501–519. In: Russo D. (ed.): *Handbook of the Mammals of Europe*. *Chiroptera*. Cham: Springer Nature Switzerland, xvii+963 pp.
Amorim F., Razgour O., Mata V. A., Lopes S., Godinho R., Ibáñez C., Juste J., Rossiter S. J., Beja P. & Rebelo H. 2020: Evolutionary history of the European free-tailed bat, a tropical affinity species spanning across the Mediterranean Basin. *Journal of Zoological Systematics and Evolutionary Research* **58**: 499–518.
Ancilloto L., Santini L., Ranc N., Maiorano L. & Russo D. 2016: Extraordinary range expansion in a common bat: the potential roles of climate change and urbanisation. *The Science of Nature* **103**(15): 1–8.
Andersen K. 1905: On some bats of the genus Rhinolophus, with remarks on their mutual affinities, and descriptions of twenty-six new forms. *Proceedings of the Zoological Society of London* **1905**(2): 75–145.
Andersen K. 1918: Diagnoses of new bats of the families Rhinolophidæ and Megadermatidæ. *Annals and Magazine of Natural History*, *Nineth Series* **2**: 374–384.
Anisimova M., Gil M., Dufayard J.-F., Dessimoz C. & Gascuel O. 2011: Survey of branch support methods demonstrates accuracy, power, and robustness of fast likelihood-based approximation schemes. *Systematic Biology* **60**: 685–699.
Anonymous 1879a: [Къ обозрѣнію дѣятельности члена-сотрудника Н. А. Сѣверцова] [Report on the activities of the member-fellow N. A. Severcov]. *Izvěstìâ Imperatorskago Russkago Geografičeskago Obŝestva* **15**: 63–64 (in Russian).
Anonymous 1879b: Экспедиція Консерватора Музея Академіи Наукъ В. Ф. Руссова [Expedition of V. F. Russov, a preservationist at the Museum of the Academy of Sciences]. *Izvěstìâ Imperatorskago Russkago Geografičeskago Obŝestva* **15**: 296–297 (in Russian).
Ânuševič A. I., Ajzin B. M., Kydyraliev A. K., Umrihina G. S., Fedânina T. F., Šukurov È. D., Grebenûk R. V. & Tokobaev M. M. 1972: *Млекопитающие Киргизии* [*Mammals of Kirghizstan*]. Frunze: Izdatel′stvo Ilim, 463 pp (in Russian).
Argiropulo A. I., 1939: К распространению и экологии некоторых млекопитающих Армении [On the distribution and ecology of some mammals of Armenia]. *Zoologičeskij Sbornik* **1** (*Trudy Biologičeskogo Instituta* **3**): 27–66 (in Russian, with a summary in German).
Arlettaz R., Ruedi M., Ibañez C., Palmeirim J. & Hausser J. 1997: A new perspective on the zoogeography of the sibling mouse-eared bat species Myotis myotis and Myotis blythii: morphological, genetical and ecological evidence. *Journal of Zoology*, *London* **242**: 45–62.
Arthur D. R. 1956: The Ixodes ticks of Chiroptera (Ixodoidea, Ixodidae). *Journal of Parasitology* **42**: 180–196.
Arthur D. R. 1963: *British Ticks*. London: Butterworths, 213 pp.
Artûšin I. V., Kruskop S. V., Lebedev V. S. & Bannikova A. A. 2018: Молекулярная филогения кожанов (Mammalia, Chiroptera, Eptesicus) с акцентом на исторической эволюции и таксономии видовой группы E. serotinus [Molecular phylogeny of the serotine bats (Mammalia, Chiroptera, Eptesicus) with a stress on the historical evolution and taxonomy of the E. serotinus species group]. *Izvestiâ Rossijskoj Akademii Nauk*, *Seriâ Biologičeskaâ* **2018**(5): 527–536 (in Russian).
Artyushin I. V., Lebedev V. S., Smirnov D. G. & Kruskop S. V. 2012a: Taxonomic position of the Bobrinski's serotine (Eptesicus bobrinskoi, Vespertilionidae, Chiroptera). *Acta Chiropterologica* **14**: 291–303.
Artyushin I., Lebedev V., Bannikova A. & Kruskop S. 2012b: A molecular reappraisal of the taxonomic status of Eptesicus serotinus turcomanus. *Vespertilio* **16**: 31–42.
Ashrafi S., Zarrintab M. & Eagderi S. 2016: A new locality for the desert long-eared bat, Otonycteris leucophaea (Severcov, 1873) in Iran. *Acta Biologica Turcica* **29**: 35–37.
Aukema B. & Rieger C. H. 1996: *Catalogue of the Heteroptera of the Palaearctic Region*. *Volume 2*. *Cimicomorpha I*. Leiden: the Netherlands Entomological Society, xiv+361 pp.
Babaev H. 1965: Распределение и численность летучих мышей в Туркмении [Distribution and abundance of bats in Turkmenistan]. *Izvestiâ Akademii Nauk Turkmenskoj SSR*, *Seriâ Biologičeskih Nauk* **4**: 51–54 (in Russian).
Babaev H. & Dmitrieva V. P. 1966: Широкоухий складчатогуб (Tadarida teniotis Rafinesque) и ушан (Plecotus auritus wardi Thomas) – новые виды рукокрылых для фауны Туркмении [The European free-tailed bat (Tadarida teniotis Rafinesque) and long-eared bat (Plecotus auritus wardi Thomas) – new species for the fauna of Turkmenistan]. *Zoologičeskij Žurnal* **45**: 779–780 (in Russian, with a summary in English).
Bailey S. E., Mao X., Struebig M., Tsagkogeorga G., Csorba G., Heaney L. R., Sedlock J., Stanley W., Rouillard J. M. & Rossiter S. J. 2016: The use of museum samples for large-scale sequence capture: A study of congeneric horseshoe bats (family Rhinolophidae). *Biological Journal of the Linnean Society* **117**: 58–70.

Balog Š. 2023: *Molekulárně genetická proměnlivost netopýrů rodu Hypsugo v západní Palearktidě* [*Molecular Genetic Variation in Bats of the Genus Hypsugo in the Western Palaearctic*]. Unpubl. MSc. Thesis. Praha: Department of Zoology, Charles University, 106 pp (in Czech).

Balvín O., Kratochvíl L. & Vilímová J., 2013: Batbugs (Cimex pipistrelli group, Heteroptera: Cimicidae) are morphologically, but not genetically differentiated among bat hosts. *Journal of Zoological Systematics and Evolutionary Research* **51**: 287–295.

Barabanov A. V. & Ananjeva N. B. 2007: Catalogue of the available scientific species-group names for lizards of the genus Phrynocephalus Kaup, 1825 (Reptilia, Sauria, Agamidae). *Zootaxa* **1399**: 1–56.

Baranova G. I., Gureev A. A. & Strelkov P. P. 1981: *Каталог типовых экземпляров коллекции Зоологического института АН СССР. Млекопитающие* (*Mammalia*). *Выпуск 1. Насекомоядные* (*Insectivora*), *рукокрылые* (*Chiroptera*), *зайцеобразные* (*Lagomorpha*) [*Catalogue of Type Specimens in the Collection of the Zoological Institute of the Academy of Sciences of the Soviet Union. Part 1. Insectivores* (*Insectivora*), *Bats* (*Chiroptera*), *Hares and Pikas* (*Lagomorpha*)]. Leningrad: «Nauka» Leningradskoe otdelenie, 24 pp (in Russian).

Barlow K. E. & Jones G. 1999: Roosts, echolocation calls and wing morphology of two phonic types of Pipistrellus pipistrellus. *Zeitschrift für Säugetierkunde* **64**: 257–268.

Bates P. J. J. & Harrison D. L. 1997: *Bats of the Indian Subcontinent*. Sevenoaks: Harrison Zoological Museum, 258 pp.

Bayefsky-Anand S., Skowronski M. D., Fenton M. B., Korine C. & Holderied M. W. 2008: Variations in the echolocation calls of the European free-tailed bat. *Journal of Zoology*, *London* **275**: 115–123.

Beaucournu J.-C. 1966: Sur les quelques Ixodoidea (Acarina) paléarctiques inféodés aux micro-chiroptères. *Annales de Parasitologie Humaine et Comparée* **41**: 495–502.

Beaucournu J. C. 1967: Contribution à la connaissance de la biologie d'Ixodes (Eschatocephalus) vespertilionis Koch, 1844 et d'Ixodes (Pomerantzevella) simplex Neumann, 1906 (Acarina, Ixodoidea) parasites des Chiroptères. *Annales de Spéléologie* **22**: 543–580.

Beaucournu J. C. & Hellal H. 1977: Liste annotée des siphonaptères de Tunisie. *Bulletin de la Société de Pathologie Exotique* **70**: 527–537.

Beaucournu J.-C., Léger N. & Roisin G. 1975: Liste annotée des siphonaptères du Maroc. *Bulletin de la Société de Pathologie Exotique* **68**: 83–90.

Bejšebaev K. 1966: Рыжая вечерница (Nyctalus noctula) в ореховых лесах южной Киргизии [Common noctule (Nyctalus noctula) in the wallnut forests of southern Kirghizstan]. *Zoologičeskij Žurnal* **45**: 1583 (in Russian).

Benda P. 2021: Systematic catalogue of mammals (Mammalia) in the collection of the National Museum Prague. I. Chiroptera: Rhinolophoidea 1. *Lynx*, *n.s*. **52**: 155–203.

Benda P. & Gaisler J. 2015: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 12. Bat fauna of Afghanistan: revision of distribution and taxonomy. *Acta Societatis Zoologicae Bohemicae* **79**: 267–458.

Benda P. & Gvoždík V. 2010: Taxonomy of the genus Otonycteris (Chiroptera: Vespertilionidae: Plecotini) as inferred from morphological and mtDNA data. *Acta Chiropterologica* **12**: 83–102.

Benda P. & Horáček I. 1995: Geographical variation of three species of Myotis (Mammalia, Chiroptera) in South of the Western Palearctics. *Acta Societatis Zoologicae Bohemicae* **59**: 17–39.

Benda P. & Karataş A. 2005: On some Mediterranean populations of bats of the Myotis mystacinus morpho-group (Chiroptera: Vespertilionidae). *Lynx*, *n.s.* **36**: 9–38.

Benda P. & Mashkour M. 2021: A finding of Eptesicus gobiensis in an ancient salt mine in Iran and notes on the status of this bat in the Middle East (Mammalia: Chiroptera). *Journal of the National Museum* (*Prague*), *Natural History Series* **190**: 61–72.

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

Benda P. & Uhrin M. 2017: First records of bats from four Dodecanese islands, Greece (Chiroptera). *Lynx*, *n.s.* **48**: 15–38.

Benda P. & Uhrin M. 2019: On the bat fauna of the Bahrain Archipelago (Chiroptera). *Lynx*, *n.s.* **50**: 5–27.

Benda P. & Uvizl M. 2021: Taxonomic revision of *Myotis emarginatus*: detailed morphometric analysis and final evaluation of the evidence (Chiroptera: Vespertilionidae). *Lynx*, *n.s*. **52**: 25–54.

Benda P., Ivanova T., Horáček I., Hanák V., Červený J., Gaisler J., Gueorguieva A., Petrov B. & Vohralík V. 2003a: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 3. Review of bat distribution in Bulgaria. *Acta Societatis Zoologicae Bohemicae* **67**: 245–357. 51.

Benda P., Hulva P., Andreas M. & Uhrin M. 2003b: Notes on the distribution of Pipistrellus pipistrellus complex in the Eastern Mediterranean: First records of P. pipistrellus for Syria and of P. pygmaeus for Turkey. *Vespertilio* **7**: 87–95.

Benda P., Hulva P. & Gaisler J. 2004: Systematic status of African populations of Pipistrellus pipistrellus complex (Chiroptera: Vespertilionidae), with a description of a new species from Cyrenaica, Libya. *Acta Chiropterologica* **6**: 193–217.

Benda P., Andreas M., Kock D., Lučan R. K., Munclinger P., Nová P., Obuch J., Ochman K., Reiter A., Uhrin M. & Weinfurtová D. 2006: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean. Part 4. Bat fauna of Syria: distribution, systematics, ecology. *Acta Societatis Zoologicae Bohemicae* **70**: 1–329.

Benda P., Dietz C., Andreas M., Hotový J., Lučan R. K., Maltby A., Meakin K., Truscott J. & Vallo P. 2008: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 6. Bats of Sinai (Egypt) with some taxonomic, ecological and echolocation data on that fauna. *Acta Societatis Zoologicae Bohemicae* **72**: 1–103.

Benda P., Georgiakakis P., Dietz C., Hanák V., Galanaki K., Markantonatou V., Chudárková A., Hulva P. & Horáček I. 2009: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 7. The bat fauna of Crete, Greece. *Acta Societatis Zoologicae Bohemicae* **72**: 105–190.

Benda P., Lučan R. K., Obuch J., Reiter A., Andreas M., Bačkor P., Bohnenstengel T., Eid E. K., Ševčík M., Vallo P. & Amr Z. S. 2010a: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 8. Bats of Jordan: fauna, ecology, echolocation, ectoparasites. *Acta Societatis Zoologicae Bohemicae* **74**: 185–353.

Benda P., Červený J., Konečný A., Reiter A., Ševčík M., Uhrin M. & Vallo P. 2010b: Some new records of bats from Morocco (Chiroptera). *Lynx*, *n.s.* **41**: 151–166.

Benda P., Hanák V. & Červený J. 2011: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and the Middle East. Part 9. Bats from Transcaucasia and West Turkestan in collection of the National Museum, Prague. *Acta Societatis Zoologicae Bohemicae* **75**: 159–222.

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 Societatis Zoologicae Bohemicae* **76**: 163–582.

Benda P., Spitzenberger F., Hanák V., Andreas M., Reiter A., Ševčík M., Šmíd J. & Uhrin M. 2014: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 11. On the bat fauna of Libya II. *Acta Societatis Zoologicae Bohemicae* **78**: 1–162.

Benda P., Kruskop S. V. & Horáček I. 2016a: On the occurrence of Rhinolophus lepidus in West Turkestan: data from the Zoological Museum of the Moscow State University. *Vespertilio* **18**: 11–21.

Benda P., Gazaryan S. & Vallo P. 2016b: On the distribution and taxonomy of bats of the Myotis mystacinus morpho-group from the Caucasus region (Chiroptera: Vespertilionidae). *Turkish Journal of Zoology* **40**: 842–863.

Benda P., Abi Said M. R., Bou Jaoude I., Karanouh R., Lučan R. K., Sadek R., Ševčík M., Uhrin M. & Horáček I. 2016c: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 13. Review of distribution and ectoparasites of bats in Lebanon. *Acta Societatis Zoologicae Bohemicae* **80**: 207–316.

Benda P., Ševčík M., Bego F., Sachanowicz K., Spitzenberger F., Tájek P., Tájková P. & Uhrin M. 2019: Bats (Mammalia: Chiroptera) of the Eastern Mediterranean and Middle East. Part 15. The fauna of bats and bat ectoparasites of Albania with a catalogue of bats from the western Balkans in the collection of the National Museum, Prague. *Acta Societatis Zoologicae Bohemicae* **83**: 1–238.

Benda P., Uvizl M., Vallo P., Reiter A. & Uhrin M. 2022: A revision of the Rhinolophus hipposideros group (Chiroptera: Rhinolophidae) with definition of an additional species from the Middle East. *Acta Chiropterologica* **24**: 269–298.

Beron P. 1969: Contribution à l'étude des Acariens parasites des Chiroptères en Hongrie II. Fam.: Laelapidae, Macronyssidae, Argasidae et Ixodidae. *Parasitologica Hungarica* **2**: 159–166.

Beron P. 2020: *Acarorum Catalogus VI*: *Order Mesostigmata*. *Gamasina*: *Dermanyssoidea* (*Rhinonyssidae*, *Spinturnicidae*). Sofia: Pensoft & National Museum of Natural History, 265 pp.

Bhat H. R. & Kulkarni S. M. 1974: A survey of haematophagous arthropods in western Himalayas, Sikkim and hill districts of West Bengal: Pupipara (Diptera) (families: Hippoboscidae, Nycteribiidae and Streblidae). *Indian Journal of Medical Research* **62**: 1121–1133.

Bìanki V. 1917: Предварительныя замѣтки о летучихъ мышахъ (Chiroptera) Россіи [Preliminary notes on bats (Chiroptera) of Russia]. *Ežegodnik" Zoologičeskago Muzeâ Akademìi Nauk"* **21**: lxxiii–lxxxii (in Russian).

Bìanki V. 1918: Неизвѣстныя въ литературѣ мѣстонащожденія русскихъ Chiroptera [In literature unknown records of the Russian Chiroptera]. *Ežegodnik" Zoologičeskago Muzeâ Akademìi Nauk"* **22**: viii–ix (in Russian).

Bil′kevič" S. N. 1918: Коллекція Закаспійскаго Музея. Млекопитающія (Mammalia) [Catalogue of the Transcaspian Museum. Mammals (Mammalia)]. *Izvěstiâ Zakaspijskago Muzeâ* **1**: 1–12 (in Russian).

Blanford W. T. 1875: Descriptions of new Mammalia from Persia and Balúchistán. *Annals and Magazine of Natural History*, *Fourth Series* **16**: 309–313.

Blyth E. 1844: Notices of various Mammalia, with descriptions of many new species. *Journal of the Asiatic Society of Bengal* **13**: 463–494.

Bobrinskoi N. 1931: Neue Angaben über die geographische Verbreitung der Fledermäuse (Chiroptera) Rußlands. *Zoologischer Anzeiger* **96**: 265–268.

Bobrinskoj N. A. 1918: Замѣтки о летучихъ мышахъ, добытыхъ въ Бухарскомъ Ханствѣ лѣтомъ 1914 г. [Notes on bats collected in the Khanate of Bokhara in the summer 1914]. *Materialy k" Poznaniû Fauny i Flory Rossìi*, *Otdel" Zoologičeskij* **15**: 1–22 (in Russian).

Bobrinskoj N. A. 1925: Материалы для фауны летучих мышей Туркестанского края. (Западный Туркестан с Семиреченской и Закаспийской областями, Хива и Бухара) [Records of the bat fauna of the Turkestan Province (West Turkestan with the Regions of Semirechie and of Transcaspia, Khiva and Bokhara).]. *Bûlleten' Moskovskogo Obŝestva Izpytatelej Prirody*, *Otdel Biologičeskij*, *Novaâ Seriâ* **34**: 330–374 (in Russian, with a summary in English).
Bobrinskoj N. A. 1926: Предварительное сообщение о летучих мышах (Chiroptera) из Центральной Азии [Preliminary report on bats (Chiroptera) of Central Asia]. *Doklady Akademii Nauk SSSR* **1926**: 95–98 (in Russian).
Bobrinskoj N. 1929: Bats of Central Asia. *Ežegodnik Zoologičeskogo Muzeâ Akademii Nauk SSSR* **1929**: 217–244.
Bobrinskoj N. A. & Kuzâkin A. P. 1937: Новые данные по географическому распространению летучих мышей (Chiroptera) СССР [New data on the geographical distribution of bats (Chiroptera) in the Soviet Union]. *Bûlleten' Moskovskogo Obŝestva Ispytatelej Prirody*, *Otdel Biologičeskij*, *Novaâ Seriâ* **46**(5): 265–267 (in Russian, with a summary in English).
Bogdanov″ M. N. 1882: *Описаніе хивинскаго похода 1873 года*, *составлено подъ редакціею генеральнаго штаба генералъ-лейтенанта В. Н. Троцкаго*. *Выпуск XII*. *Очерки природы хивинскаго оазиса и пустыни Кизылъ-кумъ* [*Description of the March to the Khiva in 1873*, *drew up under the Edition of the General Staff's Lieutenant General V. N. Trockij*. *Part XII*. *Notes on the Nature of the Khiva Oasis and the Kyzylkum Desert*]. Taškent″: Tipografiâ, arenduemaâ F. V. Bazilevskim″, iv+155 pp (in Russian).
Bogdanov O. P. 1950: О нахождении широкоухого складчатогуба (Tadarida teniotis Rafinesque) в Баба-Таге [On a finding of the European free-tailed bat (Tadarida teniotis Rafinesque) in the Baba-Tag Mountains]. *Izvestiâ Akademii Nauk UzSSR* **1950**(4): 129–130 (in Russian).
Bogdanov O. P. 1952: Дополнения к фауне насекомоядных и рукокрылых Таджикистана [Additions to the fauna of insectivores and bats of Tajikistan]. *Izvestiâ Akademii Nauk Uzbekskoj SSR* **1952**(2): 95–96 (in Russian).
Bogdanov O. P. 1953a: *Фауна Узбекской ССР. Том III. Млекопитающие. Вып. 2. Рукокрылые* [*Fauna of Uzbekistan. Volume III. Mammals. No. 2. Bats*]. Taškent: Izdatel′stvo Akademii Nauk UzSSR, 159 pp (in Russian).
Bogdanov O. P. 1953b: К экологии белобрюхого стрелоуха (Otonycteris hemprichi Peters 1859) [On the ecology of the desert long-eared bat (Otonycteris hemprichi Peters 1859)]. *Akademiâ Nauk Uzbekskoj SSR*, *Institut Zoologii i Parazitologii*, *Trudy* **2**: 82–83 (in Russian).
Bogdanov O. P. 1954: О зимовках леучих мышей в окресностях Сталинабада [On the hibernation of bats in the surroundings of Stalinabad]. *Doklady Akademii Nauk Tadžikskoj SSR* **13**: 17–19 (in Russian).
Bogdanov O. P. 1956a: Летучие мыши Таджикистана [Bats of Tajikistan]. *Doklady Akademii Nauk Tadžikskoj SSR* **15**: 69–75 (in Russian).
Bogdanov O. P. 1956b: Зимовки летучих мышей в долине реки Зеравшан [Hibernation of bats in the Zeravšan river valley]. *Zoologičeskij Žurnal* **35**: 1097–1099 (in Russian).
Bogdanov O. P. 1960: К распространению и экологии длиннохвостой ночницы (Myotis longicaudatus Ognev) [On the distribution and ecology of the long-tailed mouse-eared bat (Myotis longicaudatus Ognev)]. *Zoologičeskij Žurnal* **39**: 1895–1896 (in Russian, with a summary in English).
Bogdanov O. P. 1968: Новые данные по распространению рукокрылых в Средней Азии (горы Нуратау) [New data on the distribution of bats in West Turkestan (Nuratau Mts.)]. *Zoologičeskij Žurnal* **47**: 643–644 (in Russian, with a summary in English).
Bogdanov O. P. 1974: Особенности распространения и показатели численности рукокрылых Средней Азии [Distribution patterns and abundance indices of bats in West Turkestan]. Pp. 77–78. In: Strelkov P. P. & Kuzâkin A. P. (eds.): *Материалы первого Всесоюзного совещания по рукокрылым* (*Chiroptera*) [*Proceedings of the First Pan-Union Symposium on Bats* (*Chiroptera*)]. Leningrad: Zoologičeskij Institut Akademii Nauk SSSR, 184 pp (in Russian).
Bogdanowicz W. 1992: Phenetic relationships among bats of the family Rhinolophidae. *Acta Theriologica* **37**: 213–240.
Bogdanowicz W., Van Den Bussche R. A., Gajewska M., Postawa T. & Harutyunyan M. 2009: Ancient and contemporary DNA sheds light on the history of mouse-eared bats in Europe and the Caucasus. *Acta Chiropterologica* **11**: 289–305.
Bonaparte C. L. Principe 1832–1841 [1837]: *Iconografia della Fauna Italica per le Quatro Classi degli Animali Vertebrati*. *Tomo I*. *Mammiferi e Ucelli*. Roma: dalla Tipografia Salviucci [not contnuously paginated].
Borisenko A. V. & Pavlinov I. Â. 1995: Подотряд Microchiroptera [Sub-Order Microchiroptera]. Pp. 72–120. In: Pavlinov I. Â., Borisenko A. V., Kruskop S. V. & Âhontov E. L. (eds.): Млекопитающие Евразии. II. Non-Rodentia. Систематико-географический справочник [Mammals of Eurasia. II. Non-Rodentia. Systematical-geographical review]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **23**: 1–334 (in Russian).
Borisenko A. V., Kruskop S. V., Pavlinov I. Â. & Spasskaâ N. N. 2001: Класс Mammalia [Class Mammalia]. Pp. 163–228. In: Borisenko A. V. & Pavlinov I. Â. (eds.): Типы позвоночных в Зоологическом музее Московского университета [Types of vertebrates in the Zoological Museum of the Moscow University]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **41**: 5–251 (in Russian, with English notes).
Borovskij S. G. & Voroncov N. N. 1970: Гигантская вечерница (Nyctalus lasiopterus) в западном Приарлье [Greater noctule (Nyctalus lasiopterus) in the western Aral region]. *Zoologičeskij Žurnal* **49**: 940 (in Russian).

