

Article

The Biodiversity of Demodecid Mites (Acariformes: Prostigmata), Specific Parasites of Mammals with a Global Checklist and a New Finding for *Demodex sciurinus*

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Abstract: Demodecidae are the most specialized parasitic mites of mammals; they typically inhabit the skin, but they have been found in other tissues and organs. They can cause demodecosis (a disease which is hazardous and difficult to cure) in humans, domestic animals and livestock. They are parasites with high host and topical specificity. They have been found for most orders of mammals, and they are common in the populations of numerous host species. Therefore, they not only constitute an important subject of veterinary and medical study, but also comprise an excellent model for faunistic and parasitological analyses concerning different aspects of functioning and evolution of the host–parasite relationship. The current level or knowledge of demodecid mites is irregular and fragmentary, and numerous questions require elaboration and ordering, from the taxonomic diversity to geographic distribution and relations with hosts. Such data may be of use i.a. for the development of more efficient and reliable diagnostic methods, as well as understanding the etiology and pathogenesis mechanisms of demodecosis, currently a contentious issue. The present paper lists all formally-described valid species of demodecid mites, together with other functioning specific names, verified and with comments on their status. This is significant for correct species identification and demodecosis diagnostics. The list has been drawn up on the basis of data acquired in the period 1842–2020. It contains 122 valid species of parasite, including their hosts and geographic distribution, data on parasitism, as well as only the second record of *Demodex sciurinus* in Eurasian red squirrel *Sciurus vulgaris* in over 100 years since its initial discovery.

Keywords: Acariformes; Demodecidae; Prostigmata; checklist; diversity; parasites

1. Introduction

The members of the Demodecidae are specialized, typically monoxenic mammal parasites, and are likely abundant within host populations. They are stationary parasites, with their whole life cycle spent on the host; however, depending on the species, its topography, seasonal dynamics and transmission mechanism, they may exhibit a variable level of infestation prevalence, which may reach up to 100% [1,2]. Typically, the presence of demodecid mites does not produce disease symptoms, even at high infestation intensity and high density on the skin [3–5]. However, under favorable host circumstances, the high density of these mites may be linked to the development of demodecosis (formerly demodicosis, demodicidosis). Demodecosis often has a complicated course, depending on various factors including the species constituting the etiologic factor. Its symptoms typically include the presence of various skin lesions with different topography, hair loss, eyelid margin inflammation and conjunctivitis, and changes within gum

mucous membranes; however, it also can occur in generalized form. Complications may also occur in the form of secondary bacterial or fungal infections. It is suspected that the possibility of developing the parasitosis may be increased by reduced host immunity, poor condition or incorrect diet, such as deficiencies in vitamins and micronutrients [6,7]. Despite the high infestation prevalence in wild mammal populations, demodecosis is observed relatively rarely. However, it constitutes a serious problem for humans, domestic animals and livestock. *Demodecosis canina*, a domestic dog disease, typically caused by *D. canis* is characterized by a particularly hazardous course, with a chronic or even fatal result [2,8]. It has a highly variable course and symptoms, which on the one hand may be linked to the vast diversity of its hosts, with different breeds demonstrating variable susceptibility, as well as etiological factors, as three new species of these mites have been identified in dogs relatively recently (Table 1). Another burdensome and resilient parasitosis is *demodecosis hominis*, caused in humans by the synhospital human demodecid mite *D. brevis*, associated with skin sebaceous glands, and *D. folliculorum*, found in hair follicles. It manifests there typically in the form of skin lesions (e.g., pityriasis folliculorum, rosacea-like demodecidosis, pustular folliculitis, papulo-pustular scalp eruptions, perioral dermatitis and hyperpigmented patches of the face) in the head area (skin and facial hair), hair loss and eyelid margin inflammation, as well as conjunctivitis. The nature of the pathogenesis depends on various factors, such as the etiological agent (i.e., demodecid species), and the symptoms are reminiscent of other dermatoses; therefore, diagnostics, including demodecid species identification, is important for efficient treatment [6]. A number of demodecosis variants, dictated by the host inhabited by the demodecid mite, have been described for cats and cattle, or laboratory animals such as mice and hamsters (Table 1).

Due to their morphological modifications, including miniaturization, or various adaptations to parasitism within the different microhabitats, offered by the skin, tissues and organs of the host, the Demodecidae can claim to be the most specialized parasitic mites of mammals. Moreover, they demonstrate high host and topical specificity, representing the majority of orders of mammals [9]. Their long evolutionary relationship with hosts makes them the perfect model for faunistic or parasitological analyses concerning different aspects of the functioning of a host–parasite relationship and the co-evolution of these mites and their hosts. Although the family includes species of high medical and veterinary importance, their level of recognition is insufficient, and the available information regarding them is fragmentary and dispersed. A series of issues need to be studied and ordered, from taxonomic diversity, to geographic distribution and relations with hosts. In particular, data on their distribution, including their occurrence in different areas of the host range, remains incomplete. The majority of records describe cases of these parasites found in relation to parasitosis (*demodecosis*) symptoms, and these are relatively rare, being restricted mostly to domestic mammals and humans, and are only sporadically observed in wild animals [2,4,10]. Detecting an asymptomatic infestation is complicated by the miniature size of the mite, with the smallest species reaching only 70–80 µm in length, and its secretive life history; in addition, the parasites inhabit a range of skin structures, including normal and sensory hair follicles and different types of glands, as well as a variety of organ tissue types, such as the tongue, gums, anterior segments of the digestive tract or auditory canals [11]. Therefore, certain species, despite inhabiting widely distributed and common hosts, are known only from singular case studies or in sparse records [4,12].

Furthermore, the literature, particularly parasitological and veterinarian studies, encompasses a series of unverified data, including species with an actual *nomen nudum* status, invalid-unauthorized synonyms or information based on doubtful identification [2,10]: The numbers of species classified into this family varies from several dozen to over one hundred depending on the source [10,13,14]. Originally, one comprehensive study existed, covering the 16 then-known species [15], including full data on their distribution and documented records. Only one global checklist, covering 100 species and their hosts, has been published in modern times [13], this being a part of a more extensive study of the Eleutherengona as obligatory mammal parasites. However, it does not include data on records or any validation of the functioning of the names in the literature, and Demodecidae checklists for the selected host group, i.e., rodents and soricomorphs, that have been published [16–18].

The present paper serves as a comprehensive study of all known species, and includes a verification of the unauthorized names, including the *nomen nudum*. Furthermore, it also includes a new record: The

second finding of *Demodex sciurinus* globally, confirming the existence of this species close to one hundred years from its original discovery. Another significant objective of the revision is to organize currently-available Demodecidae records, not only for faunistic purposes, but also for parasitological, veterinary and medical research. A key value of such a summary of the current state of research is that it also highlights the absence of information from numerous countries where demodecid mites, and its relationship with demodectosis, are a significant area of study: In some of these areas, no information on the distribution of demodecid mite species has been published. Our global data also constitute a significant starting point for future, more comprehensive regional analyses, as well as the development of diversity models in the context of host–parasite relationships. These more specific findings would be of great value in the development of more efficient and reliable diagnostic methods, and in improving our understanding of the etiological mechanisms and pathogenesis of demodectosis, which is currently a contentious issue.

2. Materials and Methods

2.1. Detection of Demodecidae in *Sciurus vulgaris*

One squirrel, *Sciurus vulgaris*, originating from northern Poland (Gdynia 54°30' N 18°32' E), collected in 2017, was examined for demodecid mites.

Demodecid mites were isolated using skin digestion methods [19]. Skin fragments of 1 cm² were collected from several body regions, including the head (around eyes, ear pinnae, nose, lips, chin, cheeks and vertex), neck, abdomen, back, limbs, tail and genital-anal area. Skin samples were preserved in 70% ethanol and digested in 10% potassium hydroxide solution. The obtained samples were decanted and analyzed using phase-contrast microscopy; an examination of 1 cm² of skin was equal to the analysis of approximately 100 wet preparations. The mites were mounted in polyvinyl-lactophenol solution and photographed. The following measurements (µm) were taken as follows: Total body length equals length of gnathosoma, podosoma and opisthosoma; gnathosomal width equals width at base; and podosomal and opisthosomal width equals maximum width. The specimens were deposited in scientific collections within the framework of the Collection of Extant Invertebrates in Department of Invertebrate Zoology and Parasitology, University of Gdańsk, Poland (UGDIZP).

2.2. Literature Review—The Checklist Structure, Biogeographic and Parasitological Data Analysis

The checklist has been drawn up based on manuscripts published during the period 1842–2020 (278 items). It also contains a new record, marked in the Table 1 as the present study. Demodecidae species have been listed in systematic order, and in alphabetical order within the genera. The list includes all formally described species and other functioning specific names; all of which are verified and provided with comments on their status. Information on dates of host species, as well as the occurrence have been also included. Wherein, for cosmopolitan demodecid mite species, selected records from various range regions were given. Host records related to unidentified *Demodex* spp. have not been included.

The scientific names, common names, and systematics of the hosts follow Wilson and Reeder [20] and the Taxonomic Information System [21].

3. Results

3.1. A New Record of *Demodex sciurinus*

The examined squirrel specimens were found to have *D. sciurinus* (Table 2, Figure 1). A total number of 13 females and 8 males were identified, as well as several specimens at nymphal stages; male and immature stages were demonstrated for the first time. All mites were found in the skin of the penis. The presence of demodecid mites was not associated with demodecosis symptoms.

