

HISTORICAL REVIEW OF THE GENUS *DERMANYSSUS* DUGÈS, 1834 (ACARI: MESOSTIGMATA: DERMANYSSIDAE)

ROY L.* & CHAUVE C.M.*

Summary:

A synthetic review of the historical systematics of *Dermanyssus* Dugès, 1834 (Acari: Mesostigmata: Dermanyssidae) is provided. The classification at the specific level in this early genus has not really been clarified during more than a century despite its economic impact, and the history of the genus is complex and includes various stages. Moreover, *Dermanyssus* currently includes 23 species, whereas the last review took only 18 species into account. Changes in the species status and position in the genus *Dermanyssus* from 1834 until today are presented. The evolution of the generic definition is explored and compared with other genera of the group. How the discrimination between the different species evolved in the genus is also examined. Some difficulties in the specific definitions are discussed. A current diagnosis of the genus *Dermanyssus* is given. A table of the species included in this genus since its first description along with their respective current positions, a list of the currently included species in *Dermanyssus* with their hosts, and a world map presenting their geographic distribution are provided.

KEY WORDS : Acari, Mesostigmata, Gamasida, *Dermanyssus*, historical review, systematics.

Résumé :

REVUE HISTORIQUE DU GENRE *DERMANYSSUS* (ACARI : MESOSTIGMATA : DERMANYSSIDAE)
La systématique historique de *Dermanyssus* Dugès, 1834 (Acari : Mesostigmata : Dermanyssidae) est révisée de manière synthétique. La classification au niveau spécifique de ce vieux genre n'a pas été véritablement clarifiée durant plus d'un siècle malgré son impact économique, si bien que son histoire est quelque peu complexe et présente diverses étapes. En outre, le genre *Dermanyssus* englobe à l'heure actuelle 23 espèces, tandis que la dernière révision prenait seulement 18 espèces en compte. Les changements de statut et de position des espèces dans le genre *Dermanyssus* depuis 1834 jusqu'à présent sont présentés. Le processus d'évolution de la définition du genre est exploré par comparaison avec d'autres genres du groupe. La manière dont la discrimination entre les différentes espèces a évolué est aussi considérée. Certaines difficultés dans la définition spécifique sont discutées. Une description diagnostique actualisée du genre *Dermanyssus* est fournie. Un tableau des espèces qui ont été incluses dans le genre depuis sa création avec leur position respective, une liste des espèces actuelles du genre *Dermanyssus* avec leurs hôtes, ainsi qu'une carte de leur distribution mondiale sont fournis.

MOTS CLÉS : Acari, Mesostigmata, Gamasida, *Dermanyssus*, revue historique, systématique.

INTRODUCTION

The genus *Dermanyssus* Dugès, 1834 (Acari: Mesostigmata: Dermanyssidae) includes hematophagous mite species which are ectoparasites of birds. *Dermanyssus* is the type genus of a family whose name has represented various groups all along 19th century, with more or less internal splitting. Dermanyssidae Kolenati, 1859 included first mites with diverse habits, some of them being obligatory ectoparasites and others free-living or facultative ectoparasites. Berlese (1892) separated the former and the last group in two different families: Dermanyssidae and Laelapidae respectively. Then numerous steps occurred, Dermanyssidae status alternating from subfamily-group name to family-

group name, including only obligatory ectoparasites. Radovsky (1966, 1967) separated this group into the two following families, depending on some morphological and biological characters: Macronyssidae Oudemans, 1936 and Dermanyssidae. Really Dermanyssidae appear phylogenetically closer to free-living Laelapids than to Macronyssidae. Consequently, Moss (1968, 1978) considered only the two following genera to be included in Dermanyssidae: *Dermanyssus* and *Liponyssoides*. In this paper, we follow this last classification.

Along with *Liponyssoides*, *Dermanyssus* possesses some morphological mainly located in the mouthparts adaptations to hematophagous habits. Adult females, protonymphs and deutonymphs possess conspicuously thin and elongated chelicerae, with a second segment adapted to hematophagy. Faces of opposed second segments are medially concave, so that they may form a tube by joining together through which blood is withdrawn. Chelae are conspicuously reduced, even if digits can be seen with a scanning electron microscope (cf. Fig. 2; Radovsky, 1969; Phillis, 2006). Male cheli-

* Laboratoire de Parasitologie et Maladies Parasitaires, École Nationale Vétérinaire de Lyon, 1, avenue Bourgelat, 69280 Marcy-L'Étoile, France.

Correspondence: Lise Roy.

Tel.: 00 33 4 78 87 25 74 – Fax: 00 33 4 78 87 25 77.