Bregetova N. G. 1956: *Гамазовые клещи* (*Gamasoidea*). *Краткий определитель* [*Gamasoid Mites* (*Gamasoidea*). *A Short Key*]. Moskva & Leningrad: Izdatel′stvo Akademii Nauk SSSR, 247 pp (in Russian).
Burgin C. J. 2019a: Genus Rhinolophus Lacépède, 1799. Pp. 280–332. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.
Burgin C. J. 2019b: [Species accounts of Eptesicus]. Pp. 846–849. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.
Burgin C. J. 2019c: Turkestani long-eared-bat Otonycteris leucophaea. P. 871. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.
Butovskij P. M., Šajmardanov R. T. & Strelkov P. P. 1985: Отряд рукокрылые – Chiroptera Blumenbach, 1779 [Order Bats – Chiroptera Blumenbach, 1779]. Pp. 125–260. In: Bekenov A., Butovskij P. M., Kasabekov B. B., Lankin P. M., Strelkov P. P., Stogov I. I., Fedosenko A. K., Šajmardanov R. T. & Šubin I. G. (eds.): *Млекопитающие Казахстана в четырех томах*. *Том четвертый*. *Насекомоядные и рукокрылые* [*Mammals of Kazakhstan in Four Volumes*. *Volume Four*. *Insectivores and Bats*]. Alma-Ata: Nauka Kazahskoj SSR, 280 pp (in Russian).
Černyšev V. I. 1958: Фауна и экология млекопитающих тугаев Таджикистана [Fauna and ecology of mammals of the alluvial meadows of Tajikistan]. *Akademiâ Nauk Tadžikskoj SSR*, *Institut Zoologii i Parazitologii*, *Trudy* **85**: 1–167 (in Russian).
Chakraborty S. 1977: Taxonomic studies on the greater horseshoe bat, Rhinolophus ferrumequinum (Schreber) [Chiroptera: Rhinolophidae]. *Journal of the Bombay Natural History Society* **74**: 341–343.
Chakravarty R. 2017: A new distribution record of the European free-tailed bat Tadarida teniotis (Chiroptera: Molossidae) from the western Himalaya, India. *Journal of Threatened Taxa* **9**: 10463–10467.
Chakravarty R., Ruedi M. & Ishtiaq F. 2020: A recent survey of bats with descriptions of echolocation calls and new records from the western Himalayan region of Uttarakhand, India. *Acta Chiropterologica* **22**: 197–224.
Chakravarty R., Mohan R., Voigt C. C., Krishnan A. & Radchuk V. 2021: Functional diversity of Himalayan bat communities declines at high elevation without the loss of phylogenetic diversity. *Scientific Reports* **11**(22556): 1–13.
Chattopadhyay B., Garg K. M., Swami Doss D. P., Vinothkumar A. K., Kandula S., Rheindt F. E. & Ramakrishnan U. 2021: Cryptic diversity of Rhinolophus lepidus in South Asia and differentiation across a biogeographic barrier. *Frontiers of Biogeography* **13**(4; e49625): 1–11.
Cheesman R. E. 1921: Report on a collection of mammals made by Col. J. E. B. Hotson in Shiraz, Persia. *Journal of the Bombay Natural History Society* **27**: 573–581.
Chen S.-F., Jones G. & Rossiter S. J. 2009: Determinants of echolocation call frequency variation in the Formosan lesser horseshoe bat (Rhinolophus monoceros). *Proceedings of the Royal Society B*: *Biological Sciences* **276**: 3901–3909.
Chornelia A. & Hughes A. C. 2023: Phenotypic traits evolution and morphological traits associated with echolocation calls in cryptic horseshoe bats (Rhinolophidae). *Journal of Systematics and Evolution* **61**: 719–732.
Chornelia A., Lu J. & Hughes A. C. 2022: How to accurately delineate morphologically conserved taxa and diagnose their phenotypic disparities: species delimitation in cryptic Rhinolophidae (Chiroptera). *Frontiers in Ecology and Evolution* **10**(854509): 1–18.
Chou C.-H. & Cheng H.-C. 2012: Echolocation calls of the eleven insectivorous bats of Taiwan. *Journal of Biodiversity* **14**: 33–62.
Choudhury A. 2016: *The Mammals of India*. *A Systematic & Cartographic Review*. Guwahati: Gibbon Books & The Rhino Foundation for Nature in NE India, 328 pp.
Ciechanowski M., Sachanowicz K., Rachwald A. & Benda P. 2005: First records of Tadarida teniotis (Rafinesque, 1814) (Chiroptera, Molossidae) from Serbia and Montenegro and from Bosnia and Herzegovina. *Mammalia* **69**: 257–260.
Çoraman E., Furman A., Karataş A. & Bilgin R. 2013: Phylogeographic analysis of Anatolian bats highlights the importance of the region for preserving the Chiropteran mitochondrial genetic diversity in the Western Palaearctic. *Conservation Genetic* **14**: 1205–1216.
Çoraman E., Dundarova H., Dietz C. & Mayer F. 2020: Patterns of mtDNA introgression suggest population replacement in Palaearctic whiskered bat species. *Royal Society Open Science* **7**(191805): 1–13.
Corbet G. B. 1964: The grey long-eared bat Plecotus austriacus in England and the Channel Islands. *Proceedings of the Zoological Society of London* **143**: 511–515.
Corbet G. B. 1978: *The Mammals of the Palaearctic Region*: *A Taxonomic Review*. London & Ithaca: British Museum (Natural History) & Cornell University Press, [vii]+314 pp.
Corbet G. B. & Hill J. E. 1992: *The Mammals of the Indomalayan Region*: *A Systematic Review*. Oxford & London: Oxford University Press & British Museum (Natural History), [vi]+488 pp.
Costa M. 1966: The present stage of knowledge of mesostigmatic mites in Israel (Acari, Mesostigmata). *Israel Journal of Zoology* **15**: 69–82.
Csorba G. & Bates P. J. J. 1995: A new subspecies of the horseshoe bat Rhinolophus macrotis from Pakistan (Chiroptera, Rhinolophidae). *Acta Zoologica Academiae Scientiarum Hungaricae* **41**: 285–293.

Csorba G. & Bates P. J. J. 2016: Replacement name for Rhinolophus macrotis topali Csorba et Bates, 1995. *Annales Musei Historico-Naturalis Hungarici* **108**: 283–285.
Csorba G., Ujhelyi P. & Thomas N. 2003: *Horseshoe Bats of the World* (*Chiroptera*: *Rhinolophidae*). Bishop's Castle: Alana Books, xxxii+160 pp.
Cyculina E. A. 2001: *Таксономия ночниц подрода Selysius* (*Chiroptera*, *Vespertilionidae*, *Myotis*) *Палеарктики* [*Taxonomy of the Mouse-eared Bats of the Subgenus Selysius* (*Chiroptera*, *Vespertilionidae*, *Myotis*) *of the Palaearctic*]. Unpubl. PhD. Abstract. Sankt-Peterburg: Zoologičeskij Institut Rossijskoj Akademii Nauk, 22 pp (in Russian).
Dai W., Li A., Chang Y., Liu T., Zhang L., Li J., Leng H., Li Z., Jin L., Sun K. & Feng J. 2023: Diet composition, niche overlap and partitioning of five sympatric rhinolophid bats in southwestern China during summer. *Frontiers in Ecology and Evolution* **11**(1108514): 1–12.
Das P. K. 1986: Studies on the taxonomy and geographical distribution of the species of bats obtained by the Silent Valley (Kerala, India) Expedition, 1980. *Records of the Zoological Survey of India* **84**: 259–276.
Datzmann T., Dolch D., Batsaikhan N., Kiefer A., Helbig-Bonitz M., Zöphel U., Stubbe M. & Mayer F. 2012: Cryptic diversity in Mongolian vespertilionid bats (Vespertilionidae, Chiroptera, Mammalia). Results of the Mongolian-German biological expeditions since 1962, No. 299. *Acta Chiropterologica* **14**: 243–264.
DeBlase A. F. 1980: The bats of Iran: systematics, distribution, ecology. *Fieldiana Zoology*, *N.S.* **4**: i–xvii+1–424 pp.
Dement'ev G. P., Rustamov A. K. & Spangenberg E. P. 1955: Материалы по фауне наземных позвоночных юго-восточной Туркмении [Data on the fauna of terrestrial vertebrates of south-eastern Turkmenistan]. *Trudy Turkmenskogo Sel'skohozâjsvennogo Instituta Im. M. I. Kalinina* **7**: 125–183 (in Russian).
Denzinger A., Siemers B. M., Schaub A. & Schnitzler H.-U. 2001: Echolocation by the barbastelle bat, Barbastella barbastellus. *Journal of Comparative Physiology A* **187**: 521–528.
Deunff J. & Beaucournu J.-C. 1981: Phénologie et variations du dermecos chez quelques espèces de Spinturnicidae (Acarina, Mesostigmata). *Annales de Parasitologie* (*Paris*) **56**: 203–224.
Deunff J., Volleth M., Keller A. & Aellen V. 1990: Description de Spinturnix nobleti n. sp. (Acari, Mesotigmata, Spinturnicidae), parasite spécifique de Pipistrellus (Hypsugo) savii (Chiroptera, Vespertilionidae). *Revue Suisse de Zoologie* **97**: 477–488.
Deunff J., Keller A. & Aellen V. 1997: Redescription of Spinturnix punctata (Sundevall, 1833) (Acari, Mesostigmata, Spinturnicidae), a specific parasite of Barbastella barbastellus (Chiroptera, Vespertilionidae). *Revue Suisse de Zoologie* **104**: 199–206.
Deunff J., Walter G., Bellido A. & Volleth M. 2004: Description of a cryptic species, Spinturnix bechsteini n. sp. (Acari, Mesostigmata, Spinturnicidae), parasite of Myotis bechsteinii (Kuhl, 1817) (Chiroptera, Vespertilionidae) by using ecoethology of host bats and statistical methods. *Journal of Medical Entomology* **41**: 826–832.
Dietz C., Gazaryan A., Papov G., Dundarova H. & Mayer F. 2016: Myotis hajastanicus is a local vicariant of a widespread species rather than a critically endangered endemic of the Sevan lake basin (Armenia). *Mammalian Biology* **81**: 518–522.
Dimo N. A. 1915: Почвенныя изслѣдованія въ бассейнѣ р. Аму-Дарьи [Soil investigations in the Amu Darya Basin]. *Ežegodnik" Otděla Zemel'nyh" Ulučšenìj* **6**: 270–291 (in Russian).
Dobson G. A. 1879: Order Chiroptera. Pp. 11–13. In: Blanford W. T.: *Scientific Results of the Second Yarkand Mission*; *Based Upon the Collection and Notes of the Late Ferdinand Stoliczka*, *PhD*. Calcutta: Office of the Superintendent of Government Printing, 94 pp.
Dolch D., Batsaikhan N., Thiele K., Scheffler I., Kiefer A., Mayer F., Samjaa R., Stubbe A., Stubbe M., Krall L. & Steinhauser D. 2007: Contributions to the Chiroptera of Mongolia with first evidences on species communities and ecological niches. *Erforschung Biologischer Ressourcen der Mongolei* [Halle/Saale] **10**: 407–458.
Dolch D., Steinhauser D., Gärtner B., Thiele K., Ariunbold J., Batsajchan N., Lchagvasuren D., Stubbe A. & Stubbe M. 2021a: Selten in der Mongolei nachgewiesene Fledermausarten. *Erforschung Biologischer Ressourcen der Mongolei* [Halle/Saale] **14**: 207–229.
Dolch D., Stubbe M., Gärtner B., Thiele K., Ariunbold J., Batsaikhan N., Lkhagvasuren D., Stubbe A. & Steinhauser D., 2021b: Phylogenie, Morphologie und Ökologie mongolischer Langohrfledermäuse der Gattung Plecotus (Mammalia, Chiroptera, Vespertilionidae). *Erforschung Biologischer Ressourcen der Mongolei* [Halle/Saale] **14**: 123–185.
Dood S. B. & Kurta A. 1988: Additional records of Michigan bat ectoparasites. *Great Lakes Entomologist* **21**(3): 115–116.
Dool S. E., Puechmaille S. J., Dietz C., Juste J., Ibáñez C., Hulva P., Roué S. G., Petit E. J., Jones G., Russo D., Toffoli R., Viglino A., Martinoli A., Rossiter S. J. & Teeling E. C. 2013: Phylogeography and postglacial recolonization of Europe by Rhinolophus hipposideros: evidence from multiple genetic markers. *Molecular Ecology* **22**: 4055–4070.
Dool S. L., Puechmaille S. J., Foley N. M., Allegrini B., Bastian A., Mutumi G. L., Maluleke T. G., Odendaal L. J., Teeling E. C. & Jacobs D. S. 2016: Nuclear introns outperform mitochondrial DNA in interspecific phylogenetic reconstructions: lessons from horseshoe bats (Rhinolophidae: Chiroptera). *Molecular Phylogenetetics and Evolution* **97**: 196–212.

Dorandt″ F. 1877: *Матеріалы*, *собранные метеорологическим отдѣломъ ученой экспедиціи на Аму-Дарью*. *1874–1875* [*Materials*, *Collected by the Meteorological Division of the Scientific Expedition to Amu Darya. 1874–1875*]. Sanktpeterburg″: Tipografiâ Imperatorskoj Akademìi Nauk″, 243 pp (in Russian and German).
Dubinin V. B. & Bregetova N. G. 1952: Паразитические кровососущие клещи позвоночных животных Туркменистана [Parasitic blood-sucking mites of the vertebrates of Turkmenistan]. *Trudy Zoologičeskogo Instituta Akademii Nauk SSSR* [Leningrad] **10**: 45–60 (in Russian).
Dundarova H., Altybaev K., Mamatkalykov P., Momosheva G., Nizamiev A. & Sultanbek kyzy B. 2021: Underground habitats as a unit for bat conservation in southwestern Kyrgyzstan. *Acta Zoologica Bulgarica* **73**: 597–605.
Dundarova H., Orlova M., Anisimov N., Baskakova S., Shakula G., Shakula F., Shakula S. & Amirekul K. 2022: A new species of Spinturnix (Acari: Spinturnicidae) from the Turkestani long-eared bat Otonycteris leucophaea (Chiroptera: Vespertilionidae) in Kazakhstan. *Zootaxa* **5222**: 443–456.
Dusbábek F. 1962: Parasitische Fledermausmilben der Tschechoslowakei I. Fam. Spinturnicidae Oudms., 1901 (Acarina, Gamasides). *Časopis Československé Společnosti Entomologické* **59**: 357–380.
Dusbábek F. 1964a: Parasitische Fledermausmilben der Tschechoslowakei II. Fam. Dermanyssidae Kol., 1859 (Acarina: Gamasides). *Československá Parasitologie* **11**: 77–125.
Dusbábek F. 1964b: Bericht über die Vertreter der Gattung Diplostaspis Kol., 1857 (= Spinturnix von Heyden, 1826) (Acarina: Gamasides), aufbewahrt im Naturhistorischen Museum in Wien. *Annalen des Naturhistorischen Museums in Wien* **67**: 389–393.
Dusbábek F. 1966: A contribution to the knowledge of parasitic mites from Mongolia (Acarina, Gamasides): results of the Mongolian-German biological expeditions since 1962, No. 9. *Mitteilungen aus dem Zoologischen Museum in Berlin* **42**: 43–58.
Dusbábek F. 1970: Mite parasites (Acarina) of bats from Afghanistan. *Folia Parasitologica* (*Praha*) **17**: 61–76.
Dusbábek F. 1972: The zone of bat acarinia in central Europe. *Folia Parasitologica* (*Praha*) **19**: 139–154.
Dusbábek F. 1973: The acarinia zone of bats under conditions of Central Europe. Pp. 771–774. In: Daniel M. & Rosický B. (eds.): *Proceedings of the 3rd International Congress of Acarology*, *Prague*, *1971*. Praha: Academia, 837 pp.
Dusbabek F. & Pinčuk L. M. 1971: Новый вид клеща Macronyssus barbastellinus sp. n. (Parasitiformes: Gamasoidea) с летучей мыши [New species of mite Macronyssus barbastellinus sp. n. (Parasitiformes: Gamasoidea) from a bat]. *Parazitologiâ* **5**: 401–404 (in Russian, with a summary in English).
Dzeverin I. 2023: Synonymisation of Myotis aurascens with M. davidii (Chiroptera, Vespertilionidae) is premature. *Zoodiversity* **57**: 19–28.
Dzeverin I. I. & Strelkov P. P. 2008: Таксономический статус остроухих ночниц (Myotis blythii, Chiroptera, Vespertilionidae) с Алтая [Taxonomic status of Myotis blythii (Chiroptera, Vespertilionidae) from the Altai]. *Zoologičeskij Žurnal* **87**: 973–982 (in Russian, with a summary in English).
Ellerman J. R. & Morrison-Scott T. C. S. 1951: *Checklist of Palaearctic and Indian Mammals 1758 to 1946*. London: Trustees of the British Museum, 810 pp.
Etemad E. 1967: Notes on bats from Iran. *Mammalia* **31**: 275–280.
Evans O. G. 1968: The external morphology of the post-embryotic developmental stages of Spinturnix myoti Kol. (Acari: Mesostigmata). *Acarologia* **10**: 589–608.
Evans G. O. & Till W. M. 1964: A new species of Dermanyssus and a redescription of Steatonyssus superans Zemskaya (Acari: Mesostigmata). *Acarologia* **6**: 624–631.
Evin A., Baylac M., Ruedi M., Mucedda M. & Pons J.-M. 2008: Taxonomy, skull diversity and evolution in a species complex of Myotis (Chiroptera: Vespertilionidae): a geometric morphometric appraisal. *Biological Journal of the Linnean Society* **95**: 529–538.
Fain A. 1959: Les acariens psoriques parasites des chauves souris. VI. Le genre Prosopodectes Canestrini 1897 est composite et doit tomber en synonymie de Notoedres Railliet 1893. *Acarologia* **1**(3): 324–334.
Farhang-Azad A. 1969: Bats from North Khorassan, Iran. *Mammalia* **33**: 730–732.
Fedčenko A. P. 1875: Путешествіе въ Туркестанъ [Journey to Turkestan]. *Izvěstìâ Imperatorskago Obŝestva Lûbitelej Estestvoznanìâ*, *Antropologìi i Ètnografìi* **11**(7): 1–160 (in Russian).
Fedčenko B. A. 1902: Памиръ и Шугнанъ (Предварительный отчетъ) [The Pamirs and Shughnan (preliminary report)]. *Izvěstìâ Imperatorskago Russkago Geografičeskago Obŝestva* **38**: 273–305 (in Russian).
Fedčenko O. A. 1903: Флора Памира. Собственныя изслѣдованія 1901 года и сводъ предыдущихъ [Flora of the Pamirs. Own research in 1901 and a review of the previous]. *Trudy Imperatorskago S.-Petersburskago Botaničeskago Sada* **21**: 233–471 (in Russian).
Fedčenko O. A. 1909: Четвертое дополненіе къ „Флорѣ Памира“ [Fourth addendum to the “Flora of the Pamirs”]. *Trudy Imperatorskago S.-Petersburskago Botaničeskago Sada* **28**: 455–514 (in Russian).
Fedorov A. A. & Fedorov A. A. 1949: Яблоня южной Киргизии [Apple tree of southern Kirghizstan]. *Trudy Ûžno-Kirgizskoj Èkspedicii* **1**: 218–253 (in Russian).

Fedorova S. Ž. 2012: Иксодовые клещи (Parasitiformes: Ixodidae) Кырызстана: их разнообразие и эпидемиологическое значение [The ixodid ticks (Parasitiformes: Ixodidae) of Kirghizstan: their biodiversity and epidemiologic significance]. *Izvestiâ Vuzov* **6**: 127–133 (in Russian).

Felten H., Spitzenberger F. & Storch G. 1977: Zur Kleinsäugerfauna West-Anatoliens. Teil IIIa. *Senckenbergiana Biologica* **58**: 1–44.

Filippova N. A. 1966: *Аргасовые клещи* (*Argasidae*). *Фауна СССР. Паукообразные. Том IV. Вып. 3* [*Argasid Ticks* (*Argasidae*). *The Fauna of the USSR. Arachnida. Volume IV. No. 3*]. Moskva & Leningrad: Nauka, 255 pp (in Russian).

Filippova N. A. 1972: Новые данные по клещам рода Ixodes Latr. (Ixodoidea, Ixodidae) – специфическим паразитам летучих мышей [New data on ticks of the genus Ixodes Latr. (Ixodoidea, Ixodidae) – specific parasites of bats]. *Èntomologičeskoe Obozrenie* **1972**(2): 463–475 (in Russian, with a summary in English).

Filippova N. A. 1977: Иксодовие клещи подсем. Ixodinae. Фауна СССР. Паукообразные. Новая серия 4 [Ixodid Ticks of the Subfamily Ixodinae. Fauna of the Soviet Union. Arachnida. New Series 4]. Leningrad: Nauka, 396 pp (in Russian).

Filippova N. A. & Čunihin S. P. 1969: Клещ Argas (Chiropterargas) boueti Roubaud et Colas Belcour, 1933 (Parasitiformes, Argasidae) – новый вид фауны СССР [The tick Argas (Chiropterargas) boueti Roubaud et Colas Belcour, 1933 (Parasitiformes, Argasidae) – a new species of the fauna of the USSR]. *Zoologičeskij Žurnal* **48**: 1407–1409 (in Russian).

Funakoshi K. 2010: [Acoustic identification of thirteen insectivorous bat species from the Kyushu District, Japan]. *Mammalian Science* **50**: 165–175 (in Japanese, with an abstract in English).

Funakoshi K. & Kunisaki T. 2000: On the validity of Tadarida latouchei, with reference to morphological divergence among T. latouchei, T. insignis and T. teniotis (Chiroptera, Molossidae). *Mammal Study* **25**: 115–123.

Funakoshi K., Nomura E., Matsukubo M. & Wakita Y. 2010: Postnatal growth and vocalization development of the lesser horseshoe bat, Rhinolophus cornutus, in the Kyushu district, Japan. *Mammal Study* **35**: 65–78.

Furey N. M., Mackie I. J. & Racey P. A. 2009: The role of ultrasonic bat detectors in improving inventory and monitoring surveys in Vietnamese karst bat assemblages. *Current Zoology* **55**: 327–341.

Furey N. M., Tu V. T., Hitch A. T., Pimsai A., Kimashalen C., Vuthy B., Raksmey Y., Sarak C., Borthwick S. A., Ch'ng L., Sinly S., Csorba G., Saveng I., Smith G. J. D., Dany C. & Mendenhall I. H. 2021: First records of seemingly rare bats (Mammalia: Chiroptera) in Cambodia, with a revised checklist of species for the country. *Acta Chiropterologica* **23**: 345–369.

Furman A., Çoraman E., Nagy Z. L., Postawa T., Bilgin R., Gajewska M. & Bogdanowicz W. 2013: Phylogeography of the large Myotis bats (Chiroptera: Vespertilionidae) in Europe, Asia Minor, and Transcaucasia. *Biological Journal of the Linnean Society* **108**: 189–209.

Furman A., Çoraman E., Çelik Y. E., Postawa T., Bachanek J. & Ruedi M. 2014: Cytonuclear discordance and the species status of Myotis myotis and Myotis blythii (Chiroptera). *Zoologica Scripta* **43**: 549–561.

Gadžiev A. T., Dubovčenko T. A. & Džafarov G. D. 1990: Состав фауны эктопаразитов подковоносов (Rhinolophus) на территории СССР [Composition of the ectoparasite fauna of the horseshoe bats (Rhinolophus) on the territory of the Soviet Union]. Pp. 122–129. In: Il′in V. J., Strelkov P. P. & Rodinov V. A. (eds.): *Рукокрылые*: *Материалы пятого всесоюзного совещания по рукокрылым* (*Chiroptera*) [*Bats*: *Proceedings of the Fifth Pan-Union Conference on Bats*]. Penza: Vsesoûznoe Teriologičeskoe Obŝestvo & Penzenskij Gosudarstvennyj Pedagogičeskij Institut Imeni V. G. Belinskogo, 174 pp (in Russian).

Gaisler J. 1970: The bats (Chiroptera) collected in Afghanistan by the Czechoslovak Expeditions of 1965–1967. *Acta Scientiarum Naturalium Academiae Scientiarum Bohemoslovacae Brno*, *n.s.* **4**(6): 1–56.

Gaisler J. 1971: Systematic review and distinguishing characters of the bats (Chiroptera) hitherto recorded in Afghanistan. *Zoologické Listy* **20**: 97–110.

Glasounow D. 1893: Un nouvel Orectochilus de la faune de la Russie. *Trudy Russkago Èntomologičeskago Obŝestva* **27**: 442–443.

Goff M. L., Loomis R. B., Welbourn W. C. & Wrenn W. J. 1982. A glossary of chigger terminology (Acari: Trombiculidae). *Journal of Medical Entomology* **19**: 221–238.

Gorban′ A. A., Artûšin I. V., Bannikova A. A., Undrahbaâr È. & Kruskop S. V. 2022: Филогеография степной ночницы, Myotis davidii (Chiroptera; Vespertilionidae) в восточной части ареала вида [Phylogeography of the steppe whiskered bat, Myotis davidii (Chiroptera; Vespertilionidae) in the eastern part of the species range]. *Doklady Rossijskoj Akademii Nauk*, *Nauki o Žizni* **502**: 77–82 (in Russian, with a summary in English).

Gricina M. A., Nuridžanov D. A. & Abduraunov T. V. 2013: Некоторые новые находки рыкокрылых в Узбекистане [Some new records of bats in Uzbekistan]. *Plecotus et al.* **15–16**: 44–52 (in Russian, with a summary in English).

Gubar′ov M. 1941: Матеріали до фауни Chiroptera Нагірного Карабаха (АзРСР) [Data on the fauna of Chiroptera of the Nagorno-Karabakh (Azerbaijan)]. *Kyivskij Deržavnyj Universitet*, *Trudy Zoologičnogo Muzeû* **1**: 287–291 (in Ukrainian, with summaries in Russian and English).

Guillén Servent A., Francis C. M. & Ricklefs R. E. 2003: Phylogeny and biogeography of the horseshoe bats. Pp. xii–xxiv. In: Csorba G., Ujhelyi P. & Thomas N. (eds.): *Horseshoe Bats of the World* (*Chiroptera*: *Rhinolophidae*). Bishop's Castle, UK: Alana Books, xxxii+160 pp.

Guindon S., Dufayard J.-F., Lefort V., Anisimova M., Hordijk W. & Gascuel O. 2010: New algorithms and methods to estimate maximum likelihood phylogenies: assessing the performance of PhyML 3.0. *Systematic Biology* **59**: 307–321.

Győrössy D., Csorba G., Szabadi K. L., Estók P., Tu V. T., Thong V. D., Furey N. M., Huang J. C.-C., Tuanmu M.-N., Fukui D., Zsebők S. & Görföl T. 2024: The calls of Vietnamese bats: a major step toward the acoustic characterization of Asian bats. *Scientific Reports* **14**(23335): 1–19.

Habilov T. K. 1979: Новое местонахождение крупной зимовки рукокрылых Chiroptera, Rhinolophidae в Таджикистане [New finding of a large hibernaculum of bats (Chiroptera, Rhinolophidae) in Tajikistan]. *Izvestiâ Akademii Nauk Tadžikskoj SSR*, *Otdelenie Biologičeskih Nauk* **2**(75): 89–92 (in Russian).

Habilov T. K. 1980: О зимовках рукокрылых в северном Таджикистане [On the hibernation of bats in northern Tajikistan]. Pp. 77–87. In: Kuzâkin A. P. & Panûtin K. K. (eds.): *Вопросы териологии*. *Рукокрылые* (*Chiroptera*) [*Questions in Theriology*. *Bats* (*Chiroptera*)]. Moskva: Nauka, 320 pp (in Russian).

Habilov T. K. 1982: Новые данные по размножению ушана (Plecotus auritus L., 1758) в Таджикистане [New data on reproduction of the long-eared bat (Plecotus auritus L., 1758) in Tajikistan]. *Doklady Akademii Nauk Tadžikskoj SSR* **25**: 53–56 (in Russian, with a summary in Tajik).

Habilov T. K. 1983: Обыкновенный длиннокрыл (Miniopterus schreibersi Kuhl., 1819) [Chiroptera, Vespertilionidae] – новый вид фауны рукокрылых Таджикистана [Schreiber's bat (Miniopterus schreibersi Kuhl, 1819) [Chiroptera, Vespertilionidae] – new species of the bat fauna of Tajikistan]. *Doklady Akademii Nauk Tadžikskoj SSR* **26**: 668 (in Russian, with a summary in Tajik).

