

## Short note

# Helminth infections of urban hibernating *Nyctalus noctula* groups (Chiroptera, Vespertilionidae) in Belarus

Vladimir V. SHIMALOV<sup>1</sup>, Viktor T. DEMYANCHIK<sup>2</sup>,  
Viktor V. DEMYANCHIK<sup>2</sup>

<sup>1</sup>Brest State University, Boulevard of Cosmonauts 21, 224665 Brest, Belarus

<sup>2</sup>The Polesie Agrarian Ecological Institute of the NAS of Belarus, Sovetskikh Pogranichnikov street 41, 224030 Brest, Belarus

Corresponding Author: Vladimir V. Shimalov; e-mail: shimalov@rambler.ru

**ABSTRACT.** The city of Brest is one of the places in southwestern Belarus where common noctules *Nyctalus noctula* (Schreber, 1774) spend the winter. The aim of the study is to investigate the helminth infection of urban hibernating groups of this species of bats. The bat carcasses were subjected to a post-mortem examination. Organs and tissues compression was used to examine 26 of common noctules three groups that died in Brest city during the hibernation period from causes beyond our control. All of the examined common noctules were infected with helminths. Eight species of helminths were found: 4 species of trematodes, 1 species of cestode and 3 species of nematodes. Six species were localized in the intestine, 1 species in the stomach and larvae of 1 species in the wall of the stomach. More often, the common noctule was infected with the nematode *Molinostrongylus skrjabini* Skarbilovich, 1934 (92.3%), the trematodes *Paralecithodendrium chilostomum* (Mehlis, 1831) (88.5%), *Lecithodendrium linstowi* Dollfus, 1931 (84.6%) and *Plagiorchis koreanus* Ogata, 1938 (84.6%). The finding represents the first record of the trematode *P. koreanus* in bats in Belarus. The results further represent the first record of *N. noctula* as host for larvae of nematode *Physaloptera myotis* (Babos, 1954) in Belarus.

**Keywords:** parasite biodiversity, common noctule, *Nyctalus noctula*, urban ecology, Brest city, Belarus

## Introduction

The common noctule *Nyctalus noctula* (Schreber, 1774) is a widespread species of migratory bats in Europe. Until the end of the 20th century, the hibernation range of this bat species began 0.7–0.9 km south and west of the borders of Belarus [1–3]. After 1999, regular hibernations of the common noctule were established in the extreme southwest of Belarus and adjacent regions of Poland and Ukraine [1,4–6]. In 2019–2021 the largest hibernation colonies of the common noctule in Belarus were identified in Brest. Helminth infections of common noctules were studied in various European countries, for example, in Belarus [7–10], Bulgaria [11], Hungary [12], Moldova [13–18], Poland [19–24], Romania [25], Ukraine [26–29]. To date, no helminthological study of representative batches of the common noctule in the state of hibernation in

Belarus and neighboring regions of other countries has been carried out. The aim of the study is to investigate the helminth infection of hibernating groups of this species of bats in Brest, South-West Belarus.

## Materials and Methods

The search and monitoring of hibernating groups (colonies) of chiropterans in different regions of Belarus has been carried out by the authors since the early 1990s. During the monitoring of the largest migratory groups (Brest, Belarus) of the common noctule, a significant number of individuals died in the third decade of March 2022. A part of the individuals (a total 26 bats were examined: 19 males and 7 females) that died on March 15 and 16, 2022 during hibernation in Brest from the three largest groups of the common noctule (these groups were

combined to complete the infection picture) were examined by complete helminthological autopsy according to Skrjabin [30]. All common noctules were well preserved and were suitable for helminthological study. Used some identification keys of the trematodes and cestodes [31,32], monographs [29,33], and articles [13–23,27–29,34].

