

Original papers

Demodecid mites (Acariformes, Demodecidae) in brown long-eared bat *Plecotus auritus* (Chiroptera, Vespertilionidae) – second record in the world and systematic status of *Demodex chiropteralis* Hirst, 1921

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ABSTRACT. As many as 26 species of parasitic mites of the Demodecidae family have thus far been described in the Chiroptera, of which only three have been found in bats from Europe. The first of the latter group was *Demodex chiropteralis* Hirst, 1921, described on the basis of only two females originating from one bat from Great Britain; an observation which has never been made since. The present study reports the discovery of both male and female *D. chiropteralis* in Poland, together with other unknown demodecid mites which may well belong to new species. The present study confirms the existence of *D. chiropteralis* after nearly one hundred years from its original description, as well as the first determination of representatives of the Demodecidae in the Chiroptera of Central Europe.

Key words: Acariformes, Demodecidae, demodecid mites, *Demodex chiropteralis*, Chiroptera, bats

Introduction

A large number of the 120 known species of skin and tissue mites of the Demodecidae family have been described in rodents. In total, 45 species have been recorded, of which 43 of the genus *Demodex*, and one each of *Glossicodex* and *Ophthalmodex*. The best understood group is that of the demodecid mites of rodents from Europe; however, these include Palearctic, cosmopolitan and synanthropic species [1]. The majority of known Demodecidae species have been described in the house mouse *Mus musculus* Linnaeus, 1758 (seven species of demodecid mites) and the brown rat *Rattus norvegicus* Berkenhout, 1769 (five species) [2–8].

Following mice and rats, the second richest group of known demodecid fauna has been identified in bats, with as many as 26 species of *Demodex* (17 species), *Ophthalmodex* (six) and

Pterodex (one) and *Stomatodex* (two) having been isolated. The highest number of species have been described from the Seba's short-tailed bat *Carollia perspicillata* (Linnaeus, 1758) (New World leaf-nosed bats Phyllostomidae), a host from Central and South America. Four species have been found in this bat: *Demodex carolliae* Desch, Lebel, Nutting et Lukoschus, 1971; *D. longissimus* Desch, Nutting et Lukoschus, 1972; *Ophthalmodex carolliae* Lukoschus, Woeltjes, Desch et Nutting, 2009 and *Pterodex carolliae* Lukoschus, Woeltjes, Desch et Nutting, 1980 [9–14]. In contrast, a total of only three demodecid mite species have been described in bats from Europe, these being known from single observations in five bat species of vesper bat (Vespertilionidae): *D. aelleni* Fain, 1960 in Daubenton's bat *Myotis daubentonii* (Kuhl, 1817), *D. chiropteralis* Hirst, 1921 in the brown long-eared bat *Plecotus auritus* (Linnaeus, 1758) and



Fig. 1. *Demodex chiropteralis* (A: female, B: male) and *Demodex* sp. (C: female, D: male) from *Plecotus auritus*

Stomatodex corneti Fain, 1960 in the barbastelle *Barbastella barbastellus* (Schreber, 1774), greater mouse-eared bat *M. myotis* Borkhausen, 1797 and pond bat *M. dasycneme* (Boie, 1825) [15–16].

The first demodecid mite species recorded from European (and Palearctic) bats was *D. chiropteralis*, described by Hirst [15] based on two females obtained in 1919 from one host individual from Great Britain. It is the only known record of this demodecid mite: its existence has never since been confirmed. Furthermore, Hirst [15] reports the presence of several specimens of a considerably smaller demodecid mite species identified as *D. soricinus* Hirst, 1818, in an individual *P. auritus*. However, as the original description of the species was based primarily on metrical features, and hence was very brief, it remains uncertain that *D. soricinus* sensu Hirst, 1818 can be equated with *D. soricinus* sensu Bukva, 1993, which is probably a specific parasite of the common shrew *Sorex araneus* Linnaeus, 1758. Similar doubts were also expressed by Bukva [17], when providing a redescription of the species.

Materials and Methods

Six specimens of dead *P. auratus* from northern Poland (Pomeranian voivodeship) were examined for demodecid mites.

The host skin fragment digestion method was used to recover skin mites [18]. Skin fragments of 1 cm² were collected from several body regions, including the head (around eyes, nose, lips, chin, cheeks, vertex), neck, abdomen, back, membrane wings, limbs and genital-anal area. Skin samples were preserved in 70% ethanol and digested in 10% KOH solution; the samples obtained were decanted (examination of 1 cm² of the skin equal to the analysis of approximately 100 wet preparations) and examined using phase-contrast microscopy (Nikon Eclipse 50i). The specimens were placed in polyvinyl-lactophenol solution and measured, with all measurements in micrometres. All measurements were taken as follows: total body length = length of gnathosoma, podosoma and opisthosoma; gnathosomal width = width at base; podosomal and opisthosomal width = maximum width.