Habilov T. K. 1986: Новые данные о рукокрылых (Chiroptera, Vespertilionidae) Бадахшана [New data on bats (Chiroptera, Vespertilionidae) of Badakhshan]. *Doklady Akademii Nauk Tadžikskoj SSR* **29**: 628–631 (in Russian, with a summary in Tajik).

Habilov T. K. 1988: Спаривание большого (Rhinolophus ferrumeguinum Schreb.) и бухарского (Rhinolophus bocharicus Kast. et Akim.) подковоносов [Chiroptera: Rhinolophidae] на зимовке [Mating in the greater horseshoe bat (Rhinolophus ferrumequinum Schreb.) and Central Asian horseshoe bat (Rhinolophus bocharicus Kaŝ. et Akim.) in a hibernaculum (Chiroptera: Rhinolophidae)]. *Doklady Akademii Nauk Tadžikskoj SSR* **31**: 62–63 (in Russian, with a summary in Tajik).

Habilov T. K. 1990: О дневной активности позднего кожана (Eptesicus serotinus) [On the diurnal activity of the common serotine (Eptesicus serotinus)]. Pp. 89–92. In: Il′in V. Û., Strelkov P. P. & Rodionov V. A. (eds.): *Рукокрылые*. *Материалы пятого всесоюзного совещания по рукокрылым* (*Chiroptera*) [*Bats*. *Proceedings of the Fifth Pan-Union Symposium on Bats* (*Chiroptera*)]. Penza: Vsesoûznoe Teriologičeskoe Obŝestvo (Leningradskoe otdelenie) & Penzenskij Gosudarstvennyj Pedagogičeskij Institut imeni V. G. Belinskogo, 174 pp (in Russian).

Habilov T. K. 1991: О находке зимой нетопыря-карлика (Pipistrellus pipistrellus Schreb) и дву[х]цветного кожана (Vespertilio murinus L.) в г. Ленинабаде [On the winter records of the common pipistrelle (Pipistrellus pipistrellus Schreb.) and parti-coloured bat (Vespertilio murinus L.) in Leninabad]. *Doklady Akademii Nauk Tadžikskoj SSR* **34**: 528–530 (in Russian, with a summary in Tajik).

Habilov T. K. 1992: *Фауна Республики Таджикистан*. *Том XX*. *Часть VII*. *Млекопитающие*. *Рукокрылые* [*Fauna of the Republic of Tajikistan*. *Volume XX*. *Part VII*. *Mammals*. *Bats*]. Dušanbe: Izdatel′stvo Doniš, 352 pp (in Russian).

Habilov T. K. 1993: *Рукокрылые Таджикистана и сопредельной территории. Автореферат диссертации на соискание учебной степени доктора биологических наук* [*Bats of Tajikistan and Surrounding Areas. Abstract of a Doctor Thesis*]. Taškent: Institut Zoologii, Akademiâ Nauk Respubliky Uzbekistan, 54 pp (in Russian, with summaries in Tajik and English).

Habilov T. K. 1995: К биологии пустынного кожана (Eptesicus bottae) и нетопыря-карлика (Pipistrellus pipistrellus) в Северном Таджикистане [To the life history of Botta's serotine (Eptesicus bottae) and the common pipistrelle (Pipistrellus pipistrellus) in northern Tajikistan]. Pp. 59–66. In: Habilov T. K. (ed.): *Рукокрылие* (*Chiroptera*). *Материалы VI Совещания по рукокрылым стран СНГ* [*Bats* (*Chiroptera*). *Proceedings of the Sixth Symposium on Bats of the Countries of the Commonwealth of Independent States*]. Hudžand: Hudžandskij Gosudarstvennyj Universitet, 111 pp (in Russian).

Habilov T. K. 2003: *Фауна Республики Таджикистан*. *Том XX*, *Часть 8* (*продолжение*). *Млекопитающие*. *Рукокрылые* [*Fauna of the Republic of Tajikistan*. *Volume XX*. *Part 8* (*Continuation*). *Mammals*. *Bats*]. Hudžand: Izdatel′stvo Nuri Ma″rifat, 1199 pp (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2013: Новые данные по размножению азиатской широкоушки Barbastella leucomelas (Cretzschmar, 1826) в Таджикистане [New data on reproduction of the eastern barbastelle Barbastella leucomelas (Cretzschmar, 1826) in Tajikistan]. *Plecotus et al*. **15–16**: 53–58 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2014a: Новые данные о численности остроухой ночницы (Myotis blythi Tomes, 1857) в заброшенных штольнях предгорий северного склона Туркистанского хребта (Северный Таджикистан) [New data on the abundance of the lesser mouse-eared bat (Myotis blythii Tomes, 1857) in abandoned mines of foothills of the northern slope of the Turkiston Mountains (northern Tajikistan)]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **31**: 98–101 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2014b: Новые данные о численности ушана Стрелкова (Plecotus strelkovi Spitzenberger, 2006) в заброшенных штольнях предгорий северного склона Туркестанского хребта (Северный Таджикистан) [New data on Strelkov's long-eared bat (Plecotus strelkovi Spitzenberger, 2006) in abandoned mines of foothills of the northern slope of the Turkiston Mountains (northern Tajikistan)]. *Izvestiâ Akademii Nauk Respubliki Tadžikistan*, *Otdelenie Biologičeskih i Medicinskih Nauk* **188**: 20–28 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Tadžibaeva D. È. 2016a: Индийский подковонос (Rhinolophus lepidus Blyth, 1844) новый вид фауны рукокрылых Таджикистана [Blyth's horseshoe bat (Rhinolophus lepidus Blyth, 1844) – new species of the bat fauna of Tajikistan]. P. 102. In: Titov S. V. & Rožnov V. V. (eds.): *Актуальные вопросы современной зоологии и экологии животных*. *Материалы Всероссийской научной конференции*, *посвященной 70-летнему юбилею кафедры* «*Зоология и экология*» *Пензенского государственного университета и памяти порфесора В. П. Денисова* (*1932–1997*). *г. Пенза*, *15–18 ноября 2016 г*. [*Current Questions in the Contemporary Zoology and Animal Ecology*. *Proceedings of the Pan-Russian Scientific Conference*, *devoted to the 70th anniversary of the Department of Zoology and Ecology of the Penza State University and to the memory of Professor V. P. Denisov* (*1932–1997*). *Penza*, *15–18 November 2016*]. Penza: Izdatel′stvo PGU, 118 pp (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2016b: О летучих мышах юго-западного Таджикистана и Дарваза [About the bats of south-western Tajikistan and the Darvoz Mts.]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **38**: 62–70 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2018: Первые находки индийского подковоноса (Rhinolophus lepidus, Chiroptera) на территории Таджикистана [First records of Blyth's horseshoe bat (Rhinolophus lepidus, Chiroptera) on the territory of Tajikistan]. *Izvestiâ Vyših Učebnyh Zavedenij*, *Povolžskij Region*, *Estestvennye Nauki*, *Zoologiâ* **21**: 3–10 (in Russian, with an abstract in English).

Habilov T. K. & Tadžibaeva D. È. 2019a: Изменения в составе фауны и численности рукокрылых на территории северного Таджикистана за последние 50 лет [Changes in the bat fauna composition and abundance on the territory of Tajikistan in the last 50 years]. P. 101. In: Saidov A. S. (ed.): *Материалы VIII-ой Международной конференции* «*Экологические особенности биологического разнообразия*» (*Таджикистан*, *г*. *Худжанд*, *3–4 октября 2019 г*.) [*Proceedings of the VIIIth International Conference* "*Ekological Specificities of Biodiversity*" (*Tajikistan*, *Hudžand*, *3–4 October 2019*)]. Dušanbe: Doniš & Akademiâ Nauk Respubliki Tadžikistan, 246 pp (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2019b: Рукокрылые (Chiroptera) Таджикистана: итоги изучения и перспективы [Bats (Chiroptera) of Tajikistan: research conclusions and perspectives]. Pp. 219–220. In: Tembotova F. A. (ed.): *Горные экосистемы и их компоненты*. *Материалы VII Всероссийской конференции с международным участием*, *посвященной 30-летию научной школы чл.-корр*. *РАН А. К. Темботова и 25-летию Института экологии горных территорий им*. *А. К. Темботова РАН* (*г. Нальчик*, *15–20 сентября 2019 г*.) [*Montane Ecosystems and Their Components*. *Proceedings of the VIIth Pan-Russian Conference with International Participation*, *Devoted to the 30th Anniversary of the Scientific School of the Member-Correspondent of the Russian Academy of Sciences A. K. Tembotov and 25th Anniversary of the A. K. Tembotov Institute of Ecology of the Montane Territories of the Russian Academy of Sciences* (*Nal'čik*, *15–20 September 2019*)]. Mahačkala: ALEF, 264 pp (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2020a: Изменение видового состава, сезонного пребывания и численности рукокрылых в заброшенной штольне №4 в предгорях северного склона Туркестанского хребта у Исфары (Северный Таджикистан), в 1976–2020 гг [Changes in the species composition, seasonal occurrence and abundance of bats in the abandoned mine No. 4 in the foothills of the northern slope of the Turkiston Mountains near Isfara (northern Tajikistan), in 1976–2020]. *Plecotus et al*. **23**: 31–49 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2020b: Бухарская ночница (Myotis bucharensis): сенсационная находка спустя столетие в Таджикистане и спустя полвека – в Средней Азии [Bukhara myotis (Myotis bucharensis): a sensational finding after a century in Tajikistan and after a half of century in West Turkestan]. *Plecotus et al*. **23**: 72–79 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2020c: Экологические наблюдения за рукокрылыми (Chiroptera) в заброшенных штольнях в окресностях Исфары (Северный Таджикистан) в 1976–2020 гг. [Ecological observations of bats (Chiroptera) in abandoned mines in the surroundings of Isfara (northern Tajikistan) in 1976–2020]. *Trudy Karadagskoj Naučnoj Stancii Im. T. I. Vâzemskogo – Prirodnogo Zapovednika RAN* **15**: 75–80 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2020d: Современный статус и вопросы охраны рукокрылых в Таджикистане [Current status and tasks of protection of bats in Tajikistan]. Pp. 23–25. In: Gašev S. N. (ed.): *Международная научно-практическая конференция* «*Экосистемные услуги и менеджмент природных ресурсов*». *Материалы международной научно-практической конференции*. *Тюмень*, *Тюменский государственный университет 28. 11. 2019 – 30. 11. 2019* [*International Scientific-Practical Conference* "*Ecological Services and Management of Natural Resources*". *Proceedings of International Scientific-Practical Conference*. *Tûmen'*, *Tûmen' State University 28–30 November 2019*]. Tûmen′: Tûmenskij gosudarstvennyj universitet, 345 pp (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2021a: Результаты отлова рукокрылых паутинными сетями в Северном Таджикистане в 2016–2021 гг. [Results of the mist-netting of bats in northern Tajikistan in 2016–2021]. *Issledovaniâ Živoj Prirody Kyrgyzstana* **2021**(2): 127–129 (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2021b: О современном статусе представителей отряда рукокрылух (Chiroptera) на территории Таджикистана [About the contemporary statuses of representatives of the order bats (Chiroptera) on the territory of Tajikistan]. *Plecotus et al*. **24**: 35–49 (in Russian, with a summary in English).

Habilov T. K. & Tadžibaeva D. È. 2021c: Видовое разнообразие рукокрылых Северного Таджикистана: 45 лет спустя [Species diversity of bats of northern Tajikistan: after 45 years]. Pp. 122–123. In: Anonymous (ed.): «*Горные экосистемы и их компоненты*». *Материалы VIII Всероссийской конференции с международным участием, посвященной Году науки и технологий в Российской Федерации* ["*Montane Ecosystems and Their Components*". *Proceedings of the VIIIth Pan-Russian Conference with International Participation, Devoted to the Year of Science and Technology in the Russian Federation*]. Nal′čik: Institut èkologii gornyh territorij im. A. K. Tembotova RAN, 158 pp (in Russian).

Habilov T. K. & Tadžibaeva D. È. 2021d: О зоогеографическом составе фауны рукокрылых (Chiroptera) на территории Таджикистана [On the zoogeographical composition of the fauna of bats (Chiroptera) in the territory of Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **59**: 64–66 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Tadžibaeva D. È. 2022a: О наблюдении белобрюхого стрелоуха Otonycteris leucophaea Severcov, 1873 в окресности Рушана Горнобадахшанской автономной области [On the record of the Turkestani long-eared bat Otonycteris leucophaea Severcov, 1873 near Rušan in the Gorno-Badakhshan Autonomous Province]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **62**: 75–76 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Tadžibaeva D. È. 2022b: Видовое разнообразие рукокрылых (Chiroptera) Северного Таджикистана: 45 лет спустя [Species diversity of bats (Chiroptera) of northern Tajikistan: after 45 years]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **63**: 61–68 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Tadžibaeva D. È. 2022c: О зимных находках рукокрылых (Chiroptera) в Северном Таджикистане [On the winter records of bats (Chiroptera) in northern Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **60**: 42–44 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Tadžibaeva D. È. 2023: Осёдлые и перелётные виды рукокрылых (Chiroptera) в северном Таджикистане [Sedentary and migratory species of bats (Chiroptera) in northern Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **64**: 26–28 (in Russian, with summaries in Tajik and English).

Habilov T. K. & Zyrânova U. Û. 1995: К вопросу о суточной активности нетопыря-карлика (Pipistrellus pipistrellus) в г. Худжанде [To the question of diurnal activity of the common pipistrelle (Pipistrellus pipistrellus) in the city of Huçand]. Pp. 66–71. In: Habilov T. K. (ed.): *Рукокрылие* (*Chiroptera*). *Материалы VI Совещания по рукокрылым стран СНГ* [*Bats* (*Chiroptera*). *Proceedings of the Sixth Symposium on Bats of the Countries of the Commonwealth of Independent States*]. Hudžand: Hudžandskij Gosudarstvennyj Universitet, 111 pp (in Russian).

Habilov T. K., Tadžibaeva D. È. & Šumkina A. 2016: О летичих мушах пещеры Кани-Гут (южная Киргизия) [About bats of the Kani-Gut cave (southern Kighizstan)]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **39**: [122–129] (in Russian, with a summary in English).

Habilov T. K., Tadžibaeva D. È. & Dundarova H. 2018: Новые данные по распространению и биологии индийского подковоноса Rhinolophus lepidus Blyth, 1844 в Средней Азии [New data on the distribution of Blyth's horseshoe bat Rhinolophus lepidus Blyth, 1844 in West Turkestan]. *Plecotus et al*. **21**: 57–61 (in Russian, with a summary in English).

Hackett T. D., Holderied M. W. & Korine C. 2016: Echolocation call description of 15 species of Middle-Eastern desert dwelling insectivorous bats. *Bioacoustics* **26**: 217–235.

Haitlinger R. 1978: Pasożyty zewnętrzne nietoperzy Dolnego Śląska. IV. Macronyssidae, Dermanyssidae, Veigaiaidae [External parasites of bats of Lower Silesia. IV. Macronyssidae, Dermanyssidae, Veigaiaidae]. *Wiadomości Parazytologiczne* **24**: 707–718 (in Polish).

Haitlinger R. & Łupicki D. 2008: Arthropods (Acari, Siphonaptera, Heteroptera, Psocoptera) associated with Nyctalus noctula (Schreber, 1774) (Chiroptera: Vespertilionidae) in southern Poland. *Wiadomości Parazytologyczne* **54**: 123–130.

Haitlinger R. & Ruprecht A. L. 1985: Stawonogi zebrane na nietoperzach z Kujaw (Acari i Siphonaptera) [Arthropods collected from bats in Kujawy (Acari and Siphonaptera)]. *Polskie Pismo Entomologiczne* 55: 615–618 (in Polish, with an abstract in English).

Hanák V. 1965: Zur Systematik der Bartfledermaus Myotis mystacinus Kuhl, 1819 und über das Vorkommen von Myotis ikonnikovi Ognev, 1912 in Europa. *Věstník Československé Společnosti Zoologické* **29**: 353–367.

Hanák V. 1966: Zur Systematik und Verbreitung der Gattung Plecotus, Geoffroy, 1818 (Mammalia, Chiroptera). *Lynx*, *n.s*. **6**: 57–66.

Hanák V. 1969: Zur Kenntnis von Rhinolophus bocharicus Kastchenko et Akimov, 1917 (Mammalia: Chiroptera). *Věstník Československé Společnosti Zoologické* **33**: 315–327.

Hanák V. & Gaisler J. 1971: The status of Eptesicus ognevi Bobrinskii, 1918, and remarks on some other species of this genus (Mammalia: Chiroptera). *Věstník Československé Společnosti Zoologické* **35**: 11–24.
Harrison D. L. 1964: *The Mammals of Arabia*. *Volume I*. *Introduction*, *Insectivora*, *Chiroptera*, *Primates*. London: Ernest Benn Limited, 192 pp.
Harrison D. L. 1976: Scientific results of the Oman Flora and Fauna Survey, 1975. Decription of a new subspecies of Botta's serotine (Eptesicus bottae Peters, 1869, Chiroptera: Vespertilionidae) from Oman. *Mammalia* **39**[1975]: 415–418.
Harrison D. L. & Bates P. J. J. 1991: *The Mammals of Arabia*. *Second Edition*. Sevenoaks: Harrison Zoological Museum, 354 pp.
Hastriter M. W. & Tipton V. J. 1975: Fleas (Siphonaptera) associated with small mammals of Morocco. *Journal of the Egyptian Public Health Association* **50**(2): 79–169.
Hayman R. W. & Hill J. E. 1971: Part 2. Order Chiroptera. Pp.: 1–73. In: Meester J. & Setzer H. W. (eds.): *The Mammals of Africa*. *An Identification Manual*. Washington: Smithsonian Institution Press [not paginated continually].
Heddergott M. 2009: Erstnachweis der Fledermausfliege Basilia mongolensis nudior Hůrka, 1972 in Deutschland (Diptera: Nycteribiidae). *Studia Dipterologica* **15**: 301–304.
Heinrich G. 1936: Ueber die von mir im Jahre 1935 in Bulgarien gesammelten Säugetiere. *Izvestiâ na Carskitě Prirodonaučni Instituti v" Sofiâ* **9**: 33–48.
Heller K.-G. & von Helversen O. 1989: Resource partitioning of sonar frequency bands in rhinolophoid bats. *Oecologia* **80**: 178–186.
von Helversen O. 1989: Bestimmungsschlüssel für die europäischen Fledermäuse nach ausseren Merkmalen. *Myotis* **27**: 41–60.
von Helversen O., Heller K.-G., Mayer F., Nemeth A., Volleth M. & Gombkötö P. 2001: Cryptic mammalian species: a new species of whiskered bat (Myotis alcathoe n. sp.) in Europe. *Naturwissenschaften* **88**: 217–223.
Hill J. E. & Yoshiyuki M. 1980: A new species of Rhinolophus (Chiroptera, Rhinolophidae) from Iriomote Island, Ryukyu Islands, with notes on the Asiatic members of the Rhinolophus pusillus group. *Bulletin of the National Science Museum*, *Series A* (*Zoology*) **6**: 179–189.
Hoang D. T., Chernomor O., von Haeseler A., Minh B. Q. & Vinh L. S. 2018: UFBoot2: Improving the ultrafast bootstrap approximation. *Molecular Biology and Evolution* **35**: 518–522.
Hoogstraal H. 1957: Bat ticks of the genus Argas (Ixodoidea, Argasidae) 2. Secretargas new subgenus and A. transgariepinus White, 1846, its adult and immature stages; with a definition of the subgenus Argas. *Annals of the Entomological Society of America* **50**: 544–549.
Hopkins G. H. E. & Rothschild M. 1956: *An Illustrated Catalogue of Rothschild Collection of Fleas* (*Siphonaptera*) *in the British Museum* (*NH*). *Volume II*. *Cotopsyllidae*, *Vermipsyllidae*, *Stephanocircidae*, *Ischnopsyllidae*, *Hypsophthalmidae*, *and Xiphiopsyllidae*. London: British Museum (Natural History), 445 pp.
Horáček I. 1991: Enigma of Otonycteris: ecology, relationship, classification. *Myotis* **29**: 17–30.
Horáček I. & Benda P. 2004: Hypsugo savii (Bonaparte, 1837) – Aplenfledermaus. Pp. 911–941. In: Krapp F. (ed.): *Handbuch der Säugetiere Europas*. *Band 4*: *Fledertiere. Teil II*: *Chiroptera II*. *Vespertilionidae 2*, *Molossidae*, *Nycteridae*. Wiebelsheim: Aula-Verlag, x+605–1186 pp.
Horáček I. & Hanák V. 1986: Generic status of Pipistrellus savii and comments on classification of the genus Pipistrellus (Chiroptera, Vespertilionidae). *Myotis* **23–24**: 9–16.
Horáček I. & Zima J. 1996: Evolutionary divergence in the lesser horseshoe bat. P. 26. In: Lina P. & Smeenk C. (eds.): *VIIth European Bat Research Symposium*. *12–16 August 1996*, *Veldhoven*, *The Netherlands*. *Programme*, *Abstracts*, *List of Participants*. Veldhoven: Bat Research Agency, [ix]+112 pp.
Horáček I., Hanák V. & Gaisler J. 2000: Bats of the Palearctic region: a taxonomic and biogeographic review. Pp. 11–157. In: Wołoszyn B. W. (ed.): *Proceedings of the VIIIth European Bat Research Symposium*. *Vol*. *I*. *Approaches to Biogeography and Ecology of Bats*. Kraków: Chiropterological Information Center, Institute of Systematics and Evolution of Animals PAS, 280 pp.
Hron T., Farkašová H., Gifford R. J., Benda P., Hulva P., Görföl T., Pačes J. & Elleder D. 2018: Remnants of an ancient Deltaretrovirus in the genomes of horseshoe bats (Rhinolophidae). *Viruses* [Basel] **10**(4; 185): 1–8.
Huang X., Metzner W., Zhang K., Wang Y., Luo B., Sun C., Jiang T. & Feng J. 2018: Acoustic similarity elicits responses to heterospecific distress calls in bats (Mammalia: Chiroptera). *Animal Behaviour* **146**: 143–154.
Huihua Z., Shuyi Z., Mingxue Z. & Jiang Z. 2003: Correlations between call frequency and ear length in bats belonging to the families Rhinolophidae and Hipposideridae. *Journal of Zoology*, *London* **259**: 189–195.
Hulva P., Horáček I., Strelkov P. P. & Benda P. 2004: Molecular architecture of Pipistrellus pipistrellus/Pipistrellus pygmaeus complex (Chiroptera: Vespertilionidae): further cryptic species and Mediterranean origin of the divergence. *Molecular Phylogenetics and Evolution* **32**: 1023–1035.
Hulva P., Benda P., Hanák V., Evin A. & Horáček I. 2007: New mitochondrial lineages within the Pipistrellus pipistrellus complex from Mediterranean Europe. *Folia Zoologica* **56**: 378–388.

Hulva P., Fornůsková A., Chudárková A., Evin A., Allegrini B., Benda P. & Bryja J. 2010: Mechanisms of radiation in a bat group of the genus Pipistrellus inferred by phylogeography, demography and population genetics. *Molecular Ecology* **19**: 5417–5431.
Hůrka K. 1963: Bat fleas (Aphaniptera, Ischnopsyliidae) of Czechoslovakia II. Subgenus Hexactenopsylla Oud., genus Rhinolophopsylla Oud., subgenus Nycteridopsylla Oud., subgenus Dinycteropsylla Ioff. *Acta Universitatis Carolinae – Biologica* **1963**(1): 1–73.
Hůrka K. 1964: Distribution, bionomy and ecology of the European bat flies with special regard to the Czechoslovak fauna (Dip., Nycteribidae). *Acta Universitatis Carolinae – Biologica* **1964**(3): 167–234.
Hůrka K. 1969: Basilia (Basilia) rybini sp. n. and notes on the Nycteribiidae of the Caucasus and Central Asia (Diptera, Pupipara). *Acta Entomologica Bohemoslovaca* **66**: 387–398.
Hůrka K. 1970: Systematic, faunal and bionomical notes on the European and Asiatic flea species of the family Ischnopsyllidae (Aphaniptera). *Acta Universitatis Carolinae – Biologica* **1969**: 11–26.
Hůrka K. 1976: Stylidia orientalis stat. n. and notes on the Nycteribiidae of the Kirgizia (Diptera, Pupipara). *Acta Entomologica Bohemoslovaca* **73**: 343–347.
Hůrka K. 1980: Nycteribiidae – Muchulovití [Nycteribiidae – bat flies]. Pp. 479–509. In: Chvála M. (ed.): *Fauna ČSSR. Svazek 22. Krevsající mouchy a strečci – Diptera. Čeledi Ceratopoginidae*, *Simuliidae*, *Tabanidae*, *Hypodematidae*, *Oestridae*, *Gasterophilidae*, *Hippoboscidae a Nycteribiidae* [*Fauna of Czechoslovakia. Volume 22. Blood Sucking Flies – Diptera. Families Ceratopoginidae*, *Simuliidae*, *Tabanidae*, *Hypodematidae*, *Oestridae*, *Gasterophilidae*, *Hippoboscidae*, *and Nycteribiidae*]. Praha: Academia, 540 pp (in Czech).
Hůrka K. 1984: New taxa and new records of Palearctic Nycteribiidae and Streblidae (Diptera: Pupipara). *Věstník Československé Společnosti Zoologické* **48**: 90–101.
Hůrka K. 1997: New data on taxonomy and distribution of Palaearctic, Oriental and Neotropical Ischnopsyllidae (Siphonaptera), Nycteribiidae and Streblidae (Diptera). *Acta Societatis Zoologicae Bohemicae* **61**: 23–33.
Hutson A. M., Rossiter S. J., Csorba G. & Burgin C. J. 2020: Family Rhinolophidae (horseshoe bats). Pp. 130–145. In: Burgin C. J., Wilson D. E., Mittermeier R. A., Rylands A. B., Lacher T. E. & Sechrest W. (eds.): *Illustrated Checklist of the Mammals of the World. Volume 2*: *Eulipotyphla to Carnivora*. Barcelona: Lynx Edicions, 535 pp.
Hutson A. M., Rossiter S. J., Csorba G. & Burgin C. J. 2023: Family Rhinolophidae – horseshoe bats. Pp. 475–483. In: Chernasky A. (ed.): *All the Mammals of the World*. Barcelona: Lynx Nature Books, 799 pp.
Ikeda Y. & Motokawa M. 2021: Phylogeography of the Japanese greater horseshoe bat Rhinolophus nippon (Mammalia: Chiroptera) in Northeast Asia: New insight into the monophyly of the Japanese populations. *Ecology and Evolution* **11**: 18181–18195.
Ibáñez C., García-Mudarra J. L., Ruedi M., Stadelmann B. & Juste J. 2006: The Iberian contribution to cryptic diversity in European bats. *Acta Chiropterologica* **8**: 277–297.
Ioff I. G. 1949: *Aphaniptera Kirgizii* [*The Aphaniptera of Kirghizstan*]. Moskva: Izdatel′stvo Akademii Medicinskih Nauk SSSR, 212 pp (in Russian).
Ioff I. G. & Bondar′ E. P. 1956: Блохи Туркмении [The fleas of Turkmenistan]. *Trudy Naučno-issledovatel'skogo Protivočumnogo Instituta Kavkaza i Zakavkazâ* **1**: 29–118 (in Russian).
Ioff I. G., Tiflov V. E., Argiropulo A. I., Fedina O. A., Dudolkina L. A. & Širanovič I. P. 1946: Новые виды блох (Aphaniptera) [New species of fleas (Aphaniptera)]. *Medicinskaâ Parazitologiâ* **15** : 85–94 (in Russian).
Ioff I. G., Gerškovič N. A., Zagniborodova E. N., Labunec N. F., Lebedev Û. D., Mikulin M. A., Skalon O. I., Tiflov V. E., Švarc E. A., Ûrkina V. I. & Âgubânc I. M. 1953: Новые виды блох (Suctoria-Aphaniptera). Сообщ. 3 [New species of fleas (Suctoria-Aphaniptera). Part 3]. *Medicinskaâ Parazitologiâ* **22**: 460–465 (in Russian).
Javanbakht H. & Shahabi S. 2015: New record and echolocation call description of Hypsugo savii (Chiroptera: Vespertilionidae) from west of Iran: evidence of sperm storage in the species. *Journal of Zoological and Bioscience Research* **2**(3): 1–5.
Jenyns L. 1828: The distinctive characters of two British species of Plecotus, supposed to have been confounded under the name of long-eared bat. *Transactions of the Linnean Society of London* **16**: 53–60.
Jiang T., Metzner W., You Y., Liu S., Lu G., Li S., Wang L. & Feng J. 2010: Variation in the resting frequency of Rhinolophus pusillus in mainland China: Effect of climate and implications for conservation. *Journal of the Acoustical Society of America* **128**: 2204–2211.
Jones G. & van Parijs S. M. 1993: Bimodal echolocation in pipistrelle bats: are cryptic species present? *Proceedings of the Royal Society of London B*: *Biological Sciences* **251**: 119–125.
Jones G. & Rayner J. M. V. 1989: Foraging behavior and echolocation of wild horseshoe bats Rhinolophus ferrumequinum and R. hipposideros (Chiroptera, Rhinolophidae). *Behavioral Ecology and Sociobiology* **25**: 183–191.
Jordan K. & Rothschild N. C. 1921: New genera and species of bat fleas. *Ectoparasites* **1**: 142–162.
Juste J., Benda P., Garcia-Mudarra J. L. & Ibáñez C. 2013: Phylogeny and systematics of Old World serotine bats (genus Eptesicus, Vespertilionidae, Chiroptera): an integrative approach. *Zoologica Scripta* **42**: 441–457.