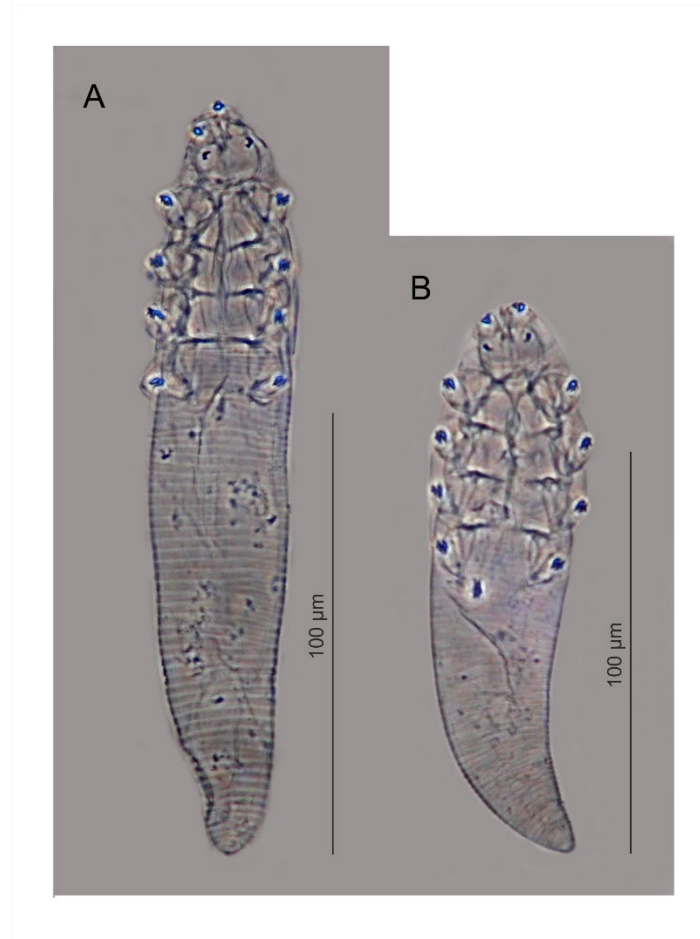


Figure 1. *Demodex sciurinus*: (A) female. (B) male.

3.2. Biodiversity and Geographic Distribution of Demodecidae Mites

A total of 122 demodecid mite species with verified systematic status are presently known, of which one represents *Apodemox*, 106 *Demodex*, one *Glossicodex*, seven *Ophthalmodex*, one *Pterodex*, one *Rhinodex*, one *Soricidex* and four *Stomatodex* (Table 1). Representatives of the Demodecidae have been recorded on all continents outside of the polar regions (Figure 2), and their presence is typically dictated by the presence of a typical host; however, no studies of this group have been conducted in numerous areas of its range, even for common mammal species. Many species of hosts have wide distribution ranges and are also considered cosmopolitan.

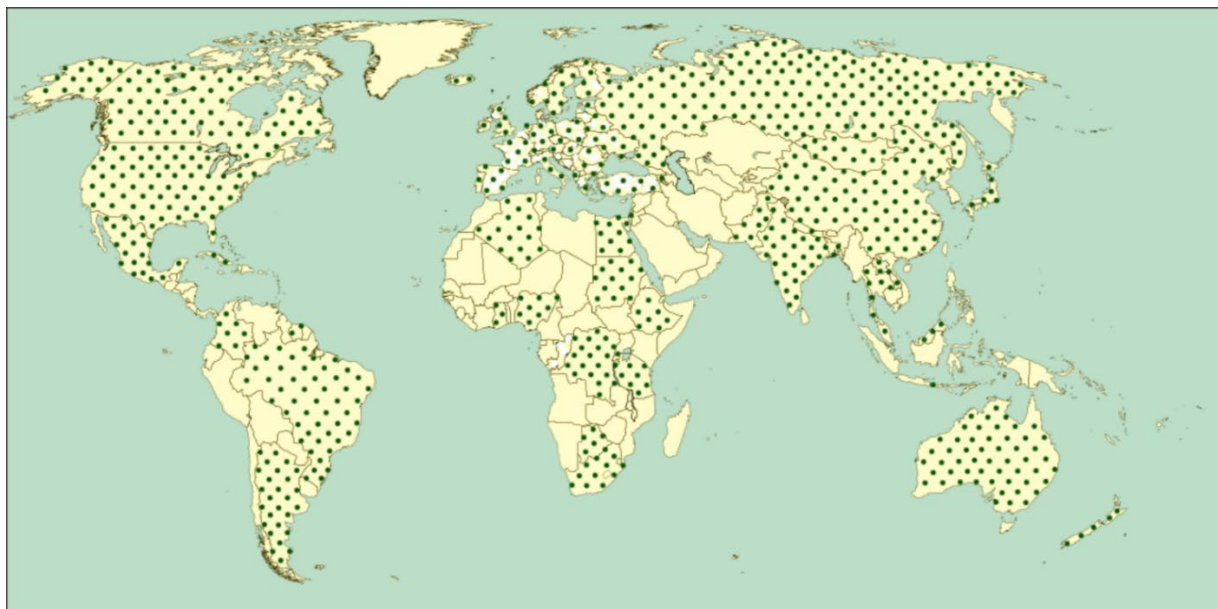


Figure 2. Geographis distribution (green dots) of Demodecidae in the world.

3.3. Demodecidae Parasitism and Relationships with Hosts

The greatest diversity of Demodecidae has, thus far, been described for bats (five genera), followed by rodents (three genera) and soricomorphs (two genera) as hosts; only *Demodex* representatives have been recorded in the remaining mammal orders. In turn, the species diversity in the individual host groups typically corresponds to the species diversity of the host (Figures 3 and 4). Hence the highest number of Demodecidae species have been described from the most abundant groups of mammals, e.g., 43 from rodents, 27 from bats, 17 from ungulates and 15 from carnivorans. In contrast, the Demodecidae from primates (six species) or marsupials (three species) have been especially poorly studied, which may be associated with limited access to the material. More than one species of Demodecidae has been recorded in 27 species of mammals, and the greatest number of synhospital species have been described among rodents and bats (Table 3).

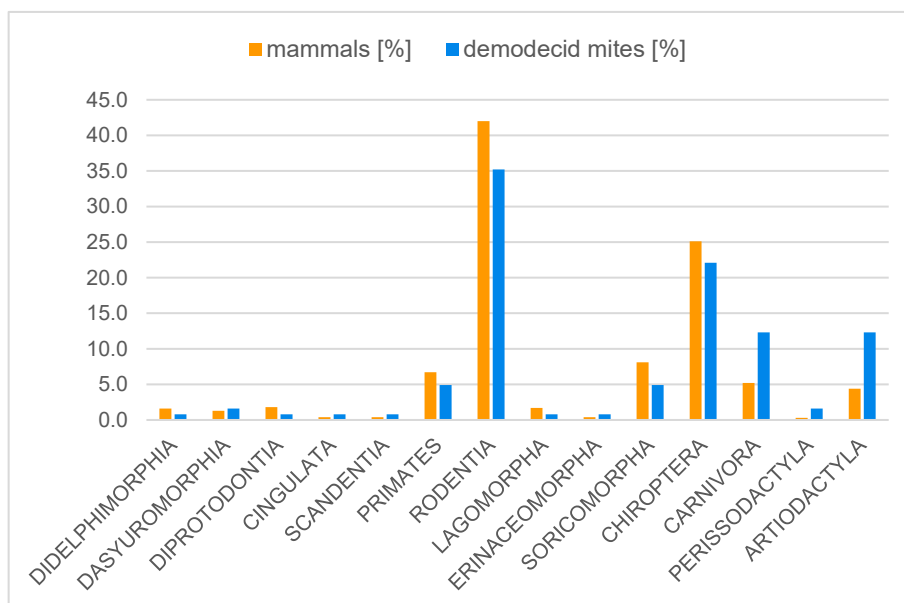


Figure 3. Share (%) of species from particular orders within mammals in comparison with the participation (%) of related demodecid mites.

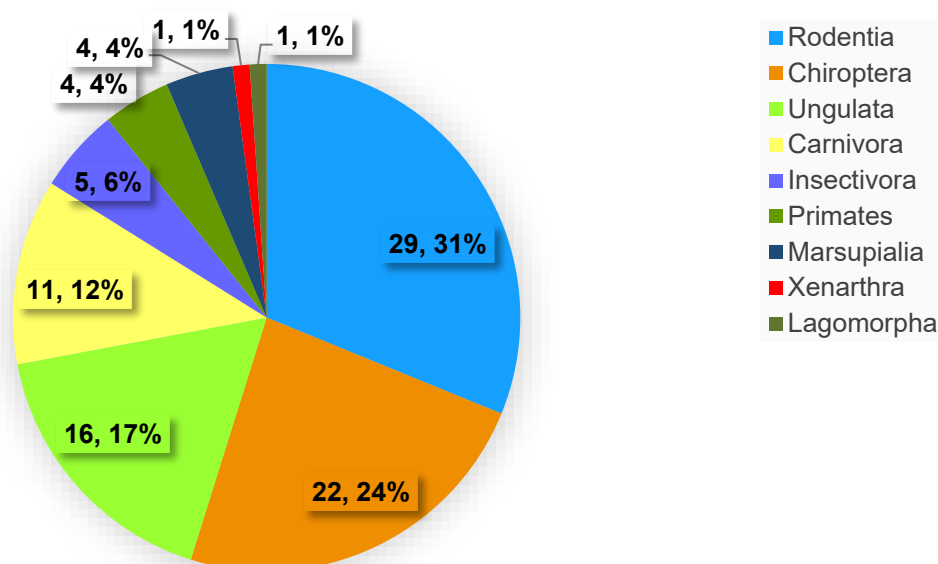


Figure 4. Mammals—hosts of Demodecidae (species number and % of mammals from different orders).