## Results and Discussion

The total rate of helminth infection of the 26 common noctules was 100%. Eight species of helminths were found in the analyzed common noctules. Four trematode species, one cestode species and three nematode species were among them. These species are: *Lecithodendrium linstowi* Dollfus, 1931; *Paralecithodendrium chilostomum* (Mehlis, 1831) [(=*Prosthodendrium chilostomum* (Mehlis)=*Prosthodendrium (Prosthodendrium) chilostomum* (Mehlis, 1831)], *Parabascus semisquamosus* (Braun, 1900), *Plagiorchis koreanus* Ogata, 1938; *Vampirolepis skrjabinariana* (Skarbilovich, 1946), *Aonchotheca eubursata* (Skarbilovich, 1946) [(=*Skrjabinocapillaria eubursata* Skarbilovich, 1946=*Capillaria eubursata* (Skarbilovitsch, 1946)], *Molinostrongylus skrjabini* Skarbilovich, 1934 and *Physaloptera myotis* (Babos, 1954). The results of helminthological examination are presented in table 1.

Infections by 2–6 species of helminths were localized in animals. Cases of infection by 5 and 6 species were more often noted (30.8% and 38.5% of examined common noctules, respectively). The prevalence of trematodes, cestodes and nematodes was 100%, 23.1% and 92.3%, respectively. Animals were more often infected with trematodes. The range of intensity of the helminths was 1–560 for trematodes (overall mean was 232.2 specimens), 1–2 for cestodes (overall mean was 1.2 specimens) and 1–318 for nematodes (overall mean was 61.5 specimens). All these species of helminths are ordinary parasites of bats in various European countries [7,10,12–23,25–29,35–37].

A total 7,520 helminth specimens were found in common noctules, and this is an average of 289.2 individuals per animal. In one male of the common noctule, in which 6 species of helminths were found, a total the number of parasitic worms were reached 1,305 individuals.

The vast majority of helminth species were localized in the intestine of common noctules, and only the nematode *A. eubursata* was localized in the

stomach, while the encapsulated larvae of the nematode *P. myotis* in the stomach wall.

The nematode *M. skrjabini*, the trematodes *P. chilostomum*, *L. linstowi* and *P. koreanus* were more often to infected common noctules. The prevalence of these helminths was 92.3%, 88.5%, 84.6% and 84.6%, respectively. The larvae of nematode *P. myotis* has been found in common noctules in Belarus for the first time. The literature provides, for instance, well-documented cases for *P. myotis* parasitizing northern bats and serotine bats on larval stage in this country [10,38].

High rates of infection of common noctules with these helminth species were noted in other regions of Belarus and abroad. Thus, 75.0% of common noctules in Belovezhskaya Pushcha [7], 47.0% in the Berezinsky Reserve [8] and 75.0% in other areas of Belarus [9] are infected with the nematode *M. skrjabini* at an intensity of infection being 2–32, 5–48 and 1–179 specimens, respectively. 84.6% of examined common noctules were infected with this helminth (intensity of infection was 16–200 specimens) in Ukraine [27], 100% (10–136 specimens) in Białowieża Forest, Poland [23], 63.75% in Wrocław city, Poland [24], 66.68% (1–179 specimens) in Moldova [17].

Trematodes *P. chilostomum* and *L. linstowi* were found in 39.3% and 14.3% of common noctules in Belovezhskaya Pushcha [7], in 23.5% (the first helminth) in the Berezinsky Reserve [8], in 63.9% and 5.6% in other areas of Belarus [9]. The number of trematode *P. chilostomum* in one infected common noctule reached 661 (Belovezhskaya Pushcha) and 996 specimens (other areas of Belarus). 100% of common noctules were infected with these both trematode species in Białowieża Forest, Poland with a large number of collected helminths (1951 and 1570 specimens, respectively) [20] and 86.0% (the first helminth) in Wrocław city, Poland [24].

Trematodes *L. linstowi*, *P. chilostomum* and *P. semisquamosus* were marked by high numbers of specimens (Tab. 1). The mean number of helminths was 111.2, 100.9 and 107.7 specimens, respectively. Although in our case the infection of common noctules with trematode *P. semisquamosus* was 38.5% with a high intensity of infection (up to 390 specimens), in Poland it was detected in 28.6% (Lublin Palatinate) [19] and 15.0% (1–3 specimens in Białowieża Forest) [21], and in Moldova in 73.01% with mean intensity of infection being 37.5 specimens [15].