Kalko E. 1995: Foraging behavior, capture techniques, and echolocation in European pipistrelle bats. *Animal Behaviour* **50**: 861–880.
Kalyaanamoorthy S., Minh B. Q., Wong T. K. F., von Haeseler A. & Jermiin L. S. 2017: ModelFinder: Fast model selection for accurate phylogenetic estimates. *Nature Methods* **14**: 587–589.
Karataş A. & Çakir M. 2004: Spinturnix acuminata (C. L. Koch, 1836), a new species to the fauna of Turkey (Acari, Mesostigmata). *Zoology in the Middle East* **31**: 117–118.
Kaŝenko N. Ṙ. 1905: Обзоръ млекопитающихъ Западной Сибири и Туркестана. Выпускъ 1-й. Chiroptera, рукокрылыя. – Insectivora, насѣкомоядныя [Overview of the mammals of western Siberia and Turkestan. Part 1. Chiroptera, bats. – Insectivora, insectivores]. *Izvěstiâ Imperatorskago Tomskago Universiteta* **27**: i–xvi+1–102+i–v (in Russian).
Kaŝenko N. Ṙ. & Akimov″ M. P. 1918: Rhinolophus bocharicus sp. n. *Ežegodnik″ Zoologičeskago Muzeâ Rossijskoj Akademìi Nauk″* **22**: 221–223 (in Russian).
Kaškarov R. D. & Mitropol′skaâ Û. O. 2004: Каталог млекопитающих (Insectivora и Chiroptera) зоологической коллекции Национального университета Узбекистана [Catalogue of mammals (Insectivora and Chiroptera) of the zoological collection of the National University of Uzbekistan]. *Selevinia* **2003**: 225–232 (in Russian).
Kaškarov R. D. & Mitropol′skaâ Û. O. 2012: Зоологическая коллекция Н. А. Зарудного – прошлое, настоящее, будущее [Zoological collection of N. A. Zarudnyj – past, present, future]. Pp. 345–350. In: Ibragimov R. (ed.): *Наземные позвоночные животные аридных экосистем* [*Land Vertebrates of Arid Ecosystems*]. Taškent: Chinor ENK, 352 pp (in Russian).
Katoh K. & Standley D. M. 2013: MAFFT Multiple Sequence Alignment Software Version 7: improvements in performance and usability. *Molecular Biology and Evolution* **30**: 772–780.
Kawai K., Nikaido M., Harada M., Matsumura S., Lin L.-K., Wu Y., Hasegawa M. & Okada N. 2003: The status of the Japanese and East Asian bats of the genus Myotis (Vespertilionidae) based on mitochondrial sequences. *Molecular Phylogenetics and Evolution* **28**: 297–307.
Kazakov D. V., Artyushin I. V., Khabilov T. K., Tadzhibaeva D. E. & Kruskop S. V. 2020: Back to life and to taxonomy: new record and reassessment of Myotis bucharensis (Chiroptera: Vespertilionidae). *Zootaxa* **4878**: 129–144.
Khabilov T. K. 1989a: Notes on the reproduction of pipistrelle bats, Pipistrellus pipistrellus Schreb., 1774, in Tajikistan. Pp. 175–180. In: Hanák V., Horáček I. & Gaisler J. (eds.): *European Bat Research 1987*. Praha: Charles University Press, 718 pp.
Khabilov T. K. 1989b: The bats of Tajikistan: species composition, distribution and protection. Pp. 415–419. In: Hanák V., Horáček I. & Gaisler J. (eds.): *European Bat Research 1987*. Praha: Charles University Press, 718 pp.
Khabilov T. & Tadzhibaeva D. 2013: A new data about breeding [of] Plecotus strelkovi Spitzenberger, 2006 in Tajikistan. P. 89. In: Schneeberger K. & Popa-Lisseanu A. (eds.): *3rd International Berlin Bat Meeting*: *Bats in the Anthropocene*. *Berlin*, *Germany*, *1st–3rd of March 2013*. Berlin: Liebnitz Institute for Zoo and Wildlife Research (IZW), 152 pp.
Khabilov T. K. & Zohidova (Tadzhibaeva) D. A. 2023: The bats (Chiroptera) from Tajikistan in the Prague National Museum of Natural History (Czesh Republic). *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **66**: 35–37.
Khajeh A., Mohammadi Z., Ghorbani F. & Jahantigh H. 2021: Molecular and morphometric characterization of fruit bats of the genus Rousettus Gray, 1821 (Chiroptera: Pteropodidae) in Iran. *Zoology in the Middle East* **67**: 1–11.
Kipson M., Gazaryan S. & Horáček I. 2023: Savi's pipistrelle Hypsugo savii (Bonaparte, 1837). Pp. 95–112. In: Russo D. (ed.): *Handbook of the Mammals of Europe*. *Chiroptera*. Cham: Springer Nature Switzerland, xvii+963 pp.
Kiričenko A. N. 1952: Новые и малоизвестные полужестокрылые (Hemiptera – Heteroptera) Таджикистана [New and less known hemipterans (Hemiptera – Heteroptera) of Tajikistan]. *Trudy Zoologičeskogo Instituta Akademii Nauk SSSR* [Leningrad] **10**: 140–198 (in Russian).
Klein J.-M., Mofidi C., Chamsa M., Karimi Y., Bahmanyar M. & Seydian B. 1963: Les puces (Insecta, Siphonaptera) de l'Iran. *Bulletin de la Société de Pathologie Exotique* **56**: 533–550.
Klompen J. S. H. 1992: Phylogenetic relationships in the mite family Sarcoptidae (Acari: Astigmata). *Miscellaneous Publications*, *Museum of Zoology*, *University of Michigan* **180**: i–v+1–154.
Kłys G. & Lis J. A. 2022: Pipistrellus kuhlii (Kuhl, 1817) (Mammalia: Chiroptera): a species new to the fauna of Tajikistan. *Rocznik Muzeum Górnośląskiego w Bytomiu*, *Przyroda* **28**: 1–6.
Kock D. 1984: Basilia mongolensis nudior Hurka 1972 in Österreich (Insecta: Diptera: Nycteribiidae). *Seckenbergiana Biologica* **65**: 43–46.
Kock D. 1999: Tadarida (Tadarida) latouchei, a separate species recorded from Thailand with remarks on related Asian taxa (Mammalia, Chiroptera, Molossidae). *Senkenbergiana Biologica* **78**: 237–240.
Kock D. & Nader I. A. 1984: Tadarida teniotis (Rafinesque, 1814) in the W-Palaearctic and a lectotype for Dysopes rupelii Temminck, 1826 (Chiroptera: Molossidae). *Zeitschrift für Säugetierkunde* **49**: 129–135.
Kolonin G. V. 2007: Mammals as hosts of ixodid ticks (Acarina, Ixodidae). *Entomological Review* **87**: 401–412.
Koopman K. F. 1966: Taxonomic and distributional notes on southern African bats. *Puku* **4**: 155–165.

Koopman K. F. 1993: Order Chiroptera. Pp. 137–241. In: Wilson D. E. & Reeder D. M. (eds.): *Mammal Species of the World. A Taxonomic and Geographic Reference*. Washington & London: Smithsonian Institution Press, 1206 pp.
Koopman K. F. 1994: Chiroptera: Systematics. Pp. 1–217. In: Niethammer J., Schliemann H. & Starck D. (eds.): *Handbuch der Zoologie. Band VIII. Mammalia. Teilband 60*. Berlin & New York: Walter de Gruyter, vii+224 pp.
Korelov M. N. 1947: Заметки по систематике летучих мышей (Chiroptera) Казахстана [Notes on the systematics of bats (Chiroptera) of Kazakhstan]. *Vestnik Akademii Nauk Kazahskoj SSR* **1947**(1–2): 117–119 (in Russian).
Kornev A. P. 1941: Новые данные о фауне Памира [New data on the fauna of the Pamirs]. *Priroda* [Leningrad] **30**(5): 83–84 (in Russian).
Kovaleva I. M. & Ŝerbak N. N. 1990: О находке новой обитаемой рукокрылыми пещеры в горах западного Копетдага (Туркмения) [On a record of new cave dwelled by bats in mountains of the western Kopetdagh Mts. (Turkmenistan)]. Pp. 57–58. In: Il′in V. Û., Strelkov P. P. & Rodionov V. A. (eds.): *Рукокрылие. Материалы пятого Всесоюзного совещания по рукокрылым* (*Chiroptera*) [*Bats. Proceedings of the Fifth Pan-Union Symposium on Bats* (*Chiroptera*)]. Penza: Penzenskij Gosudarstvennyj Pedagogičeskij Institut Imeni V. G. Belinskogo, 174 pp (in Russian).
Kozlov P. K. 1906: *Монголія и Камъ. Труды экспедиціи Императорскаго Русскаго Географическаго Общества совершенной въ 1899–1901 гг. подъ руководствомъ П. К. Козлова. Томъ I. Часть вторая. Камъ и обратный путь* [*Mongolia and Kam. Papers of the Expedition of the Imperial Russian Geographical Society Made in 1899–1901 Under the Command of P. K. Kozlov. Volume I. Part Second. Kam and the Return Way*]. S.-Peterburg″: Tipo-Litografiâ “Gerol′d″”, x+257–734 pp (in Russian).
Kruskop S. V. 2015: Dark and pale: taxonomic status of the barbastelle (Barbastella: Vespertilionidae, Chiroptera) from Central Asia. *Acta Chiropterologica* **17**: 49–57.
Kruskop S. V. & Borissenko A. V. 1996: A new subspecies of Myotis mystacinus (Vespertilionidae, Chiroptera) from East Asia. *Acta Theriologica* **41**: 331–335.
Kruskop S. V., Borisenko A. V., Ivanova N. V., Lim B. L. & Eger J. L. 2012: Genetic diversity of northeastern Palaearctic bats as revealed by DNA barcodes. *Acta Chiropterologica* **14**: 1–14.
Kruskop S. V., Artyushin I. V., Yuzefovich A. P., Undrakhbayar E., Speranskya A. S., Lisenkova A. A., Bannikova A. A. & Lebedev V. S. 2020: Genetic diversity of Mongolian long-eared bats (Plecotus; Vespertilionidae; Chiroptera). *Acta Chiropterologica* **22**: 243–255.
Kudrâšova N. I. 1978: Ревизия клещей рода Miyatrombicula (Trombiculidae) фауны СССР. [Revision of chigger mites of the genus Miyatrombicula (Trombiculidae) of the fauna of the Soviet Union]. *Parazitologiâ* **12**: 154–166 (in Russian, with a summary in English).
Kudrâšova N. I. 1991: Ревизия рода Oudesmansidium stat. n. (Acariformes: Trombiculidae) [Revision of the genus Oudemansidium stat. n. (Acariformes: Trombiculidae)]. *Parazitologiâ* **25**: 305–315 (in Russian, with a summary in English).
Kudrâšova N. I. 1992: Заметки о роде Willmannium n. stat. (Trombiculidae) с описанием новых видов и мест находок [Notes of the genus Willmannium n. stat. (Trombiculidae) with descriptions of new species and new records]. *Zoologičeskij Žurnal* **71**(3): 33−46 (in Russian, with a summary in English).
Kudrâšova N. I. 1998: Клещи краснотелки (Acariformes, Trombiculidae) Восточной Палеарктики [The chigger mites (Acariformes, Trombiculidae) in the eastern Palaearctic]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **39**: 1–342 (in Russian).
Kudrâšova N. I. & Rybin S. N. 1974: Новые виды клещей-краснотелок (Acariformes, Trombiculidae) из Киргизии [New species of chigger mites (Acariformes, Trombiculidae) from Kirghizstan]. *Zoologičeskij Žurnal* **53**: 633–639 (in Russian, with a summary in English).
Kudrâšova N. I. & Rybin S. N. 1983: Новый вид клещей краснотелок (Trombiculidae) с летучих мушей из Киргизии [A new species of chigger mite (Trombiculidae) from bats from Kirghizstan]. *Parazitologiâ* **17**: 489–492 (in Russian, with a summary in English).
Kunickaâ N. T. 1968: Дополнительные сведения о блохах (Aphaniptera) Средней Азии и Казахстана [Additional data on fleas (Aphaniptera) of West Turkestan and Kazakhstan]. *Zoologičeskij Žurnal* **47**: 473–475 (in Russian).
Kůs P. 2008: *Molekulárně genetická studie vrápenců východního Středomoří* (*Chiroptera*: *Rhinolophidae*: *Rhinolophus*) [*Molecular Genetic Study of Horseshoe Bats of the Eastern Mediterranean* (*Chiroptera*: *Rhinolophidae*: *Rhinolophus*)]. Unpubl. MSc. Thesis. Praha: Department of Zoology, Charles University, 80 pp (in Czech).
Kuzâkin A. P. 1934: Летучие мыши г. Ташкента и систематические заметки о некоторых формах Chiroptera с Кавказа, Бухары и Туркмении [Bats of the city of Toškent and systematical remarks on some forms of the Chiroptera from the Caucasus, Bukhara and Turkmenistan]. *Bûlleten′ Moskovskogo Obŝestva Ispytatelej Prirody*, *Otdel Biologičeskij*, *Novaâ Seriâ* **43**: 316–330 (in Russian, with a summary in English).
Kuzâkin A. P. 1935: Новые данные по систематике и географическому распространению летучих мышей (Chiroptera) в СССР [New data on systematics and geographical distribution of bats (Chiroptera) in the Soviet Union]. *Bûlleten′ Moskovskogo Obŝestva Ispytatelej Prirody*, *Otdel Biologičeskij*, *Novaâ Seriâ* **44**: 428–438 (in Russian, with a summary in German).

Kuzâkin A. P. 1944: II. Отряд Рукокрылые. Ordo Chiroptera [II. Order Bats. Ordo Chiroptera]. Pp. 59–108. In: Bobrinskij N. A. (ed.): *Определитель млекопитающих СССР* [*Key to the Identification of Mammals of the Soviet Union*]. Moskva: Sovetskaâ Nauka, 440 pp (in Russian).

Kuzâkin A. P. 1950: *Летучие мыши* (*Систематика*, *образ жизни и польза для сельского и лесного хозяйства*) [*Bats* (*Systematics*, *Life History and Utility in Agriculture and Forestry*)]. Moskva: Sovetskaâ Nauka, 444 pp (in Russian).

Kuzâkin A. P. 1965: Отряд Рукокрылые. Ordo Chiroptera [Order Bats. Ordo Chiroptera]. Pp. 79–116. In: Kuzâkin A. P. (ed.): *Определитель млекопитающих СССР* [*Key to the Identification of Mammals of the Soviet Union*]. Moskva: Prosveŝenie, 384 pp (in Russian).

Kuz′min I. V., Botvinkin A. D. & Habilov T. K. 2001: Лиссавирус выделен от усатой ночницы в северном Таджикистане [A lyssavirus isolated from a whiskered bat in northern Tajikistan]. *Plecotus et al*. **4**: 75–81 (in Russian, with a summary in English).

Kuznecov B. A. 1948: Млекопитающие Казахстана [Mammals of Kazakhstan]. *Materialy k Poznaniû Fauny i Flory SSSR*, *n.s*., *Otdel Zoologičeskij* **13**: 1–224 (in Russian).

Lanza B. 1999: I parassiti dei pipistrelli (Mammalia, Chiroptera) della fauna italiana. *Museo Regionale di Scienze Naturali*, *Monografie* [Torino] **30**: 1–318.

Laptev M. K. 1934: Материалы к познанию фауны позвоночных Туркменистана (Большие Балханы и Западный Копет-Даг) [Data on knowledge of the fauna of vertebrates of Turkmenistan (Bol′šie Balhany Mts. and western Kopetdagh Mts.)]. *Izvestiâ Turkmenskogo Meždуvedomostvennogo Komiteta po Ohrane Prirody i Razvitiû Prirodnyh Bogatstv* **1**: 115–195 (in Russian, with summaries in English and Turkmen).

Laptev M. K. 1937: Материалы к познанию фауны позвоночных животных Таджикской ССР [Data on the knowledge of the fauna of vertebrate animals of Tajikistan]. *Trudy Turkmenskogo Sel′sko-Hozâjstvennogo Instituta* **2**: 167–182 (in Russian).

Lewis R. E. 1973: Siphonaptera collected during the 1965 Street Expedition of Afghanistan. *Fieldiana*: *Zoology* **64**: i–xi+1–161.

Li G., Jones G., Rossiter S. J., Chen S.-F., Parsons S. & Zhang S. 2006: Phylogenetics of small horseshoe bats from East Asia based on mitochondrial DNA sequence variation. *Journal of Mammalogy* **87**: 1234–1240.

Li Y., Wang J., Metzner W., Luo B., Jiang T., Yang S., Shi L., Huang X., Yue X. & Feng J. 2014: Behavioral responses to echolocation calls from sympatric heterospecific bats: implications for interspecific competition. *Behavioral Ecology and Sociobiology* **68**: 657–667.

Lindberg K. 1961: Recherches biospéléologiques en Afghanistan. *Lunds Universitets Årskrift* **57**(1): 1–39.

Liu Y., Jiang T., Berquist S. & Feng J. 2009: Vocal characters and wing morphology of Rhinolophus marshalli from Tiantang Cave, Guangxi Province, China. *Mammalia* **73**: 373–376.

Liu X., Yan B., Wang Q., Jiang M., Tu C., Chen C., Hornok S. & Wang Y. 2018: Babesia vesperuginis in common pipistrelle (Pipistrellus pipistrellus) and the bat soft tick Argas vespertilionis in the People's Republic of China. *Journal of Wildlife Diseases* **54**: 419–421.

Liu T., Sun K., Csorba G., Zhang K., Zhang L., Zhao H., Jin L., Thong V. D., Xiao Y. & Feng J. 2019: Species delimitation and evolutionary reconstruction within an integrative taxonomic framework: A case study on Rhinolophus macrotis complex (Chiroptera: Rhinolophidae). *Molecular Phylogenetics and Evolution* **139**(106544): 1–14.

Liu T., Zhang K., Dai W., Jin L., Sun K. & Feng J. 2021: Evolutionary insights into Rhinolophus episcopus (Chiroptera, Rhinolophidae) in China: Isolation by distance, environment, or sensory system? *Journal of Zoological Systematics and Evolutionary Research* **59**: 294–310.

López-Baucells A. 2019a: Savi's pipistrelle Hypsugo savii. P. 810. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.

López-Baucells A. 2019b: Common pipistrelle Pipistrellus pipistrellus. P. 771. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.

López-Baucells A. 2019c: [Species accounts of Barbastella and Plecotus]. Pp. 860–870. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.

López-Baucells A. & Burgin C. J. 2019: [Species accounts of Eptesicus]. Pp. 850–852. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *9*. *Bats*. Barcelona: Lynx Editions, 1008 pp.

López-Bosch D., Huang J. C.-C., Wang Y., Palmeirim A. F., Gibson L. & López-Baucells A. 2021: Bat echolocation in continental China: a systematic review and first acoustic identification key for the country. *Mammal Research* **66**: 405–416.

Loumassine H. E., Marniche F., Bounaceur F. & Aulagnier S. 2019: Seasonal diet of Asellia tridens (Chiroptera: Hipposiderodae) in north-western Africa. *European Zoological Journal* **2019**: 1–9.

L′vov D. K., Kostûkov M. A., Daniârov O. A., Tuhtaev T. M., Šerikov B. K., Bun′etbekov A. A., Bulyčev V. P. & Gordeeva Z. E. 1984: Вспышка арбовирусной инфекции в Таджикской ССР, вызванной вирусом Иссук-Куль (Иссык-Кульская лихорадка) [Outbreak of arbovirus infection in Tajikistan caused by the Issyk-Kul virus (Issyk-Kul fever)]. *Voprosy Virusologii* **29**: 89–92 (in Russian, with a summary in English).

L′vova V. I. 1945: Млекопитающие Гиссарской долины и прилежащих горных районов [Mammals of the Ḥisor valley and adjacent mountainous areas]. *Trudy Tadžikskogo Filiala Akademii Nauk SSSR*, *Zoologiâ i Parazitologiâ* **14**: 22–28 (in Russian).
Maa T. C. 1965: An interim world list of batflies (Diptera: Nycteribiidae and Streblidae). *Journal of Medical Entomology* **1**: 377–386.
Maa T. C. 1975: On the generic name Phthiridium vs Stylidia. *Pacific Insects* **16**: 487–490.
Mahmood-ul-Hassan M. & Salim M. 2015: Two new bat species (Chiroptera: Mammalia) for Pakistan: Miniopterus fuliginosus and Myotis formosus. *Mammalia* **79**: 125–129.
Mahmood-ul-Hassan M., Jones G. & Dietz C. 2009: *The Bats of Pakistan*. *The Least Known Creatures*. Saarbrücken: VDM Verlag Dr. Müller Aktiengesellschaft & Co. KG, xii+155 pp.
Malinovskij K. Û. 1988: Новые данные о распространении рукокрылых (Chiroptera) в Таджикистане [New data on the distribution of bats (Chiroptera) in Tajikistan]. *Doklady Akademii Nauk Tadžikskoj SSR* **31**(2): 137–140 (in Russian, with a summary in Tajik).
Mans B. J., Kelava S., Pienaar R., Featherston J., de Castro M. H., Quetglas J., Reeves W. K., Durden L. A., Miller M. M., Laverty T. M., Shao R., Takano A., Kawabata H., Moustafa M. A. M., Nakao R., Matsuno K., Greay T. L., Evasco K. L., Barker D. & Barker S. C. 2021: Nuclear (18S-28S rRNA) and mitochondrial genome markers of Carios (Carios) vespertilionis (Argasidae) support Carios Latreille, 1796 as a lineage embedded in the Ornithodorinae: re-classification of the Carios sensu Klompen and Oliver (1993) clade into its respective subgenera. *Ticks and Tick-borne Diseases* **12**(4; 101688): 1–12.
Maslova O. V. (ed.) 1956: *Обзор русских путешествий и экспедиций в Среднюю Азию*. *Часть II*. *1856–1869* [*Review of Russian Travels and Expeditions to West Turkestan*. *Part II*. *1856–1869*]. Taškent: Sredneaziâtskij gosudarstvennyj universitet im. V. I. Lenina, 102 pp (in Russian).
Maslova O. V. (ed.) 1962: *Обзор русских путешествий и экспедиций в Среднюю Азию*. *Часть III*. *1869–1880* [*Review of Russian Travels and Expeditions to West Turkestan*. *Part III*. *1869–1880*]. Taškent: Taškentskij gosudarstvennyj universitet im. V. I. Lenina, 181 pp (in Russian).
Mata V. A., Amorim F., Guillén-Servent A., Beja P. & Rebelo H. 2017: First complete mitochondrial genomes of molossid bats (Chiroptera: Molossidae). *Mitochondrial DNA Part B*: *Resources* **2**: 152–154.
Mathews F., Anderson M., Coomber F., Finch D., Le Marquand C., O'Malley K. & Wright P. 2023: Common pipistrelle Pipistrellus pipistrellus (Schreber, 1774). Pp. 555–589. In: Russo D. (ed.): *Handbook of the Mammals of Europe*. *Chiroptera*. Cham: Springer Nature Switzerland, xvii+963 pp.
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 Chiropterologica* **7**: 23–37.
Mayer F., Dietz C. & Kiefer A. 2007: Molecular species identification boosts bat diversity. *Frontiers in Zoology* **4**(4): 1–5.
Medvedev S. G. 1984: *Блохи сем*. *Ischnopsyllidae* (*Siphonaptera*) *CCCP*. *Диссертация* [*Fleas of the family Ischnopsyllidae* (*Siphonaptera*) *of the Soviet Union*. *Dissertation*]. Unpubl. PhD. Thesis. Leningrad: Zoologičeskij Institut Akademii Nauk SSSR, 299 pp (in Russian).
Medvedev S. G. 1992: Экология блох сем. Ischnopsyllidae (Siphonaptera) фауны CCCP [Ecology of fleas of the family Ischnopsyllidae (Siphonaptera) of the fauna of the Soviet Union]. *Parazologičeskij Sbornik* **37**: 17–40 (in Russian, with a summary in English).
Medvedev S. G. & Polkanov A. Û. 1997: К фауне блох сем. Ischnopsyllidae (Siphonaptera) Средней Азии и Казахстана [On the fauna of fleas of the family Ischnopsyllidae (Siphonaptera) of West Turkestan and Kazakhstan]. *Parazitologiâ* **31**: 13–23 (in Russian, with a summary in English).
Medvedev S. G., Habilov T. K. & Rybin S. N. 1984: К биологии блох летучих мышей (Ischnopsyllidae: Siphonaptera) Средней Азии и южного Казахстана [On the biology of bat fleas (Ischnopsyllidae: Siphonaptera) of West Turkestan]. *Parazitologiâ* **18**: 140–149 (in Russian, with a summary in English).
Medvedev S. G., Stanûkovič M. K., Tiunov M. P. & Farafonova G. V. 1991: Эктопаразиты летучих мышей Дальнего Востока [Ectoparasites of bats of the Far East]. *Parazitologiâ* **25**: 27–38 (in Russian, with a summary in English).
Meklenburcev R. N. 1935: Заметки по биологии летучих мышей окрестностей Ташкента [Notes on the life history of bats in the surroundings of Taškent]. *Bûlleten' Sredne Aziatskogo Gosudarstvennogo Universiteta* **24**: 105–114 (in Russian).
Meklenburcev R. N. 1936: Материалы по млекопитающим и птицам Памира [Records of mammals and birds of the Pamirs]. *Trudy Sredneaziatskogo Gosudarstvennogo Universiteta*, *Seriâ VIII-a*, *Zoologiâ* **22**: 1–40 (in Russian, with a summary in English).
Meklenburcev R. N. 1937: Материалы по фауне птиц и млекопитающих хребта Нура-Тау [Records of the fauna of birds and mammals of the Nura-Tau Mts.]. *Trudy Sredne Aziatskogo Gosudarstvennogo Univerziteta*, *Seriâ VIII-a*, *Zoologiâ* **26**: 1–51 (in Russian, with a summary in English).
Merzlyakova I. 2002: 16. The Mountains of Central Asia and Kazakhstan. Pp. 377–402. In: Shahgedanova M. (ed.): *The Physical Geography of Northern Eurasia*. New York: Oxford University Press, xx+570 pp.

