



Received: 30 November 2016  
Accepted: 13 February 2017  
Published: 28 February 2017

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## ZOOLOGY | SHORT COMMUNICATION

# First record of a *Leptus* Latreille mite (Trombidiformes, Erythraeidae) associated with a Neotropical trapdoor spider (Araneae: Mygalomorphae: Actinopodidae)

Lidianne Salvatierra<sup>1\*</sup> and Marlus Q. Almeida<sup>2</sup>

**Abstract:** The first occurrence of a parasitic mite, *Leptus* Latreille (Trombidiformes, Erythraeidae) parasitizing an adult male of a trapdoor spider *Actinopus* Perty, 1833 (Araneae: Mygalomorphae: Actinopodidae) and the first occurrence of *Leptus* sp. larvae in the municipality of Manaus, Amazonas state, Brazil are reported.

**Subjects:** Environment & Agriculture; Zoology; Entomology & Acarology

**Keywords:** Acari; parasitism; mutualism; ectoparasite; Arachnida; Neotropical; Amazon

The cosmopolitan genus *Leptus* Latreille, 1796 (Prostigmata: Parasitengona: Erythraeidae) has a total of 10 species described for Brazil, 27 species for the Neotropical region, and more than 270 described species worldwide (Haitlinger, 2004; Mqkol & Wohltmann, 2012). *Leptus* mites have seven larval stages of which nymphs are ectoparasitic using a wide range of arthropods to feed and transport (Penney & Green, 2011).

After hatching from eggs, the mite larvae pierce the cuticle of the invertebrate host and gain access to the host's hemolymph and interstitial fluids via a straw-like stylostome. After engorging, larvae drop off the host and transform into eight-legged nymphs and then adults (Penney & Green, 2011). Both adults and deutonymphs are free-living predators of small invertebrates. Most common hosts are insects (Flechtmann, 1980; Kamran, Afzal, Bashir, & Raza, 2009; Teixeira, 2011; Wilson, Rubink, & Collins, 1990; Wilson, Wooley, Nunamaker, & Rubink, 1987) and arachnids such as opiliones, scorpions, and spiders (Fain, Gummer, & Whitaker, 1987; Mohamed & Mohamed, 2011; Townsend, Mulholland, Bradford, Proud, & Parent, 2006; Welbourn & Young, 1988).

This work reports the first occurrence of larva of the genus *Leptus* parasitizing an adult male of a trapdoor spider *Actinopus* (Araneae: Mygalomorphae: Actinopodidae) and the first occurrence of

### ABOUT THE AUTHOR

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### PUBLIC INTEREST STATEMENT

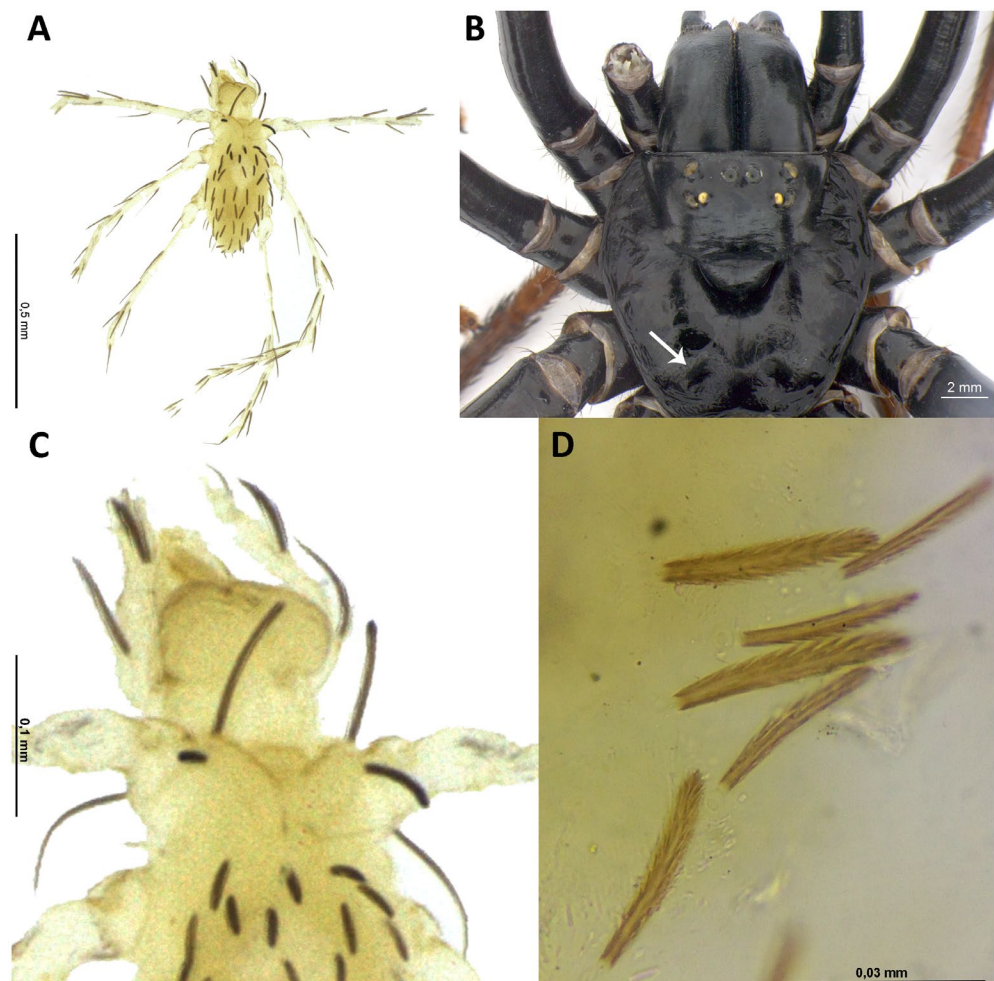
Mites are among the most diverse and successful of all the invertebrate groups. Many mites are parasitic on plants and animals. Most host-parasitic association is poorly described and understood. Investigations of the host-parasitic association can elucidate the biology and animal behavior, the link between parasites and pathogens, and define the role of the mite in transmission and pathogenesis. This article reports the first occurrence of larva of the genus *Leptus* parasitizing an adult male of a trapdoor spider *Actinopus*.