4. Discussion

Although the Demodecidae are associated with almost all of the modern mammalian orders (Table 1), their distribution and occurrence in host populations have been poorly and unevenly studied. This paucity of information has been attributed to the difficulty in detecting asymptomatic infestation, the low number of faunistic studies and issues associated with correct species identification. This is confirmed by the high number of records for demodecid mites without species identification, listed as *Demodex* sp. e.g., [22–29], including valuable new records of hosts.

4.1. Demodecidae Biodiversity Analysis in the Light of Taxonomic Identification Problems

The number of demodecid mite species described thus far (122) does not seem to be very high when considering that over 5000 mammal species could act as potential hosts. This primarily stems from technical issues linked to their detection (e.g., miniature size, secretive life history with rare manifesting of their presence in the form of demodecosis), and the strict species description criteria used for the group: Representative series of specimens of both sexes are used, often with juvenile stages [9,11].

Demodecidae species associated with human, domestic and livestock mammals are an important issue in the comprehensive elaboration of this group. Although demodecid mites have been listed in handbooks and other overview papers, in lists with parasites with data on their pathogenic importance for hosts in different countries and continents, comparatively few published records exist. Therefore, verification of whether these purported Demodecidae indeed occur in these sources, or can be potentially detected in them, has proven difficult. A series of demodecosis descriptions, case studies or clinical studies exist indicating occurrence of individual demodecid mites in a given area; however, these descriptions typically lack the information needed to determine the geographic locality of the parasite or its frequency of occurrence, or whether earlier records exist. Often the identification of the demodecid mite is limited only to the genus e.g., [30–35].

In addition, a number of species with unverified status or *nomen nudum* exist in the parasitological or veterinary literature. As the Demodecidae are monoxenic parasites, hosts are often assigned species solely on the basis of an alleged host specificity. Recording the presence of a *Demodex* species in a new host species suggests a high probability that this species is new to Science; however, this requires an appropriate taxonomic analysis to be conducted and a description in accordance with the International Commission on

Zoological Nomenclature (ICZN) requirements to be published [2,10]. Unfortunately, such newly-discovered taxa have been assigned unsupported names with suitable descriptions; these have also been copied in other publications, thus becoming established in the specialist literature. For instance, the lists of the parasitofauna of the gerbil, a commonly-used laboratory animal, frequently contain a reference to *Demodex merioni* [36,37]: An alleged species not supported with a description and not assigned to any concrete host species, since the term gerbil is used to refer to a multitude of taxa. A similar situation concerned *D. cornei* from the domestic dog. The name had functioned for many years to describe an alleged species referred to as “short form” from the dog epidermis. Although morphological and morphometric research [8,38] has confirmed the existence of such species, the lack of a formal, unambiguous description meant that it was impossible to verify records from different parts of the world, as these were mostly based on the criterion of length, possibly confirmed with topical distinctiveness. Although, eventually, the specific status has been explained and confirmed with an appropriate species description [2], this does not provide any possibility to verify earlier records not supported with morphological characteristics. The groundlessness of using size as a criterion to identify species within the same host has been further confirmed by the discovery of another “short” canine demodexid species, *D. cyonis*. Furthermore, literature data including the *nomina nuda* *D. araneae* and *D. bonaparti* has been published without an appropriate description [39], despite being correctly distinguished by the author: A specialist on Demodecidae research. Likewise, the description of *D. myotidis*, *D. sciurei*, *D. sylvilagi* or *D. transitionalis* were included in an unpublished dissertation, a procedure that does not meet the ICZN criterion on the publication of species descriptions (Table 1).

At present, numerous directions in Demodecidae research have employed molecular methods; however, their outcomes are not reliable given the lack of correlation between morphological taxonomy and molecular divergence. An example here would be *D. “felis”*, which was recorded for the domestic cat in a study solely based on molecular analyses [40]. The authors, who assigned it a temporary name, giving the impression of a species name, stipulate that it is only a working name proposal, intended for the purpose of distinguishing the alleged species, which, according to those authors, differs from other feline demodexid mites e.g., [41–44]. Such a study where cladistics is based solely on molecular data without confirming that the inferred genetic distance is a reliable evidence at the infraspecific level, cannot provide a sufficient basis to assign a species name for an identified demodexid mite; this is especially true as the results, in this case, have not been supported with any other evidence, including morphology, and it cannot be said which taxa they concern. However, despite this irregularity, the species already functions in the veterinary literature at the specific name level.

Another issue in the study of Demodecidae distribution concerns the existence of uncertainties with regards to correct identification. Individual species can differ with regard to sets of characters and small morphological elements which may be only several micrometers in size, sometimes less than 1 μm ; such minute variation requires the use of suitable preparation methods, phase contrast techniques and immersion microscopy, as well as experience in such taxonomic analyses. At the same time, some studies use alleged host specificity or, sometimes, size as the basis for identification; however, the study methods described in the works do not leave any doubt that a correct identification had not been possible. As a host may be associated with different specific Demodecidae species with similar sizes and proportions, any application of the host specificity criterion in species identification is not only insufficient, but also groundless. An accidental transfer onto atypical hosts cannot be excluded, which may happen under favorable conditions, even in the case of highly-specialized parasites.

4.2. State and Perspectives for the Study on Geographic Distribution

In view of presented data, the highest number of species (confirmed records) have been recorded in Poland (51 species), the USA (23), Czech Republic (18) and Great Britain (18). Naturally, this does not stem from any special preferences of the Demodecidae for the hosts occurring in those countries, but it is consequence of sampling bias. A clear contrast can be seen between Demodecidae records obtained from

wild, domestic and livestock mammals. Detections in wild animals are rare, because demodecid mites rarely manifest their presence in the form of *demodecosis*.

It is also possible that the occurrence of the known Demodecidae species is considerably wider than that indicated by the published data, and likely coincides with the ranges of their hosts. This has been confirmed by the latest records of *D. chiropteralis*, *D. melesinus* and, the present record of, *D. sciurinus*: Species formerly known only from individual records from England, and a single observation recorded a hundred years previously from distant Poland. The currently identified individuals of *D. sciurinus* exhibited traits complying with the description and figures published by Hirst [45], despite the description deviating from the modern standards assumed for the Demodecidae taxonomy. Therefore, a redescription will definitely be necessary in the future; this would include an initial description of the juvenile stages, which will be possible after collecting a wider range of material from a greater number of hosts. Current intensive research conducted within the area of Poland has further confirmed the presence of almost all species formerly described from the Czech Republic, the Netherlands or the USA, provided that typical hosts are to be found. It should be added that many species exhibit very high infestation prevalence in the host populations, reaching up to 100% e.g., [1,4,12,18,19].

It is currently important to organize the diverse body of data concerning the occurrence of species of medical and veterinary significance, i.e., to verify and correlate data on the occurrence of demodectosis in various host species with information on the occurrence of the agent species, as confirmed by taxonomic identification.

4.3. Host-Parasite Relationships

The diversity of Demodecidae in individual host groups is typically convergent with the species richness of the host group (Figures 2 and 3). Moreover, the study of this group of species is also related to the incidence rate of demodectosis and the practical importance of hosts, thus the number of species described from carnivores is relatively higher (with regards to the biodiversity of this group) than for other mammals. Among the 17 demodecid mite species described for carnivorous mammals, six originate from domestic dogs and cats. In addition, the availability of material for study, and the technical issues related to detection, are other significant factors. The detection of asymptomatic infestation is labor-intensive, with an efficiency that is inversely proportionate to the host size. It is therefore unsurprising that the highest number of species have been described from small mammals. In contrast, the Demodecidae from primates (six species), or marsupials (three species) have been especially poorly studied, which may be associated with the limited access to the material, with only individual specimens of selected species obtained from zoological gardens being tested, and the fact that certain areas of the world, such as Asia and Australia, are absent from the body of data (Table 1). Therefore, it is possible that the number of existing species is considerably higher than presented herein.

The Demodecidae exhibit high specificity towards hosts (monoxeny). Only five species are considered oligoxenic, i.e., recorded from more than one host; however, all host species were closely related. Of this group, *D. apodemi* and *S. corneti* have been described according to insufficient criteria, based on the current state of knowledge, and hence require redescription. In turn, *D. sabani* and *D. kutzeri* also require taxonomic revision, as they may constitute aggregate species, with their taxa being difficult to distinguish according to morphological criteria; such revision should include additional criteria such as ontogeny, molecular characteristics and parasitological testing. Furthermore, the host status is not always clear, e.g., *D. kutzeri* has been recorded from various deer species, with ambiguous species status (*Cervus canadensis* or *C. elaphus canadensis*).