Meyer-Oehme D. 1965: Die Saeugetiere Afghanistans (Teil III). Chiroptera. *Science* (Kabul) **August 1965**: 42–58.
Micherdziński W. 1980: *Eine taxonomische Analyse der Familie Macronyssidae Oudemans*, *1936*. *I. Subfamilie Ornithonyssinae Lange*, *1958* (*Acarina*, *Mesostigmata*). Warszawa: Państwowe Wydawnictwo Naukowe, 263 pp.
Mifsud C. M. & Vella A. 2019: Acoustic characterization of bats from Malta: setting a baseline for monitoring and conservation of bat populations. *Bioacoustics* **28**: 427–442.
Milchram M., Dietz C., Mayer F., Gurke M., Krainer K., Mixanig H., Wieser D. & Reiter G. 2023: Moving north: Morphometric traits facilitate monitoring of the expanding steppe whiskered bat Myotis davidii in Europe. *Hystrix*, *n.s*. **34**: 19–23.
Minář J. & Hůrka K. 1980: Parasitäre Dipteren (Insecta, Diptera: Hypodermatidae, Hyppoboscidae, Nycteribiidae) aus der Mongolei. Ergebnisse der Mongolisch-Deutschen Expeditionen seit 1962, Nr. 94. *Mitteilungen aus dem Zoologischen Museum in Berlin* **56**: 187–189.
Monadjem A., Joubert C., Richards L., Nielsen I. B., Nielsen M., Kjartansdóttir K. R., Bohmann K., Mourier T. & Hansen A. J. 2016: First record of Vespertilio murinus from the Arabian Peninsula. *Vespertilio* **18**: 79–89.
Moniuszko H. & Mąkol J. 2014: Chigger mites (Actinotrichida: Parasitengona, Trombiculidae) of Poland. An updated distribution and hosts. *Annals of Parasitology* **60**: 103–117.
Morales A. E., Ruedi M., Field K. & Carstens B. C. 2019: Diversification rates have no effect on the convergent evolution of foraging strategies in the most speciose genus of bats, Myotis. *Evolution* **73**: 2263–2280.
Mulârskaâ L. V. 1973: Три новых вида тромбикулид (Acariformes, Trombiculidae) из Азербайджана [Three new species of trombiculids (Acariformes, Trombiculidae) from Azerbaijan]. *Parazitologiâ* **7**: 312–320 (in Russian, with a summary in English).
Muratov R. Š., Habilov T. K. & Tadžibaeva È. 2017: О новых находках двухцветного кожана Vespertilio murinus L. 1758 и статусе его пребывания в Таджикистане [About new records of the parti-coloured bat Vespertilio murinus L. 1758 and the status of its presence in Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **42**: 59–61 (in Russian, with summaries in Tajik and English).
Nader I. A. & Kock D. 1983: Notes on some bats from the Near East (Mammalia: Chiroptera). *Zeitschrift für Säugetierkunde* **48**: 1–9.
Nader I. A. & Kock D. 1990: Eptesicus (Eptesicus) bottae (Peters 1869) in Saudi Arabia with notes on its subspecies and distribution (Mammalia: Chiroptera: Vespertilionidae). *Senckenbergiana Biologica* **70**: 1–13.
Naderi S., Dietz C., Mirzajani A. & Mayer F. 2017: First record of Nathusius' pipistrelle, Pipistrellus nathusii (Mammalia: Chiroptera), from Iran. *Zoology in the Middle East* **63**: 93–94.
Nemenz H. 1960: Contribution à l'etude de la faune Afghanistan 18. Ixodoidea: Argasidae. *Entomologisk Tidskrift* **81**: 45–47.
Nguyen L., Schmidt H. A., von Haesler A. & Minh B. Q. 2015: IQ-TREE: a fast and effective stochastic algorithm for estimating maximum likelihood phylogenies. *Molecular Biology and Evolution* **32**: 268–274.
Neuhauser H. N. 1969: *The Bats of Afghanistan*. *A Study Resulting from the Street Expedition of 1965*. Unpubl. MSc. Thesis. Athens: University of Georgia, 111 pp.
Neuhauser H. N. & DeBlase A. F. 1971: The status of Pipistrellus aladdin Thomas from Central Asia. *Mammalia* **35**: 273–282.
Neuhauser H. N. & DeBlase A. F. 1974: Notes on bats (Chiroptera: Vespertilionidae) new to the faunal lists of Afghanistan and Iran. *Fieldiana*: *Zoology* **62**(5): 85–96.
Niethammer J. 1983: Die Säugetiere Afghanistans. *Mitteilungen des Deutschen Orient-Instituts im Verbund der Stiftung Deutsches Übersee-Institut* **22**: 211–228.
Nikaido M., Kawai K., Cao Y., Harada M., Tomita S., Okada N. & Hasegawa M. 2001: Maximum likelihood analysis of the complete mitochondrial genomes of eutherians and a reevaluation of the phylogeny of bats and insectivores. *Journal of Molecular Evolution* **53**: 508–516.
Nikulina N. A. 2004: Каталог паразитических гамазовых клещей млекопитающих Северной Евразии [*Catalogue of Gamasid Mite Parasites of Mammals of Northern Eurasia* (*Russia*)]. Sankt-Peterburg: Tipografiâ «Akcioner i Ko», 170 pp (in Russian).
Obrist M. K., Boesch R. & Flückiger P. F. 2004: Variability in echolocation call design of 26 Swiss bat species: consequences, limits and options for automated field identification with a synergetic pattern recognition approach. *Mammalia* **68**: 307–322.
Ogneff S. I. & Heptner W. G. 1928: Einige Mitteilungen über die Säugetiere des mittleren Kopet-Dag und der anliegenden Ebene (Russisch-Turkestan). *Zoologischer Anzeiger* **75**: 258–266.
Ognev S. I. 1927: A synopsis of the Russian bats. *Journal of Mammalogy* **8**: 140–157.
Ognev S. I. 1928: *Звери Восточой Европы и Северной Азии*. *Том I* [*Mammals of Eastern Europe and Northern Asia*. *Volume I*]. Moskva & Leningrad: Gosudarstvennoe Izdatel′stvo, 631 pp (in Russian).
Ognev S. I. 1950: *Звери СССР и прилежащих стран*. *Том VII*. *Грызуны* (*продолжение*) [*Mammals of the Soviet Union and Adjacent Countries*. *Volume VII*. *Rodents* (*Continuation*)]. Moskva & Leningrad: Izdatel′stvo Akademii Nauk SSSR, 706+xv pp.

Ohno M., Tomioka Y. & Goto J. 2008: [First record of Nycteridopsylla dictena (Kolenati) in Japan]. P. 29. In: Anonymous (ed.): *Proceeding of the 68th Annual Meeting of the Entomological Society of Japan*. Entomological Society of Japan (in Japanese).

Orlova M. V. & Anisimov N. V. 2023: Three new species of bat-parasitic gamasid mites of the genera Spinturnix, Macronyssus and Steatonyssus (Acari: Mesostigmata: Spinturnicidae, Macronyssidae) from Siberia and Mongolia, with keys to species of Russia and adjacent countries. *Persian Journal of Acarology* **12**(2): 211–239.

Orlova M. V. & Kazakov D. V. 2016: Новые находки редких видов клещей рода Spinturnix von Heyden, 1826 (Mesostigmata: Gamasina: Spinturnicidae) в России и Таджикистане [New records of rare species of ticks of the genus Spinturnix von Heyden, 1826 (Mesostigmata: Gamasina: Spinturnicidae) in Russia and Tajikistan]. *Parazitologiâ* **50**: 404–408 (in Russian, with a summary in English).

Orlova M. V. & Orlov O. L. 2018: First record of the parasitic gamasid mite Spinturnix emarginata (Kolenati, 1856) in Crimea. *Acarina* **26**: 237–242.

Orlova M. V. & Zhigalin A. V. 2014: New records of the bat fly Basilia mongolensis in the mountains of Asia (Diptera). *Vespertilio* **17**: 127–128.

Orlova M. V., Stanyukovich M. K. & Orlov O. L. 2015a: *Gamasid Mites* (*Mesostigmata*: *Gamasina*) *Parasitizing Bats* (*Chiroptera*: *Rhinolophidae*, *Vespertilionidae*, *Molossidae*) *of Palaearctic Boreal Zone* (*Russia and Adjacent Countries*). Tomsk: Tomsk State University, 149 pp.

Orlova M. V., Žigalin A. V., Orlov O. L., Kruskop S. V. & Bogdanov I. I. 2015b: К фауне эктопаразитов редких и малоизученых видов рукокрылых южной Сибири [To the fauna of ectoparasites of rare and less known species of bats of southern Siberia]. *Izvestiâ Rossijskoj Akademii Nauk*, *Seriâ Biologičeskaâ* **2015**(3): 310–315 (in Russian, with a summary in English).

Orlova M. V., Kazakov D. V., Kravchenko L. B. & Zhigalin A. V. 2017a: Ectoparasite fauna of the Siberian bat Myotis sibiricus (Chiroptera: Vespertilionidae) with a revision of previous data on ectoparasites from Brandt's bat Myotis brandtii s.l. and the whiskered bat M. mystacinus s.l. of the Eastern Palaearctic. *Entomological Review* **97**: 1166–1173.

Orlova M. V., Orlov O. L., Kazakov D. V. & Zhigalin A. V. 2017b: Approaches to the identification of ectoparasite complexes of bats (Chiroptera: Vespertilionidae, Miniopteridae, Rhinolophidae, Molossidae) in the Palaearctic. *Entomological Review* **97**: 684–701.

Orlova M. V., Smirnov D. G., Anisimov N. V., Orlov O. L., Klimov P. B., Vekhnik V. P., Murashko E. S. & Lukyanenko A. M. 2020: Parasitic macronyssid mites (Mesostigmata: Macronyssidae) from bats of northern Caucasus with key for females of the genus Macronyssus Kolenati, 1858 of Russia and adjacent countries. *International Journal of Acarology* **46**: 364–372.

Orlova M. V., Thong V. T., Anisimov N. V., Smirnov D. G. & Orlov O. L. 2021a: New findings of spinturnicid mites (Mesostigmata: Gamasina: Spinturnicidae) from the Caucasus. *Parasitology International* **85**(102429): 1–5.

Orlova M. V., Klimov P. B., Orlov O. L., Kruskop S. V. & Lebedev V. S. 2021b: New geographic and host records of spinturnicid mites (Mesostigmata: Spinturnicidae) in Asia, with description of the protonymph of Spinturnix tylonycterisi. *International Journal of Acarology* **47**: 361–365.

Orlova M. V., Klimov P. B., Moskvitina N. S., Orlov O. L., Zhigalin A. V., Smirnov D. G., Dzhamirzoev H. S., Vekhnik V. P., Pavlov A. V., Emelyanova A. A. & Khristenko E. 2021c: New records of bat flies (Diptera: Nycteribiidae), with an updated checklist of the nycteribiids of Russia. *Zootaxa* **4927**: 410–430.

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. *Ecologica Montenegrina* **63**: 105–112.

Papadatou E., Butlin R. K. & Altringham J. D. 2008: Identification of bat species in Greece from their echolocation calls. *Acta Chiropterologica* **10**: 127–143.

Parsons S. & Jones G. 2000: Acoustic identification of twelve species of echolocating bat by discriminant function analysis and artificial neural networks. *Journal of Experimental Biology* **203**: 2641–2656.

Pavlinov I. Â. & Rossolimo O. L. 1987: Систематика млекопитающих СССР [Systematics of mammals of the Soviet Union]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **25**: 1–285 (in Russian).

Pavlinov I. Â. & Rossolimo O. L. 1998: Систематика млекопитающих СССР. Дополнения [Systematics of mammals of the Soviet Union. Addenda]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **38**: 1–191 (in Russian).

Péricart J. 1972: *Hémiptères Anthocoridae*, *Cimicidae et Microphysidae de l'Ouest-Paléarctique*. *Faune de l'Europe et du Bassin Méditerranéen*, *7*. Paris: Masso & Cie., 402 pp.

Peters W. 1869: Bemerkungen über neue oder weniger bekannte Flederthiere, besonders des Pariser Museums. *Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin* **1869**: 391–406.

Peus F. 1957: Flöhe aus Afghanistan. *Beiträge zur Entomologie* **7**(5–6): 604–608.

Pěvcov″ M. V. 1895: *Путешествіе по Восточному Туркестану*, *Кунъ-Луню*, *съверной окраинъ Тибетскаго Нагорья и Чжунгаріи въ 1889-мъ и 1890-мъ годахъ* [*Journey to East Turkestan*, *Kun-Lun*, *Northern Margins of the Tibetan Plateau and to Dzungaria in 1889 and 1890*]. S.-Peterburg″: Tipografiâ M. M. Stasûleviča, 423 pp (in Russian).

Phauk S., Phen S. & Furey N. M., 2013: Cambodian bat echolocation: a first description of assemblage call parameters and assessment of their utility for species identification. *Cambodian Journal of Natural History* **2013**(1): 16–26.
Pienaar R., de Klerk D. G., Putterill J. F. & Mans B. J. 2018: Notes on maternal behaviour in soft ticks: Specifically observed in Argas (Argas) striatus Bedford, 1932 and Argas (Secretargas) transgariepinus White, 1846. *Ticks and Tick-Borne Diseases* **9**: 889–895.
Pinčuk L. M. 1971: Паразитические клещи семейства Spinturnicidae (Parasitiformes: Gamasidae) от летучих мышей Молдавии [Parasitic mites of the family Spinturnicidae (Parasitiformes: Gamasidae) of bats from Moldavia]. *Parazity Životnyh i Rastenij* **7**: 93–110 (in Russian)
Polkanov A. Û. & Medvedev S. G. 1997: К фауне никтерибиид (Diptera: Nycteribiidae) Средней Азии и Казахстана [On the fauna of bat flies (Diptera: Nycteribiidae) of West Turkestan and Kazakhstan]. *Parazitologiâ* **31**: 116–125 (in Russian, with a summary in English).
Povolný D. 1957: Kritická studie o štěnicovitých (Het. Cimicidae) v Československu [Critical study of cimicids (Het. Cimicidae) of Czechoslovakia]. *Zoologické Listy* **6**: 57–80 (in Czech, with summaries in Russin and German).
Prasad V. 1969: Bat mites (Acarina: Spinturnicidae) mainly from South-East Asia and the Pacific region. *Acarologia* **11**: 657–677
Prževal′skij N. M. 1883: *Третье путешествіе въ Центральной Азіи. Изъ Зайсана черезъ Хами въ Тибетъ и на верховья Желтой рѣки* [*Third Travelling to Central Asia. From Zajsan through Hami to Tibet and to the Uplands of the Yellow River*]. S.-Peterburg″: Tipografiâ V. S. Balaševa, 473 pp (in Russian).
Prževal′skij N. M. 1888: *Четвертое путешествіе въ Центральной Азіи. Отъ Кяхты на истоки Желтой рѣки, изслѣдованіе сѣверной окраины Тибета и путь черезъ Лобъ-Норъ по Бассейну Тарима* [*Fourth Travelling to Central Asia. From Kyakhta to the Springs of the Yellow River, Explorations of the Northern Margins of Tibet and the Journey over the Lobnor through the Tarim Basin*]. S.-Peterburg″: Tipografiâ V. S. Balaševa, 536 pp (in Russian).
Puechmaille S. J., Argouilh M., Piyapan P., Yokubol M., Mie K. M., Bates P. J. J., Satasook C., New T., Hla B. S. S., Mackie I. J., Petit E. J. & Teeling E. C. 2011: The evolution of sensory divergence in the context of limited gene flow in the bumblebee bat. *Nature Communications* **2**(573): 1–9.
Quetglas J., Balvín O., Lučan R. K. & Benda P. 2012: First records of the bat bug Cacodmus vicinus (Heteroptera: Cimicidae) from Europe and further data on its distribution. *Vespertilio* **16**: 243–248.
Quetglas J., Nogueras J., Ibáñez C. & Beaucournu J-C. 2014: Presencia en la Península Ibérica de una pulga africana de murciélagos: Rhinolophopsylla unipectinata arabs (Siphonaptera: Ischnopsyllidae) y otras nuevas citas de pulgas de murciélagos para España y Marruecos. *Galemys* **26**: 41–47.
Radde G. & Walter A. 1889: Die Säugethiere Transkaspiens. *Zoologische Jahrbücher*, *Abteilung für Systematik, Geographie und Biologie der Thiere* **4**: 993–1094.
Radovsky F. J. 1967: The Macronyssidae and Laelapidae (Acarina: Mesostigmata) parasitic on bats. *University of California Publications in Entomology* **46**: 1–288.
Rahmatulina I. K. 2005: *Рукокрылые Азербайджана* (*фауна*, *экология*, *зоогеография*) [*Bats of Azerbaijan* (*Fauna*, *Ecology*, *Zoogeography*)]. Baku: Nacional′naâ Akademiâ Nauk Azerbajdžana, 480 pp (in Russian).
Raman S. & Hughes A. C. 2020: Echobank for the bats of Western Ghats biodiversity hotspot, India. *Acta Chiropterologica* **22**: 349–364.
Razgour O., Korine C. & Saltz D. 2010: Pond characteristics as determinants of species diversity and community composition in desert bats. *Animal Conservation* **13**: 505–513.
Reeves W. K., Orlova M. V. & Kruskop S. V. 2024: Description of pupal stages of Nycteribia quasiocellata Theodor and Eucampsipoda sundaicum Theodor, and key to identification of pupipara of Eurasian nycteribiid flies. *Comparative Parasitology* **91**: 88–92.
Rejmov R. 1982: Рукокрылые южного Приаралья [Bats of the southern part of the Aral Sea region]. Pp. 345–346. In: Panteelev P. A. (ed.): *Млекопитающие СССР. 3-й съезд Всесоюсного териологического общества. Москва, 1–5 февраля 1982. Тезисы докладов* [*Mammals of the Soviet Union. Third Congress of the Pan-Union Theriological Society. Moskva, 1–5 February 1982*]. Moskva: Vsesoûznoe teriologičeskoe obšestvo, 346 pp (in Russian).
Rejmov R. 1985: *Млекопитающие южного Приаралья* (*экология*, *охрана и использование*) [*Mammals of the Southern Part of the Aral Sea Region* (*Ecology*, *Conservation and Utility*)]. Taškent: FAN, 96 pp (in Russian).
Robinson M. F. 1996: A relationship betwen echolocation calls and noseleaf widths in bats of the genera Rhinolophus and Hipposideros. *Journal of Zoology*, *London* **239**: 389–393.
Rosina V. V. 2015: First Neogene Otonycteris (Chiroptera: Vespertilionidae) from Ukraine: its biostratigraphic and paleogeographic significance. *Paleovertebrata* **39**: 1–13.
Rossolimo O. L. & Pavlinov I. Â. 1979: Каталог типовых экземпляров млекопитающих хранящихся в Зоологическом музее МГУ [Catalogue of type specimens of mammals deposited in the Zoological Museum of the Moscow State University]. *Sbornik Trudov Zoologičeskogo Muzeâ MGU* **18**: 5–43 (in Russian).

Rozanov M. P. 1935: Маршрут зоологического отряда ТКЭ 1932 г. – Общий очерк Памира. – Млекопитающие Памира [Route of the zoological division of the Tajikistan Complex Expedition 1932. – Overview of the Pamirs. – Mammals of the Pamirs]. *Trudy Tadžikskoj Kompleksnoj Èkspedicii Akademii Nauk SSSR 1932 g.* **32**: 4–60 (in Russian).
Rudnick A. 1960: A revision of the mites of the family of Spinturnicidae (Acarina). *University of California Publications in Entomology* **17**: 157–284.
Ruedi M. 2023: Lesser mouse-eared bat Myotis blythii (Tomes, 1857). Pp. 135–159. In: Russo D. (ed.): *Handbook of the Mammals of Europe*. *Chiroptera*. Cham: Springer Nature Switzerland, xvii+963 pp.
Ruedi M., Saikia U., Thabah A., Görföl T., Thapa S. & Csorba G. 2021: Molecular and morphological revision of small Myotinae from the Himalayas shed new light on the poorly known genus Submyotodon (Chiroptera: Vespertilionidae). *Mammalian Biology* **101**: 465–480.
Russo D. & Jones G. 2002: Identification of twenty-two bat species (Mammalia: Chiroptera) from Italy by analysis of time-expanded recordings of echolocation calls. *Journal of Zoology*, *London* **258**: 91–103.
Russo D., Salinas-Ramos V. B. & Ancillotto L. 2023: Barbastelle bat Barbastella barbastellus (Schreber, 1774). Pp. 1–22. In: Russo D. (ed.): *Handbook of the Mammals of Europe*. *Chiroptera*. Cham: Springer Nature Switzerland, xvii+963 pp.
Rybin S. N. 1961: Новый вид блохи – Nycteridopsylla oligochaeta sp. nov. – паразит азиатской широкоушки (Barbastella darjelingensis Dobs.) [A new species of flea – Nycteridopsylla oligochaeta sp. nov. – a parasite of the Asian barbastelle (Barbastella darjelingensis Dobs.)]. *Trudy Naučno-issledovatel'skogo Protivočumnogo Instituta Kavkaza i Zakavkazâ* **5**: 206–210 (in Russian).
Rybin S. N. 1980: Рукокрылые южной Киргизии [Bats of southern Kirghizstan]. Pp. 87–95. In: Kuzâkin A. P. & Panûtin K. K. (eds.): *Вопросы териологии*. *Рукокрылые* (*Chiroptera*) [*Questions in Theriology*. *Bats* (*Chiroptera*)]. Moskva: Nauka, 320 pp (in Russian).
Rybin S. N. 1983: Гамазоидные клещи рукокрылых и их убежищ в южной Киргизии [Gamasoid mites of bats and their roosts in southern Kirghizstan]. *Parasitologiâ* **17**: 355–360 (in Russian, with a summary in English).
Rybin S. N. 1991: Новый вид блохи из южной Киргизии – Nycteridopsylla singula sp. n. (Siphonaptera: Ischnopsyllidae) [New species of flea from southern Kirghizstan – Nycteridopsylla singula sp. n. (Siphonaptera: Ischnopsyllidae)]. *Parazitologiâ* **25**: 172–174 (in Russian, with a summary in English).
Rybin S. N., Horáček I. & Červený J. 1989: Bats of southern Kirghizia: distribution and faunal status. Pp. 421–441. In: Hanák V., Horáček I. & Gaisler J. (eds.): *European Bat Research 1987*. Praha: Charles University Press, 720 pp.
Sachanowicz K., Wower A. & Bashta T.-A. 2006: Further range extension of Pipistrellus kuhlii (Kuhl, 1817) in central and eastern Europe. *Acta Chiropterologica* **8**: 543–548.
Sachanowicz K., Piskorski M. & Tereba A. 2017: Systematics and taxonomy of Pipistrellus kuhlii (Kuhl, 1817) in Central Europe and the Balkans. *Zootaxa* **4306**: 53–66.
Saidov A., Khabilov T. & Amirov Z. 2017: Mammalia. Pp. 401–489. In: Saidov A. (ed.): *The Red Book of the Republic of Tajikistan*. *Second Edition*. *Volume 2*. *Fauna*. Dushanbe: Academy of Sciences of the Republic of Tajikistan, 496 pp (in Tajik, Russian and English)
Sanborn C. C. & Hoogstraal H. 1953: Some mammals of Yemen and their ectoparasites. *Fieldiana*: *Zoology* **34**: 229–252.
Satunin K. A. 1896: Vorläufige Mittheilungen über die Säugethierfauna der Kaukasusländer. *Zoologische Jahrbücher*, *Abtheilung für Systematik*, *Geographie und Biologie der Thiere* **9**: 277–314.
Satunin K. 1901: Zwei neue Säugethiere aus Transkaukasien. *Zoologischer Anzeiger* **24**: 461–464.
Satunin″ K. 1905: Новыя и малоизвѣстныя млекопитающія Кавказа и Закаспиійской Области [New and less known mammals of the Caucasus and Transcaspian Province]. *Izvěstìâ Kavkazskago Muzeâ* **2**: 45–69 (in Russian).
Satunin″ K. A. 1906: Обзоръ мекопитающихъ Закаспійской Области [Review of mammals of the Transcaspian Province]. *Zapiski Kavkazskago Otdelâ Imperatorskago Russkago Geografičeskago Obŝestva* **25**(3): 1–56 (in Russian).
Satunin″ K. A. 1908: Матеріалы къ познанію млекопитающихъ Кавказскаго Края и Закаспиійской Области. VIII. Экскурсія Кавказскаго Музея въ степи и предгорья восточнаго Закавказья весною 1907 г. [Data on the knowledge of mammals of the Caucasus and Transcaspian Provinces. VIII. Research trip of the Caucasus Museum to the steppes and foothills of the eastern Transcaucasia in the autumn 1907]. *Izvěstìâ Kavkazskago Muzeâ* **4**: 41–67 (in Russian).
Satunin″ K. A. 1910: Матеріалы къ познанію млекопитающихъ Кавказскаго Края и Закаспійской Области, XII–XVI. XVI. Млекопитающія Кавказа и прилежащихъ странъ, хранящіяся въ Зоологическомъ Музеѣ Императорской Академіи Наукъ въ С.-Петербургѣ [Data on the knowledge of mammals of the Caucasus and Transcaspian Provinces, XII–XVI. XVI. Mammals of the Caucasus and adjacent countries deposited in the Zoological Museum of the Imperial Academy of Sciences in Saint-Petersburg]. *Izvěstìâ Kavkazskago Muzeâ* **4**: 278–285 (in Russian and German).
Satunin″ K. A. 1914: *Опредѣлитель млекопитающихъ Россійской Имперіи*. *Выпускъ первый*. (*Рукокрылыя*, *Насѣкомоядныя и Хищныя*) [*Key to the Mammals of the Russian Empire*. *First Volume*. (*Bats*, *Insectivores and Carnivores*)]. Tiflis″: Tipografiâ Kancelârii Namestnika E. I. V. na Kavkaze, 148 pp (in Russian).
Satunin″ K. A. & Radde G. I. 1899: Краткія замѣтки относительно названныхъ млекопитающихъ [Short notes on the properly named mammals]. Pp. 49–77. In: Radde G. I. (ed.): *Коллекціи Кавказскаго Музея*. *Томъ I*. *Зоологія*

