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SHORT COMMUNICATION

New records of spiders (Araneae) as hosts of terrestrial Parasitengona mites (Acari: Actinotrichida: Prostigmata)

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Abstract. New data are provided on larvae of terrestrial Parasitengona mites parasitizing spiders. Larvae of Erythraeidae and Trombidiidae are recorded as parasites of spiders representing five families. Members of Philodromidae and Tetragnathidae (*Pachygnatha clercki* Sundevall 1823) are reported as hosts of Trombidioidea for the first time. The available information indicates that some Trombidiidae have a narrow host range with affinity to spiders, whereas the Erythraeidae are more opportunistic parasites.

Keywords: Acari, parasitic larvae, Araneae

Parasitengona, one of the most diverse groups among Acari, comprise aquatic (Hydrachnidia) and terrestrial (Trombidia) species. They are known as protelean parasites, with the vast majority of larvae parasitic on arthropods or vertebrates and active postlarval forms being predaceous or pollinivorous (Wohltmann 2000).

Data on host-parasite relationships between spiders and Parasitengona mites are scattered in the literature and pertain exclusively to Trombidia. In many cases the host identification is limited to higher taxonomic ranks; i.e., order or family. Such identifications constitute a limiting factor in studies on autecology of parasitic species. Altogether, larvae of four families, Erythraeidae, Trombidiidae, Microtrombidiidae and Eutrombidiidae, including 25 named species, have been recorded as parasites of 24 named species of spiders representing 20 families (Oudemans 1897; Welbourn & Young 1988; Reillo 1989; Southcott 1991, 1999; Fain & Jocqué 1996a; Haitlinger 1996; Baker & Selden 1997; Wohltmann 1999). The aim of this work is to provide a list of new records of larvae of terrestrial Parasitengona that exploit spiders as hosts.

Spiders were collected in the Czech Republic (Ostrov u Macochy, by R. Mlejnek), Russia (Novosibirsk Region, by D.V. Logunov), France (Blois, Loir-et-Cher, by C. Hervé) and Poland (Lower Silesia, by J. Łaydanowicz, D. Łupicki and J. Mąkol). The alcohol-preserved (70-75% ethanol) mites were fixed on microscope slides in Swan's fluid. Spiders preserved in ethanol were examined for attached Parasitengona larvae, which were then counted. An examination of attachment sites of larvae on hosts was carried out when possible. Engorged larvae were macerated in Nesbitt's fluid prior to fixation. Identification was made under a Nikon Eclipse E600 light microscope, on the basis of Southcott (1992), Mąkol (2005) and Łaydanowicz & Mąkol (2010). Nomenclature of spiders follows Platnick (2010). The mites and spiders are deposited at the Department of Invertebrate Systematics and Ecology, Wrocław University of Environmental and Life Sciences, Poland, and in the collection of the Muséum national d'Histoire naturelle, Paris, France.

Larvae of two Parasitengona families, Erythraeidae (two species) and Trombidiidae (one species), were recorded as parasites of spiders from five families (Table 1). Ten host records, with specific affiliation of the spider, are new. Species of Philodromidae and *Pachygnatha clercki* have not been previously recorded as hosts of Trombidioidea. A new host and parasite record applies to *Xysticus lanio* C.L. Koch 1835 parasitized by *Leptus mariae*. *Trombidium brevimanum* was found to parasitize spiders of four families: Theridiidae, Linyphiidae, Tetragnathidae and Philodromidae. The distribution of *L. mariae* is extended for the Czech Republic, and that of *T. brevimanum* for Russia and France.

The number of parasites per host varied between one and five. In the case of Erythraeidae, larvae were attached to the opisthosoma and legs of the hosts, whereas Trombidiidae were attached to the prosoma and opisthosoma, with an apparent tendency to occupy places close to the pedicel. One trombidiid larva was found attached to the leg; however, due to the unengorged state, the successful parasitism of this particular specimen cannot be confirmed.

The results of the present studies confirm the opinion of Welbourn and Young (1988) that larvae of Trombidiidae occur most frequently on spiders, whereas these of Erythraeidae only seldom parasitize these hosts. The latter observation contrasts with records concerning parasitism of Parasitengona on Opiliones (Cokendolpher & Mitov 2007; Gabryś et al. 2011, this volume), of which erythraeid larvae are regarded as the most frequent parasites. Also, the larvae of Microtrombidiidae and Eutrombidiidae have been reported on spiders only infrequently (Welbourn & Young 1988; Southcott 1994; Fain & Jocqué 1996b).

Considering the number of species assigned to Trombidiidae (191), Microtrombidiidae (320), Eutrombidiidae (ca 50) and Erythraeidae (ca 300) (Mąkol 2007; Mąkol & Gabryś 2005, 2008), combined with the variety of species reported as parasites of spiders, it seems obvious that more specialized taxa can be recognized in the Trombidiidae (with respect to parasitism on spiders), than in the Erythraeidae, which seem to be more opportunistic parasites. For the time being *Trombidium brevimanum* remains the only species whose larvae exploit spiders as regular hosts and whose host spectrum seems to be restricted to arachnids (Wohltmann 1999; Gabryś et al. 2011, this volume; Judson & Mąkol 2011, this volume).