E-mail : l.roy@vet-lyon.fr

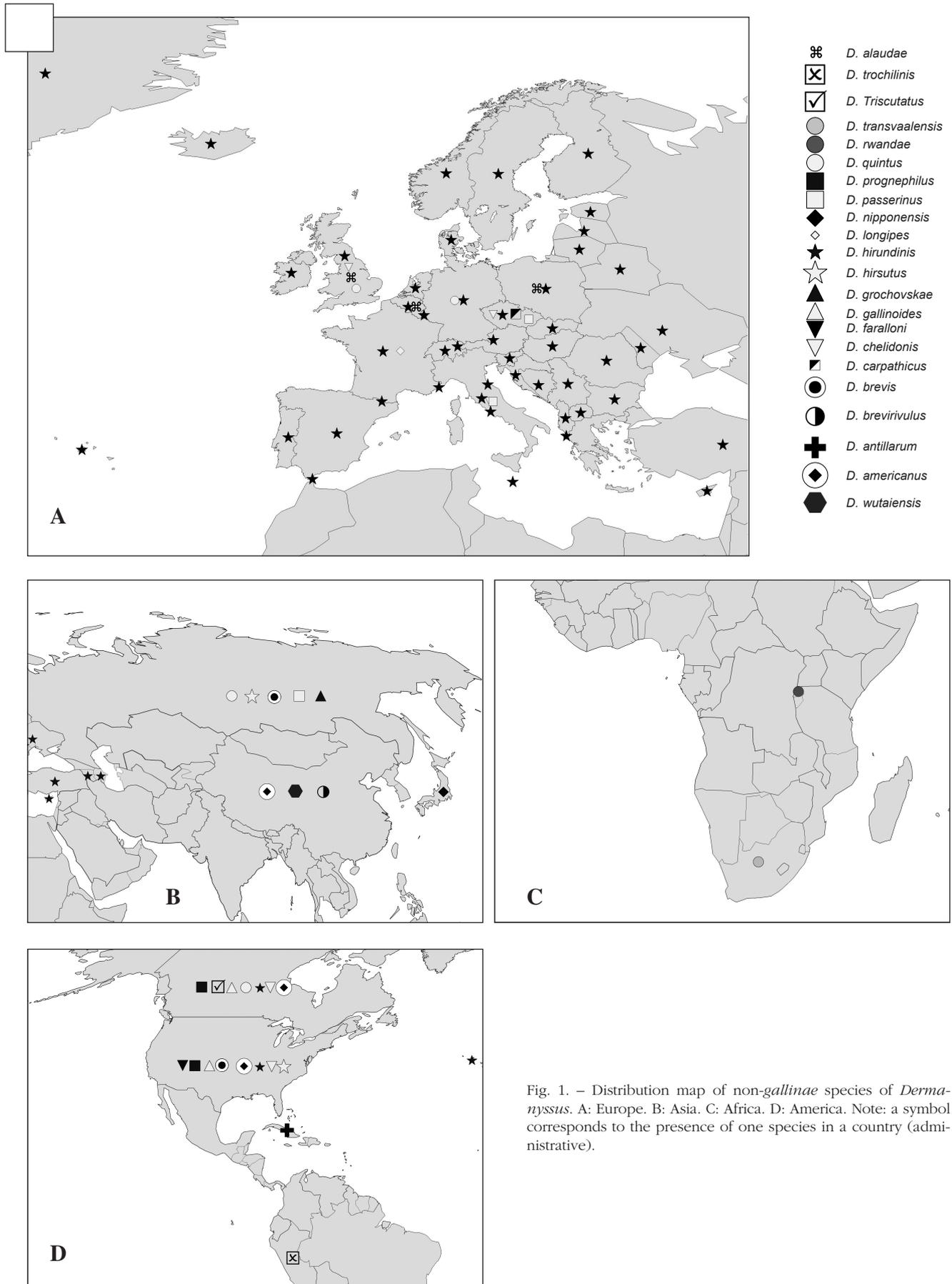


Fig. 1. – Distribution map of non-gallinae species of *Dermyssus*. A: Europe. B: Asia. C: Africa. D: America. Note: a symbol corresponds to the presence of one species in a country (administrative).

cerae are broader and male chelae are enlarged, with a long spermadactyl.

The poultry red mite *D. gallinae* (De Geer, 1778) is very common in layer houses in Europe. The economic impact of this parasite is quite important and may take many forms, including the following: downgraded eggs, decreased egg production, anaemia, possible death from exsanguination. The poultry red mite can also transmit diseases such as avian spirocheatosis, fowl cholera, salmonellosis, etc. Despite such economic importance, the classification of this genus at species level has been in a state of confusion for many years. About 40-50 years ago, some authors began working precisely on the genus *Dermanyssus*. According to some of them, *D. gallinae* may not be the only *Dermanyssus* parasitising laying hens. Consequently, some other closely related species might often have been confused with this species. A rather low host-specificity and a rather wide geographic distribution of *Dermanyssus* species contribute to obscure the issue.

Most species of this genus are not very host specific: for instance, more than 30 bird species are potential hosts for *D. gallinae* (Zemskaya, 1971) and 40 bird species (belonging to eight different orders) for *D. hirundinis* (Hermann, 1804) (Moss *et al.*, 1970; Moss, 1978; Fend'a & Schniererová, 2004; Fend'a, unpublished data). Most of the *Dermanyssus* species are nidicolous. Although some of them can be found frequently on the host and can deposit their eggs on its feathers (*D. grochovskae* Zemskaya, 1961, *D. quintus* Vitzthum, 1921 and *D. americanus* Ewing, 1922), most of them climb onto their host only to get a meal and then go back to their hiding-place in the host nest or roost. Moreover,

many species of *Dermanyssus* are distributed on more than one continent (Fig. 1). The history of *Dermanyssus* is very complicated and has never been extensively examined. Moreover, this early genus currently includes 23 species, whereas the last review of the genus took only 18 species into account. For both these reasons and in order to get a clear view of the genus before reviewing it, it seemed necessary to examine it cursorily from its description until the present and to check the current species included in it. In order to get a view of the generic history, the text will be broken down as follows: changes in the species status and position in the genus *Dermanyssus* from 1834 until today are presented first, then the generic definition and its evolution are explored. Afterwards, the species definitions and their difficulties will be examined. Finally, concerning the genus as is currently defined, a list of the currently included species in *Dermanyssus* is provided. Abbreviations: Setal terminology follows Lindquist & Evans, 1965 for the dorsum and Evans, 1963 for the legs.

CHANGES IN THE STATUS AND THE POSITION OF SPECIES IN THE GENUS *DERMANYSSUS* FROM 1834 UNTIL TODAY

Dugès described the genus *Dermanyssus* in 1834, in which he included five new species: *D. avium* Dugès, 1834, *D. vesperilionis* Dugès, 1834, *D. convolvuli* Dugès, 1834, *D. oribatis* Dugès, 1834, and *D. hominis* Dugès, 1834. The type-species *D. gallinae* (De Geer, 1778) was described by De Geer in the

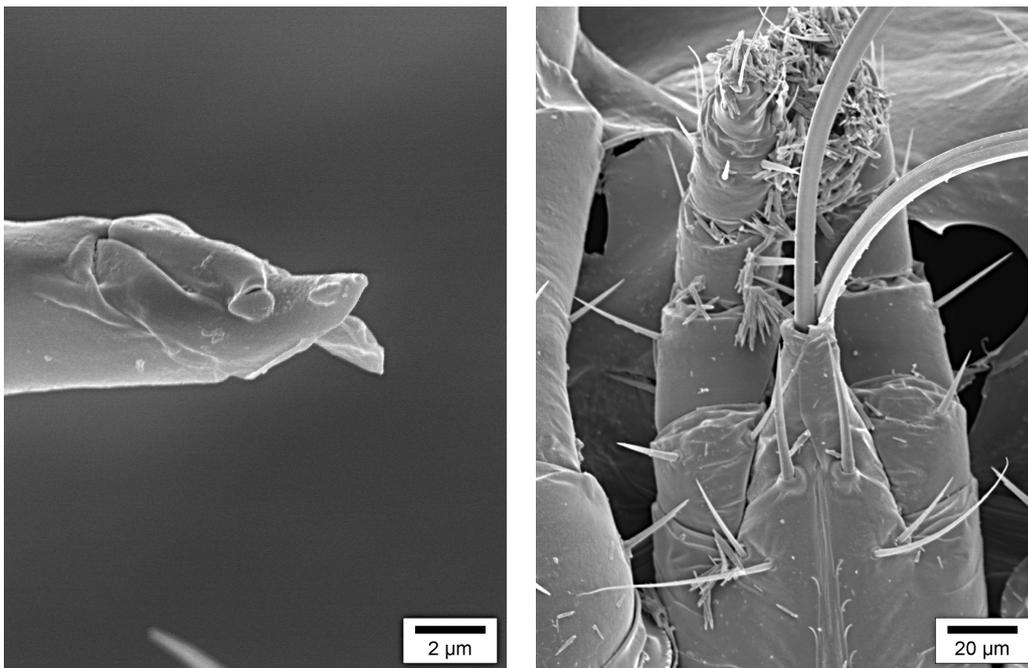


Fig. 2. – *Left*: characteristically reduced chela in *D. gallinae*. *Right*: second segments of chelicerae medially concave in *D. gallinae* (electron scanning microscope).

genus *Acarus*. In 1834, Dugès named it *D. avium*, and considered *A. gallinae*, although senior, synonymous with *D. avium*. *D. gallinae* was later reinstated as the senior synonym (Koch, 1836). *D. vespertilionis* has been suppressed by the International Commission of Zoological Nomenclature (ICZN) under the plenary powers for the principle of priority, but not for homonymy (Melville & Smith, 1987). About *D. oribatis* and *D. convo-*

lvuli, Dugès only noted for each: species name, followed by a comma and the personal latin pronoun *nobis*. Without any description and as species names suggest host associations far from the common ones, birds, in *Dermanyssus*, *D. oribatis* and *D. convolvuli* might be deemed *nomina dubia*. In any case, they cannot be included in *Dermanyssidae sensu* Radovsky (1966). *D. hominis* seems to have been omitted by all

