ISSN 2449-8955 European Journal of Biological Research *Research Article*

DOI: http://dx.doi.org/10.5281/zenodo.3835917

Leiodinychus orbicularis (C.L. Koch, 1839) in bat boxes in Poland

Jerzy Błoszyk[1,2], Tomasz Rutkowski[2], Grzegorz Wojtaszyn[3], Zofia Książkiewicz-Parulska[1], Michał Zacharyasiewicz[1], Agnieszka Napierała[1]*

[1] Department of General Zoology, Faculty of Biology, Adam Mickiewicz University, Poznań, ul. Uniwersytetu Poznańskiego 6, 61-614 Poznań, Poland

[2] Natural History Collections, Faculty of Biology, Adam Mickiewicz University, Poznań, ul. Uniwersytetu Poznańskiego 6, 61-614 Poznań, Poland

[3] Polish Society for Nature Conservation "Salamandra", ul. Stolarska 7/3, 60-788 Poznań, Poland

*Correspondence: Phone: +48618295847; E-mail: agan@amu.edu.pl

Received: 25 March 2020; **Revised submission:** 27 April 2020; **Accepted:** 19 May 2020

http://www.journals.tmkarpinski.com/index.php/ejbr

ABSTRACT: The presented studies are the first one on the occurrence of mites in bat boxes and focuses on Uropodina (Acari: Mesostigmata). Investigation was carried out in Western Poland in October 2015. Guano was collected from 58 bat boxes occupied by 10 species of bats. Excrements from particular bat boxes were placed separately in string bags and transported to the laboratory. The extracted fauna was preserved in 75% ethanol and mites were identified with stereoscopic light microscope. The study revealed only one species of Uropodina mite on bat guano in the studied bat boxes, namely *Leiodinychus orbicularis* (C.L. Koch, 1839).

Keywords: Bats; Guano; *Leiodinychus orbicularis*; Nidicolous species.

1. INTRODUCTION

Previous studies shown, that bat guano in caves, constitute a habitat for mites belonging to suborder Uropodina. These mites create communities consisting of species that usually occur in unstable habitats [1]. In European caves, two Uropodina species were recorded on the guano, namely: *Phaulodiaspis rackei* (Oudemans, 1912) and *Phaulodiaspis advena* (Trägårdh, 1912) [2-4]. In this study we aimed to check if guano in bat boxes is also inhabited by mites from suborder Uropodina. The investigation presented here is a first on the subject.

2. MATERIALS AND METHODS

The guano was collected in October 2015 from 58 bat boxes occupied by 10 species of bats, namely *Eptesicus serotinus* (Schreber, 1774), *Myotis brandtii* (Eversmann, 1845), *Myotis myotis* (Borkhausen, 1797), *Myotis mystacinus* (Kuhl, 1817), *Myotis nattereri* (Kuhl, 1817), *Nyctalus leisleri* (Kuhl, 1817), *Nyctalus noctula* (Schreber, 1774), *Pipistrellus nathusii* (Keyserling and Bläsius, 1839), *Pipistrellus pygmaeus* (Leach, 1825), *Plecotus auritus* (Linnaeus, 1758) [5-7]. The occurrence of Uropodina mites however, was not considered in relation to particular species of bats, since in a one bat box the guano might have been produced

by various species of bats (according to the previous studies, the species of bat that produces guano is not significant for the species of mite - the example of *Phaulodinychus advena* and Australian *Uroobovella coprophila* [8, 9].

The studied bat boxes were scattered across ca. 20 km² in southern Wielkopolska, Western Poland (near Ostrzeszów 51°25′N 17°55′E; the area covers Kotlina Milicka, Dolina Baryczy Landscape Park and nature protection area Natura 2000 Dolina Baryczy; Figure 1) during an action of banding bats and cleaning out bat boxes. The study area is covered mainly with coniferous forests interspersed with agricultural landscape, and is crossed by numerous roads along which small villages are scattered.

