

Acarologia

A quarterly journal of acarology, since 1959
Publishing on all aspects of the Acari

All information:

<http://www1.montpellier.inra.fr/CBGP/acarologia/>
acarologia-contact@supagro.fr



**Acarologia is proudly non-profit,
with no page charges and free open access**

Please help us maintain this system by
encouraging your institutes to subscribe to the print version of the journal
and by sending us your high quality research on the Acari.

Subscriptions: Year 2021 (Volume 61): 450 €

<http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php>

Previous volumes (2010-2020): 250 € / year (4 issues)

Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)



Acarologia is under **free license** and distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

Eutrombicula tinami (Oudemans, 1910) (Trombidiformes: Trombiculidae) in Brazil: a neglected ectoparasite of several animals including humans

Ricardo Bassini-Silva^a, Fernando de Castro Jacinavicius^{a,b}, Adriano Pinter^c,
Gislene F. S. R. Fournier^a, Camile Lugarini^d, Ariane Ferreira^e, Luciano
Moreira-Lima^f, Erika Hingst-Zaher^f, Cal Welbourn^g, Ron Ochoa^h, Darci
Moraes Barros-Battesti^{a,i}

^a Departamento de Medicina Veterinária Preventiva e Saúde Animal, Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo-FMVZ-USP, São Paulo, SP, Brazil.

^b Laboratório Especial de Coleções Zoológicas, Instituto Butantan, São Paulo, SP, Brazil.

^c Superintendência de Controle de Endemias-SUCEN, São Paulo, SP, Brazil.

^d Instituto Chico Mendes de Conservação da Biodiversidade-ICMBio, Florianópolis, SC, Brazil.

^e Centro de Ciências Biológicas, Universidade Federal de Santa Catarina, Florianópolis, SC, Brazil.

^f Museu Biológico, Instituto Butantan, São Paulo, SP, Brazil.

^g Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, FL, USA.

^h Systematic Entomology Laboratory, United States Department of Agriculture, Agricultural Research Service, Beltsville, MD, USA.

ⁱ Departamento de Patologia Veterinária, Faculdade de Ciências Agrárias e Veterinárias-UNESP, Jaboticabal, SP, Brazil.

Original research

ABSTRACT

The genus *Eutrombicula* comprises ca. 80 species worldwide, some of which have been reported as causative agents of severe irritation to the host's skin, known as trombiculiasis. Six species of *Eutrombicula* have been recorded from Brazil until present, with two reports of humans as hosts. In this study, *Eutrombicula tinami* (Oudemans) is redescribed and new records for the states of Minas Gerais, Rio de Janeiro, Santa Catarina and São Paulo as well as new parasite-host associations with Columbiformes, Cuculiformes, Passeriformes, Tinamiformes, Carnivora, Didelphimorphia and Lagomorpha are listed. Besides that, a two detailed report cases of trombiculiasis is provided.

Keywords Chiggers; ectoparasites; distribution; hosts; mammals; birds; trombiculiasis

Introduction

Some non-host specific chigger genera (Trombidiformes: Trombiculidae, Leeuwenhoekiiidae and Walchiidae) parasitize several vertebrates groups, including humans (Shatrov 2000). Infestation by these mites can causes severe itching known as trombiculiasis, and there is also a possibility disease transmission (Mullen and OConnor 2002). One genus is *Eutrombicula* Ewing, 1938 with more than 80 species, six of which are recorded in Brazil: *Eutrombicula alfreddugesi* (Oudemans, 1910), *Eutrombicula batatas* (Linnaeus, 1758), *Eutrombicula bruyanti* (Oudemans, 1910), *Eutrombicula daemoni* (Bassini-Silva and Jacinavicius, 2018), *Eutrombicula goeldii* (Oudemans, 1910) and *Eutrombicula tinami* (Oudemans, 1910) (Stekolnikov and González-Acuña 2010; Bassini-Silva *et al.* 2018, Jacinavicius *et al.* 2018a).

Received 13 June 2019
Accepted 24 September 2019
Published 10 October 2019

Corresponding author
Darci Moraes Barros-Battesti:
barros.battesti@gmail.com

Academic editor
Małkol, Joanna

DOI
10.24349/acarologia/20194343

ISSN 0044-586X (print)
ISSN 2107-7207 (electronic)

© Copyright
Bassini-Silva R. *et al.*

Distributed under
Creative Commons CC-BY 4.0



The Neotropical species *E. tinami*, was described from Brazil by Oudemans (1910) and later recorded from Panama (Brennan and Lukoschus 1971), Surinam (Brennan and Lukoschus 1971) and Venezuela (Brennan and Reed 1974), parasitizing birds, rodents and marsupials (Oudemans 1910; Brennan and Lukoschus 1971; Brennan and Reed 1974; 1975; Jacinavicius *et al.* 2018a).

In the northern region of Brazil, locals use the term ‘micuim’ for chiggers, but in the southern region, there is no common name, suggesting most Brazilians including the medical community are unaware of chigger and their medical importance.

Here we redescribe *E. tinami*, with new locality and host records as well as new human trombiculiasis records.