	Species included or previously included in <i>Dermanyssus</i>	Current position	Comments
1778	* <i>D. gallinae</i> (De Geer, 1778) * <i>D. alaudae</i> (Schrank, 1781)	<i>Dermanyssidae Dermanyssus</i> <i>Dermanyssidae Dermanyssus</i>	In 1781, Schrank named <i>alaudae</i> the seventh species he described in 1776.
	* <i>D. hirundinis</i> (Hermann, 1804) <i>D. truncatus</i> (Olfers, 1816) <i>D. hominis</i> (Dugès, 1834)	<i>Dermanyssidae Dermanyssus</i> synonymy > <i>D. alaudae</i> synonymy > <i>D. gallinae</i>	Bory de Saint Vincent described this species in 1823 and more completely in 1828 without any name nor systematic position within the Acari group. Dugès placed it in genus <i>Dermanyssus</i> and named it in 1834.
	<i>D. avium</i> Dugès, 1834 <i>D. vespertilionis</i> Dugès, 1834	synonymy > <i>D. gallinae</i> suppressed	ICZN direction 66: suppressed under the plenary powers for the principle of priority, but not for homonymy.
	<i>D. convolvuli</i> Dugès, 1834 <i>D. oribatis</i> Dugès, 1834 <i>D. musculi</i> Koch, 1836	? ? <i>Macronyssidae Steatonyssus</i>	This species has complicated history. Oudemans (1936) considered it junior synonym of <i>A. musculi</i> Schrank, which he placed in genus <i>Steatonyssus</i> (homonymy and synonymy in the same time). Evans and Till (1966:278-279) suggested that <i>S. musculi</i> Schrank could be a junior synonym of <i>Ornithonyssus bacoti</i> Hirst, 1913.
	<i>D. arcuatus</i> Koch, 1839 <i>D. carnifex</i> Koch, 1839	<i>Hirstionyssidae Echinonyssus</i> <i>Hirstionyssidae Echinonyssus</i>	Tenorio (1984) treats this species as <i>nomen dubium</i> .
	<i>D. coriaceus</i> Koch, 1839 <i>D. lanius</i> Koch, 1839 <i>D. noctulae</i> Koch, 1839 <i>D. murinus</i> Lucas, 1840 <i>D. avium</i> Wagner, 1841 <i>D. pipistrellae</i> Koch, 1841 <i>D. lacertarum</i> (Contarini, 1843) <i>D. natricis</i> Gervais, 1844 <i>D. musculi</i> Johnston, 1849	synonymy > <i>D. arcuatus</i> synonymy > <i>D. carnifex</i> synonymy > <i>D. arcuatus</i> <i>Macronyssidae Steatonyssus</i> synonymy > <i>D. murinus</i> synonymy > <i>D. arcuatus</i> ? <i>Macronyssidae Ophionyssus</i> <i>Hirstionyssidae Echinonyssus</i>	A complicated history. Seems to be conspecific to <i>D. musculi</i> Koch which is conspecific to <i>A. musculi</i> Shrank.
	<i>D. flavus</i> Kolenati, 1857 <i>D. glutinosus</i> Kolenati, 1857 <i>D. granulosis</i> Kolenati, 1857 <i>D. ambulans</i> Thorell, 1872 <i>D. richiardii</i> Canestrini & Fanzago, 1877 <i>D. sylviarum</i> Canestrini & Fanzago, 1877 <i>D. hirundinis</i> Berlese, 1889	<i>Macronyssidae Macronyssus</i> synonymy > <i>M. granulosis</i> <i>Macronyssidae Macronyssus</i> <i>Haemogamasidae Haemogamasus</i> ? <i>Macronyssidae Ornithonyssus</i> homonymy > nomen novum: <i>D. chelidonis</i>	
	* <i>D. longipes</i> Berlese & Trouessart, 1889	<i>Dermanyssidae Dermanyssus</i>	<i>nomen dubium</i> .
1889	* <i>D. passerinus</i> Berlese & Trouessart, 1889	<i>Dermanyssidae Dermanyssus</i>	<i>species inquirenda</i> .

Table I (to be continued).

	Species included or previously included in <i>Dermanyssus</i>	Current position	Comments
1902	<i>D. albatus</i> Oudemans, 1902	synonymy > <i>D. arcuatus</i>	
	<i>D. aegyptius</i> Hirst, 1913	Dermanyssidae <i>Liponyssoides</i>	
	<i>D. muris</i> Hirst, 1913	Dermanyssidae <i>Liponyssoides</i>	
	<i>D. sanguineus</i> Hirst, 1914	Dermanyssidae <i>Liponyssoides</i>	
	* <i>D. quintus</i> Vitzthum, 1921	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. americanus</i> Ewing, 1922	Dermanyssidae <i>Dermanyssus</i>	
	<i>D. oti</i> Ewing, 1925	synonymy > <i>D. americanus</i>	
	<i>D. evotomydis</i> Ewing, 1933	synonymy > <i>D. gallinae</i>	
	* <i>D. prognepbilus</i> Ewing, 1933	Dermanyssidae <i>Dermanyssus</i>	
	<i>D. brasiliensis</i> Fonseca, 1935	Dermanyssidae <i>Liponyssoides</i>	
	* <i>D. brevis</i> Ewing, 1936	Dermanyssidae <i>Dermanyssus</i>	
	<i>D. scutatus</i> Ewing, 1936	homonymy > <i>nomen novum</i> : <i>D. hirsutus</i>	
	* <i>D. chelidonis</i> Oudemans, 1939	Dermanyssidae <i>Dermanyssus</i>	This species has been described in 1889 by Berlese as <i>D. birundinis</i> . Because of homonymy, Oudemans renamed it in 1939.
	* <i>D. triscutatus</i> Krantz, 1959	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. grochovskae</i> Zemska, 1961	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. transvaalensis</i> Evans & Till, 1962	Dermanyssidae <i>Dermanyssus</i>	
	<i>D. intermedius</i> Evans & Till, 1964	Dermanyssidae <i>Liponyssoides</i>	
	* <i>D. gallinoides</i> Moss, 1966	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. faralloni</i> Nelson & Furman, 1967	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. hirsutus</i> Moss & Radovsky, 1967	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. antillarum</i> Dusbabek & Cerny, 1971	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. trochilinis</i> Moss, 1978	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. carpathicus</i> Zeman, 1979	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. nipponensis</i> Uchikawa & Kitaoka, 1981	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. brevirivulus</i> Gu & Ting, 1992	Dermanyssidae <i>Dermanyssus</i>	
	* <i>D. wutaiensis</i> Gu & Ting, 1992	Dermanyssidae <i>Dermanyssus</i>	
1993	* <i>D. rwandae</i> Fain, 1993	Dermanyssidae <i>Dermanyssus</i>	

Table I. – Species included or previously included in *Dermanyssus* listed in chronological order with their present position/status. Species names preceded by * are here included in *Dermanyssus*.

reviewers of *Dermanyssus* until today (*cf.* § *Species whose nomenclatural status is not clear*). To sum up, only one of the five initially included species has been considered in the subsequent studies.