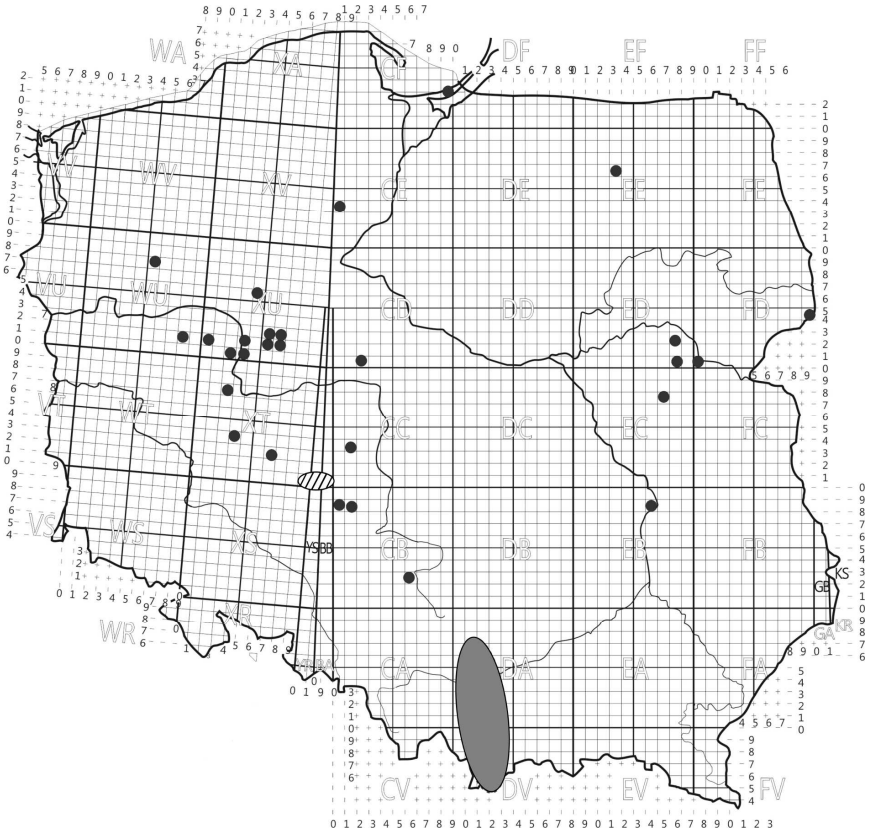

Figure 1. The UTM map of Poland showing the distribution of *L. orbicularuis* (black circles) (Błoszyk, 1983), the study plot - (dashed spot) as well as the area of the occurrence of *P. advena* (i.e. caves in Ojców and Tatra Mountains [10]).

Bat guano from particular bat boxes was placed separately in string bags and transported to the laboratory. The material was weighed on the electronic scale (0.01 g sensitivity) followed by extraction of fauna on Tullgren funnels for 5 days (i.e. until the guano completely dried out). Extracted fauna was preserved in 75% ethanol. Mites were identified with stereoscopic light microscope Olympus SZX 12 with 250–500 magnification. We use the following literature for the species identification: [3, 11-13]. The examined materials, preserved in alcohol have been deposited in the Natural History Collection of Adam Mickiewicz University, Faculty of Biology, Poznań, Poland.

3. RESULTS AND DISCUSSION

Amount of bats' guano was diverse in particular bat boxes and varied between 4 and 1,112 g (average: 117 g). We collected a total of 188 individuals of mites belonging to suborder Uropodina of which 97 were adults (females: 58 individuals; males: 38 individuals) and 91 were juveniles (deutonymphs: 49;

protonymphs: 41; larva: 1). All individuals belonged to one species, namely *Leiodinychus orbicularis* (C.L. Koch, 1839).

Leiodinychus orbicularis (Figure 2) is known from Europe as well as Algeria and India [3, 11-15]. It is coprophilous and saprophagous, and occurs in various decaying substrates such as compost or manure [3]. This mite is also a frequent inhabitant of nests and nestboxes [3, 16-25] and thus may be considered as nidicolous species [1, 3, 13] (Table 1). *Leiodinychus orbicularis* rarely occurs also in other type of habitats such as xerophilous grasses, meadows, alder forests, hornbeam forests, mixed deciduous forests, beech-wood on lowland, oak-woods, yew-tree stands, mixed forests (with pine), parks, nest of small mammals, rotten trunks and hollows in trees [16 and unpublished data]. Our study shows that *L. orbicularis* also occurs in bat boxes and dwells in guano of these mammals.