*Leptus* sp. larvae in the municipality of Manaus, Amazonas state. Specimens were collected near the “Universidade Federal do Amazonas,” Manaus, Amazonas, Brazil, and are deposited into the “Coleção de Invertebrados” located at the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil. Photos were taken using a stereomicroscope Leica MZ16, equipped with Leica camera M205c.

*Actinopus* Perty, 1833, also commonly known as trapdoor spiders, are distributed throughout Central and South America (Brescovit, Bonaldo, Bertani, & Rheims, 2002; Ríos, 2014) and can be easily identified by the thoracic groove procurved and rastellum on distinct process (Brescovit et al., 2002; Raven, 1985). The biology and ecology of the species are still little known, females and young males have cryptic habits, living most of the time in excavated burrows, closed by a trap door made of soil particles and silk, making difficult to detect these spiders in their natural habitat (Brescovit et al., 2002; Coyle, Goloboff, & Samson, 1990; Miglio, 2009). Few works reported associations between mites and mygalomorph spiders (Ebermann & Goloboff, 2002; Masan, Simpson, Perotti, & Braig, 2012; Welbourn & Young, 1988). The spider was identified as belonging to *Actinopus cucutaensis* Mello-Leitão, 1941 by the copulatory bulb with elongated and well-developed paraembolic apophysis.

The six-legged *Leptus* larva (body length 0.55 mm, width 0.18 mm) (Figure 1(A), (C–D)) was located near posterior margin on dorsal portion of the spider’s carapace (body length 22.6 mm; carapace long 11.7 mm, wide 11.1 mm) (Figure 1(B)). The specimen was firmly attached to the carapace by its chelicerae, and when it was removed, no injury caused by its mouthparts was visibly detected. The larva is an undescribed species of *Leptus*.

Figure 1. (A) Mite larva of *Leptus* sp., habitus, dorsal view; (B) spider of *Actinopus* sp., carapace, dorsal view (white arrow indicates where mite was attached); (C) details of larva’s gnathosoma and dorsal scutum; (D) dorsal idiosomal setae.



Currently, 79 arachnid species among mites (9 spp.), spiders (17 spp.), scorpions (11 spp.), harvestmen (39 spp.), pseudoscorpions (2 spp.), and tailless whip scorpions (1 sp.) were reported as host of *Leptus* spp. (Table 1).