After these descriptions, many species were created in *Dermanyssus* by other authors. We list 57 species which are included or have been included in the genus (Table I). 32 species are changed in status or position: ten species have been synonymized with other *Dermanyssus* species. Two species receive *nomina nova* because they are deemed junior homonyms. One was suppressed under the plenary powers (*cf.* above). 16 species are now included in some other groups: five in the other genus of Dermanyssidae *Liponyssoides*, seven in several genera of the family Macronyssidae, three in the family Hirstionyssidae, one in the family Haemogamasidae. Four are *incertae sedis* or *species inquirenda* (*cf.* § *Species whose nomenclatural status is not clear*). Finally, one species is suggested here being synonymized (*D. hominis*). As a result, 23 species are included in *Dermanyssus*.

Strandtmann & Wharton (1958) listed ten species in *Dermanyssus*: *D. gallinae*, *D. birundinis*, *D. quintus*, *D. americanus*, *D. oti* Ewing, 1925, *D. evotomydis* Ewing, 1933, *D. prognepbilus* Ewing, 1933, *D. brevis*

Ewing, 1936, *D. scutatus* Ewing, 1936, *D. chelidonis* Oudemans, 1939.

Evans & Till (1962) recognized 14 species, two of which, overlooked by Strandtmann & Wharton (1958), were considered doubtful but not to be invalidated (*D. passerinus* Berlese & Trouessart, 1889 and *D. longipes* Berlese & Trouessart, 1889). Two others had been described after 1958 (*D. triscutatus* Krantz, 1959 and *D. grochovskae*), one was a new species (*D. transvaalensis* Evans & Till, 1962). Another one, which had been considered synonymous with *D. gallinae* by Oudemans, was restored (*D. alaudae* (Schrank, 1781)). From the ten listed species in Strandtmann and Wharton 1958, two were synonymized (*D. oti* with *D. americanus* and *D. evotomydis* with *D. gallinae*).

Moss (1968) also included 14 species in *Dermanyssus*, but not exactly the same as Evans & Till (1962). The differences were: the newly named *D. hirsutus* Moss & Radovsky, 1967 (= *D. scutatus*, *praeocc.*), the recently described *D. gallinoides* Moss, 1966 and *D. faralloni* Nelson & Furman, 1967 (in a footnote, because this species had been described as Moss's paper went to press), and the omission of *D. passerinus* and *D. longipes*. In 1978, Moss added four species: *D. antillarum* Dusbabek & Cerny, 1971, *D. trochilinis* Moss, 1978,

D. passerinus and *D. longipes*, the last two being considered *incertae sedis* and not included in the key for identification. Thus, in the last review of genus *Dermanyssus*, only 18 species were included.

The five species which have been described after Moss's last review are: *D. brevirivulus* Gu & Ting, 1992, *D. carpathicus* Zeman, 1979, *D. nipponensis* Uchikawa & Kitaoka, 1981, *D. rwandae* Fain, 1993, *D. wutaiensis* Gu & Ting, 1992.

EVOLUTION OF THE GENUS DEFINITION COMPARED WITH THE OTHER GENERA OF THE GROUP

This early genus definition follows a somewhat complex evolution, and it is necessary to explore its history throughout the literature in order to understand it. Dugès (1834) described the genus *Dermanyssus* as follows: "*Palporum articulus 5^{us} minimus; labium acutum; mandibulae maribus chelatae, ungue longissimo, feminis ensiformes; corpus molle; pedes antici longiore; coxae contiguae. Larvae hexapodae, adultis vix dissimiles*". Such a morphological description appears today extremely general and fits most current mesostigmates. About a century later, in 1923 and in 1936, Ewing provided short surveys of this genus in North America. The first one, included in a review of North American dermanyssids, listed only two species, and the second survey, being a compact summation, included several recently described species.

In 1958, Strandtmann and Wharton, in a large opus reviewing the classification of the mesostigmates parasitic on vertebrates, pointed out the serious need of revision of the genus *Dermanyssus*: "The genus is in need of revision. It is doubtful that all the species listed below really are specific entities" (Strandtmann & Wharton, 1958, p. 122).

From then on, three steps can be distinguished, on the whole, which lead to the current and stabilized description. Many other genera have been created, which are more or less closely related to *Dermanyssus*.

First, two of these genera are very closely related to *Dermanyssus*: *Allodermanyssus* Ewing, 1923 and *Liponyssoides* Hirst, 1913. The exploration of both these genera compared with *Dermanyssus* helped the definition to become more precise. Krantz (1959) and Sheals (1962) took part in the evolution of the genus definition, discussing the relationships among the three closely related genera. According to both the authors, *Allodermanyssus* was not valid anymore. But Krantz considered *Allodermanyssus* synonymous with *Dermanyssus*, whereas Sheals considered *Allodermanyssus* synonymous with *Liponyssoides*. This discordance induced a

deeper investigation of the description of *Dermanyssus*. Krantz described the first *Dermanyssus* species having a divided dorsal shield in the adult stage: *D. triscutatus* (dorsal shield short, several metanotal scutella present). He also pointed out the fact that the discrimination between *Allodermanyssus* and *Dermanyssus* based on the character incomplete/complete dorsal shield in the adult stage is not correct anymore. But he neglected to consider the genus *Liponyssoides*. Sheals examined the three genera together. In order to explain the new synonymy he established between *Allodermanyssus* and *Liponyssoides*, he provided some arguments concerning the ontogeny (one seta less on the femur and one less on the palp genu in the adult stage in *Dermanyssus*).

Another apparently important argument concerned the chaetotaxy of the dorsal shield and applied, according to Sheals, not only to *Dermanyssinae* but also to *Macronyssinae* (today *Macronyssidae*; cf. infra): he considered the presence/absence of seta *j3* a character related to the host group in both taxa (present in all parasites of mammalian and absent in all parasites of birds). However, it should be noted that the more recently described species *D. trochilinis* is an exception to such a hypothesis: it is parasitic on birds and doesn't lack *j3*. Moreover, genus *Ornithonyssus* (*Macronyssidae*) lacks *j3* and includes species which are parasitic on mammals (e.g. *O. bacoti* on rodents). In short, Sheals was wrong in this last hypothesis.

Secondly, Evans & Till (1962) stabilized *Dermanyssus* description: they wrote the first worldwide monograph on the genus *Dermanyssus*. Many generic characters were based on the ontogeny and the chaetotaxy of shields and legs.

Finally, Radovsky (1966, 1967) established *Macronyssinae* (*Mesostigmata*: *Dermanyssidae*) as the macronyssid family. This status change is very important. From then on, dermanyssids species *i.e.* *Dermanyssus* spp. and *Liponyssoides* spp., are to be distinguished from macronyssids in having the 2nd segment of the chelicerae elongate and very slender (the 1st one is elongate, and differently conformed, in *Macronyssids*), the chelae reduced (edentate, but each digit visible with an optic microscope in *Macronyssids*) and a deutonymphal stage which needs a blood meal in order to accomplish its moulting (deutonymphs moult without feeding, as do larvae, in *macronyssids*).