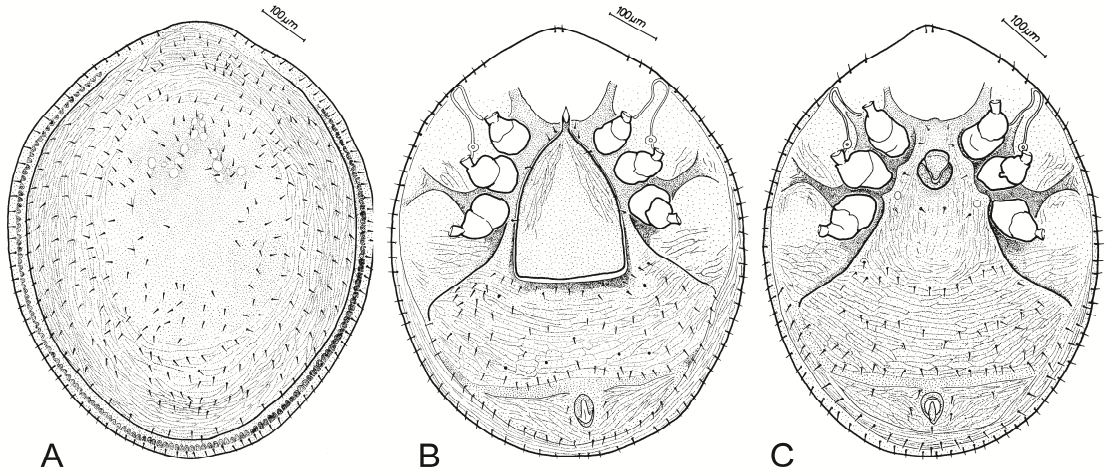

Figure 2. *Leiodinychus orbicularis* - female, dorsal side (A) and ventral side (B); male - ventral side (C).

In this study we did not discover European Uropodina mites that have been already recorded on bats guano in caves, i.e. *Phaulodinychus rackei* (Oudemans, 1912) and *Pahulodinychus advena* (Trägårdh, 1912) [2, 9, 10, 26]. The absence of *P. advena* in bat boxes in Western Poland may results from the geographical range of this species; it occurs in Czech Republic, Slovakia, France, Germany, Austria, Hungary and Romania [3] while in Poland it reaches its northern border of the range and occurs only in southern part of the country [16] (Figure 1). On the other hand, *P. rackei* previously classified as coprophilous that dwells on bat guano [2], seem to be associated mostly with nests of moles in Central Europe [1, 3, 16].

4. CONCLUSION

In conclusion, *L. orbicularis* is attracted to the guano of both bats in bat boxes and birds in nestboxes conversely to other species from this group of mites which have different trophic requirements. On the other hand, the species was not recorded in bat guano in caves probably due to its preferences to warmer and drier environments than caves. Presence of only one representative of Uropodina mites on guano in bat boxes may be also related with specific entomofauna inhabiting bat boxes since these mites use phoresy for spreading between the unstable microhabitats and show high selectivity for a species of a carrier [3, 4].

Table 1. Habitat preferences of *L. orbicularis* in Poland: N – number of samples; F – frequency (%); Ns – number of positive samples; X – mean of specimens/per positive sample, Nsp – number of specimens.

Habitat	N	F	Ns	X±SD	Nsp
Open habitat					
Xerophilous grasses	97	1.03	1	8	8
Sandhills	27	-	-	-	-
Rocks grasses (noncalcareous)	159	-	-	-	-
Rocks grasses on limestone	105	-	-	-	-
Meadows	1,192	2.52	30	45.13± 130.64	1,354
Moorlands	18	-	-	-	-
Peat-bogs	87	-	-	-	-
Sedgelands	415	-	-	-	-
Agrocenoses	8	-	-	-	-
Schoenoplectus and reed beds	5	-	-	-	-
Forest and shrubs					
Alder forest – soil and litter	212	0.47	1	2	2
Marshy forest – soil and litter	621	-	-	-	-
Hornbeam forest – soil and litter	7,100	0.13	9	6.15±13.06	80
Mixed deciduous forest – soil and litter	735	0.14	1	1	1
Beech-wood on lowland – soil and litter	158	0.63	1	1	1
Beech-wood in the mountain – soil and litter	864	-	-	-	-
Oak-wood – only soil and litter	75	1.33	1	1	1
Pine forest – only soil and litter	1,508		-	-	-
Spruce forest in the mountain – soil and litter	509	-	-	-	-
Spruce forest on lowland – soil and litter	82	-	-	-	-
Fir forest – soil and litter	234	-	-	-	-
Larch stand – soil and litter	46	-	-	-	-
Yew-tree stand – soil and litter	244	0.82	2	4±4.24	8
Fir-beech forest – soil and litter	86	-	-	-	-
Mixed forest (with pine) – soil and litter	730	2.60	19	23.31±52.27	433
Mixed forest (with spruce) – soil and litter	105	-	-	-	-
Dwarf pine	60	-	-	-	-
Brushwood	358	-	-	-	-
Parks – soil and litter	410	2.20	9	7.56±8.38	68
Merocenoses					
Ant-hills	42	-	-	-	-
Nest of small mammals	242	0.83	2	3,5±8.38	7
Nest of birds	823	10.94	90	31.54±93.78	2,839
Rot trunks	1,376	0.80	11	2.00±3,54	32
Hollows in tree	244	4.10	10	9.10±13.50	51
Bark of tree	87	-	-	-	-
Total	18,160	2.06	187		4,885