Table 1. Helminth infections of common noctules (n=26, divided in three hibernation roosts) found in Brest city, Belarus (March 2022)

Helminth species	Group 1, n=20		Group 2, n=3		Group 3, n=3		Total, n=26	
	Number of infected	No. helminths (min-max; total; mean)	Number of infected	No. helminths (min-max; total; mean)	Number of infected	No. helminths (min-max; total; mean)	Prevalence %	No. helminths (min-max; total; mean)
<b>Trematoda</b>								
Lecithodendriidae Lühe, 1901								
<i>Lecithodendrium linstowi</i> Dollfus, 1931	16	2–520; 1626; 101.6	3	52–560; 746; 248.7	3	8–54; 74; 24.7	84.6	2–560; 2446; 111.2
<i>Paralecithodendrium chilosomum</i> (Mehlis, 1831)	18	4–380; 1908; 106	2	8–66; 74; 37	3	2–322; 338; 112.7	88.5	2–380; 2320; 100.9
Phanerozooidae Mehra, 1935								
<i>Parabascus semisquamosus</i> (Braun, 1900)	7	2–106; 321; 45.9	1	390; 390; 390	2	8–358; 366; 183	38.5	2–390; 1077; 107.7
Plagiorchiidae Lühe, 1901								
<i>Plagiorchis koreanus</i> Ogata, 1938	16	1–70; 171; 10.7	3	3–4; 10; 3.3	3	3–6; 13; 4.3	84.6	1–70; 194; 8.8
<b>Cestoda</b>								
Hymenolepididae Ariola, 1899								
<i>Vampirolepis skrjabiniana</i> (Skarbilovich, 1946)	6	1–2; 7; 1.2	–	–	–	–	23.1	1–2; 7; 1.2
<b>Nematoda</b>								
Capillariidae Neveu-Lemaire, 1936								
<i>Anchotheca eubursata</i> (Skarbilovich, 1946)	12	1–4; 21; 1.8	1	1; 1; 1	1	1; 1; 1	53.9	1–4; 23; 1.6
Molineidae Durette-Desset et Chabaud, 1977								
<i>Molinosstrongylus skrjabini</i> Skarbilovich, 1934	19	4–182; 656; 34.5	2	14–16; 30; 15	3	32–72; 146; 48.7	92.3	4–182; 832; 34.7
Physalopteridae Leiper, 1908								
<i>Physaloptera myotis</i> (Babos, 1954), larvae	6	8–318; 593; 98.8	–	–	1	28; 28; 28	26.9	8–318; 621; 88.7

The trematode *P. koreanus* is found for the first time in Belarus. According to Krasnolobova [39], the trematode *P. koreanus* could in some cases be mistaken for *P. vespertilionis* (Müller, 1784) by researchers in various countries. In our study the trematode *P. koreanus* fully corresponded to the differential diagnosis given by Tkach and Sharpilo [28]. We paid special attention to the size of the suckers (the oral sucker is noticeably larger than the ventral sucker), the presence of a well-defined esophagus, and the fact that the yolk fields ended, without merging, at the level of the posterior edge of the ventral sucker.

Previously, other trematode from genus *Plagiorchis* as *P. vespertilionis* was recorded in *N. noctula* in Belarus [8–10]. The trematode *P. vespertilionis* was found in 35.3% of common noctules (intensity of infection was 3–15 specimens) in the Berezinsky Reserve [8], in 25.0% (1–8 specimens) in the Pinsk district of the Brest region, Minsk and Nesvizh districts of the Minsk region [9] and one specimen was localized in the intestine of one common noctule from the Zhabinka district of the Brest region of Belarus [10]. 16.3% of common noctules were infected with this helminth species in Lublin Palatinate [19], 30.8% in Białowieża Forest [22] and 78.75% in Wrocław city in Poland [24] also 11.9% in Moldova [18].

The percentage of cestode *V. skrjabinariana* infection of common noctules was 23.1 (our data), 17.6 [8], 5.6 [9] and 16.7 [10] in Belarus. Also, 7.7 [22] and 20.0 [24] in Poland, 31.74 [13] in Moldova. Basically, the number of helminths ranged from 1 to 3, rarely reaching 6 as in Belarus [9] and 20 as in Moldova [13].