Demodecid mites are generally characterized by monoxeny and a strict co-evolutionary relationship with their hosts, which is linked with the development of advanced adaptations to parasitism [9]. The mites also tend to inhabit different microhabitats within the host species, and synhospital (co-occurring) species are known to occur [46]. Although such species have been described for rodents, soricomorphs, bats, carnivores, ruminants and primates, the amount of knowledge regarding these species corresponds more to the amount of research performed on their hosts, rather than their actual distribution in the environment

(Table 3). Until recently, the highest number of Demodecidae species were known from *C. perspicillata*, a species of bat that has been thoroughly studied for the presence of these mites (Table 3); in contrast, until the end of the 20th Century, only two demodecid species were known for the house mouse: A cosmopolitan, synanthropic animal used as a laboratory subject, pet or as food for other animals and one of the best-studied mammals. Intensive research conducted in recent years has revealed five further species of parasite, including one from a new genus: *Glossicodex* (Figure 5) [11,47].

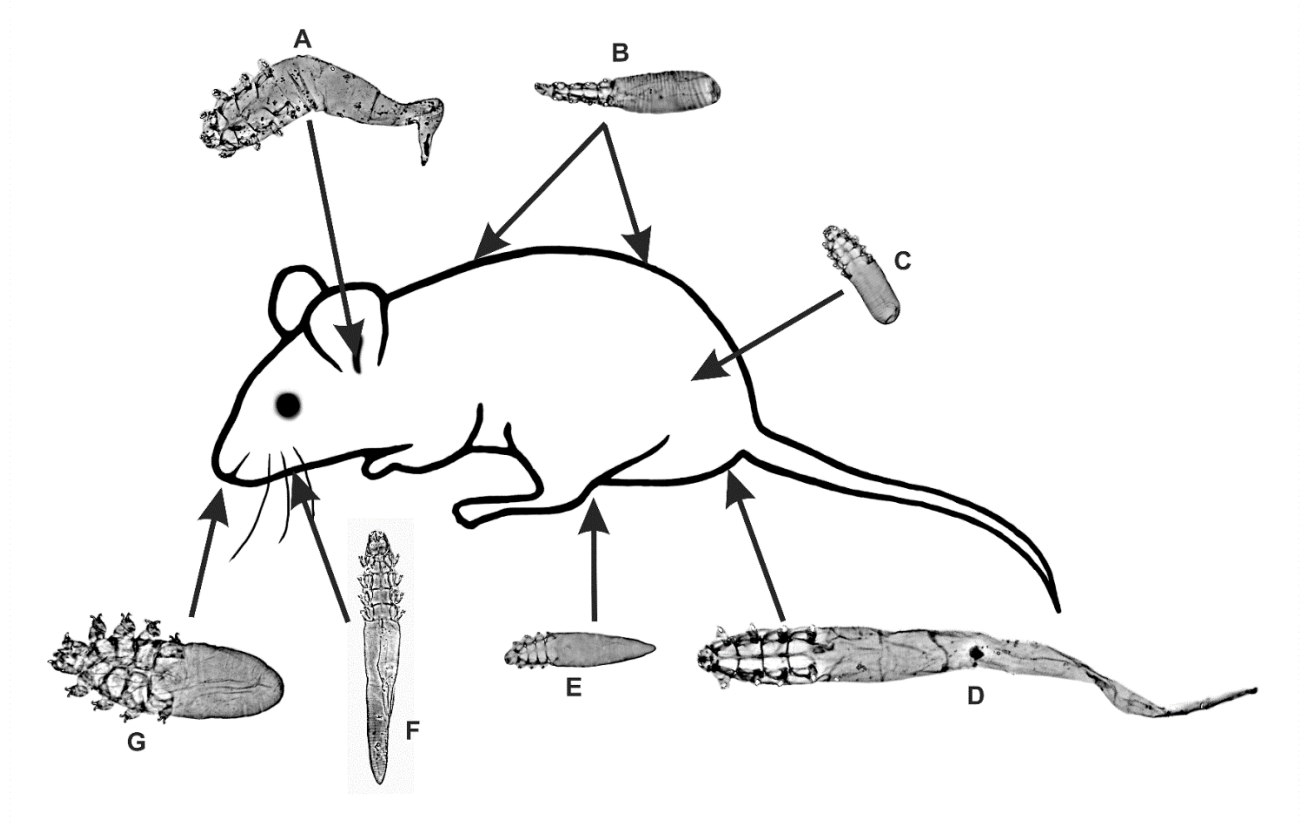


Figure 5. Topographic preferences of demodecid mites in house mouse: (A) *Demodex conicus*. (B) *Demodex muscoli*. (C) *Demodex marculus*. (D) *Demodex flagellurus*. (E) *Demodex fusiformis*. (F) *Demodex vibrissae*. (G) *Glossicodex muscoli*.

Table 1. Checklist of demodecid mites.

Demodecid Mites	Host Species (ordo, family)	Occurrence	Comments to the Status of Demodecid Mite Species
<i>Apodemox cornutus</i> Bukva, 1996	<i>Neomys anomalus</i> Cabrera, 1907 (Soricomorpha, Soricidae)	Czech Republic loc. class. [48]	Valid
<i>Demodex acutipes</i> Bukva and Preisler, 1988	<i>Cervus elaphus</i> Linnaeus, 1758 (Artiodactyla, Cervidae)	Czech Republic loc. class. [49], Poland [50]	Valid
<i>Demodex aelleni</i> Fain, 1960	<i>Myotis daubentonii</i> (Kuhl, 1817) (Chiroptera, Vespertilionidae)	Switzerland loc. class. [51]	Valid
<i>Demodex agrarii</i> Bukva, 1994	<i>Apodemus agrarius</i> (Pallas, 1771) (Rodentia, Muridae)	Poland [46,52], Slovak Republic loc. class. [53]	Valid
<i>Demodex ailuropodae</i> Xu, Xie, Liu, Zhou and Shi, 1986	<i>Ailuropoda melanoleuca</i> (David, 1869) (Carnivora, Ursidae)	China, zoological garden ex situ [54]	Valid
<i>Demodex antechini</i> Nutting and Sweatman, 1970	<i>Antechinus stuartii</i> Macleay, 1841 (Dasyuromorphia, Dasyuridae)	Australia loc. class. [55]	Valid
	<i>Apodemus agrarius</i> (Rodentia, Muridae)	Poland [52], Russia [56]	Valid;
<i>Demodex apodemi</i> Hirst, 1918	<i>Apodemus sylvaticus</i> (Linnaeus, 1758) (Linnaeus, 1758)	Great Britain loc. class [15,57], Poland [58], Russia [56]	described by Hirst [57], next considered as a subspecies <i>D.</i> <i>arvicolae</i> var. <i>apodemi</i> [15], and verified by Izdebska [16] as <i>D.</i> <i>apodemi</i> ; specimens from <i>A. agrarius</i> , probably belongs to the separate species
<i>Demodex araneae</i> Nutting, 1950	<i>Ateles</i> sp. (Primates, Atelidae)	Nutting [39] after Nutting [59]	Nom. nud.; description not published within the meaning of the ICZN

<i>Demodex aries</i> Desch, 1986	<i>Ovis aries</i> Linnaeus, 1758 (Artiodactyla, Bovidae)	New Zealand loc. class [60], Czech Republic [61]	Valid
<i>Demodex artibeii</i> Vargas, Bassols, Desch, Quintero and Polaco, 1995	<i>Artibeus aztecus</i> K. Andersen, 1906 (Chiroptera, Phyllostomidae)	Mexico loc. class. [62]	Valid
<i>Demodex arvicolae</i> Zschokke, 1888	<i>Microtus agrestis</i> (Linnaeus, 1761) (Rodentia, Cricetidae)	Astrahan/Europe on the border with Asia [56], Europe loc. class. [15]	Valid; the record from the <i>M. arvalis</i> is questionable; maybe <i>D. microti</i> was found
	<i>Microtus arvalis</i> (Pallas, 1778) (Rodentia, Cricetidae)	Astrahan/Europe on the border with Asia [56]	
<i>Demodex aurati</i> Nutting, 1961	<i>Mesocricetus auratus</i> (Waterhouse, 1839) (Rodentia, Cricetidae)	Described and finding in laboratory animals, e.g., ex situ [37,63–69]	Valid
<i>Demodex auricularis</i> Izdebska, Rolbiecki and Fryderyk, 2014	<i>Apodemus sylvaticus</i> (Rodentia, Muridae)	Poland loc. class. [58]	Valid
<i>Demodex bandicotae</i> Izdebska, Rolbiecki, Morand and Ribas, 2017	<i>Bandicota indica</i> (Beschstein, 1800) (Rodentia, Muridae)	Laos loc. class. [17]	Valid
<i>Demodex bantengi</i> Firda, Nutting and Sweatman, 1987	<i>Bos javanicus</i> d'Alton, 1823 (Artiodactyla, Bovidae)	Bali loc. class. [70]	Valid
<i>Demodex bicaudatus</i> Kniest and Lukoschus, 1981	<i>Macroglossus minimus</i> (E. Geoffroy, 1810) (Chiroptera, Pteropodidae)	Australia loc. class. [71]	Valid
<i>Demodex bisonianus</i> Kadulski and Izdebska, 1996	<i>Bison bonasus</i> (Linnaeus, 1758) (Artiodactyla, Bovidae)	Poland loc. class. [72,73–78]	Valid
<i>Demodex bonapartei</i> Nutting, 1950	<i>Mustela erminea cicognanii</i> Bonaparte, 1838 (Carnivora, Mustelidae)	Nutting [39] after Nutting [59]	Nom. nud.; description not published within the meaning of the ICZN