Material and methods

The Instituto Butantan houses the Acari Collection (IBSP) that receives material from various parts of the country. Specimens deposited in this collection are regularly prepared for identification. Of these, two hundred chiggers belonging to the genus *Eutrombicula*, previously stored in Ethanol (100%) were slide-mounting in Hoyer’s medium and some were prepared for scanning electron microscopy (SEM), both preparations according to Walter and Krantz (2009). Drawings were made with a Leica DFC 500 microscope. Extended focal range images were composed with Leica Application Suite version 2.5.0. The scanning electron microscope photographs were obtained using a Digital FEI-Quanta 250 at the Laboratório de Biologia Celular, Instituto Butantan, São Paulo. The distribution map was prepared using DIVAGIS. All the images were prepared with Adobe Photoshop v. 13.0 and Inkscape V.2. Species identifications involved using the key by Brennan and Reed (1974), and original species descriptions. Additional sources included redescrptions of *Eutrombicula* by Oudemans (1912), Jenkins (1949) as well as illustrations by Brennan and Reed (1974). The terminology follows Bassini-Silva *et al.* (2018) and Jacinavicius *et al.* (2018b).

In the present study we also report the parasitism by *E. tinami* on two humans, one male 39 y/o and other female 31y/o, who were walking in the Atlantic Rain Forest (45°19’28” W, 23°33’42” S) between 9 am and 12 pm on an unspecified day November 2014.

Results

Systematics

The chigger specimens were identified as *E. tinami* (Oudemans, 1910). Additional specimens from Minas Gerais, Rio de Janeiro, Santa Catarina and São Paulo states were studied and used to improve the redescription of *E. tinami* presented below.

***Eutrombicula tinami* (Oudemans, 1910)**

Microthrombidium tinami Oudemans 1910: 84; 1912: 24.

Trombicula tinami: Methlagl 1928: 216, 223 and 224; Ewing 1931: 10.

Eutrombicula tinami: Ewing 1938: 294; Radford, 1942: 67; Fuller, 1952: 133; Brennan and Lukoschus 1971: 44; Brennan and Reed 1974: 710; Brennan and Reed 1975: 52; Loomis and Wrenn, 1984: 158; Jacinavicius *et al.* 2018a: 9.

Otonyssus tinami: Buitendijk 1945: 338.

Eutrombicula (Eutrombicula) tinami: Vercammen-Grandjean 1965: 32.

Larva

(Figures 1–5, Tables 1 and 2)

Diagnosis — Palptibia with nude dorsal and lateral setae, and a branched ventral seta; adoral setae nude; odontus bifurcate with the inner prong smaller than the outer prong; the first

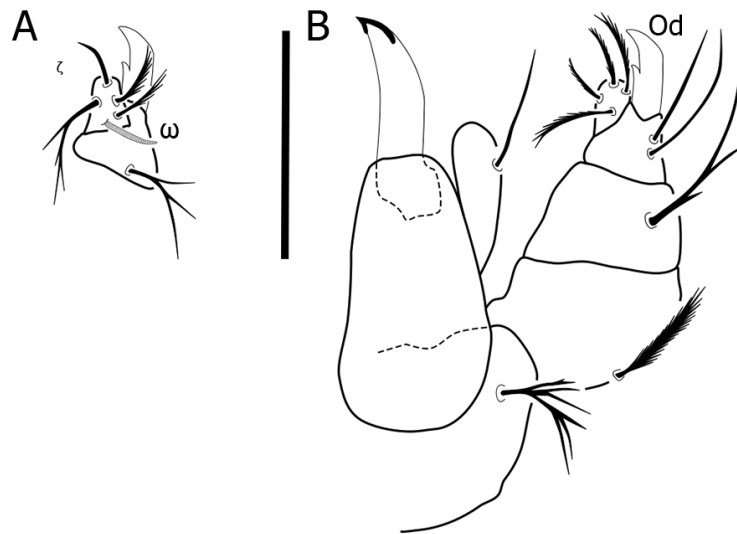


Figure 1 Morphological details of *Eutrombicula tinami* (Oudemans, 1910): A – ventral view of palptarsus; B – dorsal view of gnathosoma; symbols: ω = solenidion of palptarsus; ζ = subterminal eupathid of palptarsus; Od = odontus. Scales: A and B 50 μ m.

row (C) of dorsal opisthosoma setae with 8 setae; the second row (D) with 6 setae; tarsus of leg I with a ε distal to ω , tibia of the leg III with one mastiseta.

Redescription based on examined material (Figures 1-5)

Gnathosoma — palp setal formula B/B/NNB/7B $\zeta\omega$; odontus (= palpal claw) bifurcate; cheliceral blade with tricuspid cap; gnathobase punctate; subcapitular setae branched, *elcp* not observed (Figs. 1A-B and 5A), adoral (= galeal) setae nude (Fig. 1B).

Idiosoma — eyes 2/2 set in an ocular plate, anterior eye larger; prodorsal sclerite (= scutum) with 1 pair of flagelliform trichobothridial (= sensilla) setae (*si*) with widely distributed long and slender setules, and 5 normal setae (a pair of *ve* (= AL), a pair of *se* (= PL) and a single *vi*

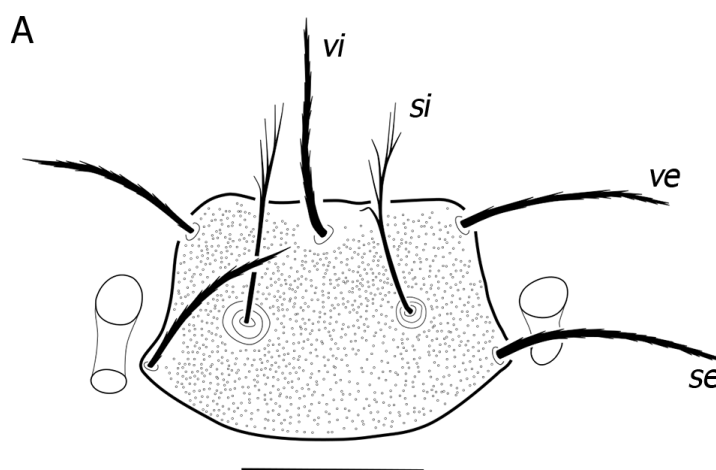


Figure 2 Morphological details of *Eutrombicula tinami* (Oudemans, 1910): A – prodorsal sclerite; symbols: *ve* = external vertical setae; *se* = external scapular setae; *vi* = internal vertical setae; *si* = internal scapular trichobothridial setae. Scales: 50 μ m.