Authors' Contributions: JB: Identification of the species; Conception of the paper and design of the first version of the manuscript; Analysis and interpretation of data. TR: Collection of material; Segregation of material in samples; Technical support. GW: Organization of field research; Material collection. ZKP:

Conception of the paper; Interpretation of data; Translation into English. MZ: Segregation of material in samples; Analysis of environmental data; AN: Conception of the paper; Preparation of the final version of the manuscript; Linguistic correction.

Conflict of Interest: The authors have no conflict of interest to declare.

Acknowledgements: Authors are grateful to Paweł Kmiecik, Grzegorz Lesiński, Maurycy Ignaczak, Wojciech Stephan and Jarosław Manias who helped with material collection.

REFERENCES

1. Napierała A, Błoszyk J. Unstable microhabitats (merocenoses) as specific habitats of Uropodina mites (Acari: Mesostigmata). Exp Appl Acarol. 2013; 60: 163-180.
2. Valle A. Intorno allo sviluppo postembrionale di *Phaulotrachytes rackei* (Oudms.) (Acari, Phaulodinychidae) [in Italian]. Commentationes Pont Acad Scient. 1954; 16: 291-314.
3. Mašán P. Mites of the cohort Uropodina (Acarina, Mesostigmata) in Slovakia. Annot Zool Bot. 2001; 223: 1-320.
4. Błoszyk J, Dylewska M. *Phaulodiaspis advena* (Trägårdh 1912) interesujący roztocz z jaskiń Ojcowskiego Parku Narodowego (Acari: Mesostigmata) [in Polish]. Prądnik. Prace i Materiały Muzeum im. Prof. Wł. Szafera. 2006; 16: 165-168.
5. Szarlik A, Gulatowska J, Wojtaszyn G. Obserwacje mroczka późnego *Eptesicus serotinus* (Schreber, 1774) w skrzynkach dla nietoperzy [in Polish]. Nietoperze. 2005; 6: 57-59.
6. Wojtaszyn G. Występowanie nocka dużego *Myotis myotis* (Borkhausen, 1797) w lasach oraz uwagi na temat zachowań godowych tego gatunku [in Polish]. Nietoperze. 2008; 9: 71-80.
7. Dondini G, Rutkowski T, Vergari S, Wojtaszyn G. Long distance migration of female Leisler's bat (*Nyctalus leisleri*) from Italy to Poland. 2012; Hystrix 23: 95-96.
8. Womersley H. A new coprophilous Uropodid mite, *Cilliba coprophila* sp. nov. from a bat cave in South Australia (Acarina-Cillibidae). Rec South Aust Mus. 1960; 13: 471-479.
9. Rafalski J. 1977. Pajęczaki (Arachnida) [in Polish]. In: Zabierowski K, ed. Studia Naturae: Przyroda Ojcowskiego Parku Narodowego Ser. N. 1st ed. Warszawa, Kraków, Polska, PWN, 1977; 300-342.
10. Błoszyk J, Napierała A, Zawada M. Stan zbadania akarofauny Ojcowskiego Parku Narodowego, ze szczególnym uwzględnieniem Uropodina (Acari: Mesostogmata). Zróżnicowanie i przemiany środowiska przyrodniczo-kulturalnego Wyżyny Karkowsko-Częstochowskiej, Ojców [in Polish]. Przyroda Tom 2004; I: 39-46.
11. Kadite BA, Petrova AD. Kohorta Uropodina, fam. Uropodidae (in Russian). In: Gilarov MS, Bregetova NG, eds. Opredelitel' obytayshchikh v pochve kleshchey Mesostigmata, 1st ed. Leningrad, Nauka, 1977; 632-691.
12. Karg W, eds. Acari (Carcina), Milben Unterordung Parasitiformes (Anactinotriches) Uropodina Kramer, Schildkrotenmilben [in German]. 1st edn. Jena, Germany: Gustv Fisher Verlag, 1989.
13. Błoszyk J. Geograficzne i ekologiczne zróżnicowanie zgrupowań roztoczy z kohorty Uropodina (Acari: Mesostigmata) w Polsce. I. Uropodina lasów grądowych (Carpinion betuli) [in Polish]. Wydawnictwo Kontekst, Poznań, 1999.
14. Radinovsky S. The biology and ecology of Granary Mites the Pacific Northwest. III. Life history and development of *Leiodinychus krameri* (Acarina: Uropodidae). Ann Entomol Soc Am. 1965; 58: 259-267.