<i>Demodex bovis</i> Stiles, 1892 (redescription Desch and Nutting 1971)	<i>Bos taurus</i> Linnaeus, 1758 (Artiodactyla, Bovidae)	Probably cosmopolitan, e.g., s. loc. [79], Egypt [80], Ethiopia [81], Nigeria [82], Sudan [83–85], Canada [86], USA [87], Argentina [88], Colombia [89], India [90], Mongolia [91], New Zealand [92,93], Czech Republic [94], Germany [95], Hungary [96], Italy [97], Poland [78,98]	Valid; European bison - an accidental finding in a closed farm
	<i>Bos taurus indicus</i> Linnaeus, 1758 (Artiodactyla, Bovidae) [<i>B. indicus</i> given by the Authors [99] is actually <i>B. t. indicus</i>]	Brazil [99]	
	<i>Bison bonasus</i> (Artiodactyla, Bovidae)	Poland, in the breeding condition ex situ [74,77]	
<i>Demodex brevis</i> Akbulatova, 1963 (redescription, Desch and Nutting 1972)	<i>Homo sapiens</i> Linnaeus, 1758 (Primates, Hominidae)	Cosmopolitan, e.g., USA [100–102], China [103,104], Australia [105], New Zealand [93], Poland [106], Russia loc. class. [107], Turkey [108–110]	Valid
<i>Demodex buccalis</i> Bukva, Vítovec and Vlček 1985	<i>Myodes glareolus</i> (Schreber, 1780) (Rodentia, Cricetidae)	Czech Republic loc. class [111], Poland [112]	Valid
<i>Demodex caballi</i> (Railliet, 1895) (redescription, Desch and Nutting 1978)	<i>Equus caballus</i> Linnaeus, 1758 (Perissodactyla, Equidae)	Probably cosmopolitan, e.g., s. loc. [113], USA [114,115], New Zealand [116]	Valid
<i>Demodex cafferi</i> Nutting and Guilfooy, 1979	<i>Syncerus caffer</i> (Sparman, 1779) (Artiodactyla, Bovidae)	Botswana loc. class. [117], Republic of South Africa [118,119]	Valid
<i>Demodex canis</i> (Leydig, 1859) (redescription, Nutting and Desch, 1978)	<i>Canis lupus familiaris</i> Linnaeus, 1758 (Carnivora, Canidae)	Probably cosmopolitan, e.g., s. loc. [120], USA [121], Colombia [122], Cuba [123], India [124–126], Nepal [127], Pakistan [128], Thailand [129], New Zealand [93,130], Bangladesh [131], Poland [2,8,38,132,133], Russia [134], Turkey [135]	Valid
<i>Demodex caprae</i> Railliet, 1895	<i>Capra hircus</i> Linnaeus, 1758 (Artiodactyla, Bovidae)	Probably cosmopolitan, e.g., Ethiopia [136], China [137], New Zealand [93], Czech Republic [138], France loc. class. [113], Poland [139], Switzerland [113,140]	Valid

<i>Demodex carolliae</i> Desch, Lebel, Nutting and Lukoschus, 1971	<i>Carollia perspicillata</i> (Linnaeus, 1758) (Chiroptera, Phyllostomidae)	Republic of Suriname loc. class. [141]	Valid
<i>Demodex castoris</i> Izdebska, Fryderyk and Rolbiecki, 2016	<i>Castor fiber</i> Linnaeus, 1758 (Rodentia, Castoridae)	Poland loc. class. [142]	Valid
<i>Demodex cati</i> Megnin, 1877 (redescription, Desch and Nutting, 1979)	<i>Felis catus</i> Linnaeus, 1758 (Carnivora, Felidae)	Probably cosmopolitan, e.g., s. loc. [143], USA [144,145], Brazil [146], New Zealand [116], Bulgaria [147], Germany [148], Great Britain [15], Italy [149], Poland [132], Spain [150]	Valid
<i>Demodex caviae</i> Bacigalupo and Roveda, 1954	<i>Cavia porcellus</i> (Linnaeus, 1758) (Rodentia, Caviidae)	Described and finding in laboratory animals, e.g., ex situ [151–153]	Valid
<i>Demodex cervi</i> Prietsch, 1886	<i>Rusa unicolor</i> (Kerr, 1792) (Artiodactyla, Cervidae)	Germany ex situ [154]	Valid; hom. for <i>D. cervi</i> sensu Kutzer and Grünberg, 1972 (see <i>D. kutzeri</i>)
<i>Demodex chiropteralis</i> Hirst, 1921	<i>Plecotus auritus</i> (Linnaeus, 1758) (Chiroptera, Vespertilionidae)	Great Britain loc. class. [155], Poland [12]	Valid
<i>Demodex conicus</i> Izdebska and Rolbiecki, 2015	<i>Mus musculus</i> Linnaeus, 1758 (Rodentia, Muridae)	Poland loc. class. [156]	Valid
<i>Demodex cornei</i> : Izdebska and Rolbiecki, 2018	<i>Canis lupus familiaris</i> Linnaeus, 1758 (Carnivora, Canidae)	Probably cosmopolitan, Poland loc. class. [2]	Valid; records before 2018 have uncertain status, except Izdebska [8] and Izdebska and Fryderyk [38]
<i>Demodex corniculatus</i> Izdebska, 2012	<i>Apodemus flavicollis</i> (Melchior, 1834) (Rodentia, Muridae)	Poland loc. class. [1,16]	Valid
<i>Demodex criceti</i> Nutting and Rauch, 1958	<i>Mesocricetus auratus</i> (Waterhouse, 1839) (Rodentia, Cricetidae)	Described and finding in laboratory animals, e.g., ex situ [37,65,66,68,69,157]	Valid

<i>Demodex cricetuli</i> Hurley and Desch, 1994	<i>Cricetulus migratorius</i> (Rodentia, Cricetidae)	Described in laboratory animals ex situ [158]	Valid
<i>Demodex cuniculi</i> Pfeiffer, 1903	<i>Oryctolagus cuniculus</i> (Linnaeus, 1758) (Lagomorpha, Leporidae)	In the breeding condition, e.g., China [15], Great Britain loc. class. [15,159]	Valid
<i>Demodex cyonis</i> Morita, Ohmi, Kiwaki, Ike and Nagata, 2018	<i>Canis lupus familiaris</i> Linnaeus, 1758 (Carnivora, Canidae)	Japan loc. class. [160]	Valid
<i>Demodex dasypodi</i> Desch and Stewart, 2002	<i>Dasypus novemcinctus</i> Linnaeus, 1758 (Cingulata, Dasypodidae)	USA loc. class. [161]	Valid
<i>Demodex desmodi</i> Desch, 1994	<i>Desmodus rotundus</i> (E. Geoffroy, 1810) (Chiroptera, Phyllostomidae)	Republic of Suriname loc. class. [162]	Valid
<i>Demodex erinacei</i> Hirst, 1917	<i>Erinaceus europaeus</i> Linnaeus, 1758 (Erinaceomorpha, Erinaceidae)	Great Britain loc. class. [163]	Valid
<i>Demodex erminae</i> Hirst, 1919	<i>Mustela erminea</i> Linnaeus, 1758 (Carnivora, Mustelidae)	New Zealand [93], Great Britain loc. class.[15]	Valid
<i>Demodex equi</i> Railliet, 1895	<i>Equus caballus</i> Linnaeus, 1758 (Perissodactyla, Equidae)	Probably cosmopolitan, e.g., s. loc. [113], USA [164], Great Britain [15], Poland [165]	Valid
<i>Demodex felis</i>	<i>Felis catus</i> Linnaeus, 1758 (Carnivora, Felidae)	[40]	Nom. nud.
<i>Demodex flagellurus</i> Bukva, 1985	<i>Mus musculus</i> (Rodentia, Muridae)	Czech Republic loc. class. [166], Poland [167–169]	Valid
<i>Demodex folliculorum</i> (Simon, 1842) (redescription Desch and Nutting, 1972)	<i>Homo sapiens</i> (Primates, Hominidae)	Cosmopolitan, e.g., Algeria [170], Egypt [171], USA [100,101], China [103], India [172,173], Australia [105], New Zealand [93,130], Belgium [174], Croatia [175], Germany loc. class. [176], Great Britain [177], Greece [178], Iceland [179], Ireland [180], Poland [106], Turkey [108–110,181,182]	Valid
<i>Demodex folliculorum sinensis</i> Xie, Liu, Hsu and Hsu, 1982	<i>Homo sapiens</i> (Primates, Hominidae)	China [183]	