Two nematodes found by us in the stomach of common noctules from Brest infected 53.9% of animals (nematode *A. eubursata*) and 26.9% of animals (larvae of nematode *P. myotis*). We noted the maximum number of larvae of nematode *P. myotis* (318) in the wall of the stomach in one male of the common noctule. He also localized five more species of helminths: 70 specimens of trematode *P. koreanus*, 380 specimens of trematode *P. chilostomum*, 520 specimens of trematode *L. linstowi*, 16 specimens of nematode *M. skrjabini* and one specimen of nematode *A. eubursata*.

The nematode *A. eubursata* was found in 28.6% of common noctules in Belovezhskaya Pushcha [7], in 75.0% in the Pinsk district of the Brest region, Minsk and Nesvizh districts of the Minsk region [9], in 33.3% in the Kamenets district of the Brest region

of Belarus [10], in 100% in Białowieża Forest in Poland [23], in 30.95% in Moldova [16]. The maximum number of helminths in one animal (14) was recorded in Poland.

In addition to Belarus, larvae of nematode *P. myotis* were infected a small number of common noctules in Poland – 2.04% [19] and 5.0% – [24] as well as in Moldova – 7.93% [17].

An interesting helminthological study of common noctules was carried out in Poland, in the urbanized area of the Wrocław city center [24]. As in our case, a high percentage of helminth infection in common noctules (96.25), a high total number of collected helminths (10.240), a high average number of helminths found (132.9) was noted, similar helminth species were identified (trematode *P. chilostomum*, cestode *V. skrjabinariana*, nematodes *M. skrjabini* and *P. myotis*). Unfortunately, the authors did not indicate the season of the year when the studies were conducted.

In conclusion, eight species of helminths (four species of trematodes, one species of cestodes, three species of nematodes) were found in 26 common noctules during the hibernation period in Brest in March 2022. The total infection with helminths was 100%, with the average intensity of infection being 289.2 specimens. The major group of helminth species found in this study are the nematode *M. skrjabini*, and the trematodes *P. chilostomum*, *L. linstowi* and *P. koreanus*. The trematode *P. koreanus* is registered for the first time in Belarus. The common noctule is a new host for larvae of nematode *P. myotis* in Belarus.

## Acknowledgements

The authors express their gratitude to Maria Demyanchik from Brest State University, Belarus and Valentin Rabchuk from the Polesie Agrarian Ecological Institute of the NAS of Belarus for assistance in field observations and collection of bat carcasses.

## References

- [1] Kurskov A.N. 1981. Bats of Belarus. Nauka i tekhnika. Minsk (in Russian).
- [2] Stebbings R.E. 1988. Conservation of European Bats. Christopher Helm, London.
- [3] Wołoszyn B.W. (Ed.). 1994. Zimowe spisy nietoperzy w Polsce: 1988–1992. Wyniki i ocena skuteczności. Publikacje Centrum Informacji Chiropterologicznej