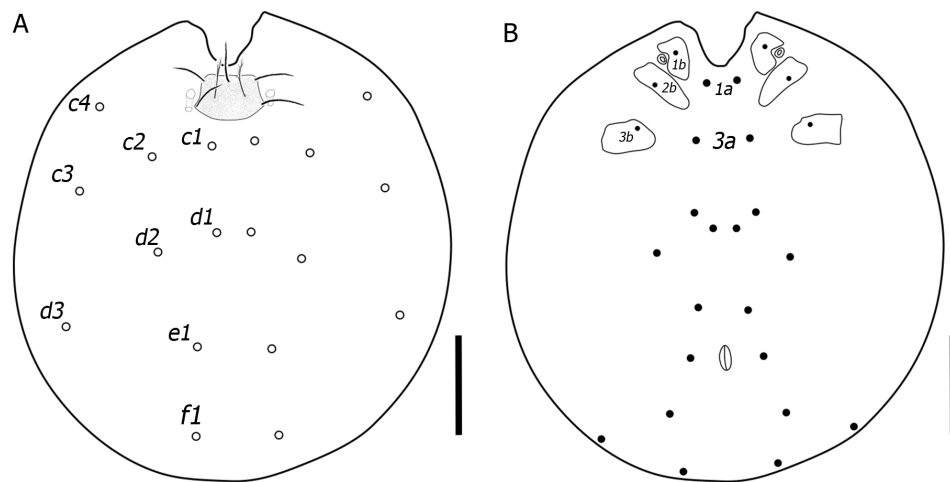


Figure 3 Morphological details of *Eutrombicula tinami* (Oudemans, 1910); A – dorsal view of idiosoma; B – ventral view of idiosoma. Solid circles = ventral setae; open circles = dorsal setae. Symbols: c₁-c₄ = C row setae; d₁-d₃ = D row setae; e₁ = E row setae; f₁ = F row; 1a = anterior sternal setae; 3a = posterior sternal setae; 1b = coxal field I seta; 2b = coxal field II seta; 3b = coxal field III seta. Scales: A and B 100 μm.

(= AM) seta), $se > ve > si > vi$; the anterior margin of the prodorsal sclerite slightly undulating, and the lateral margins slightly concave posteriorly, posterior margin convex (Figs. 2A and 5C). Thirty four opisthosomal setae, dorsal opisthosoma with 4 pairs of setae in the C row, with the c₄ pair in an anterior position (= humeral setae), D row with 3 pairs of setae, E row with 1 pair of setae, F row with 1 pair of setae, totaling 18 dorsal opisthosomal setae, and 16 ventral opisthosomal setae (10 setae anterior to the anus and 6 setae posterior) (Figs 3A-B, 5B). Two pairs of sternal setae (1a, 3a) between coxal fields.

Legs — femur legs I-III each divided into a basifemur and telofemur, each leg terminated with a pair of claws and a claw-like empodium, without onychotriches, coxal fields striate. *Leg I* - coxal field with 1 branched seta 1b (1B), *elcI* not observed; trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, 3 σ with κ; tibia 8B, 2 φ with κ; tarsus 21B, with ω, ε, dorsal eupathidium (ζ') with a companion seta z and terminating with a subterminal eupathidium (ζ''), base of famulus (ε) distal to ω (Figs. 4A). *Leg II* - coxal field seta 2b (1B); trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ; tibia 6B, 2 φ; tarsus 15B, with ω, ε, and subterminal eupathidium (ζ), base of ε proximal to ω (Fig. 4B). *Leg III* - coxal field seta 3b (1B) on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ, tibia 6B, φ; tarsus 14B and one mastiseta (Figs. 4C and 5E).

Table 1 Standard measurements of *Eutrombicula tinami* (n=30).

	AW	PW	SB	ASB	PSB	SD	P-PL	AP	vi	ve	se	si	1a	3a	DMIN	DMAX	VMIN	VMAX
Fuller (1952)	76-77	92	29	35	56-59	-		38	56-59	48-53	62-63	53-59	-	-	-	-	-	-
Minimum	78	93	21	44	30	74	23	33	43	46	58	60	57	42	46	54	32	39
Maximum	88	116	29	49	36	85	26	36	46	55	60	64	59	44	50	60	33	45
Mean	83	104	25	46	33	79	24	35	44	50	59	62	58	43	48	57	32	42

Legend: AW = distance between the bases of the vi setae; PW = distance between the bases of the se setae; SB = distance between the si bases; ASB = distance from the si bases to extreme anterior margin of the prodorsal sclerite; PSB = distance from the si bases to the extreme posterior margin of the prodorsal sclerite; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance between the bases of vi and se; vi = anteromedial seta; ve = anterolateral setae; se = posterolateral setae; si = flagelliform trichobothridial setae; 1a = anterior sternal setae; 3a = posterior sternal setae; DMIN = minimum length of dorsal opisthosomal setae; DMAX = maximum length of dorsal opisthosomal setae; VMIN = minimum length of ventral opisthosomal setae and VMAX = maximum length of ventral opisthosomal setae.