<i>Demodex foveolator</i> Bukva, 1984	<i>Crocidura suaveolens</i> (Pallas, 1811) (Soricomorpha, Soricidae)	Czech Republic loc. class. [184], Poland [18]	Valid
<i>Demodex fusiformis</i> Izdebska and Rolbiecki, 2015	<i>Mus musculus</i> (Rodentia, Muridae)	Poland loc. class. [169]	Valid
<i>Demodex gapperi</i> Nutting, Emejuaiwe and Tisolel, 1971	<i>Myodes gapperi</i> (Rodentia, Cricetidae)	USA loc. class. [185]	Valid
<i>Demodex gatoi</i> Desch and Stewart, 1999	<i>Felis catus</i> Linnaeus, 1758 (Carnivora, Felidae)	USA loc. class. [186,187], Austria [188], Finland [189], Poland [44,132], Spain [150])	Valid
<i>Demodex ghanensis</i> Oppong, Lee and Yasin, 1975	<i>Bos taurus</i> (Artiodactyla, Bovidae)	Ghana loc. class. [190], Sudan [83]	Valid
<i>Demodex glareoli</i> Hirst, 1919	<i>Myodes glareolus</i> (Rodentia, Cricetidae)	Great Britain loc. class. [15], Poland [112]	Valid; described by Hirst [15] as a subspecies <i>D. arvicolae</i> var. <i>glareoli</i> , than verified by Izdebska [112] as <i>D. glareoli</i>
<i>Demodex gliricolens</i> Hirst, 1921	<i>Arvicola amphibius</i> (Linnaeus, 1758) (Rodentia, Cricetidae)	Great Britain loc. class. [155]	Valid
<i>Demodex gracilentus</i> Izdebska and Rolbiecki, 2013	<i>Apodemus agrarius</i> (Rodentia, Muridae)	Poland loc. class. [46]	Valid
<i>Demodex huttereri</i> Mertens, Lukoschus and Nutting, 1983	<i>Apodemus agrarius</i> (Rodentia, Muridae)	Germany loc. class. [191], Poland [192]	Valid
<i>Demodex injai</i> Desch and Hillier, 2003	<i>Canis lupus familiaris</i> Linnaeus, 1758 (Carnivora, Canidae)	Probably cosmopolitan, USA loc. class. [193], Brazil [194], Spain [195], Poland [8,38]	Valid

<i>Demodex intermedius</i> Lukoschus, Mertesn, Nutting and Nadchatram, 1984	<i>Tupaia glis</i> (Diard, 1820) (Scandentia, Tupaiidae)	Malaysia loc. class. [196]	Valid
	<i>Alces alces</i> (Linnaeus, 1758) (Artiodactyla, Cervidae)	Poland [197]	
	<i>Capreolus capreolus</i> (Linnaeus, 1758) (Artiodactyla, Cervidae)	Poland [198,199]	
	<i>Cervus elaphus</i> Linnaeus, 1758 (Artiodactyla, Cervidae)	Austria [200], Czech Republic loc. class. [154], Poland [198,201]	
<i>Demodex kutzeri</i> Bukva, 1987	<i>Cervus elaphus nelsoni</i> Nelson, 1902 (Artiodactyla, Cervidae)	USA [202,203]	Valid; (= <i>D. cervi</i> sensu Kutzer and Grünberg, 1972; hom. for <i>D.</i> <i>cervi</i> Prietsch, 1886)
	<i>Cervus nippon pseudaxis</i> Gervais, 1841 (Artiodactyla, Cervidae)	Berlin, zoological garden ex situ [154]	
	<i>Dama dama</i> (Linnaeus, 1758)	Poland [204]	
	<i>Odocoileus hemionus hemionus</i> (Rafinesque, 1817) (Artiodactyla, Cervidae)	USA [202,203]	
	<i>Odocoileus virginianus</i> (Zimmermann, 1780) (Artiodactyla, Cervidae)	USA [202]	
<i>Demodex lacrimalis</i> Lukoschus and Jongman, 1974	<i>Apodemus sylvaticus</i> (Rodentia, Muridae)	Italy [205], Netherlands loc. class. [205], Poland [206]	Valid
<i>Demodex leucogasteri</i> Hughes and Nutting, 1981	<i>Onychomys leucogaster</i> (Wied- Neuwied, 1841) (Rodentia, Cricetidae)	USA loc. class. [207]	Valid
<i>Demodex longior</i> Hirst, 1918	<i>Apodemus sylvaticus</i> (Rodentia, Muridae)	Great Britain loc. class. [15,57], Poland [46], Russia [56]	Valid
<i>Demodex longissimus</i> Desch, Nutting and Lukoschus, 1972	<i>Carollia perspicillata</i> (Chiroptera, Phyllostomidae)	Republic of Suriname loc. class. [208]	Valid

<i>Demodex lutrae</i> Izdebska and Rolbiecki, 2014	<i>Lutra lutra</i> (Linnaeus, 1758) (Carnivora, Mustelidae)	Poland loc. class. [3]	Valid
<i>Demodex macaci</i> Karjala, Desch and Starost, 2005	<i>Macaca mulatta</i> (Zimmermann, 1780) (Primates, Cercopithecidae)	USA, laboratory colony ex situ [209]	Valid
<i>Demodex macroglossi</i> Desch, 1981	<i>Macroglossus minimus</i> (Chiroptera, Pteropodidae)	Australia loc. class. [210]	Valid
<i>Demodex marculus</i> Izdebska and Rolbiecki, 2015	<i>Mus musculus</i> (Rodentia, Muridae)	Poland loc. class. [169]	Valid
<i>Demodex marsupiali</i> Nutting, Lukoschus and Desch, 1980	<i>Didelphis marsupialis</i> Linnaeus, 1758 (Didelphimorphia, Didelphidae)	Republic of Surinam loc. class. [211]	Valid
<i>Demodex melanopteri</i> Lukoschus, Jongman and Nutting, 1972	<i>Eptesicus brasiliensis melanopterus</i> (Jentink, 1904) (Chiroptera, Vespertilionidae) [<i>E. melanopterus</i> given by the Authors [212] is actually <i>E. b. melanopterus</i>]	Republic of Suriname loc. class. [212]	Valid
<i>Demodex melesinus</i> Hirst, 1921	<i>Meles meles</i> (Linnaeus, 1758) (Carnivora, Mustelidae)	Great Britain loc. class. [213], Poland [4]	Valid
<i>Demodex merioni</i> (=meriones)	<i>Meriones</i> spp. (Rodentia, Muridae)	Finding in laboratory animals, e.g. [36,37]	Nom. nud.
<i>Demodex mexicanus</i> Vargas, Bassols, Desch, Quintero and Polaco, 1995	<i>Corynorhinus mexicanus</i> G. M. Allen, 1916 (Chiroptera, Vespertilionidae)	Mexico loc. class. [62]	Valid
<i>Demodex microti</i> Izdebska and Rolbiecki, 2013	<i>Microtus arvalis</i> (Rodentia, Cricetidae)	Poland loc. class. [214]	Valid

<i>Demodex mollis</i> Izdebska, Rolbiecki, Fryderyk and Mierzyński, 2017	<i>Apodemus flavicollis</i> (Rodentia, Muridae)	Poland loc. class. [1]	Valid
<i>Demodex molossi</i> Desch, Nutting and Lukoschus, 1972	<i>Molossus molossus</i> (Pallas, 1766) (Chiroptera, Molossidae)	Republic of Suriname loc. class. [208]	Valid
<i>Demodex muscardini</i> Hirst, 1917	<i>Muscardinus avellanarius</i> (Linnaeus, 1758) (Rodentia, Gliridae)	Armenia [56], Great Britain loc. class. [15,163]	Valid
<i>Demodex musculi</i> Oudemans, 1897 (redescription, Izdebska and Rolbiecki, 2015)	<i>Mus musculus</i> (Rodentia, Muridae)	Europe [15], ds loc. class. [215], Poland [167,169], Russia [56], Spain [216]; laboratory animals, e.g., ex situ [7,217,218]	Valid
<i>Demodex myotidis</i>	<i>Myotis lucifugus lucifugus</i> (Le Conte, 1831) (Chiroptera, Vespertilionidae)	Nutting [39] after Nutting [59]	Nom. nud.; description not published within the meaning of the ICZN
	<i>Myotis septentrionalis</i> Trouessart, 1897 (Chiroptera, Vespertilionidae)	Nutting [39] after Di Benedetto [219]	
	<i>Eptesicus fuscus</i> (Beauvois, 1796) (Chiroptera, Vespertilionidae)	Nutting [39] after Di Benedetto [219]	
<i>Demodex mystacina</i> Desch, 1989	<i>Mystacina tuberculata</i> Gray, 1843 (Chiroptera, Mystacinidae)	New Zealand loc. class. [220]	Valid
<i>Demodex nanus</i> Hirst, 1918 (redescription Desch, 1987)	<i>Rattus norvegicus</i> (Berkenhout, 1769) (Rodentia, Muridae)	Great Britain [57], Poland [19,221,222], Russia [56]; laboratory animals ex situ [223]	Valid
	<i>Rattus rattus</i> (Linnaeus, 1758) (Rodentia, Muridae)	New Zealand [223], Great Britain loc. class. [57], Russia [56]	
<i>Demodex neomydis</i> Bukva, 1995	<i>Neomys anomalus</i> (Soricomorpha, Soricidae)	Czech Republic loc. class. [224]	Valid