- ISEZ PAN, Kraków (in Polish).
- [4] Demyanchik V.T., Demyanchik M.G. 2000. [Chiropterans of Belarus: a reference guide]. (Ed. S. Lavrov). Brest (in Russian).
- [5] Godlevska E. 2014. Northward expansion of the winter range of *Nyctalus noctula* (Chiroptera: Vespertilionidae) in Eastern Europe. *Mammalia* 79(3): 315–324. doi:10.1515/mammalia-2013-0178
- [6] Lesiński G., Janus K. 2019. Successful wintering of the noctule *Nyctalus noctula* on a balcony in Warsaw (Central Poland). *Ecologia Balkanica* 11(2): 291–294.  
[https://www.researchgate.net/profile/Grzegorz-Lesinski/publication/338233498\\_Successful\\_Wintering\\_of\\_the\\_Noctule\\_Nyctalus\\_noctula\\_on\\_a\\_Balcony\\_in\\_Warsaw\\_Central\\_Poland/links/5e0a03eea6fdcc283749fee5/Successful-Wintering-of-the-Noctule-Nyctalus-noctula-on-a-Balcony-in-Warsaw-Central-Poland.pdf](https://www.researchgate.net/profile/Grzegorz-Lesinski/publication/338233498_Successful_Wintering_of_the_Noctule_Nyctalus_noctula_on_a_Balcony_in_Warsaw_Central_Poland/links/5e0a03eea6fdcc283749fee5/Successful-Wintering-of-the-Noctule-Nyctalus-noctula-on-a-Balcony-in-Warsaw-Central-Poland.pdf)
- [7] Morozov Yu. F. 1961. [To the helminth fauna of chiropterans of Belovezhskaya Pushcha]. *Proceedings of the Academy of Sciences of Belarus. Biological Series* 2: 92–98 (in Belorussian).
- [8] Karasev N.F. 1970. [Helminths of mammals of the Berezinsky Reserve. In: Berezinsky Reserve Research]. (Eds. I.D. Yurkevich, V.S. Romanov, I.N. Serzhanin, V.S. Geltman, A.V. Boyko, K.D. Chubanov). Urozhay, Minsk: 155–179 (in Russian).
- [9] Merkuseva I.V. 1971. [Infestation of bats with helminths on the territory of Belarus]. *Proceedings of the Academy of Sciences of Belarus. Biological Series* 5: 72–74 (in Belorussian).
- [10] Shimalov V.V., Demyanchik M.G., Demyanchik V.T. 2011. The helminth fauna of bats (Microchiroptera) in the Republic of Belarus. *Proceedings of the National Academy of Sciences of Belarus. Biological Series* 3: 104–110 (in Russian with summary in English).
- [11] Băčvarov G. 1963. Kăm helmintofaunata na prilepitate (Chiroptera) v Bălgariâ [On the helminthofauna of bats (Chiroptera) in Bulgaria]. *Trudove na Visšia pedagogičeski institut Plovdiv. Matematika, fizika, khimiâ, biologiâ* 1(1): 99–101 (in Bulgarian, with a summary in Russian and French).
- [12] Murai E. 1976. Cestodes of bats in Hungary. *Parasitologia Hungarica* 9: 41–62.
- [13] Andreiko O.F., Skvortsov V.G., Konovalov Yu.N. 1969. [Cestodes of bats in Moldavia. In: Parasites of vertebrates]. (Ed. A.A. Spassky). Kartya Moldovenyaske, Kishinev: 31–36 (in Russian).
- [14] Skvortsov V.G. 1969. [Trematodes of *Prosthodendrium* species (family Lecithodendriidae) in bats of Moldavia. In: Parasites of vertebrates]. (Ed. A.A. Spassky). Kartya Moldovenyaske, Kishinev: 67–98 (in Russian).
- [15] Skvortsov V.G. 1970. [Trematodes of family Lecithodendriidae in bats of Moldavia. In: Parasites of animals and plants]. (Ed. A.A. Spassky). The Academy of Sciences of MSSR, Kishinev: 17–36 (in Russian).
- [16] Skvortsov V.G. 1971. [Nematodes in bats of Moldavia (report 1). In: Parasites of animals and plants]. (Ed. A.A. Spassky). The Academy of Sciences of MSSR, Kishinev: 52–63 (in Russian).
- [17] Skvortsov V.G. 1971. [Nematodes in bats of Moldavia (report 2). In: Parasites of animals and plants]. (Ed. A.A. Spassky). Shtiintsa, Kishinev 7: 75–93 (in Russian).
- [18] Skvortsov V.G. 1972. [Trematodes of family Plagiorchiidae Lühe, 1901 in bats of Moldavia. In: Parasites of animals and plants]. (Ed. A.A. Spassky). Shtiintsa, Kishinev 8: 46–50 (in Russian).
- [19] Sołtys A. 1959. The helminth fauna of bats (Chiroptera) of Lublin Palatinate. *Acta Parasitologica Polonica* 7(34): 599–613.
- [20] Zdzitowiecki K. 1969. Helminths of bats in Poland. II. Trematodes of the subfamily Lecithodendriinae. *Acta Parasitologica Polonica* 16(24): 207–226.
- [21] Zdzitowiecki K. 1969. Helminths of bats in Poland. III. Trematodes of the family Lecithodendriidae, except for Lecithodendriinae. *Acta Parasitologica Polonica* 16(25): 227–237.
- [22] Zdzitowiecki K. 1970. Helminths of bats in Poland. I. Cestodes and trematodes of the family Plagiorchiidae. *Acta Parasitologica Polonica* 17(20): 175–188.
- [23] Zdzitowiecki K. 1970. Helminths of bats in Poland. IV. Nematodes. *Acta Parasitologica Polonica* 18(22): 255–265.
- [24] Kluwak E., Lazurek K., Aupicki D., Popiołek M., Zalesny G. 2013. Helminthfauna of the common noctule *Nyctalus noctula* (Schreber, 1774) from the Wrocław area. *Annals of Parasitology* 59(Suppl.): 37.
- [25] Chiriac E., Barbu P. 1963. Cu privier la helmintofauna unor micromamifera din R.P.R. *Analele Universității București. Seria Stiintele naturii. Biologie* 38(12): 181–191 (in Romanian).
- [26] Tkach V.V., Krochko Yu.I., Sharpilo V.P. 1983. [New species of bats trematodes in the fauna of Ukraine]. *Vestnik Zoologii* 3: 50 (in Russian).
- [27] Tkach V.V., Sharpilo V.P. 1988. [Nematodes of genus *Molinostrongylus* (Nematoda, Molineidae) from chiropterans of the fauna of USSR]. *Vestnik Zoologii* 4: 3–8 (in Russian).
- [28] Tkach V.V., Sharpilo V.P. 1990. [A new trematode species (Trematoda, Plagiorchiidae) from bats. In: News of faunistics and systematics]. Naukova Dumka, Kiev: 11–13 (in Russian).
- [29] Sharpilo V.P., Iskova, N.I. 1989. [Trematodes. Plagiorchiata. Fauna of the Ukraine]. 34(3). Naukova Dumka, Kiev (in Russian).
- [30] Skrjabin K.I. 1928. [Method of full helminthological dissection of vertebrates, including humans]. Publishing House of 1st Moscow State University, Moscow (in Russian).
- [31] Tkach V.V. 2008. Family Plagiorchiidae Lühe, 1901.