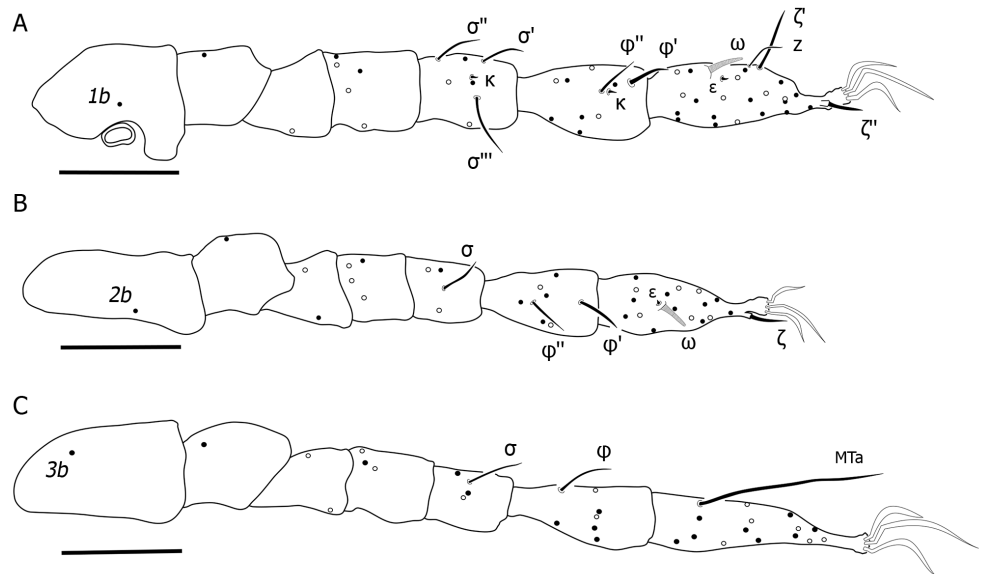


Figure 4 Morphological details of *Eutrombicula tinami* (Oudemans, 1910); A – Leg I; B – Leg II; C – Leg III. Solid circles = ventral leg setae; open circles = dorsal leg setae; symbols: ζ' = dorsal eupathid tarsus leg I; ζ'', ζ = subterminal eupathid tarsus legs I and II, respectively; ω = solenidion tarsus legs I and II; σ, σ', σ'', and σ''' = solenidia on the genu of legs I, II and III; κ = microsetae on genu and tibia of leg I; φ, φ', φ'' = solenidia on tibiae legs I, II and III; ε = famulus on tarsi of legs I and II; z = companion seta on tarsi of leg I; 1b = coxal field I seta; 2b = coxal field II seta; 3b = coxal field III seta; MTa = mastisetae on tarsus leg III. Scales: A-C 50 μm.

Distribution (Figure 6) — *Minas Gerais (MG) state* - Abaeté (45°26'44" W, 19°09'36" S); Fazenda Continente, Coronel Pacheco (43°15'56" W, 21°35'17" S); *Rio de Janeiro state* - Angra dos Reis (44°19'04" W, 23°00'24" S); Paraty (44°42'46" W, 23°13'04" S); *Santa Catarina state* - Estação Ecológica de Carijós, Florianópolis (48°30'37" W, 27°27'54" S); Reserva Biológica Marinha do Arvoredo, Florianópolis (48°21'23" W, 27°17'57" S); *São Paulo state* - Caraguatatuba (45°19'28" W, 23°33'42" S); Reserva Florestal do Morro Grande, Cotia (46°57'48" W, 23°43'48" S); Vila Verde condominium, Itapevi (46°57'41" W, 23°34'47" S); Sabaúna district, Mogi das Cruzes (46°05'16" W, 23°29'02" S); Barra do Una, Peruíbe (47°04'59" W, 24°27'01" S); Água doce, Piedade (47°25'40" W, 23°42'43" S); Santos (46°20'00" W, 23°57'39" S); Água Funda neighborhood, São Paulo (46°37'24" W, 23°38'04" S); Instituto Butantan, São Paulo (46°43'21" W, 23°33'56" S); Serra da Cantareira, São Paulo (46°31'38" W, 23°22'44" S); Vila Albertina neighborhood, São Paulo (46°41'30" W, 23°30'04" S).

Table 2 Standard measurements of *Eutrombicula tinami* (n=30).

	I	II	III	Ip	TaIII	TaW	σ I	κ I	φ I	κ I	ω I	ε I	ζ' I	ζ'' I	z	σ II	φ II	ω II	ε II	ζ II	σ III	φ III
Minimum	289	280	285	865	89	13	17	2	18	3	14	4	23	15	13	18	16	12	4	15	16	18
Maximum	299	285	300	870	97	16	19	2	19	3	15	3	25	17	13	19	20	13	4	16	17	19
Mean	293	282	293	867	94	15	18	2	18	3	15	3	24	16	13	18	18	12	4	15	16	18