CURRENT DIAGNOSIS OF DERMANYSSIDAE

Dermanyssids are characterized among *Dermanyssoides* by the following characters:

- Adult females

Gnathosoma-*chelicerae*: distal segment (= 2nd) of the female chelicerae conspicuously elongated and slender,

<i>Dermanyssus</i> species	Host species	
<i>D. alaudae</i> (Schrank, 1781)	<i>Alauda arvensis</i> <i>Lullula arborea</i>	<i>Alauda</i> : Alaudidae: Passeriformes <i>Alauda</i> : Alaudidae: Passeriformes
<i>D. americanus</i> Ewing, 1922	<i>Carpodacus lexicanus</i> <i>Emberiza cioides</i> <i>Otus asio</i> <i>Passer domesticus</i> <i>P. montanus</i> <i>Serinus canaries</i> <i>Sitta</i> sp.	<i>Carpodacus</i> : Fringilloidea: Passeriformes <i>Emberiza</i> : Fringillidae: Passeriformes <i>Otus</i> : Strigidae: Strigiformes <i>Passer</i> : Passeridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Serinus</i> : Fringillidae: Passeriformes <i>Sitta</i> : Sittidae: Passeriformes
<i>D. antillarum</i> Dusbabek & Cerny, 1971	<i>Mimus polyglottos orpheus</i> <i>Passer domesticus</i> <i>Accipiter striatus fringilloides</i> <i>Tachornis phoenicobia</i>	<i>Mimus</i> : Sturnidae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Accipiter</i> : Accipitridae: Ciconiiformes <i>Tachornis</i> : Apodidae: Apodiformes
<i>D. brevivivulus</i> Gu & Ting, 1992	<i>Galerida cristata leautungensis</i>	<i>Galerida</i> : Alaudidae: Passeriformes
<i>D. brevis</i> Ewing, 1936	<i>Alauda arvensis</i> <i>Eremophila alpestris</i>	<i>Alauda</i> : Alaudidae: Passeriformes <i>Eremophila</i> : Alaudidae: Passeriformes
<i>D. carpathicus</i> Zeman, 1979	<i>Phoenicurus phoenicurus</i> <i>Parus major</i>	<i>Phoenicurus</i> : Muscicapidae: Passeriformes <i>Parus</i> : Paridae: Passeriformes
<i>D. chelidonis</i> Oudemans, 1939	<i>Carduelis carduelis</i> <i>Delichon urbica</i> <i>Hirundo rustica</i> <i>Parus coeruleus</i> <i>Riparia riparia</i> <i>Ptyonoprogne rupestris</i>	<i>Carduelis</i> : Fringillidae: Passeriformes <i>Delichon</i> : Hirundinidae: Passeriformes <i>Hirundo</i> : Hirundinidae: Passeriformes <i>Parus</i> : Paridae: Passeriformes <i>Riparia</i> : Hirundinidae: Passeriformes <i>Ptyonoprogne</i> = <i>Hirundo</i> : Hirundinidae: Passeriformes
<i>D. faralloni</i> Nelson & Furman, 1967	<i>Oceanodroma homochroa</i> <i>Cepphus columba</i> <i>Ptychoramphus aleutica</i>	<i>Oceanodroma</i> : Hydrobatidae: Ciconiiformes <i>Cepphus</i> : Alcidae: Ciconiiformes <i>Ptychoramphus</i> : Alcidae: Ciconiiformes
<i>D. gallinae</i> (De Geer, 1778)	<i>Acrocephalus arundinaceus</i> <i>Aegolius funereus</i> <i>Carduelis carduelis</i> <i>Carduelis spinus</i> <i>Columba livia</i> <i>Delichon urbica</i> <i>Emberiza citrinella</i> <i>Erethacus rubecula</i> <i>Ficedula albicollis</i> <i>Ficedula hypoleuca</i> <i>Hirundo rustica</i> <i>Jynx torquilla</i> <i>Merops apiaster</i> <i>Parus major</i> <i>P. ater</i> <i>Passer domesticus</i> <i>P. montanus</i> <i>Phoenicurus phoenicurus</i> <i>Remiz pendulinus</i> <i>Riparia riparia</i> <i>Serinus canarius</i> <i>Sitta europaea</i> <i>Sturnus vulgaris</i>	<i>Acrocephalus</i> : Sylviidae: Passeriformes <i>Aegolius</i> : Strigidae: Strigiformes <i>Carduelis</i> : Fringillidae: Passeriformes <i>Carduelis</i> : Fringillidae: Passeriformes <i>Columba</i> : Columbidae: Columbiformes <i>Delichon</i> : Hirundinidae: Passeriformes <i>Emberiza</i> : Fringillidae: Passeriformes <i>Erethacus</i> : Muscicapidae: Passeriformes <i>Ficedula</i> : Muscicapidae: Passeriformes <i>Ficedula</i> : Muscicapidae: Passeriformes <i>Hirundo</i> : Hirundinidae: Passeriformes <i>Jynx</i> : Picidae: Piciformes <i>Merops</i> : Meropidae: Coraciiformes <i>Parus</i> : Paridae: Passeriformes <i>Parus</i> : Paridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Phoenicurus</i> : Muscicapidae: Passeriformes <i>Remiz</i> : Paridae: Passeriformes <i>Riparia</i> : Hirundinidae: Passeriformes <i>Serinus</i> : Fringillidae: Passeriformes <i>Sitta</i> : Sittidae: Passeriformes <i>Sturnus</i> : Sturnidae: Passeriformes
	Other wild birds and numerous species of domestic fowl, etc. Sometimes on mammalian species (insectivora, rodents, man)	Galliformes, Anseriformes
<i>D. gallinoides</i> Moss, 1966	<i>Asyndesmus lewis</i> <i>Colaptes cafer</i> (= <i>C. auratus</i>) <i>Dendrocopos pubescens</i> <i>Dryocopus pileatus</i> <i>Sphyrapicus varius</i>	<i>Asyndesmus</i> = <i>Melanerpes</i> : Picidae: Piciformes <i>Colaptes</i> : Picidae: Piciformes <i>Dendrocopos</i> : Picidae: Piciformes <i>Dryocopus</i> : Picidae: Piciformes <i>Sphyrapicus</i> : Picidae: Piciformes

Table II (to be continued).