**Table 1. Updated records of *Leptus* spp. parasitising arachnids**

Host	Host species	<i>Leptus</i> species	Country	References
Subclass Acari				
Order Trombidiformes				
Family Erythraeidae	<i>Abrolophus</i> sp.	<i>L. trimaculatus</i>	Germany	Wendt, Olomski, Leimann, and Wohltmann (1992)
	<i>Balaustium globigerum</i>	<i>L. ignotus</i>	Netherlands	Oudemans (1912)
	<i>Erythraeus</i> sp.	<i>L. echinopus</i>	Denmark	Southcott (1992)
Family Anystidae	<i>Anystis baccarum</i>	<i>L. killingtoni</i>	UK	Turk (1945)
	<i>A. baccarum</i>	<i>L. trimaculatus</i>	Germany	Wendt et al. (1992)
	<i>A. rosae</i>			
Order Sarcoptiformes				
Family Damaeidae	<i>Damaeus grossmani</i>	<i>Leptus</i> spp.	USA	Norton, Welbourn, and Cave (1988)
	<i>Spatiodamaeus verticillipes</i>	<i>Leptus</i> spp.	USA	Norton et al. (1988) (as <i>Damaeus verticillipes</i> )
Family Oribatellidae	<i>Oribatella extensa</i>	<i>Leptus</i> spp.	USA	Norton et al. (1988)
Family Xenillidae	<i>Xenillus occultus</i>	<i>Leptus</i> spp.	USA	Norton et al. (1988)
Order Amblypygi				
Family Charinidae	<i>Phrynus kennidae</i>	<i>Leptus</i> sp.	Dominican Republic	Armas and Trueba (2003)
Order Araneae				
Family Actinopodidae	<i>Actinopus cucutaensis</i>	<i>Leptus</i> spp.	Brazil	This paper
Family Eutichuridae	<i>Cheiracanthium</i> sp.	<i>L. hidakai</i>	Japan	Kawashima (1958)
Family Sparassidae	<i>Delena cancerides</i>	<i>L. charon</i>	Australia	Southcott (1999)
	<i>Isopeda frenchi</i>	<i>L. minno</i>	Australia	Southcott (1999)
	<i>Isopeda woodwardi</i>	<i>L. charon</i>	Australia	Southcott (1999)
	<i>Isopeda</i> sp.	<i>L. charon</i>	Australia	Southcott (1999)
	<i>Isopeda</i> sp.	<i>L. faini</i>	Australia	Southcott (1999)
	<i>Isopedella inola</i>	<i>L. orthrius</i>	Australia	Southcott (1999)
	<i>I. leai</i>	<i>L. orthrius</i>	Australia	Southcott (1999)
Family Theridiidae	<i>Enoplognatha ovata</i>	<i>Leptus</i> sp.	USA	Reillo (1989)
	<i>Holconia insignis</i>	<i>L. faini</i>	Australia	Southcott (1999)
Family Lycosidae	<i>Lycosa</i> sp.	<i>L. gifuensis</i>	Japan	Kawashima (1958)
	<i>Pardosa</i> sp.	<i>Leptus</i> sp.	USA	Sorkin (1982)
Family Uloboridae	<i>Miagrammopes singaporensis</i>	<i>L. hidakai</i>	Singapore	Baker and Selden (1997)
Family Tetragnathidae	<i>Pachygnatha clerki</i>	<i>L. ignotus</i>	UK	Parker (1962)

(Continued)