Legend: I = length of leg I; II = length of leg II; III = length of leg III; Ip = sum of leg lengths (trochanter to base of pretarsus); TaIII = length of tarsus leg III; TaW = width of tarsus leg III; σ I = average length of the three solenidia on genu of leg I; κ I = length of microseta on genu of leg I; φ I = average length of both solenidia on tibia of leg I; κ I = length of microseta on tibia leg I; ω I = length of solenidion on tarsus leg I; ε I = length of famulus on tarsus leg I; ζ' I = length of dorsal eupathidium on tarsus leg I; ζ'' I = length of subterminal eupathidium on tarsus leg I; z = length of companion seta on tarsus leg I; σ II = length of solenidion on genu leg II; φ II = length of an average of both solenidia on tibia leg II; ω II = length of solenidion on tarsus leg II; ε II = length of famulus on tarsus leg II; ζ II = length of subterminal eupathidium on tarsus leg II; σ III = length of solenidion on genu leg III and φ III = length of solenidion on tarsus leg II

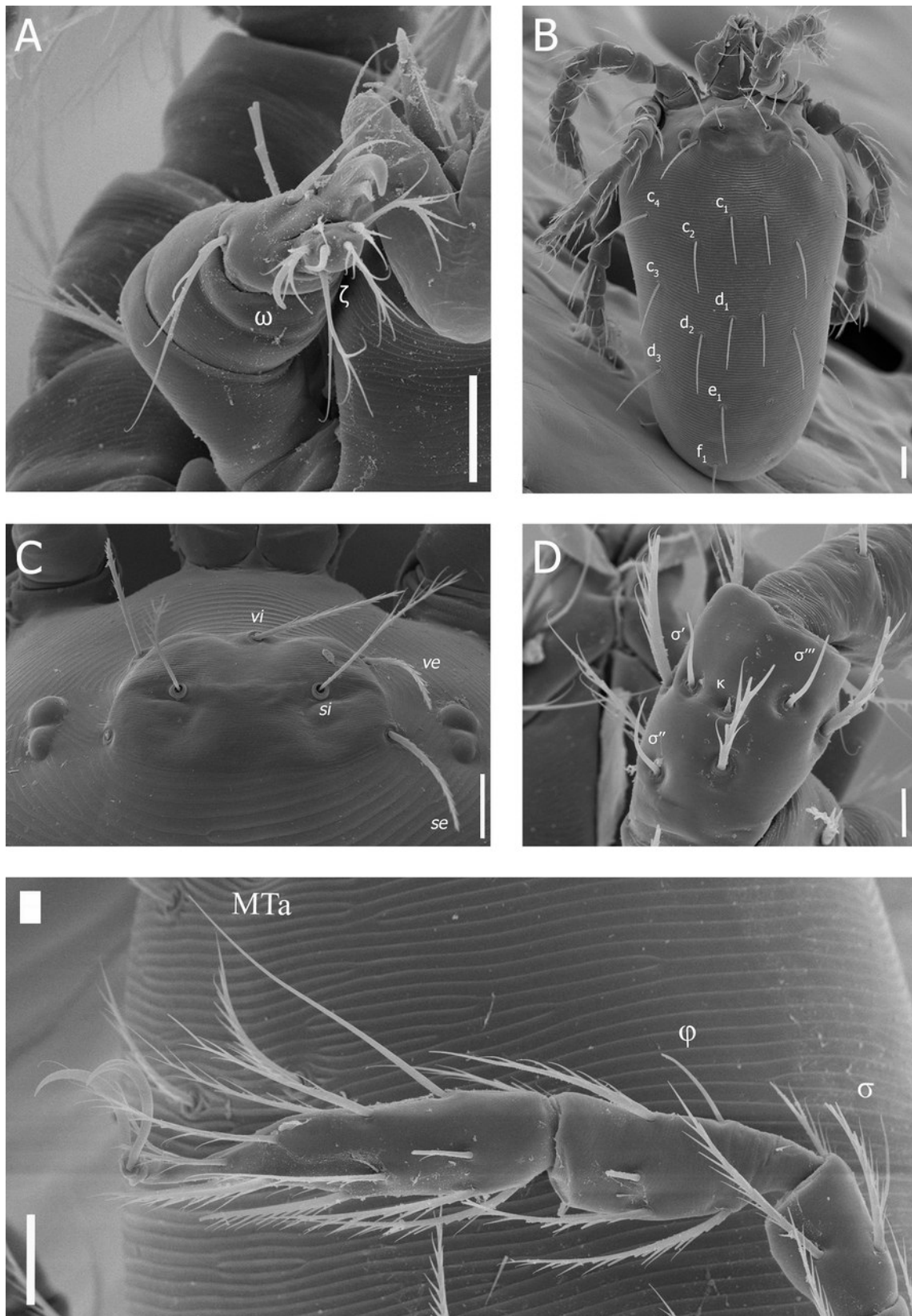


Figure 5 Scanning electron micrographs of *Eutrombicula tinami* (Oudemans, 1910); A – ventral view of palptarsus; B – dorsal view of idiosoma; C – prodorsal sclerite; D – genu of leg I; E – genu, tibia and tarsus of the leg III. Symbols: ω = palptarsal solenidium; ζ = palptarsal subterminal eupathid; c_1 - c_4 = C row setae; d_1 - d_3 = D row setae; e_1 = E row setae; f_1 = F row setae; ve = external vertical setae; se = external scapular setae; vi = internal vertical setae; si = internal scapular trichobothridial setae; σ = solenidia on genu of legs I and III; κ = microsetae on genu of leg I; ϕ = solenidia on tibiae legs III; MTa = mastisetae on the tarsi legs III. Scales: A and D 20 μ m; B 100 μ m; C and E 50 μ m.