[*Collections of the Caucasus Museum*. *Volume 1*. *Zoology*]. Tiflis″: Tipografiâ Kancelârìi Glavnonačal′stvuûŝago graždanskoû častìû na Kavkazě, 520 pp (in Russian).
Savič″ V. M. 1912: Новый видъ березы въ киргизскихъ степяхъ [New species of birch in the Kirghiz steppes]. *Věstnik″ Tiflisskago Botaničeskago Sada* **25**: 6–11 (in Russian).
Scheffler I., Dolch D., Ariunbold J., Batsaikhan N., Abraham A. & Thiele K. 2010: Ectoparasites of bats in Mongolia (Ischnopsyllidae, Nycteribiidae, Cimicidae and Spinturnicidae). *Erforschung Biologischer Ressourcen der Mongolei* [Haale/Saale] **11**: 367–381.
Scheffler I., Dolch D., Ariunbold J., Stubbe A., Abraham A. & Thiele K. 2012: Ectoparasites of bats in Mongolia, Part 2 (Ischnopsyllidae, Nycteribiidae, Cimicidae and Acari). *Erforschung Biologischer Ressourcen der Mongolei* [Haale/Saale] 12: 135–151.
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* [Haale/Saale] **13**: 395–408.
Schmidt E. 1987: Nachweise von Acari bei Chiropteren im Bezirk Neubrandenburg (DDR). *Angewandte Parasitologie* **28**: 103–107.
Schnitzler H.-U., Kalko E., Miller L. & Surlykke A. 1987: The echolocation and hunting behavior of the bat, Pipistrellus kuhli. *Journal of Comparative Physiology A* **161**: 267–274.
Seibert A.-M., Koblitz J. C., Denzinger A. & Schnitzler H.-U. 2015: Bidirectional echolocation in the bat Barbastella barbastellus: different signals of low source level are emitted upward through the nose and downward through the mouth. *Public Library of Science One* **10**(9; e0135590): 1–17.
Senotrusova V. N. 1987: *Гамазовые клещи — паразиты диких животных Казахстана* [*Gamasid Mites – Parasites of Wild Animals of Kazakhstan*]. Alma-Ata: Nauka, 220 pp (in Russian).
Ŝerbin Û. V. 1964: Некоторые особенности рукокрылых Таджикистана [Some particularities of the bats of Tajikistan]. In: Anonymous (ed.): *Тезисы докладов конференции молодых ученых Таджикистана* [*Proceedings of the Conference of Young Scientists of Tajikistan*]. Dušanbe: publisher and pages unlisted (in Russian; non vidi, ex Habilov 1992).
Ŝerbin Û. V. 1968: Материалы по распространению некоторых видов рукокрылых в Таджикистане [Records of the distribution of some bat species in Tajikistan]. *Izvestiâ Akademii Nauk Tadžikskoj SSR*, *Otdelenie Biologičeskih Nauk* **3**(32): 62–68 (in Russian, with a summary in Tajik).
Ševčík M. 2023: *Príspevky k taxonómii*, *biogeografii*, *ekológii a patogénom parazitov* (*Diptera*, *Acari*) *netopierov Starého sveta* [*Contributions to Taxonomy*, *Biogeography*, *Ecology and Pathogens of Parasites* (*Diptera*, *Acari*) *of the Old World Bats*]. Unpubl. PhD Thesis. Praha: Faculty of Science, Charles University, 166 pp (in Slovak).
Ševčík M., Benda P. & Lučan R. K. 2013: Diptera Pupipara from bats of two large eastern Mediterranean islands, Crete and Cyprus. *Turkish Journal of Zoology* **37**: 31–37.
Ševčík M., Kalúz S. & Šrámek P. 2021: A new species of Chiroptella Vercammen-Grandjean, 1960 (Acari: Trombiculidae) from diadem leaf-nosed bat Hipposideros diadema (Geoffroy) (Chiroptera: Hipposideridae) in Bali Island (Indonesia) with distribution records, hosts, and a key to the species of this genus. *Systematic Parasitology* **98**: 1–15.
Ševčík M., Špitalská E., Maliterná M., Kabát P. & Benda P. 2024: First records of Secretargas transgariepinus (Argasidae) in Libya and Jordan: corrections of collection records and detection of microorganisms. *Parasitology Research* **123**(223): 1–10.
Sěvercov″ N. A. 1873a: Вертикальное и горизонтальное распредѣление туркестанскихъ животныхъ [Vertical and horizontal distribution of the Turkestan animals]. *Izvěstiâ Imperatorskago Obŝestva Lûbitelej Estestvoznanìâ*, *Antropologìi i Ètnografìi* **8**(2): 1–136 (in Russian).
Sěvercov″ N. A. 1873b: *Путешествія по Туркестанскому Краю и изслѣдованіе горной страны Тянъ-Шаня*, *совершенныя по порученію Императорскаго Русскаго Географическаго Общества* [*Travels to the Turkestan Province and Researches in the Mountainous Country of Tian-Shan*, *Carried out on the Behest of the Imperial Russian Geographical Society*]. S.-Peterburg″: Tipografiâ K. V. Truvnikova, vi+462 pp (in Russian).
Sěvercov″ N. A. 1878: Экспедиція на Алай и Памиръ [Expedition to the Alay and Pamirs]. *Turkestanskìâ Vědomosti* **1878**(8): 30–31; (9): 34; (14): 49–50 (in Russian).
Sěvercov″ N. A. 1879a: Замѣтки о фауне позвоночныхъ Памира [Notes on the vertebrate fauna of the Pamirs]. *Zapiski Turkestanskago Otdela Imperatorskago Obŝestva Lûbitelej Estesvoznanìâ*, *Antropologìi i Ètnografìi* **1**: 58–89 (in Russian).
Sěvercov″ N. A. 1879b: Краткій отчет о Памирскихъ изслѣдованіяхъ и общихъ научныхъ результатахъ Ферганской Ученой Экспедиціи [Brief review of the Pamir researches and general scientific results of the Farg‘ona Scientific Expedition]. *Izvěstiâ Imperatorskago Russkago Geografičeskago Obŝestva* **15**: 66–78 (in Russian).
Severtzoff N. 1876: The mammals of Turkestan. *Annals and Magazine of Natural History*, *Fourth Series* **18**: 40–57.
Shah T. A. & Srinivasulu C. 2020: Echolocation calls of some bats of Gujarat, India. *Mammalia* **84**: 483–492.
Shalmon B., Kofyan T. & Hadad E. 1993: [*A Field Guide to the Land Mammals of Israel. Their Tracks and Signs*]. Jerusalem: Kater Publishing House, 216 pp (in Hebrew, with a subtitle in English).

Shatrov A. B. & Kudryashova N. I. 2006: Taxonomy, life cycles and the origin of parasitism in trombiculid mites. Pp. 119–140. In: Morand S., Krasnov B. R. & Poulin R. (eds.): *Micromammals and Macroparasites*. *From Evolutionary Ecology to Management*. Tokyo: Springer, xv+647 pp.

Shi L.-M., Feng J., Liu Y., Ye G.-X. & Zhu X. 2009: Is food resource partitioning responsible for deviation of echolocation call frequencies from allometry in Rhinolophus macrotis? *Acta Theriologica* **54**: 371–382.

Shi H., Dong J., Irwin D. M., Zhang S. & Mao X. 2016: Repetitive transpositions of mitochondrial DNA sequences to the nucleus during the radiation of horseshoe bats (Rhinolophus, Chiroptera). *Gene* **581**: 161–169.

Shulov A. 1957: Additions to the fauna of Acarina of Israel (excluding ticks and gall mites). *Bulletin of the Research Council of Israel* **6B**: 233–238.

Simmons N. B. 2005: Order Chiroptera. Pp. 312–529. In: Wilson D. E. & Reeder D. M. (eds.): *Mammal Species of the World*. *A Taxonomic and Geographic Reference*. *Third Edition*. *Volume 1*. Baltimore: The John Hopkins University Press, xxxviii+743 pp.

Sinha Y. P. 1973: Taxonomic studies on the Indian horseshoe bats of the genus Rhinolophus Lacepede. *Mammalia* **37**: 603–630.

Šluger E. G. & Amanguliev A. A. 1972: Новые виды подсемейства Trombiculinae Ewing, 1929 (Acariformes, Trombiculidae) [New species of the subfamily Trombiculinae Ewing, 1929 (Acariformes, Trombiculidae)]. *Izvestiâ Akademii Nauk Turkmenskoj SSR*, *Seriâ Biologičeskih Nauk* **2**: 42–50 (in Russian, with a summary in English).

Šluger E. G. & Kudrâšova N. I. 1969: Новые и впервые обнаруженые в СССР виды краснотелок (Acariformes, Trombiculidae) [New and for the first time found in the USSR species of chigger mites (Acariformes, Trombiculidae)]. *Parazitologiâ* **3**: 115–122 (in Russian, with a summary in English).

Smirnov D. G., Vehnik V. P. & Džamirzoev G. S. 2020: О таксономическом статусе «азиатских» широкоушек (Chiroptera: Vespertilionidae: Barbastella) на восточном Кавказе [On the taxonomic status of "Asian" barbastelles (Chiroptera: Vespertilionidae: Barbastella) in the eastern Caucasus]. *Plecotus et al*. **23**: 3–12 (in Russian, with a summary in English).

Smirnov D. G., Habilov T. K. & Tadžibaeva D. È. 2021: Моделирование потенционального распространения Barbastella walteri (Barbastella: Chiroptera, Vespertilionidae) в среднеазиатском регионе на основе биоклиматических данных [Modelling of the potential distribution range of Barbastella walteri (Barbastella: Chiroptera, Vespertilionidae) in the region of Central Asia based on bioclimatic data]. *Aridnye Èkosistemy* **27**(3): 52–60 (in Russian).

Smirnov D. G., Džamirzoev G. S. & Bykov Û. A.. 2022a: Сравнительная характеристика эхолокационных сигналов трех видов подковоносов (Chiroptera, Rhinolophidae) Восточного Кавказа (Дагестан) [Comparative characteristics of the echolocation calls in three species of horseshoe bats (Chiroptera, Rhinolophidae) of the eastern Caucasus (Daghestan)]. *Izvestiâ Vysših Učebnyh Zavedenij*, *Povolžskij Region*, *Estestvennye Nauki* **2**: 36–48 (in Russian, with an abstract in English).

Smirnov D. G., Džamirzoev G. S. & Bykov Û. A. 2022b: Myotis emarginatus (Vespertilionidae, Myotinae) в Дагестане [Myotis emarginatus (Vespertilionidae, Myotinae) in Daghestan]. *Plecotus et al*. **25**: 7–28 (in Russian, with a summary in English).

Smirnov D. G., Džamirzoev G. S., Bykov Û. A. & Vehnik V. P. 2022c: Новые находки редких видов рукокрылых (Chiroptera) на восточном Кавказе (Дагестан) [New findings of rare species of bats (Chiroptera) in the eastern Caucasus (Daghestan)]. *Zoologičeskij Žurnal* **101**: 1061–1071 (in Russian, with a summary in English).

Smirnow P. 1925: Die neuen russische Stipa-Pennata-Arten. *Repertorium Specierum Novarum Regni Vegetabilis* **21**: 231–235.

Smit P. G. A. M. 1955: Description of the male sex of the bat-flea Nycteridopsylla dictena (Kolenati). *Entomologische Berichten* **15**(17): 383–386.

Smit F. G. A. M. 1960: Contribution à l'étude de la faune d'Afghanistan 26. Siphonaptera – fleas. *Entomologische Berichten* **20**: 146–153.

Smit F. G. A. M. & Rosický B. 1973: Siphonaptera from Hindu Kush. *Folia Parasitologica* (*Praha*) **20**: 235–253.

Snit′ko V. P. & Snit′ko L. V. 2019: Новые данные о распространению нетопыря Куля Pipistrellus kuhlii (Chiroptera: Vespertilionidae) в Предуралье и на южном Урале [New data on the distribution of Kuhl's bat Pipistrellus kuhlii (Chiroptera: Vespertilionidae) in the Cis-Urals and the southern Urals]. *Bûlleten Moskovskogo Obšestva Ispytatelej Prirody*, *Otdel Biologičeskij* **124**(2): 16–19 (in Russian, with a summary in English).

Soisook P., Bumrungsri S., Satasook C., Thong V. D., Bu S. S. H., Harrison D. L. & Bates P. J. J., 2008: A taxonomic review of Rhinolophus stheno and R. malayanus (Chiroptera: Rhinolophidae) from continental Southeast Asia: an evaluation of echolocation call frequency in discriminating between cryptic species. *Acta Chiropterologica* **10**: 221–242.

Soisook P., Karapan S., Srikrachang M., Dejtaradol A., Nualcharoen K., Bumrungsri S., Oo S. S. L., Aung M. M., Bates P. J. J., Harutyunyan M., Buś M. M. & Bogdanowicz W. 2016: Hill forest dweller: a new cryptic species of Rhinolophus in the 'pusillus group' (Chiroptera: Rhinolophidae) from Thailand and Lao PDR. *Acta Chiropterologica* **18**: 117–139.

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. *Zoologica Scripta* **35**: 187–230.

Šrámek J., Gvoždík V. & Benda P. 2013: Hidden diversity in bent-winged bats (Chiroptera: Miniopteridae) of the Western Palaearctic and adjacent regions: implications for taxonomy. *Zoological Journal of the Linnean Society* **167**: 165–190.

Srinivasulu C. & Srinivasulu B. 2012: *South Asian Mammals*. *Their Diversity*, *Distribuion*, *and Status*. New York: Springer Science & Bussines Media, xi+467 pp.

Srinivasulu C., Racey P. A. & Mistry S. 2010: A key to the bats (Mammalia: Chiroptera) of South Asia. *Journal of Threatened Taxa* **2**: 1001–1076.

Srinivasulu C., Srinivasulu A., Srinivasulu B., Gopi A., Dar T. H., Bates P. J. J., Rossiter S. J. & Jones G. 2017: Recent surveys of bats from the Andaman Islands, India: diversity, distribution, and echolocation characteristics. *Acta Chiropterologica* **19**: 419–437.

Stadelmann B., Herrera L. R., Arroyo-Cabrales J., Flores-Martínez J. J., May B. P. & Ruedi M. 2004: Molecular systematics of the fishing bat Myotis (Pizonyx) vivesi. *Journal of Mammalogy* **85**: 133–139.

Stanûkovič M. K. 1990: Гамазовые и аргазовые клещи рукокрылых Прибалтики и Ленинградской области [Gamasoid mites and argasid ticks of bats from the Baltic states and Leningrad Province]. *Parasitologiâ* **24**: 193–199 (in Russian, with a summary in English).

Stanûkovič M. K. & Malinovskij K. Û. 1992: Гамазовые и аргасовые клещи рукокрылых (Chiroptera) Таджикистана. Предварительное сообщение [Gamasid mites and Argasid ticks of bats (Chiroptera) of Tajikistan. Preliminary report]. *Doklady Akademii Nauk Respubliki Tadžikistan* **35**: 68–71 (in Russian, with a summary in Tajik).

Stanyukovich M. K. 1997: Keys to the gamasid mites (Acari, Parasitiformes, Mesostigmata, Macronyssoidea et Laelaptoidea) parasitizing bats (Mammalia, Chiroptera) from Russia and adjacent countries. *Rudolstädter Naturhistorische Schriften* **7**: 13–46.

Steiner H. M. & Gaisler J. 1994: On a collection of bats (Chiroptera) from NE Turkey and N Iran. *Acta Scientiarum Naturalium Academiae Scientiarum Bohemicae Brno*, *n.s*. **28**(1): 1–37.

Stekolnikov A. A., Quetglas J., Ibáñez C. & Sánchez-Navarro S. 2022: Contribution to the fauna of chiggers (Acariformes: Trombiculidae) parasitizing bats in Spain. *Acarologia* **62**: 1201–1209.

Strelkov P. P. 1963: II. Отряд Chiroptera – рукокрылые [II. Order Chiroptera – bats]. Pp. 122–218. In: Sokolov I. I. (ed.): *Млекопитющие фауны СССР. Часть 1* [*Mammals of the Fauna of the Soviet Union*. *Part 1*]. Moskva & Leningrad: Izdatel′stvo Akademii Nauk SSSR, 640 pp (in Russian).

Strelkov P. P. 1971: Большие (Rhinolophus ferrumequinum) и бухарские (Rh. bocharicus) подковоносы (Chiroptera) из пустыни Каракумы [The greater horseshoe bat (Rhinolophus ferrumequinum) and Central Asian horseshoe bat (Rh. bocharicus) from the Karakumy Desert (Chiroptera)]. *Zoologičeskij Žurnal* **50**: 893–907 (in Russian, with a summary in English).

Strelkov P. P. 1972: Остроухие ночницы; распространение, географическая изменчивость, отличия от больших ночниц [Lesser mouse-eared bats; distribution, geographical variability and differences from the greater mouse-eared bats]. *Acta Theriologica* **17**: 355–380 (in Russian, with an abstract in English).

Strelkov P. P. 1973: Нетопыр средиземноморский (Pipistrellus kuhlii Natterer, 1819) в Средней Азии [Kuhl's pipistrelle (Pipistrellus kuhli Natterer, 1819) in West Turkestan]. *Vestnik Zoologii* **7**(2): 82–85 (in Russian, with a summary in English).

Strelkov P. P. 1980: Летучие мыши (Chiroptera, Vespertilionidae) Центрального и Западного Казахстана [Bats (Chiroptera, Vespertilionidae) of central and western Kazakhstan]. *Trudy Zoologičeskogo Instituta* [Leningrad] **99**: 99–123 (in Russian).

Strelkov P. P. 1981: Отряд Chiroptera Blumenbach, 1779 – рукокрылые [Order Chiroptera Blumenbach, 1779 – Bats]. Pp. 31–53. In: Gromov I. M. & Baranova G. I. (eds.): *Каталог млекопитающих СССР*. *Плиоцен–современность* [*Catalogue of Mammals of the Soviet Union*. *Pliocene–Recent*]. Leningrad: Nauka, 456 pp (in Russian).

Strelkov P. P. 1983a: Места находок Myotis brandti Eversmann, 1845 и Myotis mystacinus Kuhl, 1819 (Chiroptera, Vespertilionidae) по материалам музеев СССР [Record sites of Myotis brandti Eversmann, 1845 and Myotis mystacinus Kuhl, 1819 (Chiroptera: Vespertilionidae) based on the museum collections in the Soviet Union]. *Trudy Zoologičeskogo Instituta* [Leningrad] **119**: 38–42 (in Russian).

Strelkov P. P. 1983b: Усатая ночница (Myotis mystacinus) и ночница Брандта (Myotis brandti) в СССР и взаимоотношения этих видов. Сообщение 2 [Whiskered bat (Myotis mystacinus) and Brandt's bat (Myotis brandti) in the Soviet Union and relations between these species. Part 2]. *Zoologičeskij Žurnal* **62**: 259–270 (in Russian, with a summary in English).

Strelkov P. P. 1983c: Анализ распространения рукокрылых (Chiroptera) фауны Казахстана [An analysis of distribution of bats (Chiroptera) of the fauna of Kazakhstan]. *Trudy Zoologičeskogo Instituta* [Leningrad] **119**: 139–150 (in Russian).

Strelkov P. P. 1986: Гобийский кожанок (Eptesicus gobiensis Bobrinskoy, 1926) – новый вид рукокрылых фауны Палеарктики [The Gobi serotine (Eptesicus gobiensis Bobrinskoj, 1926) – a new bat species in the fauna of the Palaearctic]. *Zoologičeskij Žurnal* **65**: 1103–1108 (in Russian, with a summary in English).
Strelkov P. P. 1988: Бурый (Plecotus auritus) и серый (P. austriacus) ушаны (Chiroptera, Vespertilionidae) в СССР. Сообщение 1 [The brown (Plecotus auritus) and grey (P. austriacus) long-eared bats (Chiroptera, Vespertilionidae) in the Soviet Union. Part 1]. *Zoologičeskij Žurnal* **67**: 90–101 (in Russian, with a summary in English).
Strelkov P. P. & Šajmardanov R. T. 1983: Новые данные о распространении летучих мышей (Chiroptera) в Казахстане [New data on the distribution of bats (Chiroptera) in Kazakhstan]. *Trudy Zoologičeskogo Instituta* [Leningrad] **119**: 3–36 (in Russian).
Strelkov P. P. & Sosnovceva V. P. 1994: Новые данные о рукокрылых (Chiroptera) пустыни Каракум [New data on bats (Chiroptera) of the Karakum Desert]. *Zoologičeskij Žurnal* **73**: 140–142.
Strelkov P. P., Sosnovceva V. P. & Babaev H. B. 1978: Летучие мыши (Chiroptera) Туркмении [The bats (Chiroptera) of Turkmenistan]. *Trudy Zoologičeskogo Instituta Akademii Nauk SSSR* [Leningrad] **79**: 3–71 (in Russian, with a subtitle in English).
Strelkov P. P., Unkurova V. I. & Medvedeva G. A. 1985: Новые данные о нетопыре Куля (Pipistrellus kuhlii) и динамике его ареала в СССР [New data on Kuhl pipistrelle (Pipistrellus kuhlii) and on dynamics of its range in the Soviet Union]. *Zoologičeskij Žurnal* **64**: 87–97 (in Russian, with a summary in English).
Stubbe M. & Chotolchu N. 1968: Zur Säugetierfauna der Mongolei. Ergebnisse der Mongolisch-Deutschen Biologischen Expeditionen seit 1962, Nr. 30. *Mitteilungen aus dem Zoologischen Museum Berlin* **44**: 5–121.
Sun K.-P., Feng J., Jiang T.-L., Ma J., Zhang Z.-Z. & Jin L.-R. 2008: A new cryptic species of Rhinolophus macrotis (Chiroptera: Rhinolophidae) from Jiangxi Province, China. *Acta Chiropterologica* **10**: 1–10.
Sun K., Kimball R. T., Liu T., Wei X., Jin L., Jiang T., Lin A. & Feng J. 2016: The complex evolutionary history of big-eared horseshoe bats (Rhinolophus macrotis complex): insights from genetic, morphological and acoustic data. *Scientific Reports* **6**(35417): 1–12.
Swan D. C. 1936: Berlese's fluid: remarks upon its preparation and use as a mounting medium. *Bulletin of Entomological Research* **27**: 389–391.
Szentiványi T., Takács N., Sándor A. D., Péter Á., Boldogh S. A., Kováts D., Foster J. T., Estók P. & Hornok S. 2024: Bat-associated ticks as a potential link for vector-borne pathogen transmission between bats and other animals. *Public Library of Science Neglected Tropical Diseases* **18**(10; e0012584): 1–13.
Tadžibaeva D. È. 2015: О численности азиатской широкоушки Barbastella leucomelas Cretzschmar, 1826 в предгорях Туркестанского хребта [On the abundance of the eastern barbastelle Barbastella leucomelas Cretzschmar, 1826 in the foothills of the Turkiston Mountains]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **33**: 64–67 (in Russian, with a summary in English).
Tadžibaeva D. È. 2018: Рукокрылые северного склона Туркестанского хребта (Северный Таджикистан) [Bats of the northern slope of the Turkiston Mountains (northern Tajikistan)]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **46**: 42–45 (in Russian, with summaries in Tajik and English).
Tadžibaeva D. È. & Habilov T. K. 2016a: Новая находка белобрюхого стрелоуха (Otonycteris leucophaea Severcov, 1873) в Таджикистане [New record of the Turkestani long-eared bat (Otonycteris leucophaea Severcov, 1873) in Tajikistan]. Pp. 106–107. In: Âkubova M. M. (ed): *Материалы Республиканской научной конференции* «*Состояние биологических ресурсов горных регионов в связи с изменением климата*", *посвящённой 75-летию Памирского ботанического сада и 100-летию экспедиции академика Н. И. Вавилова*. *29–31 июля 2016 г.*, *Хорог* [*Proceedings of the National Scientific Conference* "*Status of Biological Resources of Mountainous Regions in the Relation to Climate Change*", *devoted to the 75th anniversary of the Pamir Botanical Garden and 100th anniversary of the N. I. Vavilov Expedition*. *29–31 July 2016*, *Horog*]. Dušanbe: Doniš, ix+193 pp (in Russian).
Tadžibaeva D. È. & Habilov T. K. 2016b: Первая находка остроухой ночницы Myotis blythii на зимовке в Таджикистане [First record of the lesser mouse-eared bat Myotis blythii in a hibernaculum in Tajikistan]. *Plecotus et al*. **19**: 63–65 (in Russian, with a summary in English).
Tadžibaeva D. È. & Habilov T. K. 2016c: Новая находка колонии зимующих больших (Rhinolophus ferrumequinum Schreb. 1774) и бухарских (Rhinolophus bocharicus Kast. et Akim. 1917) подковоносов на Кураминском хребте [New finding of a wintering colony of the greater horseshoe bat (Rhinolophus ferrumequinum Schreb. 1774) and Central Asian horseshoe bat (Rhinolophus bocharicus Kast. et Akim. 1917) in the Kurama Mountains]. P. 97. In: Anonymous (ed.): *Актуальные вопросы современной зоологии и экологии животных*. *Материалы Всероссийской научной конференции*, *посвященной 70-летнему юбилею кафедры* «*Зоология и экология*» *Пензенского государственного университета и памяти порфесора В. П. Денисова* (*1932–1997*). *г. Пенза*, *15–18 ноября 2016 г*. [*Current Questions in the Contemporary Zoology and Animal Ecology*. *Proceedings of the Pan-Russian Scientific Conference*, *devoted to the 70th anniversary of the Department of Zoology and Ecology of the Penza State University and to the memory of Professor V. P. Denisov* (*1932 –1997*). *Penza*, *15–18 November 2016*]. Penza: Izdatel′stvo PGU, 118 pp (in Russian).