**Table 1. (Continued)**

Host	Host species	Leptus species	Country	References
Family Philodromidae	<i>Philodromus imbecillus</i>	<i>Leptus</i> sp.	USA	Cokendolpher, Horner, and Jennings (1979)
Family Salticidae	<i>Saitis</i> sp.	<i>L. atticolus</i>	South Africa	Lawrence (1940)
Family Zodariidae	<i>Systemoplacis</i> sp.	<i>L. rwandae</i>	Rwanda	Fain and Jocqué (1996)
Undetermined spider	–	<i>L. ignotus</i>	France	Bruyant (1911)
<b>Order Opiliones</b>				
Family Manaosbiinae	<i>Cranellus montgomeryi</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
Family Cosmetidae	<i>Cynorta</i> sp.	<i>L. gracilipes</i>	Surinam	Oudemans (1910a)
	<i>Cynortula</i> sp.	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
	<i>Paecilaema inglei</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
Family Gonyleptidae	<i>Discocyrtus funestus</i>	<i>L. lomani</i>	Chile	Oudemans (1902)
Family Sclerosomatidae	<i>Gragellula niveata</i>	<i>L. phuketicus</i>	Thailand	Southcott (1994)
	<i>Gragellula</i> sp.	<i>L. phuketicus</i>	Thailand	Southcott (1994)
	<i>Gagrella</i> sp.	<i>L. gagrellae</i>	Indonesia	Oudemans (1910b)
	<i>Leiobunum calcar</i>	<i>L. indianensis</i>	USA	Fain et al. (1987)
	<i>L. formosum</i>	<i>L. indianensis</i>	USA	Cokendolpher (1993)
		<i>Leptus</i> sp.	USA	Townsend et al. (2006)
		<i>L. longipes</i>	<i>L. indianensis</i>	USA
	<i>L. nigripes</i>	<i>L. nearcticus</i>		
	<i>L. speciosum</i>	<i>L. indianensis</i>	USA	Fain et al. (1987)
	<i>L. ventricosum</i>			
	<i>L. vittatum</i>	<i>L. nearcticus</i>	USA	Fain et al. (1987)
	<i>Prionostemma</i> sp.	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
	<i>Trachyrhinus marmoratus</i>	<i>Leptus</i> sp.	USA	MacKay, Grimsley, and Cokendolpher (1992)
Family Phalangidae	<i>Lacinius ephippiatus</i>	<i>L. holmiae</i>	Slovakia	Stašiov (2003)
	<i>Lophopilio palpinalis</i>	<i>L. holmiae</i>	Slovakia	Stašiov (2003)
		<i>L. ignotus</i>	Poland	Haitlinger (1987) (as <i>Odiellus palpinalis</i> )
		<i>L. phalangii</i>	Poland	Gabrys (1991) (as <i>Odiellus palpinalis</i> )
		<i>Megabunus diadema</i>	<i>L. beroni</i>	France
	<i>Mitopus morio</i>	<i>L. beroni</i>	Belgium	Fain (1991a)
			France	Fain and Amico (1997)

(Continued)

**Table 1. (Continued)**

Host	Host species	Leptus species	Country	References
		<i>L. holmiae</i>	Denmark	Southcott (1992)
			Iceland	
			Ireland	
			Poland	
		<i>L. ignotus</i>	Bulgaria	Beron (1975)
		<i>L. kalaallus</i>	Greenland	Southcott (1992)
		<i>Leptus</i> spp.	Norway	Åbro (1988)
		<i>L. holmiae</i>	Poland	Haitlinger (1991)
	<i>Oligolophus hansenii</i>	<i>L. beroni</i>	France	Fain and Amico (1997)
	<i>Oligophorus tridens</i>	<i>L. holmiae</i>	Poland	Haitlinger (1991)
			Slovakia	Stašiov (2003)
	<i>Opilio canestrinii</i>	<i>L. holmiae</i>	Denmark	Southcott (1992)
	<i>O. pentaspinulatus</i>	<i>L. hidakai</i>	Japan	Kawashima (1958)
	<i>O. ruzickai</i>	<i>L. ignotus</i>	Bulgaria	Beron (1975)
	<i>Opilio</i> sp.	<i>L. holmiae</i>	Sweden	Southcott (1992)
		<i>L. ignotus</i>	Sweden	Oudemans (1912)
	<i>Phalangium opilio</i>	<i>L. holmiae</i>	UK	Southcott (1992)
		<i>L. ignotus</i>	Poland	Haitlinger (1987)
			France	Fain and Amico (1997)
		<i>L. mariae</i>	Poland	
		<i>L. molochinus</i>	Poland	
		<i>L. phalangii</i>	Poland	Gabrys (1991)
		<i>L. phalangii</i>	UK	Evans (1910)
		<i>Leptus</i> spp.	Norway	Åbro (1988)
	<i>P. partietinum</i>	<i>L. ignotus</i>	Netherlands	Oudemans (1912)
	<i>Phalangium</i> spp.	<i>L. ignotus</i>	France	Bruyant (1911)
	<i>Rilaena triangularis</i>	<i>L. holmiae</i>	UK	Southcott (1992) (as <i>Platybunus triangularis</i> )
		<i>L. ignotus</i>	Poland	Haitlinger (1987) (as <i>Platybunus triangularis</i> )
		<i>L. phalangii</i>	Poland	Gabrys (1991) (as <i>Platybunus triangularis</i> )
	<i>Rhamsinitis fissidens</i>	<i>L. rwandae</i>	Rwanda	Fain and Jocqué (1996)
Family Samoidae	<i>Maracaynatum trinidadense</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
	<i>Pellobunus longipalpus</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
Family Cranidae	<i>Phareicranus calcariferus</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
	<i>Santinezia serratotibilis</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)