Type depository — According to the original description and Jacinavicius et al. (2018a), the types for this species are deposited at the Naturalis Biodiversity Center, Leiden, Netherlands [formerly Rijksmuseum van Natuurlijke Historie], but Fuller (1952) reported the types were deposited in the Muséum National d’Histoire Naturelle, Paris, France, however they not available for this study.

Material examined from Brazil

Mammals

Five larvae (IBSP 1648), Santos, São Paulo (SP), 26-II-1939, *Homo sapiens* L. (Primates: Hominidae), Dr. Tuffy and A. T. Leão coll.; 3 larvae (IBSP 12522), Caraguatatuba, SP, XI-2014, same host, G. F. S. R. Fournier and A. Pinter coll.; 1 larva (IBSP 4673), Instituto Butantan, São Paulo, SP, 1940, same host, A. T. Leão coll.; 1 larva (IBSP 1975), Serra da Cantareira, SP, 12-VIII-1940, *Nasua nasua* L. (Carnivora: Procyonidae), N. Bolognani coll.; 1 larva (IBSP 1680), Vila Albertina neighborhood, São Paulo, SP, 25-II-1938, *Didelphis aurita* Wied-Neuwied (Didelphimorphia: Didelphidae), L. F. Martins coll.; 4 larvae (IBSP 10541), Barra do Una, Peruíbe, SP, 05-XI-2010, same host, F. Nieri-Bastos coll.; 2 larvae (IBSP 352), Instituto Butantan, São Paulo, SP, 24-V-1933, same host; 1 larva (IBSP 11255), Vila Verde condominium, Itapevi, SP, 13-XII-2012, same host, F. C. Jacinavicius coll.; 6 larvae (IBSP 10551), same locality and host, 29-IV-2011, A. Marcili coll.; 4 larvae (IBSP 340), Instituto Butantan, São Paulo, SP, 22-X-1933, *Sylvilagus brasiliensis* (L.) (Lagomorpha: Leporidae); 3 larvae (IBSP 353), same locality and host, 21-V-1932; 1 larva (IBSP 581), same locality and host, VII-1931; 4 larvae (IBSP 1654), Água Funda neighborhood, São Paulo, SP, 07-III-1939, *Hydrochoerus hydrochaeris* L. (Rodentia: Caviidae), Dr. Vallejo coll.; 1 larva (IBSP 10535C), Serra da Cantareira, São Paulo, SP, 12-IV-2011, *Euryoryzomys russatus* (Wagner) (Rodentia: Cricetidae), F. Nieri-Bastos coll.; 1 larva (IBSP 358), Angra dos Reis, Rio de Janeiro (RJ), VI-1931, *Dasyprocta leporina* (L.) (Rodentia: Dasyproctidae), L. Travassos coll.; 1 larva (IBSP 1681), Abaeté, Minas Gerais (MG), 05-VII-1937, *Trinomys* sp. (Rodentia: Echimyidae), E. Chagas coll.; 2 larvae (IBSP 1684), same locality and host, 01-VI-1937, E. Chagas coll..

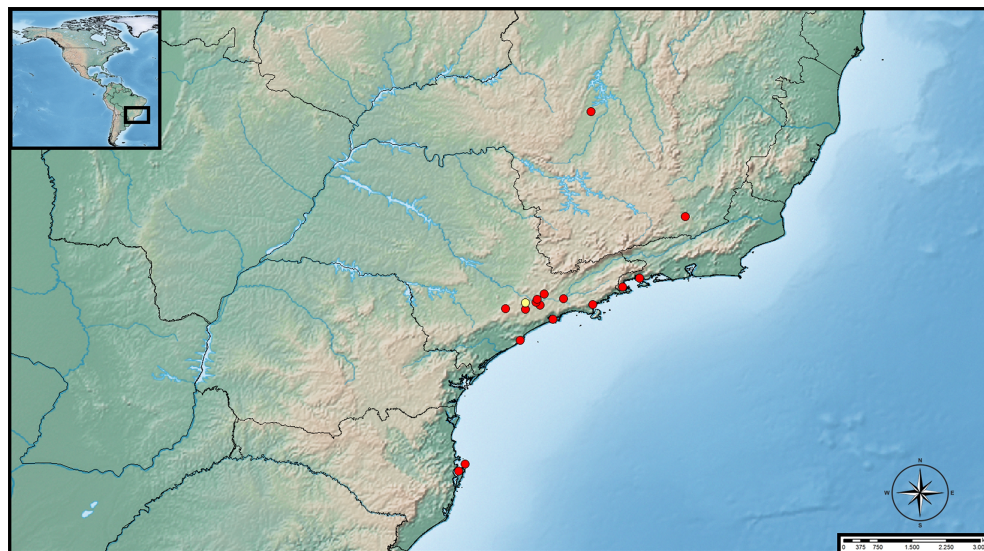


Figure 6 Geographical distribution of *Eutrombicula tinami* (Oudemans, 1910) in Brazil. The yellow dot represents a literature record, and red dots are new records.



Figure 7 Lower leg of female bitten by *Eutrombicula tinami* (Oudemans, 1910). The arrows show the areas of papular dermatitis.