Tadžibaeva D. È. & Habilov T. K. 2016d: О летнем спаривании остроухой ночницы в Таджикистане [On the mating behaviour in the lesser mouse-eared bats in Tajikistan during summer]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **37**: 46–47 (in Russian, with summary in English).

Tadžibaeva D. È. & Habilov T. K. 2017a: О летучих мышах долины реки Зеравшан в Таджикистане [About bats of the Zeravšan river valley in Tajikistan]. *Plecotus et al*. **20**: 3–16 (in Russian, with a summary in English).

Tadžibaeva D. È. & Habilov T. K. 2017b: Новая находка колонии зимующих больших (Rhinolophus ferrumequinum Schreb., 1774) и бухарских (Rhinolophus bocharicus Kast. et Akim., 1917) подковоносов на Кураминском хребте в Таджикистане [New findings of a colony of the hibernating greater horseshoe bats (Rhinolophus ferrumequinum Schreb., 1774) and Central Asian horseshoe bats (Rhinolophus bocharicus Kast. et Akim., 1917) in the Kurama Mountains in Tajikistan]. *Uzvestiâ Vyssih Učebnyh Zavedenij, Povolžskij Region*, *Estestvennye Nauki*, *Biologiâ* **17**: 33–28 (in Russian, with an abstract in English).

Tadžibaeva D. È. & Habilov T. K. 2017c: О размножении некоторых видов рукокрылых (Chiroptera) в Таджикистане [About reproduction of some species of bats (Chiroptera) in Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **43**: 26–30 (in Russian, with summaries in Tajik and English).

Tadžibaeva D. È. & Habilov T. K. 2018: Рукокрылые южного склона Кураминского хребта (Северный Таджикисти) [Bats of the southern slope of the Kurama Mountains (northern Tajikistan)]. *Vestnik Tûmenskogo Gosudarstvennogo Universiteta*, *Èkologiâ i Prirodopol'zovanie* **4**(3): 125–138 (in Russian, with a summary in English).

Tadžibaeva D. È. & Habilov T. K. 2019a: О фауне рукокрылых гор Могол-Тау [On the bat fauna of the Mogoltau Mountains]. *Plecotus et al*. **22**: 80–87 (in Russian, with a summary in English).

Tadžibaeva D. È. & Habilov T. K. 2019b: О летучих мышах города Душанбе и его окресностей [About bats of the city of Dušanbe and its surroundings]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **49**: 41–48 (in Russian, with summaries in Tajik and English).

Tadžibaeva D. È. & Habilov T. K. 2019c: О некоторых результатах отлова летуйчих мышей паутинными сетями в Северном Таджикистане [About some results of bat capturing to the mist-nets in northern Tajikistan]. Pp. 97–98. In: Saidov A. S. (ed.): *Материалы VIII-ой Международной конференции* «*Экологические особенности биологического разнообразия*» (*Таджикистан*, *г. Худжанд*, *3–4 октября 2019 г.*) [*Proceedings of the VIIIth International Conference* "*Ekological Specificities of Biodiversity*" (*Tajikistan*, *Hudžand*, *3–4 October 2019*)]. Dušanbe: Doniš & Akademiâ Nauk Respubliki Tadžikistan, 246 pp (in Russian).

Tadžibaeva D. È. & Habilov T. K. 2019d: Видовый состав рукокрылых (Chiroptera) Зеравшанской долины (Таджикистан) [Species diversity of bats (Chiroptera) of the Zaravšon valley (Tajikistan)]. Pp. 209–210. In: Tembotova F. A. (ed.): *Горные экосистемы и их компоненты*. *Материалы VII Всероссийской конференции с международным участием*, *посвященной 30-летию научной школы чл.-корр. РАН А. К. Темботова и 25-летию Института экологии горных территорий им. А. К. Темботова РАН* (*г. Нальчик*, *15–20 сентября 2019 г.*) [*Montane Ecosystems and Their Components*. *Proceedings of the VIIth Pan-Russian Conference with International Participation*, *Devoted to the 30th Anniversary of the Scientific School of the Member-Correspondent of the RAS A. K. Tembotov and 25th Anniversary of the A. K. Tembotov Institute of Ecology of the Montane Territories of the RAS* (*Nal'čik*, *15–20 September 2019*)]. Mahačkala: ALEF, 264 pp (in Russian).

Tadžibaeva D. È. & Habilov T. K. 2019e: Оценка видового разнообразия рукокрылых в предгорьях Туркестанского хребта [An assessment of the species diversity of bats in the foothills of the Turkiston Mountains]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **50**: 68–70 (in Russian, with summaries in Tajik and English).

Tadžibaeva D. È. & Habilov T. K. 2021: Малоизученые виды рукокрылых Таджикистана [Less studied bat species of Tajikistan]. P. 120. In: Anonymous (ed.): «*Горные экосистемы и их компоненты*». *Материалы VIII Всероссийской конференции с международным участием*, *посвященной Году науки и технологий в Российской Федерации* ["*Montane Ecosystems and Their Components*". *Proceedings of the VIIIth Pan-Russian Conference with International Participation*, *Devoted to the Year of Science and Technology in the Russian Federation*]. Nal′čik: Institut èkologii gornyh territorij im. A. K. Tembotova RAN, 158 pp (in Russian).

Tadžibaeva D. È. & Habilov T. K. 2022: О двух видах рукокрылых (Chiroptera), рекомендуемых в Красную книгу Республики Таджикистан [On two species of bats (Chiroptera) recommended for the inclusion into the Red Data Book of the Republic of Tajikistan]. *Učënye Zapiski*, *Seriâ Estestvennye i Èkonomičeskie Nauki* [Hudžand] **62**: 71–74 (in Russian, with summaries in Tajik and English).

Tagil′cev A. A. 1970: О жизненных схемах клещей и насекомых, связанных с летучими мышами на территории Советского союза [On the life schemes of ticks and insects, associated with bats on the territory of the Soviet Union]. *Parazitologiâ* **4**: 283–287 (in Russian, with a summary in English).

Tagil′cev A. A. 1971: О членистоногих, собраных с ночниц в Зайсанской котловине [On the arthropods collected from mouse-eared bats in the Zajsan Basin]. *Parazitologiâ* **5**: 382–384 (in Russian).

Tate G. H. H. 1941a: Results of the Archbold Expeditions. No. 39. A review of the genus Myotis (Chiroptera) of Eurasia, with special reference to species occurring in the East Indies. *Bulletin of the American Museum of Natural History* **78**: 537–565.

Tate G. H. H. 1941b: Results of the Archbold Expeditions. No. 40. Notes on Vespertilionid bats of the subfamilies Miniopterinae, Murininae, Kerivoulinae, and Nyctophylinae. *Bulletin of the American Museum of Natural History* **78**: 567–597.
Tate G. H. H. 1942: Results of the Archbold Expeditions. No. 47. Review of the Vespertilioninae bats, with special attention to genera and species of the Archbold collections. *Bulletin of the American Museum of Natural History* **80**: 221–297.
Taylor P. J. 2019: 107. European free-tailed bat Tadarida teniotis. Pp. 664–665. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World. 9. Bats*. Barcelona: Lynx Editions, 1008 pp.
Temminck C. J. 1840: *Monographies de Mammalogie*, *ou description de quelques genres de mammifères*, *dont les espèces ont été observées dans les différens musées de l'Europe*. *Tome second*. *Treizième monographie sur les cheiroptères vespertilionides*. Leiden & Paris: Van der Hoek & Ed. d'Ocagne et A. Bertrand, 141–272 pp.
Teng K. F. 1980: Notes on the genus Steatonyssus in China (Acarina: Macronyssidae). *Acta Zootaxonomica Sinica* **5**: 59–62.
Theodor O. 1954: 66a. Nycteribiidae. Pp.: 1–44. In: Lindner E. (ed.): *Die Fliegen der Paläarktischen Region. Lieferung 174*. Stuttgart: E. Schweitzerbart'sche Verlagsbuchhandlung (Erwin Nägele), 126 pp.
Theodor O. 1966: Über neue Nycteribiiden-Arten aus der Mongolei. Ergebnisse der Mongolisch-Deutschen Biologischen Expeditionen seit 1962, Nr. 13. *Mitteilungen aus dem Zoologischen Museum in Berlin* **42**: 197–210.
Theodor O. 1967: *An Illustrated Catalogue of the Rothschild Collection of Nycteribiidae* (*Diptera*) *in the British Museum* (*Natural History*)*.* London: Trustees of the British Musem (Natural History), viii+506+5 pp.
Thomas O. 1905: On a collection of mammals from Persia and Armenia presented to the British Museum by Col. A. C. Bailward. *Proceedings of the Zoological Society of London* **1905**(2): 519–527.
Thomas O. 1909: On mammals collected in Turkestan by Mr. Douglas Carruthers. *Annals and Magazine of Natural History*, *Eight Series* **3**: 257–266.
Thomas O. 1926: A new long-eared bat from Central Asia. *Annals and Magazine of Natural History*, *Nineth Series* **18**: 306–308.
de Thuemen T. 1880: Fungi aliquot novi in terra kirghisorum (Imperii Rossici) a Iuliano Schell lecti. *Nuovo Giornale Botanico Italiano* **12**: 196–199.
Tihomirov″ A. A. & Korčagin″ A. N. 1889: Списки и описаніе предметовъ находящихся въ Зоологическомъ музеѣ Императорскаго Московскаго Университета. Отдѣлъ четвертый. Списки и описаніе коллекціи млекопитающихъ музея. № 1-й [Catalogue and description of the objects housed in the Zoological Museum of the Imperial Moscow Univeristy. Fourth part. Catalogue and description of the collection of mammals of the Museum. No. 1]. *Izvěstiâ Imperatorskago Obŝestva Lûbitelej Estestvoznaniâ*, *Antropologìi i Ètnografii* **56**(4): i–ii+1–31 (in Russian).
Till M. W. & Evans O. G. 1964: The genus Steatonyssus Kolenati (Acari: Mesostigmata). *Bulletin of the British Museum* (*Natural History*), *Zoology* **11**: 511–582.
Topál G. 1971: The taxonomic position of Myotis dobsoni (Trouessart, 1879), and some statistical data to the subspecific examination of Myotis blythi (Tomes, 1857). *Annales Historico-naturales Musei Nationalis Hungarici*, *Pars Zoologica* **63**: 383–400.
Topál G. 1975: Bacula of some Old World leaf-nosed bats (Rhinolophidae and Hipposideridae, Chiroptera: Mammalia). *Vertebrata Hungarica* **16**: 21–53.
Travassos Santos Dias J. A. 1961: Contribuicao ao estudo da fauna do Afghanistao. 30. Ixodoidea. *Memórias e Estudos do Museu Zoológico da Universidade de Coimbra* **267**: 1–18.
Trifinopoulos J., Nguyen L.-T., von Haeseler A. & Minh B. Q. 2016: W-IQTREE: a fast online phylogenetic tool for maximum likelihood analysis. *Nucleic Acids Research* **44**: W232–W235.
Tsytsulina K. A. 2000: Geographical variation in Myotis mystacinus-group (Mammalia: Chiroptera, Vespertilionidae). *Trudy Zoologičeskogo Instituta* [Sankt-Peterburg] **286**: 163–168.
Tsytsulina K. & Masuda R. 2004: Molecular phylogeny of whiskered bats (Myotis, Vespertilionidae, Chiroptera) in Palaearctic region. Pp. 85–89. In: Mawatari S. F. & Okada H. (eds.): *Neo-Science of Natural History*: *Integration of Geoscience and Biodiversity Studies*. *Proceedings of International Symposium on* "*Dawn of a New Natural History – Integration of Geoscience and Biodiversity Studies*". *March 5–6*, *2004*, *Sapporo*. Sapporo: Gradiuate School of Science, Hokkaido University, 184 pp.
Tsytsulina K. & Strelkov P. P. 2001: Taxonomy of the Myotis frater species group (Vespertilionidae, Chiroptera). *Bonner Zoologische Beiträge* **50**: 15–26.
Tsytsulina K., Dick M. H., Maeda K. & Masuda R. 2012: Systematics and phylogeography of the steppe whiskered bat Myotis aurascens Kuzyakin, 1935 (Chiroptera, Vespertilioidae). *Russian Journal of Theriology* **11**: 1–20.
Tu V. T., Hassanin A., Görföl T., Arai S., Fukui D., Thanh H. T., Son N. T., Furey N. M. & Csorba G. 2017: Integrative taxonomy of the Rhinolophus macrotis complex (Chiroptera, Rhinolophidae) in Vietnam and nearby regions. *Journal of Zoological Systematics and Evolutionary Research* **55**: 177–198.
Tu V. T., Hassanin A., Furey N. M., Son N. T. & Csorba G. 2018: Four species in one: multigene analyses reveal phylogenetic patterns within Hardwicke's wooly bat, Kerivoula hardwickii-complex (Chiroptera, Vespertilionidae) in Asia. *Hystrix*, *n.s*. **29**: 111–121.

Turk F. A. & Turk S. M. 1952: Studies of Acari. 7th series. Records and descriptions of mites new to the British fauna, together with short notes on the biology of sundry species. *Annals and Magazine of Natural History*, *Twelfth Series* **5**: 475–506.
Uchikawa K. & Dusbábek F. 1978: Studies on mesostigmatid mites parasitic on mammals and birds in Japan. VIII. Bat mites of the genus Eyndhovenia Rudnick, 1960, with redescription of Eyndhovenia euryalis euryalis (Canestrini, 1884). *Bulletin of the National Science Museum Tokyo*, *Series A*, *Zoology* **4**: 245–261.
Uchikawa K. & Wada Y. 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). *Japanese Journal of Sanitary Zoology* **30**: 121–125.
Uchikawa K., Zhang M.-Y., O'Connor B. M. & Klompen H. 1994: Contribution to the taxonomy of the genus Spinturnix (Acari: Spinturnicidae), with the erection of a new genus, Emballonuria. *Folia Parasitologica* (*Praha*) **41**: 287–304.
Uhrin M., Gazaryan S. & Benda P. 2009: Does Tadarida teniotis really occur in Crimea? (Chiroptera: Molossidae). *Lynx*, *n.s.* **40**: 115–126.
Usinger R. 1966: *Monograph of Cimicidae* (*Hemiptera-Heteroptera*). The Thomas Say Foundation, Vol. 7. Baltimore, xi+585 pp.
Uvizl M. & Benda P. 2021a: Intraspecific variation of Myotis emarginatus (Chiroptera: Vespertilionidae) inferred from mitochondrial and nuclear genetic markers. *Acta Chiropterologica* **23**: 285–300.
Uvizl M. & Benda P. 2021b: Diversity and distribution of the Myotis nattereri complex (Chiroptera: Vespertilionidae) in the Middle East: filling the gaps. *Mammalian Biology* **101**: 963–977.
Uvizl M., Kotyková Varadínová Z. & Benda P. 2024: Phylogenetic relationships among horseshoe bats within the Rhinolophus ferrumequinum group (Mammalia: Chiroptera). *Zoologica Scripta* **53**: 249–266.
Van Bree P. J. H. & Dulić B. 1963: Notes on some specimens of the genus Plecotus Geoffroy, 1818 (Mammalia, Chiroptera) from the Netherlands. *Beaufortia* **10**: 7–18.
Vercammen-Grandjean P. H. & Langston L. R. 1976: *The Chigger Mites of the World*. *Volume III*. *Leptotrombidium complex*. San Francisco: George Williams Hooper Foundation, University of California, 1061 pp.
Vermeil C. 1961: Rhinolophopsylla unipectinata arabs Jordan et Rothschild 1921 siphonaptère noveau pour la Tunisie. *Annales de Parasitologie Humaine et Comparée* **36**: 168.
Vinogradov B. S. 1935: Отряд Chiroptera – рукокрылые [Order Chiroptera – bats]. Pp. 262–273. In: Pavlovskij E. N. (ed.): Звери Таджикистана, их жизнь и значение для человека [Mammals of Tajikistan, their life and significance for man]. *Trudy Tadžikistanskoj Bazy*, *Akademiâ Nauk Soûza SSR*, *Zoologiâ i Parazitologiâ* **1**: 1–273 (in Russian).
Volleth M. 1987: Differences in the location of nucleolus organizer regions in European vespertilionid bats. *Cytogenetics and Cell Genetics* **44**: 186–197.
Vaughan N., Jones G. & Harris S. 1997: Identification of British bat species by multivariate analysis of echolocation call parameters. *Bioacoustics* **7**: 189–207.
Wagner J. A. 1855: *Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen von Dr. Johann Christian Daniel von Schreber*. *Supplementband*. *Fünfte Abtheilung*: *Die Affen*, *Zahnlücker*, *Beutelthiere*, *Hufthiere*, *Insektenfresser und Handflügler*. Leipzig: Verlag von T. O. Weigel, xxvi+910 pp.
Wallin L. 1969: The Japanese bat fauna. A comparative study of chorology, species diversity and ecological differentiation. *Zoologiska Bidrag från Uppsala* **37**: 223–440.
Wang W., Tian J.-H., Chen X., Hu R.-X., Lin X.-D., Pei Y.-Y., Lv J.-X., Zheng J.-J., Dai F.-H., Song Z.-G., Chen Y.-M. & Zhang Y.-Z. 2022: Coronaviruses in wild animals sampled in and around Wuhan at the beginning of COVID-19 emergence. *Virus Evolution* **8**(1): 1–10.
Wei L., Zhou S.-Y., Zhang L.-B., Liang B., Hong T.-Y. & Zhang S.-Y. 2006: [Characteristics of echolocation calls and summer diet of three sympatric insectivorous bats species]. *Zoological Research* **27**: 235–241 (in Chinese, with an abstract in English).
Weyeneth N., Goodman S. M., Stanley W. T. & Ruedi M., 2008: The biogeography of Miniopterus bats (Chiroptera: Miniopteridae) from the Comoro Archipelago inferred from mitochondrial DNA. *Molecular Ecology* **17**: 5205–5219.
Wilson D. E. 2008: Order Chiroptera – Bats. Pp. 327–387. In: Smith A. T. & Xie Y. (eds.): *A Guide to the Mammals of China*. Princeton & Oxford: Princeton University Press, xxvi+544 pp.
Wu H., Jiang T.-L., Müller R. & Feng J. 2015: The allometry of echolocation call frequencies in horseshoe bats: nasal capsule and pinna size are the better predictors than forearm length. *Journal of Zoology*, *London* **297**: 211–219.
Wu Z., Han Y., Wang Y., Liu B., Zhao L., Zhang J., Su H., Zhao W., Liu L., Bai S., Dong J., Sun L., Zhu Y., Zhou S., Song Y., Sui H., Yang J., Wang J., Zhang S., Qian Z. & Jin Q. 2023: A comprehensive survey of bat sarbecoviruses across China in relation to the origins of SARS-CoV and SARS-CoV-2. *National Science Review* **10**(nwac:213): 1–14.
Yoshino H., Matsumura S., Kinjo K., Tamura H., Ota H. & Izawa M. 2006: Geographical variation in echolocation call and body size of the Okinawan least horseshoe bat, Rhinolophus pumilus (Mammalia: Rhinolophidae), on Okinawa-jima Island, Ryukyu Archipelago, Japan. *Zoological Science* **23**: 661–667.
Young S., Carr A. & Jones G. 2018: CCTV enables the discovery of new barbastelle (Barbastella barbastellus) vocalisations and activity patterns near a roost. *Acta Chiropterologica* **20**: 263–272.

Yusefi G. H., Faizolahi K., Darvish J., Safi K. & Brito J. C. 2019: The species diversity, distribution, and conservation status of the terrestrial mammals of Iran. *Journal of Mammalogy* **100**: 55–71.
Zajkowska P. & Mąkol J. 2021: Parasitism, seasonality, and diversity of trombiculid mites (Trombidiformes: Parasitengona, Trombiculidae) infesting bats (Chiroptera) in Poland. *Experimental and Applied Acarology* **86**: 1–20.
Zajkowska P., Moniuszko H. & Mąkol J. 2018: Host-parasite associations between bats (Mammalia: Chiroptera) and chiggers (Trombidiformes: Trombiculidae) – a review and checklist. *Annales Zoologici* **68**: 97–178.
Zajkowska P., Postawa T. & Mąkol J. 2024: Contribution to the knowledge of bat-associated chigger mite, Oudemansidium komareki (Actinotrichida: Trombiculidae) with notes on other members of the genus in western Palaearctic. *Annales Zoologici* **74**: 225–236.
Zarei A., Ashrafi S. & Shabani A. A. 2022: Examining the molecular phylogeny of the Egyptian barbastelle (Barbastella leucomelas) based on the mitochondrial COI gene: a new report from Iran. *Taxonomy and Biosystematics Journal* **13**(4): 28–42 (in Farsi, with an abstract in English).
Zbinden K. & Zingg P. E. 1986: Search and hunting signals of echolocating European free-tailed bats, Tadarida teniotis, in southern Switzerland. *Mammalia* **50**: 9–25.
Zhang J.-S., Han N.-J., Jones G., Lin L.-K., Zhang J.-P., Zhu G.-J., Huang D.-W. & Zhang S.-Y. 2007: A new species of Barbastella (Chiroptera: Vespertilionidae) from north China. *Journal of Mammalogy* **88**: 1393–1403.
Zhang L., Jones G., Zhang J., Zhu G., Parsons S., Rossiter S. J. & Zhang S. 2009: Recent surveys of bats (Mammalia: Chiroptera) from China. I. Rhinolophidae and Hipposideridae. *Acta Chiropterologica* **11**: 71–88.
Zhang L., Sun K., Liu T., Zhao H., Csorba G., Jin L., Thong V. D. & Feng J. 2018: Multilocus phylogeny and species delimitation within the philippinensis group (Chiroptera: Rhinolophidae). *Zoologica Scripta* **47**: 655–672.
Zhigalin A. 2019: New data on David's myotis, Myotis davidii (Peters, 1869) (Mammalia, Chiroptera, Vespertilionidae), in Siberia and the Urals. *Biodversity Data Journal* **7**(e34211): 1–12.
Zima J. 2004: Karyotypic variation in mammals of the Balkan Peninsula. Pp. 109–133. In: Griffiths H. I., Kryštufek B. & Reed J. M. (eds.): *Balkan Biodiversity*. *Pattern and Process in the European Hotspot*. Dordrecht: Kluwer Academic Press, 357 pp.
Zima J., Červený J., Horáček I., Červená A., Průcha K., Macholán M. & Rybin S. N. 1991: Standard karyology of eighteen species of bats (Rhinolophidae, Vespertilionidae, Molossidae) from Eurasia. *Myotis* **29**: 31–33.
Zima J., Volleth M., Horáček I., Červený J., Červená A., Průcha K. & Macholán M. 1992a: Comparative karyology of rhinolophid bats (Chiroptera: Rhinolophidae). Pp. 229–236. In: Horáček I. & Vohralík V. (eds.): *Prague Studies in Mammalogy*. Praha: Charles University Press, 246 pp.
Zima J., Volleth M., Horáček I., Červený J. & Macholán M. 1992b: Karyotypes of two species of bats, Otonycteris hemprichi and Pipistrellus tramatus (Chiroptera, Vespertilionidae). Pp. 237–242. In: Horáček I. & Vohralík V. (eds.): *Prague Studies in Mammalogy*. Praha: Charles University Press, 246 pp.
Zingg P. E. 1988: Search calls of echolocating Nyctalus leisleri and Pipistrellus savii (Mammalia: Chiroptera) recorded in Switzerland. *Zeitschrift für Säugetierkunde* **53**: 281–293.
Žumarov M. A. 2014: Современное состояние биоразнообразия млекопитающих разных экосистем южного Приаралья [Current status of the mammal biodiversity of various ecosystems in the southern part of the Aral Sea region]. *Estestvennye i Matematičeskie Nauki v Sovremennom Mire* [Novosibirsk] **2014**(24): 1–9 (in Russian).