<i>Demodex neopisthosomae</i> Desch, Lukoschus and Nadchatram, 1986	<i>Eonycteris spelaea</i> (Dobson, 1871) (Chiroptera, Pteropodidae)	Malaysia loc. class. [225]	Valid
<i>Demodex norvegicus</i> Bukva, 1995	<i>Rattus norvegicus</i> (Rodentia, Muridae)	Czech Republic loc. class. [226], Poland [19,221,222]	Valid
<i>Demodex novazelandica</i> Desch, 1989	<i>Mystacina tuberculata</i> (Chiroptera, Mystacinidae)	New Zealand loc. class. [220]	Valid
<i>Demodex nycticeii</i> Desch, 1996	<i>Nycticeius humeralis</i> (Rafinesque, 1818) (Chiroptera, Vespertilionidae)	USA loc. class. [227]	Valid
<i>Demodex odocoilei</i> Desch and Nutting, 1974	<i>Odocoileus virginianus</i> (Artiodactyla, Cervidae)	USA loc. class. [228]	Valid
	<i>Odocoileus hemionus</i> <i>columbianus</i> (Richardson, 1829) (Artiodactyla, Cervidae)	USA [229]	
<i>Demodex ovis</i> Railliet, 1895 (redescription, Desch 1986)	<i>Ovis aries</i> (Artiodactyla, Bovidae)	s. loc. [113], Australia [60], New Zeland [60], Czech Republic [61], Israel [230], Poland [231]	Valid
<i>Demodex peromysci</i> Lambert, Lukoschus and Whitaker, 1983	<i>Peromyscus leucopus</i> (Rafinesque, 1818) (Rodentia, Cricetidae)	USA loc. class. [232]	Valid
<i>Demodex phocidi</i> Desch, Dailey and Tuomi, 2003	<i>Phoca vitulina</i> Linnaeus, 1758 (Carnivora, Phocidae)	USA, sealife center ex situ [233], Poland in situ [5]	Valid
<i>Demodex phodopi</i> Desch, Davis and Klompen, 2006	<i>Phodopus sungorus</i> (Pallas, 1773) (Rodentia, Cricetidae)	Described in laboratory animals ex situ [234]	Valid
<i>Demodex phylloides</i> Csokor, 1879	<i>Sus scrofa scrofa</i> Linnaeus, 1758 (Artiodactyla, Suidae)	Poland [235–238]	Valid
	<i>Sus scrofa domesticus</i> Erxleben, 1777 (Artiodactyla, Suidae)	Probably cosmopolitan, e.g., Tanzania [239], Canada [240], USA [87], Brasil [241,242], New Zealand [93,130], historical Galicia loc. class. [243], Italy [244]	

<i>Demodex phyllostomatis</i> Leydig, 1859	<i>Phyllostomus hastatus</i> (Pallas, 1767) (Chiroptera, Phyllostomidae)	Republic of Suriname loc. class. [51,120]	Valid
<i>Demodex plecoti</i> Izdebska Rolbiecki, Mierzyński and Bidziński, 2019	<i>Plecotus auritus</i> (Chiroptera, Vespertilionidae)	Poland loc. class. [10]	Valid
<i>Demodex ponderosus</i> Izdebska and Rolbiecki, 2014	<i>Rattus norvegicus</i> (Rodentia, Muridae)	Poland loc. class. [222]	Valid
<i>Demodex pseudaxis</i> Schpringol'ts-Schmidt, 1937	<i>Cervus nippon hortulorum</i> Swinhoe, 1864 (Artiodactyla, Cervidae)	Russia/Far east [245]	Valid; need verification
<i>Demodex ratti</i> Hirst, 1917 (redescription Bukva, 1995)	<i>Rattus norvegicus</i> (Rodentia, Muridae)	Czech Republic [226], Europe, s. loc. [15,246], Poland [19,221,222,246–248], Russia [56]	Valid
<i>Demodex ratticola</i> Bukva, 1995	<i>Rattus norvegicus</i> (Rodentia, Muridae)	Czech Republic loc. class. [226], Poland [222,247,248]	Valid
<i>Demodex rosus</i> Bukva, Vítovec and Vlček, 1985	<i>Apodemus flavicollis</i> (Rodentia, Muridae)	Czech Republic loc. class. [111], Poland [249]	Valid
<i>Demodex sabani</i> Desch, Lukoschus and Nadchatram, 1984	<i>Leopoldamys edwardsi</i> (Thomas, 1882) (Rodentia, Muridae)	Malaysia [250]	Valid
	<i>Leopoldamys sabanus</i> (Thomas, 1887) (Rodentia, Muridae)	Malaysia loc. class. [250]	
	<i>Niviventer cremoriventer</i> (Miller, 1900) (Rodentia, Muridae)	Malaysia [250]	
	<i>Niviventer rapit</i> (Bonhote, 1903) (Rodentia, Muridae)	Malaysia [250]	
	<i>Rattus annandalei</i> (Bonhote, 1903) (Rodentia, Muridae)	Malaysia [250]	
	<i>Rattus tiomanicus</i> (Miller, 1900) (Rodentia, Muridae)	Malaysia [250]	

	<i>Sundamys muelleri</i> (Jentink, 1879) (Rodentia, Muridae)	Malaysia [250]	
<i>Demodex saimiri</i> Lebel and Nutting 1973	<i>Saimiri sciureus</i> (Linnaeus, 1758) (Primates, Cebidae)	Biological supply houses ex situ [251]	Valid
<i>Demodex sciurei</i> Lebel, 1970	<i>Saimiri sciureus</i> (Primates, Cebidae)	[252]	Nom. nud.; description not published within the meaning of the ICZN
<i>Demodex sciurinus</i> Hirst, 1923	<i>Sciurus vulgaris</i> Linnaeus, 1758 (Rodentia, Sciuridae)	Great Britain loc. class. [45], Poland [present study]	Valid
<i>Demodex sinocricetuli</i> Desch and Hurley, 1997	<i>Cricetulus barabensis</i> (Pallas, 1773) (Rodentia, Cricetidae)	laboratory animals ex situ [253]	Valid
	<i>Plecotus auritus</i> (Chiroptera, Vespertilionidae)	Great Britain [57,155]	
<i>Demodex soricinus</i> Hirst, 1918 (redescription Bukva, 1993)	<i>Sorex araneus</i> Linnaeus, 1758 (Soricomorpha, Soricidae) [<i>S. vulgaris</i> given by the Author [57] is actually <i>S. araneus</i>]	Czech Republic [254], Great Britain loc. class. [57], Poland [255]	Valid; <i>P. auritus</i> -probably wrong host record
<i>Demodex spelaea</i> Desch, Lukoschus and Nadchatram, 1986	<i>Eonycteris spelaea</i> (Chiroptera, Pteropodidae)	Malaysia loc. class. [225]	Valid
<i>Demodex suis</i> (Kadlec, 1975)	<i>Sus scrofa domesticus</i> (Artiodactyla, Suidae)	s. loc. [256], s. loc. [257], Czech Republic [258]	Nom abort.; syn. <i>D. phylloides</i>
<i>Demodex sungori</i> Desch, Davis and Klompen, 2006	<i>Phodopus sungorus</i> (Rodentia, Cricetidae)	Described in laboratory animals ex situ [234]	Valid
<i>Demodex sylvilagi</i> Maravelas, 1962	<i>Sylvilagus transitionalis</i> (Bangs, 1895) (Lagomorpha, Leporidae)	Nutting [39] after Maravelas [259]	Nom. nud.; description not published within the meaning of the ICZN
<i>Demodex talpae</i> Hirst, 1921	<i>Talpa europaea</i> Linnaeus, 1758 (Soricomorpha, Talpidae)	Great Britain loc. class. [155], Poland [260]	Valid
<i>Demodex tauri</i> Bukva, 1986	<i>Bos taurus</i> (Artiodactyla, Bovidae)	Czech Republic loc. class. [261]	Valid

<i>Demodex tigris</i> Shi, Xie and Hsu, 1985	<i>Panthera tigris amoyensis</i> (Hilzheimer, 1905) (Carnivora, Felidae)	China, zoological garden ex situ [262]	Valid
<i>Demodex tortellinioides</i> Desch and Holz, 2006	<i>Antechinus agilis</i> Dickman, Parnaby, Crowther and King, 1998 (Dasyuromorphia, Dasyuridae)	Australia loc. class. [263]	Valid
<i>Demodex transitionalis</i> Moravelas, 1962	<i>Sylvilagus transitionalis</i> (Bangs, 1895) (Lagomorpha, Leporidae)	Nutting [39] after Maravelas [259]	Nom. nud.; description not published within the meaning of the ICZN
<i>Demodex uncii</i> Desch, 1993	<i>Uncia uncia</i> (Schreber, 1775) (Carnivora, Felidae)	USA, zoological garden ex situ Desch [264]	Valid
<i>Demodex ursi</i> Desch, 1995	<i>Ursus americanus</i> Pallas, 1780 (Carnivora, Ursidae)	USA loc. class. [265,266]	Valid
<i>Demodex vibrissae</i> Izdebska, Rolbiecki and Fryderyk, 2016	<i>Mus musculus</i> (Rodentia, Muridae)	Poland loc. class. [47]	Valid
<i>Demodex zalophi</i> Dailey and Nutting, 1979	<i>Zalophus californianus</i> (Lesson, 1828) (Carnivora, Otariidae)	USA, Australia loc. class. [267]	Valid
<i>Glossicodex musculi</i> Izdebska and Rolbiecki, 2016	<i>Mus musculus</i> (Rodentia, Muridae)	Poland loc. class. [11]	Valid
<i>Ophthalmomox apodemi</i> Bukva, Nutting and Desch, 1992	<i>Apodemus sylvaticus</i> (Rodentia, Muridae)	Czech Republic loc. class. [268]	Valid
<i>Ophthalmomox artibeii</i> Lukoschus and Nutting, 1979	<i>Artibeus lituratus</i> (Chiroptera, Phyllostomidae)	Republic of Surinam loc. class. [269]	Valid
<i>Ophthalmomox australiensis</i> Woeltjes and Lukoschus, 1981	<i>Rhinonictes aurantia</i> (Gray, 1845) (Chiroptera, Hipposideridae)	Australia loc. class. [270]	Valid
<i>Ophthalmomox carolliae</i> Lukoschus, Woeltjes, Desch and Nutting, 1980	<i>Carollia perspicillata</i> (Chiroptera, Phyllostomidae)	Republic of Surinam loc. class. [271]	Valid