Birds

Three larvae (IBSP 370), Instituto Butantan, São Paulo, SP, no date, *Columbina talpacoti* (Temminck) (Columbiformes: Columbidae); 1 larva (IBSP 12732), Paraty, RJ, no date, *Geotrygon montana* (L.) (Columbiformes: Columbidae), L. Moreira-Lima coll.; 4 larvae (IBSP 468), Serra da Cantareira, São Paulo, SP, 16-I-1936, *Leptotila* sp. (Columbiformes: Columbidae); 6 larvae (IBSP 12165), Instituto Butantan, São Paulo, SP, 27-II-2015, *Leptotila verreauxi* (Bonaparte) (Columbiformes: Columbidae), L. Moreira-Lima coll.; 1 larva (IBSP 1689), same locality, 01-IV-1939, *Guira guira* (Gmelin) (Cuculiformes: Cuculidae), J. Navas and A. T. Leão coll.; 2 larvae (IBSP 10944), same data; 2 larvae (IBSP 1673), Sabaúna district, Mogi das Cruzes, SP, 29-I-1939, *Cyanoloxia brissonii* (Lichtenstein) (Passeriformes: Cardinalidae), N. Bolognani coll.; 14 larvae (IBSP 12213A), Paraty, SP, 19-III-2015, *Formicarius colma* Boddaert (Passeriformes: Formicariidae), L. Moreira-Lima coll.; 1 larva (IBSP 1650A), Sabaúna district, Mogi das Cruzes, SP, 29-I-1939, “unidentified bird” (Passeriformes: Fringillidae), N. Bolognani coll.; 5 larvae (IBSP 372), Instituto Butantan, São Paulo, SP, 12-III-1933, *Mimus saturninus* (Lichtenstein) (Passeriformes: Mimidae), J. Cavalheiro coll.; 1 larva (IBSP 13119), Estação Ecológica de Carijós, Florianópolis, Santa Catarina (SC), 16-XI-2015, *Geothlypis aequinoctialis* (Gmelin) (Passeriformes: Parulidae), C. Lugarini coll.; 1 larva (IBSP 13121), same locality, 9-IV-2016, *Zonotrichia capensis* (Statius Muller) (Passeriformes: Passerellidae), C. Lugarini coll.; 1 larva (IBSP 371), Instituto Butantan, São Paulo, SP, 26-V-1932, same host,

J. Cavalheiro coll.; 6 larvae (IBSP 361), Instituto Butantan, São Paulo municipality, São Paulo state, no date, *Chiroxiphia caudata* (Shaw and Nodder) (Passeriformes: Pipridae), J. Cavalheiro coll.; 3 larvae (IBSP 12378), Fazenda Continente, Coronel Pacheco, MG, 09-I-2006, same host, E. Daemon coll.; 1 larva (IBSP 12216B), Paraty, RJ, 20-III-2015, *Pyriglena leucoptera* (Vieillot) (Passeriformes: Thamnophilidae), L. Moreira-Lima coll.; 3 larvae (IBSP 12212), same locality, 16-IV-2015, *Tachyphonus coronatus* (Vieillot) (Passeriformes: Thraupidae), L. Moreira-Lima coll.; 1 larva (IBSP 13695), Estação Ecológica de Carijós, Florianópolis, SC, 17-IV-2017, same host, C. Lugarini coll.; 1 larva (IBSP 13700), same locality and host, 13-XII-2017; 1 larva (IBSP 13123), same locality and host, 1-XII-2015; 1 larva (IBSP 13699), same locality, 13-XII-2017, *Troglodytes musculus* Naumann (Passeriformes: Troglodytidae), C. Lugarini coll.; 2 larvae (IBSP 13706B), Reserva Biológica Marinha do Arvoredo, Florianópolis, SC, 24-I-2018, same host; 4 larvae (IBSP 12218), Paraty, RJ, 19-III-2015, *Turdus albicollis* Vieillot (Passeriformes: Turdidae), L. Moreira-Lima coll.; 1 larva (IBSP 13701), Reserva Biológica Marinha do Arvoredo Florianópolis, SC, 23-I-2018, same host; 1 larva (IBSP 13702), same data; 1 larva (IBSP 13703), same locality and host, 24-I-2018; 1 larva (IBSP 13704), same data; 5 larvae (IBSP 13705), same data; 1 larva (IBSP 363), Instituto Butantan, São Paulo, SP, no date, *Turdus amaurochalinus* Cabanis (Passeriformes: Turdidae); 7 larvae (IBSP 12017B), same locality, 29-I-2015, *Turdus rufiventris* Vieillot (Passeriformes: Turdidae), L. Moreira-Lima coll.; 6 larvae (IBSP 12018A), same data; 7 larvae (IBSP 12160A), same locality and host, 26-III-2015; 3 larvae (IBSP 12176), same data; 5 larvae (IBSP 12177), same data; 6 larvae (IBSP 12178), same data; 3 larvae (IBSP 12181A), same data; 2 larvae (IBSP 12162A), same locality and host, 26-II-2015; 3 larvae (IBSP 12166A), same locality and host, 27-II-2015; 2 larvae (IBSP 12167A), same data; 3 larvae (IBSP 12168), same data; 5 larvae (IBSP 12169A), same data; 6 larvae (IBSP 12170), same data; 2 larvae (IBSP 12171), same data; 1 larva (IBSP 12172A), same data; 3 larvae (IBSP 12173), same data; 6 larvae (IBSP 12195A), same data; 2 larvae (IBSP 12196A), same data; 6 larvae (IBSP 12183A), same locality and host, 27-III-2015; 7 larvae (IBSP 12184), same data; 2 larvae (IBSP 376), same locality, 3-II-1933, *Tyrannus melancholicus* Vieillot (Passeriformes: Tyrannidae); 2 larvae (IBSP 13698), Estação Ecológica de Carijós, Florianópolis, SC, 13-XII-2017, *Elaenia obscura* (d'Orbigny and Lafresnaye) (Passeriformes: Tyrannidae); 3 larvae (IBSP 1641), Reserva Florestal do Morro Grande, Cotia, SP, 20-II-1939, *Crypturellus obsoletus* (Temminck) (Tinamiformes: Tinamidae), J. Navas coll.; 3 larvae (IBSP 876), Água doce, Piedade, SP, 12-VII-1936, *Tinamus solitarius* (Vieillot) (Tinamiformes: Tinamidae).