15. Wiśniewski J, Hirshmann W. Katalog der Ganggattungen, Untergattungen, Grupen und Arten der Uropodiden der Erde [in German]. Acarologie. 1993; 40: 1-220.
16. Błoszyk J. Uropodina Polski (Acari. Mesostigmata) [in Polish]. PhD Thesis. Poznań, UAM. 1983.
17. Błoszyk J, Olszanowski Z. Materiały do znajomości roztoczy gniazd i budek lęgowych ptaków. I. Uropodina i Nothroidea (Acari: Mesostigmata et Oribatida) [in Polish]. Przegl Zool. 1985; 29: 69-74.
18. Błoszyk J, Olszanowski Z. Materiały do znajomości fauny roztoczy gniazd i budek lęgowych ptaków. II. Różnice w liczebności i składzie gatunkowym populacji Uropodina (Acari: Anactodotrichida) budek lęgowych na Mierzei Wiślanej na podstawie dwuletnich obserwacji [in Polish]. Przeg Zool 1986; 30: 63-66.
19. Fenda P, Krumpal M, Cyprich D. The soil fauna in the birds' nests in Slovakia. In: Pižl V, Tayovsky K, eds. Soil Zoological Problems in Central Europe. 1st ed. Ceske Budejovice, Czech Republic: Institute of Soil Biology Academy of Sciences of the Czech Republic, 1998; 23-30.
20. Krištofík J, Mašán P, Šustek Z. Mites (Acari), beetles (Coleoptera) and fleas (Siphonaptera) in the nests of great reed warbler (*Acrocephalus arundinaceus*) and reed warbler (*A. scirpaceus*). Biológia 2001; 56: 525-536.
21. Gwiazdowicz DJ, Błoszyk J, Mizera T, Tryjanowski P. Mesostigmatic mites (Acari: Mesostigmata) in White-Tailed sea eagle nests (*Heliaeetus albicilla*). J Raptor Res. 2005; 39: 60-65.
22. Błoszyk J, Bajerlein D, Gwiazdowicz DJ, Halliday RB, Dylewska M. Uropodine mite communities (Acari: Mesostigmata) in birds' nests in Poland. Belg J Zool. 2006; 136: 145-153.
23. Krištofík J, Mašán P, Šustek Z, Karaska D. Arthropods in the nests of lesser spotted eagle (*Aquila pomarina*). Biológia. 2009; 64: 974-980.
24. Błoszyk J, Dražina T, Gwiazdowicz D, Halliday RB, Gołdyn B, Napierała A, Rybska E. Mesostigmatic mites (Acari: Mesostigmata) in nests of the Eurasian griffon vulture (*Gyps fulvus*) in Croatia. Biológia. 2011; 66: 335-339.
25. Kristofik J, Mašán P, Sutek Z, Nuhlickova S. Arthropods (Acarina, Coleoptera, Siphonaptera) in nests of hoopoe (*Upupa epops*) in Central Europe. Biológia. 2013; 68: 155-161.
26. Demel K. Fauna Jaskiń Ojcowskich. Sprawozdania Towarzystwa Naukowego Warszawskiego. Wydz Nauk Mat i Przyr [in Polish]. 1918; 11: 623-659.