Dermanyssus species	Host species	
<i>D. grochovskae</i> Zemskaia, 1961	<i>Nucifraga caryocatactes</i> <i>Dendrocopos leucotos</i> <i>D. major</i> <i>Picus awokera awokera</i>	<i>Nucifraga</i> : Corvidae: Passeriformes <i>Dendrocopos</i> : Picidae: Piciformes <i>Dendrocopos</i> : Picidae: Piciformes <i>Picus</i> : Picidae: Piciformes
<i>D. hirsutus</i> Moss & Radovsky, 1967	<i>Colaptes cafer</i> (= <i>C. auratus</i>)	<i>Colaptes</i> : Picidae: Piciformes
<i>D. hirundinis</i> (Hermann, 1804)	<i>Acrocephalus arundinaceus</i> <i>A. palustris</i> <i>A. scirpaceus</i> <i>Antbus arboreus</i> <i>Apus affinis</i> <i>Aquila pomarina</i> <i>Anser anser</i> <i>Aythya fuligula</i> <i>A. ferina</i> <i>Chaetura pelagica</i> <i>Columba livia</i> <i>Delichon urbica</i> <i>Dendrocopos pubescens</i> <i>Ficedula albicollis</i> <i>Hirundo rustica</i> <i>H. urbica</i> <i>Iridoprocne bicolor</i> <i>Lanius minor</i> <i>L. collurio</i> <i>Luscinia megarhynchos</i> <i>Merops apiaster</i> <i>Micropus affinis</i> <i>Parus caeruleus</i> <i>P. major</i> <i>P. palustris</i> <i>Passer montanus</i> <i>P. domesticus</i> <i>Petrochelidon pyrrhonota</i> <i>Phoenicurus ochruros</i> <i>Remiz pendulinus</i> <i>Riparia riparia</i> <i>Sitta europaea</i> <i>Strix aluco</i> <i>Sturnus vulgaris</i> <i>Taeniopygia guttata castanotis</i> <i>Troglodytes aedon</i> <i>T. troglodytes</i> <i>Turdus torquatus</i> <i>Vireo olivaceus</i>	<i>Acrocephalus</i> : Sylviidae: Passeriformes <i>Acrocephalus</i> : Sylviidae: Passeriformes <i>Acrocephalus</i> : Sylviidae: Passeriformes <i>Antbus</i> : Motacillidae: Passeriformes <i>Apus</i> : Apodidae: Apodiformes <i>Aquila</i> : Accipitridae: Passeriformes <i>Anser</i> : Anatidae: Anseriformes <i>Aythya</i> : Anatidae: Anseriformes <i>Aythya</i> : Anatidae: Anseriformes <i>Chaetura</i> : Apodidae: Apodiformes <i>Columba</i> : Columbidae: Columbiformes <i>Delichon</i> : Hirundinidae: Passeriformes <i>Dendrocopos</i> : Picidae: Piciformes <i>Ficedula</i> : Muscipidae: Passeriformes <i>Hirundo</i> : Hirundinidae: Passeriformes <i>Hirundo</i> : Hirundinidae: Passeriformes <i>Iridoprocne</i> = <i>Tachynecta</i> : Hirundinidae: Passeriformes <i>Lanius</i> : Laniidae: Passeriformes <i>Lanius</i> : Laniidae: Passeriformes <i>Luscinia</i> : Muscipidae: Passeriformes <i>Merops</i> : Meropidae: Coraciiformes <i>Micropus</i> = <i>Apus</i> : Apodidae: Apodiformes <i>Parus</i> : Paridae: Passeriformes <i>Parus</i> : Paridae: Passeriformes <i>Parus</i> : Paridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Petrochelidon</i> : Hirundinidae: Passeriformes <i>Phoenicurus</i> : Muscipidae: Passeriformes <i>Remiz</i> : Paridae: Passeriformes <i>Riparia</i> : Hirundinidae: Passeriformes <i>Sitta</i> : Sittidae: Passeriformes <i>Strix</i> : Strigidae: Strigiformes <i>Sturnus</i> : Sturnidae: Sturniformes <i>Taeniopygia</i> : Passeridae: Passeriformes <i>Troglodytes</i> : Certhiidae: Passeriformes <i>Troglodytes</i> : Certhiidae: Passeriformes <i>Turdus</i> : Muscipidae: Passeriformes <i>Vireo</i> : Vireonidae: Passeriformes
	Sometimes on mammalian species (insectivora, rodents)	
<i>D. longipes</i> Berlese & Trouessart, 1889 (<i>incertae sedis</i>)	<i>Passer domesticus</i>	<i>Passer</i> : Passeridae: Passeriformes
<i>D. nipponensis</i> Uchikawa & Kitaoka, 1981	<i>Picus awokera awokera</i>	<i>Picus</i> : Picidae: Piciformes
<i>D. passerinus</i> Berlese & Trouessart, 1889 (<i>incertae sedis</i>)	<i>Emberiza cirtus</i> <i>Ficedula albicollis</i> <i>Jynx torquilla</i> <i>Parus major</i> <i>Passer italiae</i> <i>Sturnus vulgaris</i>	<i>Emberiza</i> : Fringillidae: Passeriformes <i>Ficedula</i> : Muscipidae: Passeriformes <i>Jynx</i> : Picidae: Piciformes <i>Parus</i> : Paridae: Passeriformes <i>Passer</i> : Passeridae: Passeriformes <i>Sturnus</i> : Sturnidae: Sturniformes
<i>D. prognepbilus</i> Ewing, 1933	<i>Progne subis subis</i> <i>Colaptes cafer</i> (= <i>C. auratus</i>) <i>Dendrocopos pubescens</i> <i>Melanerpes erythrocephalus</i> <i>Molothrus ater</i> <i>Sialia sialis</i>	<i>Progne</i> : Hirundinidae: Passeriformes <i>Colaptes</i> : Picidae: Piciformes <i>Dendrocopos</i> : Picidae: Piciformes <i>Melanerpes</i> : Picidae: Piciformes <i>Molothrus</i> : Fringillidae: Passeriformes <i>Sialia</i> : Muscipidae: Passeriformes

Table II (to be continued).

<i>Dermanyssus</i> species	Host species	
<i>D. quintus</i> Vitzthum, 1921	<i>Dendrocopos major</i>	<i>Dendrocopos</i> : Picidae: Piciformes
	<i>D. pubescens</i>	<i>Dendrocopos</i> : Picidae: Piciformes
	<i>Dryobates leucotes</i>	<i>Dendrocopos</i> : Picidae: Piciformes
	<i>D. major</i>	<i>Dendrocopos</i> : Picidae: Piciformes
	<i>Picoides pubescens</i>	<i>Picoides</i> : Picidae: Piciformes
	<i>P. tridactylus</i>	<i>Picoides</i> : Picidae: Piciformes
	<i>Picus viridis</i>	<i>Picus</i> : Picidae: Piciformes
<i>D. rwandae</i> Fain, 1993	<i>Apus affinis</i>	<i>Apus</i> : Apodidae: Apodiformes
<i>D. transvaalensis</i> Evans & Till, 1962	<i>Hirundo spilodera</i>	<i>Hirundo</i> : Hirundinidae: Passeriformes
	<i>Petrochelidon spilodera</i>	<i>Petrochelidon</i> : Hirundinidae: Passeriformes
<i>D. triscutatus</i> Krantz, 1959	<i>Hirundo</i> sp.	<i>Hirundo</i> : Hirundinidae: Passeriformes
	<i>Petrochelidon pyrrhonota</i>	<i>Petrochelidon</i> : Hirundinidae: Passeriformes
<i>D. trochilinis</i> Moss 1978	Trochilidae	Trochilidae: Apodiformes
<i>D. wutaiensis</i> Gu & Ting, 1992	<i>Passer montanus</i>	<i>Passer</i> : Passeridae: Passeriformes

Table II. – List of species currently included in *Dermanyssus* and their known host species, established with the help of following references: Berlese & Trouessart (1889), Bory de Saint-Vincent (1828), Dusbabek & Cerny (1971), Evans & Till (1962), Evans & Till (1964), Ewing (1922, 1933), Fain (1993), Fend'a & Schniererová (2004), De Geer (1778), Gu & Ting (1992), Haitlinger (1987), Hermann (1804), Krantz (1959), Moss (1966), Moss (1978), Moss (1970), Nelson & Furman (1967), Nosek & Lichard (1962), Schrank (1776), Uchikawa & Kitaoka (1981), Uchikawa & Takahashi (1985), Vitzthum (1921), Zeman (1979), Zeman & Jurík (1981), Zemskaya (1971), Fend'a (2006, unpublished data) and collection data from Pr. A. Fain. Taxonomic bird data follow Peterson's website.

with chelae strongly reduced (Fig. 2); *cornicules* membranous, flexible (not acute as in free-living mesostigmate species) and convergent; Podosoma-legs: coxae without spurs.