(Continued)

**Table 1. (Continued)**

Host	Host species	Leptus species	Country	References
Family Manaosbiidae	<i>Rhopalocranaus albilineatus</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
Family Stygnidae	<i>Stygnoplus clavotibialis</i>	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008)
Family Agoristenidae	<i>Avima</i> sp.	<i>Leptus</i> sp.	Trinidad	Townsend et al. (2008) (as <i>Trinella</i> sp.)
Undetermined		<i>L. bicristatus</i>	Malawi	Fain and Elsen (1987)
		<i>L. jocquei</i>		
		<i>L. puylaerti</i>		
		<i>L. polythrix</i>		
		<i>L. stieglmayri</i>	Brazil	Oudemans (1905)
		<i>L. ignotus</i>	Poland	Haitlinger (1991)
		<i>Leptus</i> sp.	USA	Welbourn (1983)
<b>Order Pseudoscorpiones</b>				
Family Neobisiidae	<i>Neobisium</i> sp.	<i>Leptus</i> sp.	France	Judson and Mqkol (2011)
Undetermined	–	<i>L. chelonethus</i>	Australia	Womersley (1934)
<b>Order Scorpiones</b>				
Family Buthidae	<i>Buthus occitanus</i>	<i>L. pyrenaeus</i>	France	Andre (1953)
	<i>Centruroides vittatus</i>	<i>Leptus</i> sp.	USA	Welbourn (1983)
	<i>Hemilychas alexandrinus</i>	<i>L. waldockae</i>	Australia	Fain (1991b) (as <i>Lychas alexandrines</i> )
	<i>Lychas</i> sp.	<i>L. korematius</i>	Australia	Southcott (1999)
Family Bothriuridae	<i>Cercophonius squama</i>	<i>L. charon</i>	Australia	Southcott (1999)
			Tasmania	Seeman and Miller (2002)
Family Scorpionidae	<i>Urodacus manicatus</i>	<i>Leptus</i> sp.	Australia	Southcott (1955) (as <i>Urodacus abruptus</i> )
		<i>L. baudini</i>	Australia	Southcott (1999)
		<i>L. urodaci</i>	Australia	Southcott (1999)
		<i>L. smithi</i>	Australia	Southcott (1999)
		<i>L. pistoris</i>	Australia	Southcott (1999)
		<i>L. carduus</i>	Australia	Southcott (1999)
		<i>Leptus</i> sp.	Australia	Fain (1991b)
		<i>U. armatus</i>		
		<i>U. hoplurus</i>		
		<i>U. yaschenkoi</i>		
<i>U. hartmeyeri</i>	<i>L. korematius</i>	Australia	Southcott (1999)	
<i>U. varians</i>	<i>L. korematius</i>	Australia	Southcott (1999)	
	<i>Urodacus cf. yaschenkoi</i>	<i>L. barmeedi</i>	Australia	Southcott (1999)
Undetermined	–	<i>Leptus</i> sp.	Mexico	Welbourn (1983)
		<i>Leptus</i> sp.	Costa Rica	Welbourn (1983)

Source: Modified from Baker and Selden (1997).

Little is known about the impact of *Leptus* larva feeding on their host upon the survival, locomotion, or reproductive capacity of their spider hosts, but it is known that *Leptus* larvae are able to transmit *Spiroplasma* bacteria which can be mutualistic or pathogenic (DiBlasi et al., 2011). Although specific associations between deutonymphs of Astigmata and Heterostigmata mites, and larvae of Prostigmata mites, and spiders are well documented, little is known about the spider mite associations in Brazil and the implications for the host.

This paper revealed an unrecorded association between trapdoor *Actinopus* spider and a *Leptus* mite for Brazil, which indicated that similar interactions (parasitic and non-parasitic) are likely to be far more diverse. Additional field and laboratory studies of the life history and ecology of parasite and host species are required.

#### Acknowledgments

We thank Dr José Albertino Rafael for lab support on realization of photos and measurements of the spider at Diptera laboratory, National Institute for Amazonian Research (INPA).

#### Funding

The authors received no direct funding for this research.

#### Competing Interests

The author declares no competing interest.

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#### Citation information

Cite this article as: First record of a *Leptus* Latreille mite (Trombidiformes, Erythraeidae) associated with a Neotropical trapdoor spider (Araneae: Mygalomorphae: Actinopodidae), Lidiane Salvatierra & Marlus Q. Almeida, *Cogent Biology* (2017), 3: 1295823.

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