APPENDIX I
Gazetteer

locality	Tajik script	coordinates	altitude [m a. s. l.]
5–6 km upstream of Pançakent	Панҷакент	39°29’N, 67°41’E	1041
6 km W of Ḩisor	Ҳисор	38°32’N, 68°30’E	806
10 km Honako, Naçi	Хонако, Наҷи	39°33’N, 67°32’E	1307
70 km Huçand–Istaravšan	Хуҷанд–Истаравшан	39°59’N, 69°01’E	832
8 km of Dušanbe, Guliston	Душанбе, Гулистон	38°32’N, 68°52’E	781
Adrasmon	Адрасмон	40°39’N, 69°59’E	1608
Agaravak	Агаравак	37°59’N, 68°34’E	915
Âhčisor	Яхчисор	38°03’N, 70°22’E	1015
Ajnī	Айнӣ	39°24’N, 68°32’E	1434
Ajvaç	Айваҷ	36°59’N, 68°02’E	323
Aktau Mts.	Актау	ca. 37°53’N, 68°25’E	1895
Aktau Mts., Ok-Bulak pass	Актау, Ок-Булак	37°58’N, 68°28’E	2027
Amondara	Амондара	39°31’N, 67°49’E	1134
Amondara and Majkatta, between	Амондара, Майкатта	39°31’N, 67°48’E	1143
Anzob	Анзоб	39°10’N, 68°49’E	2096
Ar Arak cave, Kalkot	Ар Арак, Калкот	38°14’N, 69°15’E	1486
Aruktau Mts.	Аруктау	ca. 37°47’N, 68°32’E	1300
Âšilkūl	Яшилкӯл	37°45’N, 72°53’E	3723
Babatag Mts.	Бабатаг	ca. 37°53’N, 68°09’E	1200
Bağu	Бағу	37°59’N, 71°42’E	2044
Bahorak	Бахорак	37°37’N, 69°52’E	597
Barušon	Барушон	37°56’N, 71°27’E	1995
Bešai Palangon Reserve, Tarzan forestry	Бешаи Паланғон, Тарзан	37°21’N, 68°28’E	330
Beškatan canyon	Бешкатан	ca. 40°23’N, 69°35’E	500
Boği bolo	Боғи боло	40°16’N, 69°29’E	467
Bohtar	Бохтар	37°50’N, 68°47’E	424
Bohtar, Vahš farm	Бохтар, Вахш	37°53’N, 68°48’E	436
Bulok, Qaḩramon	Булок, Қаҳрамон	40°36’N, 70°27’E	464
Būston	Бӯстон	40°31’N, 69°21’E	610
Čašme	Чашме	40°20’N, 69°38’E	543
Çilau	Чилау	39°21’N, 67°44’E	1935
Čilduhtaron	Чилдухтарон	38°19’N, 70°10’E	1917
Çilikūl	Чиликӯл	37°29’N, 68°32’E	354
Çilikūl District, Kalinin farm	Чиликӯл, Калинин	37°29’N, 68°38’E	396
Činor (= Sohta-činar)	Чинор, Сохта-Чинар	38°22’N, 68°29’E	665
Činor, Ḩulbuk District	Чинор, Ҳулбук	37°48’N, 69°38’E	474
Čolota	Чолота	40°39’N, 69°30’E	903
Čorkuḩ, Hučai-Gor cave	Чоркуҳ, Хучаи-Гор	39°58’N, 70°35’E	1145
Čoruh-Dajron	Чорух-Дайрон	40°24’N, 69°40’E	610
Čužali	Чужали	38°14’N, 68°24’E	636
Daḩana, Danğara District	Даҳана, Данғара	38°23’N, 69°18’E	682
Dahana, Guzlon range, mines	Дахана, Гузлон	40°12’N, 70°50’E	935
Dahana, Guzlon range, orchard	Дахана, Гузлон	40°12’N, 70°51’E	806
Dahana, Kurama Mts.	Дахана, Курама	40°39’N, 70°17’E	774
Daḩanakiik	Даҳанакиик	38°12’N, 68°39’E	795
Danğara District, Daḩana	Данғара, Даҳана	38°23’N, 69°18’E	682
Danğara tunnel, Hoça Šaqiqi Balhi	Данғара, Хоҷа Шақиқи Балхи	38°17’N, 69°18’E	932
Danğara, Gulizindon	Данғара, Гулизиндон	38°13’N, 69°24’E	1348
Darband	Дарбанд	38°52’N, 69°58’E	1252
Dar-Dar	Дар-Дар	39°26’N, 68°27’E	1416
Darvoz, Obgard	Дарвоз, Обгард	38°05’N, 70°25’E	1046
Dusti	Дусти	37°21’N, 68°41’E	390

locality	Tajik script	coordinates	altitude [m a. s. l.]
Dusti, Panç river	Дусти, Панҷ	37°17’N, 68°41’E	335
Dušanbe, downtown	Душанбе	38°34’N, 68°48’E	816
Džilikul′, 12 km S, Staraâ Pristan′	Джиликуль, Старая Пристань	37°25’N, 68°29’E	332
Ëged	Ёгед	38°21’N, 70°37’E	1215
Ërgī	Ёрӣ	39°31’N, 67°52’E	1282
Ëvonsu, Gurgon	Ёвонсу, Гургон	38°21’N, 69°04’E	730
Fajzobod	Файзобод	38°33’N, 69°19’E	1211
Gançina, valley	Ганҷина	37°55’N, 68°41’E	405
Gançina, village	Ганҷина	37°59’N, 68°34’E	747
Ğaribak	Ғарибак	39°32’N, 67°36’E	1037
Garmčašma	Гармчашма	37°12’N, 71°33’E	2604
Ğončī	Ғончӣ	39°58’N, 69°08’E	912
Gudos	Гудос	40°49’N, 70°29’E	1264
Guliston (= Kajrakkum)	Гулистон, Кайраккум	40°16’N, 69°48’E	351
Guliston, 8 km of Dušanbe	Гулистон, Душанбе	38°32’N, 68°52’E	781
Gulizindon, Danğara,	Гулизиндон, Данғара	38°13’N, 69°24’E	1348
Gurgon, Ëvonsu	Гургон, Ёвонсу	38°21’N, 69°04’E	730
Ğusğarf	Ғусғарф	38°44’N, 68°48’E	1186
Guzlon range, Dahana, mines	Гузлон, Дахана	40°12’N, 70°50’E	935
Guzlon range, Dahana, orchard	Гузлон, Дахана	40°12’N, 70°51’E	806
Ḩisor	Ҳисор	38°29’N, 68°36’E	738
Ḩisor, 6 km W of	Ҳисор	38°32’N, 68°30’E	806
Hoça Šaqiqi Balhi, Danğara tunnel	Хоҷа Шақиқи Балхи, Данғара	38°17’N, 69°18’E	932
Hodža-Beh-Ob pass	Ходжа-Бех-Об	38°02’N, 68°29’E	1912
Horuğ	Хоруғ	37°29’N, 71°35’E	2103
Host, Obihumbou river valley	Хост, Обихумбоу	38°33’N, 70°50’E	1691
Huçand	Хуҷанд	40°17’N, 69°37’E	341
Huçand–Istaravšan, 70 km	Хуҷанд–Истаравшан	39°59’N, 69°01’E	832
Hučai-Gor cave, Čorkuḩ	Хучаи-Гор, Чоркуҳ	39°58’N, 70°35’E	1145
Ḩulbuk District, Činor	Ҳулбук, Чинор	37°48’N, 69°38’E	474
Isfara	Исфара	40°07’N, 70°37’E	829
Isfara waste dump	Исфара	40°11’N, 70°38’E	865
Iskandarkūl	Искандаркӯл	39°05’N, 68°22’E	2192
Istaravšan	Истарафшан	39°54’N, 69°00’E	1003
Istiqlol	Истиқлол	40°34’N, 69°38’E	1248
Kajrakkum (= Guliston)	Кайраккум, Гулистон	40°16’N, 69°48’E	351
Kalinin farm, Çilikūl District	Калинин, Чиликӯл	37°29’N, 68°38’E	396
Kalkot, rocks	Калкот	38°15’N, 69°15’E	1382
Kalkot, Ar Arak cave	Калкот, Ар Арак	38°14’N, 69°15’E	1486
Kalkot, small lake	Калкот	38°14’N, 69°15’E	1282
Kalpisipar cave, Sariselom	Калписипар, Сариселом	38°07’N, 70°28’E	1168
Kansaj	Кансай	40°30’N, 69°42’E	921
Kim	Ким	40°13’N, 70°28’E	866
Kokkurak	Коккурак	40°31’N, 70°26’E	358
Kondara	Кондара	38°49’N, 68°49’E	1197
Konibodom	Конибодом	40°18’N, 70°26’E	408
Kštut	Кштут	39°27’N, 68°03’E	1175
Kuktoš	Куктош	39°29’N, 67°38’E	1008
Kūlkand	Кӯлканд	40°11’N, 70°41’E	948
Kūlob, botanical garden	Кӯлоб	37°56’N, 69°49’E	647
Kulpista	Кулписта	38°39’N, 68°48’E	1057
Kurama Mts., Dahana	Курама, Дахана	40°39’N, 70°17’E	774
Kurkat	Куркат	40°08’N, 69°16’E	441
Kūštegirmon	Кӯштегирмон	40°12’N, 69°18’E	334
Langar	Ланғар	40°03’N, 69°19’E	598

locality	Tajik script	coordinates	altitude [m a. s. l.]
Levap	Левап	37°26’N, 68°30’E	340
Lučob, garden	Лучоб	38°37’N, 68°46’E	883
Magov, mine	Магов	38°42’N, 69°06’E	1587
Magov, garden	Магов	38°41’N, 69°06’E	1445
Majkatta	Майката	39°32’N, 67°46’E	1083
Majkatta and Amondara, between	Майката, Амондара	39°31’N, 67°48’E	1143
Maskav	Маскав	37°39’N, 69°44’E	687
Meḫtar	Меҳтар	40°03’N, 69°18’E	586
Mingdona	Мингдона	39°29’N, 67°57’E	1189
Mount Ḩoça Mū″min, Qarağoč	Ҳоҷа Мӯъмин, Қарағоч	37°44’N, 69°40’E	897
Muk, Pëtri Âkim Mountains	Мук, Пётри Яким	39°09’N, 71°34’E	2212
Naçi, 10 km Honako	Наҷи, Хонако	39°33’N, 67°32’E	1307
Navobod	Навобод	39°27’N, 67°55’E	1173
Nodž canyon	Нодж	38°35’N, 68°29’E	972
Obgard, Darvoz	Обгард, Дарвоз	38°05’N, 70°25’E	1046
Obiašt	Обиашт	40°52’N, 70°28’E	1556
Ok-Bulak pass, Aktau Mts.	Ок-Булак, Актау	37°58’N, 68°28’E	2027
old road to Qo‘qon	Қо‘қон	40°13’N, 70°51’E	748
Osëbdara	Осёбдара	39°11’N, 70°45’E	1870
Padrud	Падруд	39°10’N, 67°50’E	1848
Palos	Палос	40°19’N, 69°44’E	352
Panç	Панҷ	37°14’N, 69°06’E	367
Panç river, Dusti	Панҷ	37°17’N, 68°41’E	335
Pançakent	Панҷакент	39°30’N, 67°37’E	995
Pançakent, 5–6 km upstream of	Панҷакент	39°29’N, 67°41’E	1041
Pançi Poën	Панҷи Поён	37°13’N, 68°35’E	379
Pançrud	Панҷруд	39°21’N, 68°04’E	2250
Pangaz	Пангаз	40°45’N, 70°16’E	1393
Pëtri Âkim Mountains, Muk	Пётри Яким, Мук	39°09’N, 71°34’E	2212
Poj Bulok, Zarnisor	Пой Блок, Зарнисор	40°38’N, 69°36’E	1240
Puthin	Путхин	39°24’N, 68°39’E	1717
Qaḫramon, Bulok	Қаҳрамон, Булок	40°36’N, 70°27’E	464
Qal″ai Humb	Қалъаи Хумб	38°27’N, 70°47’E	1260
Qarağoč, Mount Ḩoça Mū″min	Қарағоч, Хоҷа Мӯъмин	37°44’N, 69°40’E	897
Qarakčiqum	Қаракчикум	40°15’N, 70°04’E	369
Qaratoğ	Қаратоғ	38°37’N, 68°20’E	903
Qo‘qon, old road	Қо‘қон	40°13’N, 70°51’E	748
Rašnai Poën	Рашнаи Поён	39°14’N, 67°48’E	1541
Remon	Ремон	39°13’N, 68°40’E	2302
Romit	Ромит	38°44’N, 69°19’E	1197
Rovadin	Ровадин	39°18’N, 67°52’E	2027
Rūmon	Рӯмон	40°18’N, 69°40’E	336
Rūšon	Рӯшон	37°57’N, 71°34’E	2001
Šaḫritus and Vaḫš, between	Шаҳритус, Вахш	37°16’N, 68°15’E	873
Sangiston	Сангистон	39°24’N, 68°35’E	1482
Sari Hosor Reserve	Сари Хосор	38°32’N, 69°50’E	1454
Sariselom, Kalpisipar cave	Сариселом, Калписипар	38°07’N, 70°28’E	1168
Sindev	Синдев	37°11’N, 71°58’E	2953
Šing	Шинг	39°16’N, 67°48’E	1381
Širg, mine	Ширг	38°29’N, 70°48’E	1353
Šitharv	Ширхарв	36°52’N, 72°05’E	2798
Sohta-činar (= Činor)	Сохта-чинар (= Чинор)	38°22’N, 68°29’E	665
Somğor	Сомғор	40°20’N, 69°51’E	428
Somonien	Сомониен	38°27’N, 68°46’E	741
Staraâ Pristan′, 12 km S of Džilikul′	Старая Пристань, Джиликуль	37°25’N, 68°29’E	332

locality	Tajik script	coordinates	altitude [m a. s. l.]
Šululu	Шулулу	37°51’N, 69°48’E	777
Šurab	Шураб	40°03’N, 70°32’E	1253
Surh	Сурх	40°00’N, 70°36’E	1052
Taǧoâk	Таѓояк	40°07’N, 69°19’E	471
Tagob	Тагоб	38°50’N, 68°54’E	1447
Takeli	Такели	40°29’N, 69°26’E	502
Tarzan forestry, Bešai Palangon Reserve	Тарзан, Бешаи Палангон	37°21’N, 68°28’E	330
Tavildara	Тавилдара	38°42’N, 70°29’E	1613
Teharv	Техарв	38°32’N, 71°41’E	2048
Tomin	Томин	39°23’N, 68°38’E	1495
Tuto	Туто	37°55’N, 69°52’E	856
Uâli	Уяли	37°59’N, 68°42’E	417
Učteppa	Учтеппа	40°17’N, 69°31’E	497
Vaǧašton	Ваѓаштон	39°18’N, 67°48’E	1356
Vaḥdat	Вахдат	39°13’N, 71°12’E	1853
Vahš and Šaḥritus, between	Вахш, Шахритус	37°16’N, 68°15’E	873
Varzob	Варзоб	38°46’N, 68°49’E	1108
Viloâti Hatlon pass	Вилояти Хатлон	38°21’N, 68°43’E	1239
Volč′e canyon	Волчье	40°29’N, 70°15’E	407
Voruh	Ворух	39°51’N, 70°36’E	1508
Zafarobod	Зафаробод	40°10’N, 68°51’E	414
Zarafšon	Зарафшон	39°10’N, 68°38’E	2279
Zarafšon, Pançakent	Зарафшон, Панчакент	39°30’N, 67°37’E	995
Zarnisor	Зарнисор	40°38’N, 69°36’E	1280–2000
Zarnisor, Poj Bulok	Зарнисор, Пой Булок	40°38’N, 69°36’E	1240
Zasun	Засун	39°23’N, 68°37’E	1561
Ziddī	Зиддӣ	39°02’N, 68°49’E	2039
Zigar	Зигар	38°06’N, 70°27’E	1077
Zingroǧ	Зингроғ	38°27’N, 70°49’E	1265

APPENDIX II

GenBank Accession Numbers

species	GenBank Accession No.	country	reference
Rhinolophus cornutus	DQ297594	Japan	Li et al. 2006
Rhinolophus episcopus	MG560943	China	Zhang et al. 2018
Rhinolophus episcopus	MN077575	China	Liu et al. 2019
Rhinolophus episcopus	MN077580	China	Liu et al. 2019
Rhinolophus hipposideros	OP895197	Iran	Benda et al. 2022
Rhinolophus hipposideros	OP895198	Iran	Benda et al. 2022
Rhinolophus hipposideros	OP895199	Iran	Benda et al. 2022
Rhinolophus hipposideros	KC978707	Tajikistan	Dool et al. 2013
Rhinolophus hipposideros	KC978708	Tajikistan	Dool et al. 2013
Rhinolophus hipposideros	OP895226	Tajikistan	Benda et al. 2022: NMP 95742
Rhinolophus lepidus	MT640147	India	Chattopadhyay et al. 2021
Rhinolophus lepidus	MT640148	India	Chattopadhyay et al. 2022
Rhinolophus lepidus	MT640149	India	Chattopadhyay et al. 2023
Rhinolophus lepidus	MT640153	India	Chattopadhyay et al. 2024
Rhinolophus lepidus	MT640154	India	Chattopadhyay et al. 2025
Rhinolophus lepidus	MT640156	India	Chattopadhyay et al. 2026
Rhinolophus lepidus	MT640157	India	Chattopadhyay et al. 2027
Rhinolophus lepidus	MT640158	India	Chattopadhyay et al. 2028
Rhinolophus lepidus	MT640159	India	Chattopadhyay et al. 2029
Rhinolophus lepidus	MT640161	India	Chattopadhyay et al. 2030
Rhinolophus lepidus	MT640163	India	Chattopadhyay et al. 2031
Rhinolophus lepidus	MT640164	India	Chattopadhyay et al. 2032
Rhinolophus lepidus	MT640166	India	Chattopadhyay et al. 2033
Rhinolophus lepidus	MT640167	India	Chattopadhyay et al. 2034
Rhinolophus lepidus	MT640168	India	Chattopadhyay et al. 2035
Rhinolophus lepidus	MT640169	India	Chattopadhyay et al. 2036
Rhinolophus lepidus	MT640170	India	Chattopadhyay et al. 2037
Rhinolophus lepidus	MT640171	India	Chattopadhyay et al. 2038
Rhinolophus lepidus	MT640172	India	Chattopadhyay et al. 2039
Rhinolophus kirghisorum sp. nov.	PQ635176	Kirghizstan	this study: 218K [Kolodec Fersmana]
Rhinolophus kirghisorum sp. nov.	PQ635177	Kirghizstan	this study: 307K [Kolodec Fersmana]
Rhinolophus kirghisorum sp. nov.	PQ635178	Kirghizstan	this study: 308K [Kolodec Fersmana]
Rhinolophus kirghisorum sp. nov.	PQ635179	Kirghizstan	this study: 388K [Aškana]
Rhinolophus kirghisorum sp. nov.	PQ635180	Tajikistan	this study: NMP 95762
Rhinolophus kirghisorum sp. nov.	PQ635180	Tajikistan	this study: NMP 95764
Rhinolophus kirghisorum sp. nov.	PQ635180	Tajikistan	this study: NMP 95765
Rhinolophus kirghisorum sp. nov.	PQ635181	Kirghizstan	this study: NMP 98081
Rhinolophus kirghisorum sp. nov.	PQ635182	Kirghizstan	this study: NMP 98082
Rhinolophus kirghisorum sp. nov.	PQ635182	Kirghizstan	this study: NMP 98083
Rhinolophus kirghisorum sp. nov.	PQ635182	Kirghizstan	this study: NMP 98084
Rhinolophus macrotis	MN077654	Nepal	Liu et al. 2019
Rhinolophus macrotis	MN077657	Nepal	Liu et al. 2019
Rhinolophus malayanus	ON640701	China	Wu et al. 2023
Rhinolophus malayanus	KX099343	Burma	Soisook et al. 2016
Rhinolophus marshalli	MG560954	China	Zhang et al. 2018
Rhinolophus marshalli	MG560959	China	Zhang et al. 2018
Rhinolophus marshalli	MG560953	Vietnam	Zhang et al. 2018
Rhinolophus midas	OP895218	Oman	Benda et al. 2022
Rhinolophus midas	OP895219	Oman	Benda et al. 2022
Rhinolophus midas	OP895220	Oman	Benda et al. 2022
Rhinolophus monoceros	DQ297581	Taiwan	Li et al. 2006
Rhinolophus monticolus	KX099335	Thailand	Soisook et al. 2016
Rhinolophus monticolus	KX099336	Thailand	Soisook et al. 2016

species	GenBank Accession No.	country	reference
Rhinolophus osgoodi	MF630876	China	Huang et al. 2018
Rhinolophus osgoodi	MN077583	China	Liu et al. 2019
Rhinolophus osgoodi	MN077594	China	Liu et al. 2019
Rhinolophus osgoodi	MN077606	China	Liu et al. 2019
Rhinolophus osgoodi	MN077607	China	Liu et al. 2019
Rhinolophus osgoodi	MN077623	China	Liu et al. 2019
Rhinolophus perditus	AY141039	Japan	Tian et al. unpubl.
Rhinolophus pumilus	AB061526	Japan	Nikaido et al. 2001
Rhinolophus pusillus	DQ297574	China	Li et al. 2006
Rhinolophus pusillus	DQ297577	China	Li et al. 2006
Rhinolophus pusillus	DQ297597	China	Li et al. 2006
Rhinolophus pusillus	KR346912	China	Shi et al. 2016
Rhinolophus pusillus	MF630877	China	Huang et al. 2018
Rhinolophus pusillus	MF630878	China	Huang et al. 2018
Rhinolophus pusillus	ON012504	China	Wang et al. 2022
Rhinolophus pusillus	ON012505	China	Wang et al. 2022
Rhinolophus pusillus	ON640707	China	Wu et al. 2023
Rhinolophus pusillus	ON640708	China	Wu et al. 2023
Rhinolophus rex	MG560912	China	Zhang et al. 2018
Rhinolophus rex	MG560924	China	Zhang et al. 2018
Rhinolophus rex	MG560925	China	Zhang et al. 2018
Rhinolophus shortridgei	KX099351	Burma	Soisook et al. 2016
Rhinolophus shortridgei	KX099352	Burma	Soisook et al. 2016
Rhinolophus siamensis	MN077582	China	Liu et al. 2019
Rhinolophus siamensis	MN077605	China	Liu et al. 2019
Rhinolophus siamensis	MN077621	China	Liu et al. 2019
Rhinolophus siamensis	MN077622	China	Liu et al. 2019
Rhinolophus siamensis	MN077639	China	Liu et al. 2019
Rhinolophus siamensis	ON640698	China	Wu et al. 2023
Rhinolophus siamensis	ON640699	China	Wu et al. 2023
Rhinolophus siamensis	ON640710	China	Wu et al. 2023
Pipistrellus pipistrellus	PQ635183	Tajikistan	this study: HSU pb6147
Pipistrellus pipistrellus	PQ635190	Tajikistan	this study: HSU pb6148
Pipistrellus pipistrellus	PQ635184	Tajikistan	this study: NMP 95705
Pipistrellus pipistrellus	PQ635185	Tajikistan	this study: NMP 95706
Pipistrellus pipistrellus	PQ635186	Tajikistan	this study: HSU pb6180
Pipistrellus pipistrellus	PQ635187	Tajikistan	this study: NMP 95721
Pipistrellus pipistrellus	PQ635188	Tajikistan	this study: NMP 95722
Pipistrellus pipistrellus	PQ635185	Tajikistan	this study: HSU pb6187
Pipistrellus pipistrellus	PQ635189	Tajikistan	this study: HSU pb6188
Pipistrellus pipistrellus	PQ635190	Tajikistan	this study: NMP 95726
Pipistrellus pipistrellus	PQ635191	Tajikistan	this study: NMP 95727
Pipistrellus pipistrellus	AY426095	Kazakhstan	Hulva et al. 2004
Pipistrellus pipistrellus	EU084886	Iran	Hulva et al. 2007
Pipistrellus pipistrellus	EU084887	Iran	Hulva et al. 2007
Pipistrellus pipistrellus	KF874512	Iran	Benda et al. 2012
Pipistrellus pipistrellus	KF874513	Iran	Benda et al. 2012
Pipistrellus pipistrellus	KF874517	Iran	Benda et al. 2012
Pipistrellus pipistrellus	KF874518	Iran	Benda et al. 2012
Pipistrellus pipistrellus	KF874520	Iran	Benda et al. 2012
Pipistrellus pipistrellus	KF874521	Iran	Benda et al. 2012
Pipistrellus pipistrellus	JN087548	Jordan	Benda et al. 2010a
Pipistrellus pipistrellus	JN087549	Jordan	Benda et al. 2010a
Pipistrellus pipistrellus	JN087550	Jordan	Benda et al. 2010a
Pipistrellus pipistrellus	EU084888	Lebanon	Hulva et al. 2007

species	GenBank Accession No.	country	reference
Pipistrellus pipistrellus	EU084889	Lebanon	Hulva et al. 2007
Pipistrellus pipistrellus	KF218399	Turkey	Çoraman et al. 2013
Pipistrellus pipistrellus	KF218402	Turkey	Çoraman et al. 2013
Pipistrellus pipistrellus	EU084891	Cyprus	Hulva et al. 2007
Pipistrellus pipistrellus	AY316337	Syria	Benda et al. 2003b
Pipistrellus pipistrellus	AY316336	Syria	Benda et al. 2003b
Pipistrellus pipistrellus	AY426096	Syria	Benda et al. 2003b
Pipistrellus pipistrellus	AJ504443	Greece	Stadelmann et al. 2004
Pipistrellus pipistrellus	AY663801	Switzerland	Benda et al. 2004
Pipistrellus pipistrellus	AY426097	Russia	Hulva et al. 2004
Pipistrellus pipistrellus	AY663800	France	Benda et al. 2004
Pipistrellus pipistrellus	AY582293	Spain	Hulva et al. 2004
Pipistrellus pipistrellus	AY582292	Spain	Hulva et al. 2004
Pipistrellus pipistrellus	AY316343	Czech Republic	Hulva et al. 2004
Pipistrellus pipistrellus	AY316340	Czech Republic	Hulva et al. 2004
Pipistrellus pipistrellus	AY426098	Slovakia	Hulva et al. 2004
Pipistrellus pipistrellus	AY582291	Bulgaria	Hulva et al. 2004
Pipistrellus pipistrellus	OQ939664	Belgium	Horemans et al. unpubl.
Pipistrellus pipistrellus	DQ120851	Spain	Ibáñez et al. 2006
Pipistrellus pipistrellus	DQ120853	Spain	Ibáñez et al. 2006
Pipistrellus pipistrellus	AY426093	Morocco	Hulva et al. 2004
Pipistrellus pipistrellus	AY426094	Morocco	Hulva et al. 2004
Pipistrellus pipistrellus	AY582283	Morocco	Hulva et al. 2004
Pipistrellus pipistrellus	AY582285	Morocco	Hulva et al. 2004
Pipistrellus pipistrellus	EU084885	Italy, Sicily	Hulva et al. 2007
Pipistrellus pipistrellus	EU420890	France: Corsica	Hulva et al. 2007
Pipistrellus pipistrellus	EU420891	France: Corsica	Hulva et al. 2007
Pipistrellus pipistrellus	EU420892	France: Corsica	Hulva et al. 2007
Pipistrellus pygmaeus	EU084882	Iran	Hulva et al. 2007
Pipistrellus pygmaeus	AY316321	Iran	Hulva et al. 2007
Pipistrellus pygmaeus	AJ504441	Greece	Stadelmann et al. 2004
Pipistrellus pygmaeus	AY582282	Spain	Hulva et al. 2004
Pipistrellus pygmaeus	AY663797	Switzerland	Benda et al. 2004
Pipistrellus pygmaeus	AY426087	Turkey	Benda et al. 2003b
Pipistrellus pygmaeus	AJ504442	Cyprus	Stadelmann et al. 2004
Pipistrellus pygmaeus	EU084883	Cyprus	Hulva et al. 2007
Pipistrellus pygmaeus	EU084884	Cyprus	Hulva et al. 2007
Pipistrellus hanaki	AY316333	Libya	Benda et al. 2004
Pipistrellus hanaki	AY426091	Libya	Benda et al. 2004
Pipistrellus hanaki	EF370417	Greece: Crete	Hulva et al. 2007