. Adult males differ from adult females mainly in having more extensive sclerotization both ventrally and dorsally (holoventral shield in most cases, larger dorsal shield, including more dorsal setae than in female) and modified chelicerae (less elongated and much broader than in female, chelae with a long spermadactyl on the movable digit). The tarsi of legs III and IV bear a tooth-like protuberance. Moreover, the genital orifice is conspicuous and presternally situated.

KEY FOR DERMANYSSID GENERA

Few characters remain currently available for diagnosis between *Dermanyssus* and *Liponyssoides*. Hirst (1913) described *Liponyssoides* as a subgenus of *Dermanyssus* mainly based on a weak difference in the proportion of capitulum. Moss (1967) stated other clear differences between them based on sternal shield shape and chaetotaxy of dorsal shield, sternal shield and legs. But the three species *L. intermedius*, *D. trochilinis* and partially *D. antillarum* appear as yet intermediate between both genera with chaetotaxy. As a result, only following elements can be used for diagnosis of the two genera.

Sternal shield roughly crescent-shaped; usually parasitic on birds.....*Dermanyssus*
 Sternal shield roughly hexagonal; parasitic on rodents.....*Liponyssoides*

SPECIES SPECIFIC CHARACTERS WITHIN THE GENUS

TRADITIONAL SYSTEMATICS

Here will be dealt with characters which have been used as arguments for species description, not with diagnostic characters. For all the following characters, only adult females are to be considered.

Most of specific-level discriminant characters are based on chaetotaxy of the legs and dorsal shield and on the relative length of peritremes against the position from terminating over coxae IV to over coxae III-I.

Few other morphological characters are used. A marked difference of the dorsal setae length is very conspicuous between central setae on dorsal shield (*j4-j6* + "*j*" series except *J5*) and the other setae, which are situated all around (*J5*, "*z-Z*" series, "*r-R*" series, "*s*" series), in the seven following species: *D. alaudae*, *D. brevis*, *D. brevirivulus*, *D. hirsutus*, *D. grochovskae*, *D. quintus*, *D. rwandae*. In these species, the central seta length is near one-quarter the length of the peripheral ones, whereas they are all subequal in the other *Dermanyssus* species.

A character concerning dorsal shield development is found only in five species: mesonotal scutella are present only in *D. americanus*, *D. antillarum*, *D. transvaalensis*, *D. triscutatus* and *D. wutaiensis*. The nature of these platelets seems to correspond to the primary dorsal plates, which don't become coalesced as they

do in other *Dermanyssus* species in the adult stage. The dorsal shield is more strongly reduced in *D. triscutatus* and *D. antillarum* than in the three other species: from the “J” series, only *J1* is on the shield in *D. triscutatus* and in *D. antillarum*, whereas at least *J1* and *J2* are on the shield in *D. americanus*, *D. transvaalensis* and *D. wutaiensis*. Moreover, the dorsal scutella are proportionally quite smaller in these three latter species than in the two former.

Three very conspicuous characters are found each in a single species and concern particular opisthoventral setae:

- a ventral neotrichy in form of a cluster of elongate, simple setae laterad of the anal shield is present only in *D. hirsutus*;
- a U-shaped row of very large and deeply rooted setae on the opisthogaster is present only in *D. quintus*;
- several distally inflated setae situated posteriorly on the idiosoma are present only in *D. antillarum*.

No other *Dermanyssus* species possess such species specific, apomorphic characters.

Additionally, in *D. quintus*, the wider than long anal plate is another species specific character.

Nevertheless, apart from these characters, it should be noted that the leg and dorsal shield chaetotaxy provides most of the characters traditionally used for species discrimination in the genus *Dermanyssus*. The reliability of some of them seems to be doubtful. Evans & Till (1962) emphasized with several remarks many intraspecific variations, concerning the chaetotaxy: “The chaetotaxy of the venter of the opisthosoma shows considerable intraspecific variation” (p. 277). “The chaetotaxy of the various segments [of the legs] is considerably more variable, both inter- and intra-specifically, than in the free living and facultative parasitic Laelaptidae” (p. 278). Moss (1968) also noticed that characters of the leg chaetotaxy usually seemed to be the most variable.

Other than the chaetotactic characters of the legs and dorsal shield, the other traditionally most used character is the relative length of the peritreme. However the states of this character don't provide any defined limit. The extension of the peritreme varies continuously from coxa IV to coxa III to coxa IV to coxa I without a sharp gap from one species to another in the genus *Dermanyssus* and with intraspecific variations. Indeed, from Moss (1978) the following data can be extracted, in increasing order: the peritreme extends from the coxa IV “to middle of coxa III” in *D. transvaalensis* and *D. chelidonis*, “not as far as anterior margin of coxa III” in *D. alaudae* and *D. brevis*, “to or past anterior margin of coxa III” in *D. americanus*, “past anterior margin of coxa III” in *D. triscutatus*, “to middle of coxa II” in *D. hirsutus*, “to middle or anterior margin of coxa II” in *D. gallinae* and *D. gallinoides*, “to anterior margin of coxa II” in *D. grochovskae* and *D. birundinis*, “to middle of coxa I” in *D. prognepphilus*, “past

posterior margin or to middle of coxa I” in *D. trochilinis* and extends “anterad of base of coxa I” in *D. faraltoni*. Although the character states seem to overlap each other, it takes part in several new species arguments. For instance, the first of the two characters which are cited by Uchikawa as a distinctive property in *D. nipponensis* is the remarkable length of the peritreme. Its length is also the first of the five characteristics used by Nelson and Furman in order to distinguish *D. faraltoni* from the *a priori* most closely related species *D. birundinis*. Moreover, Oudemans (1939) cited this character as the main difference distinguishing *D. chelidonis* from *D. birundinis* and *D. gallinae*. It would be of interest to investigate the reliability of such a character as an argument for species description.

In short, many of the main traditionally used species specific characters are problematic. Chaetotactic characters of legs and dorsal shield are variable intraspecifically and the peritreme relative length doesn't seem to provide states of characters that are precise enough.