<i>Ophthalmodex juniatae</i> Veal, Giesen and Whitaker, 1984	<i>Myotis lucifugus</i> (Le Conte, 1831) (Chiroptera, Vespertilionidae)	USA loc. class. [272]	Valid
<i>Ophthalmodex molossi</i> Lukoschus, Woeltjes, Desch and Nutting, 1980	<i>Molossus molossus</i> (Chiroptera, Molossidae)	Republic of Surinam loc. class. [271]	Valid
<i>Ophthalmodex wilsoni</i> Woeltjes and Lukoschus, 1981	<i>Vespadelus pumilus</i> (Gray, 1841) (Chiroptera, Vespertilionidae)	Australia loc. class. [270]	Valid
<i>Pterodex carolliae</i> Lukoschus, Woeltjes, Desch and Nutting, 1980	<i>Carollia perspicillata</i> (Chiroptera, Phyllostomidae)	Republic of Suriname loc. class. [273]	Valid
<i>Rhinodex baeri</i> Fain, 1959	<i>Galago moholi</i> A. Smith, 1836 (Primates, Galagidae)	Rwanda loc. class. [274]	Valid
<i>Soricidex dimorphus</i> Bukva, 1982	<i>Sorex araneus</i> Linnaeus, 1758 (Soricomorpha, Soricidae)	Czech Republic loc. class. [275,276], Poland [255]	Valid
<i>Stomatodex cercarteti</i> Desch, 1991	<i>Cercartetus nanus</i> (Desmarest, 1818) (Diprotodontia, Burramyidae)	Australia loc. class. [277]	Valid
<i>Stomatodex corneti</i> Fain, 1960			Valid
<i>Stomatodex corneti corneti</i> Fain, 1960	<i>Barbastella barbastellus</i> (Schreber, 1774) (Chiroptera, Vespertilionidae)	Belgium loc. class. [51], Great Britain [278]	
	<i>Nycteris</i> sp. (Chiroptera, Nycteridae)	Rwanda [51]	
<i>Stomatodex corneti myotis</i> Fain, 1960	<i>Myotis dasycneme</i> (Boie, 1825) (Chiroptera, Vespertilionidae)	Belgium [51]	
	<i>Myotis myotis</i> (Borkhausen, 1797) (Chiroptera, Vespertilionidae)	Belgium [51]	
<i>Stomatodex galagoensis</i> Fain, 1959	<i>Galago moholi</i> A. Smith, 1836 (Primates, Galagidae)	Rwanda loc. class. [274]	Valid

<i>Stomatodex rousetti</i> Fain, 1960	<i>Rousettus aegyptiacus</i> (Geoffroy, 1810) (Chiroptera, Pteropodidae)	Democratic Republic of the Congo loc. class. [51]	Valid
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Hom.: homonym, loc. class.: locus classicus, nom. abort.: nomen abortium, nom. nud.: nomen nudum, s. loco: sine loco, syn.: synonymum.

Table 2. Body size (micrometers) for adults of *Demodex sciurinus*.

Character	♂ (n = 8)	♀ (n = 13)
Length of gnathosoma	15 (13–18), SD 2	17 (15–18), SD 1
Width of gnathosoma (at base)	18 (15–23), SD 2	18 (14–20), SD 2
Length of podosoma	49 (43–55), SD 5	54 (50–60), SD 3
Width of podosoma	31 (28–35), SD 3	33 (30–38), SD 2
Length of opisthosoma	72 (55–90), SD 11	97 (75–125), SD 16
Width of opisthosoma	31 (25–36), SD 4	33 (30–38), SD 2
Aedeagus	20 (16–23), SD 3	–
Vulva	–	6 (4–8), SD 1
Total length of body	135 (120–158), SD 14	168 (143–193), SD 17

Table 3. Synhospital (co-occurring) demodecid mites in the same host species.

Mammals Ordo	Mammals Species	Demodecid Mites
PRIMATES	<i>Galago moholi</i>	<i>Rhinodex baeri</i>
		<i>Stomatodex galagoensis</i>
	<i>Homo sapiens</i>	<i>Demodex brevis</i>
		<i>Demodex folliculorum</i>
RODENTIA	<i>Apodemus agrarius</i>	<i>Demodex agrarii</i>
		<i>Demodex apodemi</i>
		<i>Demodex gracilentus</i>
		<i>Demodex huttereri</i>
	<i>Apodemus flavicollis</i>	<i>Demodex corniculatus</i>
		<i>Demodex mollis</i>
		<i>Demodex rosus</i>
	<i>Apodemus sylvaticus</i>	<i>Demodex apodemi</i>
		<i>Demodex auricularis</i>
		<i>Demodex lacrimalis</i>
<i>Demodex longior</i>		
<i>Ophthalmodex apodemi</i>		
<i>Mus musculus</i>	<i>Demodex conicus</i>	
	<i>Demodex flagellurus</i>	
	<i>Demodex fusiformis</i>	
	<i>Demodex marculus</i>	
	<i>Demodex musculi</i>	
	<i>Demodex vibrissae</i>	
	<i>Glossicodex musculi</i>	
	<i>Rattus norvegicus</i>	<i>Demodex nanus</i>
		<i>Demodex norvegicus</i>
		<i>Demodex ponderosus</i>
<i>Demodex ratticola</i>		
<i>Mesocricetus auratus</i>	<i>Demodex aurati</i>	
	<i>Demodex criceti</i>	
<i>Myodes glareolus</i>	<i>Demodex buccalis</i>	
	<i>Demodex glareoli</i>	
<i>Phodopus sungorus</i>	<i>Demodex phodopi</i>	
	<i>Demodex sungori</i>	

SORICOMORPHA	<i>Neomys anomalus</i>	<i>Apodemodex cornutus</i> <i>Demodex neomydis</i>	
	<i>Sorex araneus</i>	<i>Demodex soricinus</i> <i>Soricidex dimorphus</i>	
CHIROPTERA	<i>Carollia perspicillata</i>	<i>Demodex carolliae</i> <i>Demodex longissimus</i> <i>Ophthalmodex carolliae</i> <i>Pterodex carolliae</i>	
	<i>Eonycteris spelaea</i>	<i>Demodex neopisthosomae</i> <i>Demodex spelaea</i>	
	<i>Macroglossus minimus</i>	<i>Demodex bicaudatus</i> <i>Demodex macroglossi</i>	
	<i>Molossus molossus</i>	<i>Demodex molossi</i> <i>Ophthalmodex molossi</i>	
	<i>Mystacina tuberculata</i>	<i>Demodex mystacina</i> <i>Demodex novazelandica</i>	
	<i>Plecotus auritus</i>	<i>Demodex chiropteralis</i> <i>Demodex plecoti</i>	
	CARNIVORA	<i>Canis lupus familiaris</i>	<i>Demodex canis</i> <i>Demodex cornei</i> <i>Demodex cyonis</i> <i>Demodex injai</i>
		<i>Felis catus</i>	<i>Demodex cati</i> <i>Demodex gatoi</i>
PERISSODACTYLA	<i>Equus caballus</i>	<i>Demodex caballi</i> <i>Demodex equi</i>	
ARTIODACTYLA	<i>Cervus elaphus</i>	<i>Demodex acutipes</i> <i>Demodex kutzeri</i>	
	<i>Cervus nippon</i>	<i>Demodex kutzeri</i> <i>Demodex pseudaxis</i>	
	<i>Odocoileus hemionus</i>	<i>Demodex kutzeri</i> <i>Demodex odocoilei</i>	
	<i>Odocoileus virginianus</i>	<i>Demodex kutzeri</i> <i>Demodex odocoilei</i>	
	<i>Bos taurus</i>	<i>Demodex bovis</i> <i>Demodex ghanensis</i> <i>Demodex tauri</i>	
	<i>Ovis aries</i>	<i>Demodex aries</i> <i>Demodex ovis</i>	

5. Conclusions

The Demodecidae have high veterinary and medical importance, and these aspects have directed the majority of research into the family. Despite the fact that such research stretches back to the 19th Century, appropriate zoological studies (taxonomy, fauna) are scarce and limited to species descriptions, typically based on singular records from one locality and a single host. More detailed biodiversity studies, based on the analysis of the occurrence of the parasite in different populations of individual host species, or the co-occurrence of different Demodecidae in one host species, have

been published only in Poland. Even those studies have been limited by the availability of the host or the need to conduct comprehensive studies of its entire parasitofauna.

Unfortunately, no comparable data on Demodecidae are available from other regions; in addition, the group has never been included in holistic parasitofauna studies, or even studies of parasitic arthropods. The greatest obstacles to such studies are associated with parasite detection, particularly since most infestations are asymptomatic, and problems with species identification. This stands in contrast with the multitude of global medical and veterinary reports on demodicosis, or routine testing for this disease conducted at diagnostic laboratories.

There is a clear need to integrate zoological and parasitological research with medical and veterinary studies, or to perform further interdisciplinary studies. Only, such, broader approaches will provide a greater understanding of the key issues concerning Demodecidae parasitism, allow the development of efficient diagnostic methods and deepen our understanding of the causes and mechanisms of demodicosis.

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