Leptus mariae, recorded here as a parasite of *X. lanio*, has hitherto been known to parasitize members of Coleoptera, Hemiptera and Lepidoptera (Southcott 1992; Haitlinger 2009). However, it was recently also found on Opiliones (Gabryś et al. 2011, this volume), which confirms its wider host spectrum, not being restricted to Hexapoda.

Association of some other *Leptus* spp. with particular species of spiders (Fain & Jocqué 1996a; Baker & Selden 1997; Southcott 1999) suggests a high degree of host specificity. However, this might be due to the relatively poor knowledge of infraspecific range in variability of the erythraeid larvae, which could influence the assignment of independent specific status to nominal taxa known from single specimens. Further studies, focused especially on biology, may lead to

Table 1.—List of terrestrial Parasitengona larvae parasitizing Araneae. New hosts of Parasitengona mites and/or parasites of Araneae are indicated in bold.

Parasitic mite species	Spider host	Number of larvae (attachment site)
Erythraeidae		
***Leptus mariae* Haitlinger 1987**	***Xysticus lanio*** C.L. Koch 1835 (Thomisidae), 1 ind.	2 (1 – opisthosoma, 1 – legs)
Leptus molochinus (C.L. Koch 1837); syn. *L. ignotus* (Oudemans 1903)	***Tetragnatha* sp.** (Tetragnathidae), 1 juv.	1 (legs)
Trombidiidae		
Trombidium brevimanum (Berlese 1910)	***Parasteatoda lunata*** (Clerck 1757) (Theridiidae), 1 ♀	2 (1 – prosoma, 1 – opisthosoma)
	Theridion varians Hahn 1833, 1 ♀	1 (opisthosoma)
	Bolyphantes alticeps (Sundevall 1833) (Linyphiidae), 1 ♀	1
	Diplostyla concolor (Wider 1834), 1 ♀	1
	Gnathonarium dentatum (Wider 1834), 2 ♀	2, 3
	Helophora insignis (Blackwall 1841), 1 ♀, 1 ♂	1, 1 (opisthosoma)
	Oedothorax retusus (Westring 1851), 2 ♀	2 (opisthosoma), 2
	Prinerigone vagans (Audouin 1826), 1 ind.	1 (opisthosoma)
	Pachygnatha clercki Sundevall 1823 (Tetragnathidae), 2 ♀	2 (opisthosoma), 5 (4 – opisthosoma, 1 – legs)
	Tetragnatha montana Simon 1874, 1 ♀	1 (prosoma)
	Tetragnatha sp., 1 juv.	1 (prosoma)
	Philodromidae, 1 ind.	1 (prosoma)

the synonymization of species, and as a result, to a better evaluation of the degree of host specificity in *Leptus* spp.

The actual degree of infestation of spiders by Parasitengona larvae is difficult to ascertain. The Parasitengona larvae may detach quickly from the host as a result of mechanical stimuli during collection. Welbourn and Young (1988) found that 89% of the linyphiid *Ceraticelus emertoni* (O. Pickard-Cambridge 1874) were parasitized by only one larva of *Verdunella lockleii* (Welbourn and Young 1988), but the infestation was up to nine larvae per host. Adult as well as immature spiders of both sexes were parasitized. Wohltmann (1999) examined twelve spiders of three species and found four larvae to be the highest number per host. Taking all published numbers into account, the parasite load per host varies between 1 and 19, although in the majority of cases no more than four larvae were recorded (Oudemans 1912; Lawrence 1940; Michener 1946; Kawashima 1958; Parker 1965; Southcott 1966, 1986, 1991, 1994, 1999; Parker & Roberts 1974; Cokendolpher et al. 1979; Welbourn & Young 1988; Reillo 1989; Fain 1991; Fain & Jocqué 1996b; Haitlinger 1996; Baker & Selden 1997; Wohltmann 1999; present study).

Only two species of spiders, i.e. *Pachygnatha clercki* Sundevall 1823 and *Nuctenea umbratica* (Clerck 1757), are known to serve as hosts of two different Parasitengona species (André 1931; Parker 1962; Wohltmann 1999; present study); however, simultaneous parasitism has not been observed.

Attachment site preferences of parasitic larvae of Parasitengona may depend on the systematic position of the parasite. Larvae of Trombidiidae are usually found attached to the prosoma and opisthosoma of spiders. Similar site selectivity is observed in Microtrombidiidae and Eutrombidiidae. Welbourn and Young (1988) found that most eutrombidiid larvae were attached along the molt sutures of the prosoma of the host. Probably this part of exoskeleton is more accessible to penetration by the chelicerae of larvae and allows them to survive there during molting of the host.

Successful attachment to the legs of the host (i.e., leading to feeding) has only been confirmed for Erythraeidae amongst the parasitic larvae of terrestrial Parasitengona mites. Differences in site selectivity, besides the behavioral background, may result from the specific properties of the gnathosoma (Norton et al. 1988), which in Erythraeidae can be well adapted for penetration of the hard cuticle of the legs.

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