AN ATTEMPT WITH NUMERIC TOOLS

Moss tried to use more objective tools than the traditional systematics in order to explore the relationships between the *Dermanyssus* species: in 1967, he published a work on some numeric taxonomy theories (phenetics), in which he used the genus *Dermanyssus* as a model. He complained about the difficulties of finding characters in this genus and considered this to be due to a reduction and loss of structures correlated with parasitism. As a result, he selected quantitative characters, which are much easier to find than qualitative ones. His analysis resulted in two subdivisions of the genus: two subgenera, *Dermanyssus* and *Microdermanyssus*, are to be distinguished from one another by the setation of genu II (two *al* setae, one *av* and one *pv* setae in *Dermanyssus* (*Dermanyssus*); one *al* setae, no *av* and *pv* setae in *Dermanyssus* (*Microdermanyssus*)) and by the size of the unengorged female's body. Subgenus *Dermanyssus* included *D. chelidonis*, *D. gallinae*, *D. gallinoides*, *D. grochovskae*, *D. hirsutus*, *D. birundinis*, *D. prognepphilus*, *D. quintus*, *D. transvaalensis* and *D. triscutatus*. Subgenus *Microdermanyssus* included *D. alaudae*, *D. americanus* and *D. brevis*. Moreover, two species-groups were separated in the subgenus *Dermanyssus*: the *hirsutus*-group, with, among other discriminant characters, the seta *al1* of palp genu spiniform, and the *gallinae*-group, with the seta *al1* of palp genu spatulate. The *hirsutus*-group included *D. grochovskae*, *D. hirsutus* and *D. quintus*, whereas the *gallinae*-group included *D. chelidonis*, *D. gallinae*, *D. gallinoides*, *D. birundinis*, *D. prognepphilus*, *D. transvaalensis* and *D. triscutatus*. Moss used these new subdivisions in his 1968 and 1978 keys. The 1978 article was somewhat more developed than the

one from 1968 and took three new species into account (*D. antillarum*, *D. trochilinis* and *D. faralloni*). It provided a variety of information on the genus *Dermanyssus* (hosts, phylogenetic results from Moss (1967), remarks on the high variability of some characters,...). The status of the two subgenera and the two species-groups is re-examined with the changes induced by the three new species. Actually, the introduction of *D. antillarum* and *D. trochilinis* into Moss' phenetic analysis introduced some problems with the subdivisions. Nevertheless, Moss decided to continue to recognize the two subgenera and the two species-groups temporarily because he was expecting some additional elements from a new study he was preparing at that time. Unfortunately, this study was never published. As well as these doubts about the interrelationships of species in the genus *Dermanyssus*, Moss warned in 1978 that any person who wanted to attempt identification with his key to remain careful because of the considerable variation within species: "The most useful setae for identification are those in the "j" series of the dorsum. [...] Leg setae are also useful in species identification, but tend to be more variable within species than dorsal setae. [...] Variation within species is considerable. One is advised to consider several characters from several individuals of a sample when attempting an identification. A recent example of such variation is described below for *D. gallinoides*. Most key couplets list several alternative features in view of this problem." (Moss, 1978:633-634). Moss also invalidated one of the discriminant characters for *D. gallinoides*: "Dorsal shield scaling has been a reliable feature until recently for the separation of *D. gallinoides* and *D. gallinae*. Two specimens just provided by N. Wilson have predominantly scaled teeth in one case and completely scaled teeth in the other, but otherwise key to *D. gallinoides*" (Moss, 1978:634)

SPECIES WHOSE NOMENCLATURE STATUS IS NOT CLEAR

About *D. hominis*, Dugès wrote as follows: "*D. hominis*; sorte d'acaride, Bory St-Vincent". Bory de Saint-Vincent described it in 1823, in a memoir which was read during a regular meeting of the French "Académie des Sciences". He did not attribute any name and any systematic position within the Acari group to this species. Latreille and Savigny were designated to judge such a position, but did not do so (cf. Académie des Sciences, 1823-1828). Mites of this species were found infesting the body of a woman. The description of this species and its illustration by Bory de Saint-Vincent (1828) appear very similar to *D. gallinae*. This last species has been reported from humans several times (Beck, 1999; Cremer & Morrien, 1962; Holz J., 1954; Pampiglione *et al.*, 2001). Moreover, there is no type material available and the drawing of Bory de Saint-Vincent is not suffi-

cient to morphologically identify this species. As a result *D. hominis* should be synonymized with *D. gallinae*. Two species are considered *incertae sedis*: *D. passerinus* Berlese & Trouessart, 1889 and *D. longipes* Berlese & Trouessart, 1889. Evans & Till (1962) considered them *incertae sedis* because of the inadequate descriptions and the damaged type material in the Berlese collection. In Moss (1978), a part of the discussion refers to both of these species, in order to begin to solve this problem. In short, Zemskaya suggested that *D. passerinus* should be conspecific with *D. americanus* (which should be then a junior synonym), but did not demonstrate this. Moss adds an argument: both hosts of these species seem to be conspecific too, according to an ornithologist. Moreover, according to Moss, it is most likely that *D. passerinus* and *D. longipes* are conspecific. The type of *D. longipes* is too opaque to confirm such a hypothesis.

However, as the type of *D. longipes* (No. 52-47) is almost opaque and essentially unusable according to Moss and as this species has not been cited for a long time, it could be more appropriate to establish it as a *nomen dubium* instead of *incertae sedis*. Indeed, the systematic position within *Dermanyssus* does not appear to be doubtful, compared to its precise identity, which is doubtful.

As for *D. passerinus*, the type specimens are partially opaque and some papers include it in some acarofaunal lists (Nosek & Lichard, 1962; Zemskaya, 1971; Zeman & Jurík, 1981). So, the problem is more important with this species, which we suggest be considered *species inquirenda*.

D. lacertarum and *D. richiardii* are also problematic species. *D. richiardii* had been collected on two different species of insect, the hymenopteran *Xylocopa violaceus* and the lepidopteran *Cossus ligniperda* (Canestrini & Fanzago, 1877), which are not common hosts for the *Dermanyssus*. As for *D. lacertarum*, it was transferred from genus *Ricinus* by Canestrini (1877) in the same paper, with the only following sentence: "Due specie vi sono citate come nuove, il *Ricinus lacertarum*, e l'*Acarus penetrans*; il primo sembra un *Dermanyssus*, il secondo è una forma larvale". From that date, we did not find any more information on these two species. Maybe they should be established as *nomina dubia*. In any case, given the information cited above, they can not be included in the genus *Dermanyssus* anymore.

CONCLUSION AND PERSPECTIVES

The systematics of *Dermanyssus* is not completely clear as yet. Its history is complex. *Dermanyssus* seems to be well defined today, but species within the genus remain less clearly defined. Moreover,

not only was the last work on *Dermanyssus* not completely carried out, but also five new species have been described since this last review (Moss, 1978). The reliability of numerous traditional characters needs to be re-examined.

Today, 23 species are included in this genus, two of which are really doubtful. The status of *D. longipes* and *D. passerinus* is to be re-examined. *D. americanus* might be a junior synonym of *D. passerinus*. *D. hominis* is a synonym of likely *D. gallinae*. Some other early species might likely be synonymized too. The reliability of the five species described after Moss (1978), needs to be checked and they have to be integrated in a review of the entire genus.

For these reasons, it appears necessary to review the genus *Dermanyssus* at the specific level, which we plan to do, with the help of cladistic tools. Two major questions need to be answered. First, the correct definition of genus, even if it seems to be right using traditional tools, has to be checked by testing the monophyly of the group. Secondly, the a priori most problematic question of the species definitions within the genus should be explored, and maybe some species should be synonymized. Finally, as morphological characters seem to be insufficient, it seems necessary to add molecular characters to the phylogenetic analysis.

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