Table 1. Body sizes (micrometres) of *Demodex chiropteralis*

Morphological features	Present		Hirst (1921) ♀ (n=2)
	♀ (n=5)	♂ (n=1)	
Length of gnathosoma	15	15	114 and 115*
Length of podosoma	98	85	
Length of opisthosoma	138	135	115 ?**
Width of gnathosoma	23	22	***
Width of podosoma	56	63	59 and 61
Width of opisthosoma	47	43	?**
Vulva length	16	–	***
Aedeagus length	–	31	–
Total length of body	251	235	229

*length of gnathosoma and podosoma combined; **the question mark has been kept from the original record;

***the author gives no information as to the measurement.

Results

Six individuals (five females, one male) identified as *D. chiropteralis* sensu Hirst, 1921 (Fig. 1A,B) were found in two individuals of *P. auritus* (sex, locality, and date: male, Skrzyszewo 54°17'06"N 18°21'05"E, February 2014; male, Zbysław 54°14'N 17°28'E, February 2006). In terms of their metrical features (Table 1), the demodecid mite individuals correspond to the description by Hirst, and their features reflect the figure attached to the description [15]. All demodecid mites were found on the skin of the head. Only adult individuals were found, and in contrast to previous studies, one mite was male.

Other demodecid mites were also recorded in various locations of the examined bats. These were considerably smaller in size, with their body length ranging from 90 to 120 µm, and could not be classified to a known species (Fig. 1C,D). However, a detailed taxonomic analysis based on larger material comprising adult and immature developmental stages originating from various host individuals is required to prepare a full description of these species or multiple species.

Discussion

The demodecid mites found in *P. auritus* were identified as *D. chiropteralis* based on the brief description of the species by Hirst [15]; however this classification has been criticised as being insufficient according to the current standards used in Demodecidae taxonomy [7,19–21]. However,

identification is facilitated by the figure, containing numerous details significant for taxonomy of these mites, and not mentioned in the text itself. The present analysis, based on several identified individuals, indicates that the mites possess certain features, such as palp structures and claws on the tarsi, which are atypical of the genus *Demodex*. The species is therefore clearly in need of redescription, particularly regarding the female mite, and for new descriptions to be drawn up for the male form and the immature stages. Such a systematic revision may be combined with establishment of a new genus.

Since its initial discovery almost one hundred years ago, *Demodex chiropteralis* has not been identified in other hosts. However, it is probably not a rare species: its distribution simply corresponds to that of its host, the brown long-eared bat. However, despite being previously identified in the British Isles, the latest identification, described in the present paper, was made in northern Poland; this is significant, considering the fact that the brown long-eared bat is a rather sedentary species whose summer and winter hideouts tend to be just a few kilometres apart [22]. The lack of data on the occurrence of *D. chiropteralis* stems from the absence of regular studies of Demodecidae in bats. Since Hirst's original description of a demodecid mite from a bat species [15], only 15 studies have described further species, typically consisting of several examples of Demodecidae from a single host species, with only one [16] describing two species from Europe (*D. aelleni* from Switzerland and *S. corneti* from Belgium). Moreover, several of

these studies report only individual observations of unidentified *Demodex* sp. from various bat species.

It is important to note that until the middle of the 20th century, the brown long-eared bat was not distinguished from the grey long-eared bat *P. austriacus* (Fischer, 1829); this distinction was only recognized as late as in 1959 [22]. However, although Hirst [15] does not provide a precise locality of the sites from which he obtained the study material in the paper from 1921, he describes various other mites from hosts originating from England and Scotland. These specimens likely originated from the brown long-eared bat, as while *P. auritus* is one of the most common species of bat, and has one of the widest distributions among European bats, including the British Isles, *P. austriacus* is found solely in southern Europe and partially in central Europe, and is only rarely observed in the southernmost parts of Great Britain. However, it would be very interesting indeed to learn more of the demodecid mites of the grey long-eared bat and the recently described Alpine long-eared bat *P. macrobullaris* Kuzjakin, 1965, another very similar species to those two long-eared bats [23]. Such comparison would be also important because, although these are hosts with similar morphologies, they exhibit different habitat preferences [22].

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