

## Original papers

# *Demodex foveolator* (Acariformes: Demodecidae) from *Crocidura suaveolens* (Soricomorpha: Soricidae) – the second observation worldwide, and a checklist of the demodecid mites of soricomorphs

Karolina Cierocka, Joanna N. Izdebska, Leszek Rolbiecki

Department of Invertebrate Zoology and Parasitology, Faculty of Biology, University of Gdańsk, Wita Stwosza 59, 80-308 Gdańsk, Poland

Corresponding Author: Joanna N. Izdebska; e-mail: biojni@ug.edu.pl

**ABSTRACT.** Thus far, only six species of parasitic mites of the Demodecidae family have been recorded in hosts from the Soricomorpha: two from the common shrew (*Sorex araneus*), two from the Mediterranean water shrew (*Neomys anomalus*), one from the lesser white-toothed shrew (*Crocidura suaveolens*) and one from the European mole (*Talpa europaea*). The present study describes the identification of *Demodex foveolator* in *C. suaveolens* from the area of Poland (the Wielkopolska region). This is only the second record of this species in the world, a new mite species for the Polish fauna and a new host record in Poland, i.e. the first identification of Demodecidae in *Crocidura* mammals.

**Keywords:** Acariformes, Demodecidae, demodecid mites, *Demodex foveolator*, Soricomorpha, *Crocidura suaveolens*

## Introduction

The lesser white-toothed shrew, *Crocidura suaveolens* (Pallas, 1811) (Soricomorpha: Soricidae), is a palearctic species with a wide distribution ranging from Spain to Siberia [1]. In Poland, it primarily inhabits the western and southern parts of the country, where it constitutes a permanent element of the teriofauna [2].

*Crocidura suaveolens* is relatively infrequently studied in terms of its parasitology. Among the

parasitic arthropods, more is known of the typical ectoparasites, such as fleas Siphonaptera, sucking lice Anoplura (Phthiraptera) and various mite groups (Acariformes, Parasitiformes). However, even this data is fragmentary, and the degree of understanding of individual parasite groups is irregular: while close to 50 arthropod species have been associated with this host in Poland, this body of literature lacks analogous, complex studies from other areas of its distribution [3,4]. Considerably less data is available for the skin and tissue mites of the Demodecidae

Table 1. Checklist of demodecid mites of soricomorphs

Host	Demodecid mites	Occurrence
<i>Crocidura suaveolens</i>	<i>Demodex foveolator</i>	Czech Republic [6], Poland (present)
<i>Neomys anomalus</i> Cabrera, 1907	<i>Apodemodex cornutus</i> Bukva, 1996	Czech Republic [13]
	<i>Demodex neomydis</i> Bukva, 1995	Czech Republic [14]
<i>Sorex araneus</i> Linnaeus, 1758	<i>Demodex soricinus</i> Hirst, 1918 (redescription, Bukva, 1993)	England [15], Czech Republic [16], Poland [17]
	<i>Soricidex dimorphus</i> Bukva, 1982	Czech Republic [18,19], Poland [17]
<i>Talpa europaea</i> , Linnaeus, 1758	<i>Demodex talpae</i> Hirst, 1921	England [20], Poland [21]

family (Acariformes: Prostigmata). Despite the wide distribution of other Soricomorpha, comprising an estimated 440–497 species [1,5], only six species of demodecid mites have been identified by around a dozen studies worldwide (Table 1). For the lesser white-toothed shrew, the only known record of the host-specific *Demodex foveolator* Bukva, 1984 was described from the tail skin region of a host in the Czech Republic [6]; this is surprising as the lesser host is a widely-distributed mammal, being even quite common in the eastern part of its distribution [7].

The present paper is only the second global record of *D. foveolator*. In this case, the host was identified near the north-western border of its European distribution. It was a member of a population in western Poland stretching to the east and south, and has not been observed in the north-east part of the country [2]. This is the first identification of this particular mite species among Polish fauna and represents a new host record of a demodecid mite in *Crocidura* mammals in Poland.

## Materials and Methods

Nine specimens of *C. suaveolens* (four from 2017, three from 2018, two from 2019) collected from Poland (the Wielkopolska region, Słomowo near Września, 52°21'N, 17°33'E) were examined for demodecid mites.

The host skin fragment digestion method was used to recover skin mites [8]. Skin fragments of 1 cm<sup>2</sup> were collected from several body regions, including the head, neck, abdomen, back, limbs and



Fig. 1. *Demodex foveolator* (A: male, B: female, C: deutonymph with pharate female) from *Crocidura suaveolens*

genital-anal area, and tail. Skin samples were preserved in 70% ethanol and digested in 10% KOH solution; samples obtained were decanted and examined using phase-contrast microscopy. Mites were placed in polyvinyl-lactophenol solution and measured (measurements in micrometers). 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.