- In: Keys to the Trematoda. (Eds. R.A. Bray, D.I. Gibson, A. Jones). Vol. 3. CABI Publishing and the Natural History Museum, London: 295–325.
- [32] Czaplinski B., Vaucher C. 1994. Family Hymenolepididae Ariola, 1899. In: Keys to the cestode parasites of vertebrates. (Eds. L.F. Khalil, A. Jones, R.A. Bray). CAB International, Wallingford: 595–663.
- [33] Anderson R.C. 2000. Nematode parasites of vertebrates, their development and transmission. 2nd ed. CABI Publishing, Wallingford.
- [34] Kirillov A.A., Kirillova N.Yu., Vekhnik V.P. 2012. [Trematodes (Trematoda) of bats (Chiroptera) from the Middle Volga region]. *Parazitologiya* 46(5): 384–413 (in Russian with summary in English).
- [35] Lanza B. 1999. I parassiti dei pipistrelli (Mammalia, Chiroptera) della fauna Italiana. Museo Regionale di Scienze Naturali, Torino (in Italian).
- [36] Léger C. 2020. Bat parasites (Acari, Anoplura, Cestoda, Diptera, Hemiptera, Nematoda, Siphonaptera, Trematoda) in France (1762–2018): a literature review and contribution to a checklist. *Parasite* 27: article number 61. doi:10.1051/parasite/2020051
- [37] Frank R., Kuhn T., Werblow A., Liston A., Kochmann J., Klimpel S. 2015. Parasite diversity of European *Myotis* species with special emphasis on *Myotis myotis* (Microchiroptera, Vespertilionidae) from a typical nursery roost. *Parasite and Vectors* 8(1): 101–114. doi:10.1186/s13071-015-0707-7
- [38] Shimalov V. 2021. The helminth fauna of the serotine bat *Eptesicus serotinus* (Chiroptera; Vespertilionidae) in Southern Belarus. *Annals of Parasitology* 67(3): 549–552. doi:10.17420/ap6703.370
- [39] Krasnolobova T.A. 1987. [Trematodes of the fauna of the USSR. Genus *Plagiorchis*]. Nauka, Moscow (in Russian).

Received 26 July 2022

Accepted 17 November 2022