## Results and Discussion

Six lesser white-toothed shrews, were infected: three from 2017, two from 2018, and one from 2019. Among these, 61 individual demodecid mites

Table 2. Body size (micrometers) for adults and eggs of *Demodex foveolator*

Morphological features	♂ (n = 4)	♀ (n = 40)
Length of gnathosoma	16 (15–20), SD 3	19 (18–22), SD 1
Width of gnathosoma (at base)	22 (20–25), SD 2	24 (20–28), SD 2
Length of podosoma	50 (49–53), SD 1	58 (50–65), SD 4
Width of podosoma	50 (49–50), SD 1	54 (50–61), SD 3
Length of opisthosoma	60 (50–68), SD 7	86 (68–100), SD 8
Width of opisthosoma	46 (45–48), SD 1	50 (43–58), SD 3
Aedeagus	24 (20–28), SD 4	–
Vulva	–	10 (8–14), SD 1
Length and width of eggs*		66×37 (63–69×35–39), SD 3×2
Total length of body	127 (115–140), SD 10	164 (138–182), SD 10

\*measured 3 eggs

Table 3. Body size (micrometers) for immature stages of *Demodex foveolator*

Morphological features	Larva (n = 4)	Protonymph (n = 4)	Deutonymph (n = 9)
Length of gnathosoma	13 (13–14), SD 1	13 (13–15), SD 1	19 (15–25), SD 3
Width of gnathosoma (at base)	20 (20–21), SD 1	24 (23–26), SD 2	27 (23–30), SD 3
Length of podosoma	46 (40–50), SD 5	55 (50–65), SD 7	87 (63–113), SD 13
Width of podosoma	38 (33–45), SD 5	45 (43–50), SD 4	52 (43–68), SD 8
Length of opisthosoma	32 (25–35), SD 5	39 (35–45), SD 4	50 (35–70), SD 11
Width of opisthosoma	33 (28–38), SD 5	38 (35–45), SD 5	45 (33–60), SD 8
Total length of body	91 (78–98), SD 9	108 (101–115), SD 6	155 (116–198), SD 24

and three eggs were obtained and identified as *D. foveolator* (Fig. 1): 40 females, four males, four larvae, four protonymphs, nine deutonymphs. These individuals exhibit the entire set of taxonomic traits included in the species, as described by Bukva [6], and are close in meristic terms (Table 2, 3). The topographic specificity of *D. foveolator* was confirmed, as all mites were found on the skin, in the tail region.

Similarly to the first record [6], the presence of *D. foveolator* in its hosts was asymptomatic. It also exhibited a low infestation intensity, as only 61 individuals were found in six hosts (mean intensity 10.2); whereas Bukva [6] reported the presence of a couple of hundred individuals in 11 from 50 hosts examined. It is difficult to reliably estimate the prevalence of the mite in the lesser white-toothed shrew population. This mammal is rare in Poland, and research on its distribution is typically based on the analysis of owl pellets rather than on dead individuals, collections or observations [2]. It was partly due to this difficulty associated with collecting dead specimens that unfortunately only 9 specimens could be included in the present study; this relatively small number also resulted from the labor- and time-intensive nature of the research method, which was based on digestion and decantation: testing a single skin cutting of approximately 1 cm<sup>2</sup> typically requires the analysis of around 100 wet preparations.

*Demodex foveolator* was found in 66.7% of the studied lesser white-toothed shrews. The fact that the material was collected over a number years suggests that the parasite is regularly present in the tested host population. Furthermore, the fact that the shrew had previously been identified in the same region [9] indicates that this is a constant locality, and that the population may serve as a constant reservoir for this specific parasite.

Data on the presence of the Demodecidae among the Soricomorpha is extremely scarce (Table 1), even compared to the insubstantial body of evidence gathered on the demodecid fauna of other mammals. Among an estimated 125 described species of demodecid mites [10], 56 have been described from rodents [11], 26 from bats [10], and 15 from carnivorans [12]: an order with a lower number of taxa than the Soricomorpha. Although the Soricomorpha constitute close to 8% of species known in their class [5], they have only been associated with six species of demodecid mites, which is less than 5% of all demodecid species described thus far. However, this low number does not reflect their diversity, as soricomorphs have been found to host representatives of three of the seven known genera, including *Apodemodex* and *Soricidex*: two genera which have been described from soricomorphs but not in other mammals thus far.

Furthermore, in two Soricomorpha species, two specific demodecid mite species have been recorded with differing topical and topographic preferences. Similar observations have been made for other mammal groups, particularly rodents, where the skin, tissues and other organs of the hosts form a convenient habitat for several specialized, specific synhospital demodecid mites [11]. Hence, it is possible that the lack of data on the prevalence of Demodecidae in *C. suaveolens* and other Soricomorpha does not stem from the low occurrence and diversity of demodecid mites in this particular host group, but rather from an insufficient number of studies.

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