Notes about the trombiculiasis

The subjects came in contact with larval *E. tinami* in the forest, which were noticed several hours later, around 6:00pm, mainly because of the onset of intense pruritus; at this moment one of the subjects (Author Fournier, G.F.S.R.) had specimens collected by application of adhesive tape, few larvae were collected from the tape at the stereomicroscope and further identified (IBSP 12522). The clinical signs consisted of areas of papular dermatitis located on the feet, legs, knees, hands, fingers, arms, face and scalp. The lesions were circular, focal and multifocal, with papular inflammatory reaction with a center papule and a hyperemic centrifuge halo of sizes ranging from 1 to 3 cm in diameter, probably caused by exuberant cellular inflammatory reaction with manifests severe pruritus and lasts for over 72 hours as described in other *Eutrombicula* species. No infection symptoms, such as fever, were present. The pruritus ceased after about five days without any medication. Neither subject consulted a physician or used medicine to kill the parasites or control inflammation. Both subjects used physical removal with a hard bath sponge during a shower about 10 hours after exposure, but it was not evaluated whether this action was efficient or not. Both subjects experienced the same symptoms and skin manifestations. Figure 7 shows the inflammatory papules on the female subject 24 hours after exposure.

Discussion

Host records suggest some *Eutrombicula* species are not host specific. This applies to *E. tinami*, which has been reported from multiple species of birds, rodents and marsupials (Oudemans 1910; Brennan and Lukoschus 1971; Brennan and Reed 1974, 1975; Jacinavicius et al. 2018a).

Prior to this study *E. tinami* had been reported from only five hosts, *Didelphis marsupialis* from Surinam (Brennan and Lukoschus 1971), *Proechimys semispinosus* from Panama (Brennan and Lukoschus 1971), *Marmosa robinsoni* from Venezuela (Brennan and Reed 1974), *Didelphis aurita* from Brazil (Jacinavicius et al. 2018a) and the original host, *Crypturus noctivagus*, also from Brazil (Oudemans 1910). In this study, we recorded 207 *E. tinami* from 70 individual hosts representing 17 mammals and 53 birds sampled in Brazil. Mammals, including humans accounted for only 20% of the *E. tinami* recovered from hosts. All were new mammalian host records for this species, except for the host species *D. aurita*. Birds are important hosts for Brazilian *E. tinami* accounting for 80% of all the specimens recovered with 20 new host records in 15 families. The bird genus *Turdus* spp. appears to be a common host for *E. tinami* accounting for about half of all birds with *E. tinami* and nearly 60% of all specimens recovered.

This species was also found biting humans and joins *E. alfreddugesi* and *E. batatas*, in causing human trombiculiasis in Brazil.

Eutrombicula tinami was described for Brazil without specific locality information (Oudemans 1910). The only other published Brazilian record for this species was from a marsupial collected in the São Paulo, SP (Jacinavicius et al. 2018a). Here, we provide new records from the states of Minas Gerais, Rio de Janeiro, Santa Catarina and São Paulo. This species had previously published records of this species from Panama (Brennan and Lukoschus 1971), Surinam (Brennan and Lukoschus 1971) and Venezuela (Brennan and Reed 1974) indicating perhaps its distribution includes the neighboring countries.

Although *E. tinami* has been reported from several countries, the two limited redescriptions (Oudemans 1912; Fuller 1952), more than 50 years ago, did not provide enough morphological detail to identify this species. In this study, we provide new figures, SEM images and additional metric data to help identify this species.

The human bite symptoms reported here are similar to those reported by Chaccour (2005) and Faccini *et al.* (2017). The under reporting of trombiculiasis in Brazil is probably due to the difficulty of finding chiggers on a human host or identifying them when they are found. Fonseca (1932) suggested chiggers may vector pathogens in Brazil. Surveys of Brazilian and South America chiggers their hosts and host symptoms are needed to help understand the potential health risks chiggers may present to humans and domestic animals.

Acknowledgements

To Gabrielle Ribeiro de Andrade and Maria Cristina Ferreira do Rosário for technical contribution (CNPq no. 377343/2015-3 and 377342/2015-7, respectively), Beatriz Mauricio of the Laboratory of Cellular Biology of the Instituto Butantan for the images obtained through the Scanning Electron Microscopy, Debra Creel, Andrew Ulsamer (SEL-USDA), and Armando Rosario-Lebron (APHIS-USDA) for their help with references and technical support. The Smithsonian Natural History Museum and National Agricultural Library (NAL-USDA), SEL-USDA for support and assistance with specimens and references. This work was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq no. 454907/2014-1 and 440639/2015-8 to DMB-B, 377976/2014-8 to FCJ), Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP no. 2010/51875-9 to DMB-B and 2017/01416-7 to RB-S). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply

recommendation or endorsement by the USDA; USDA is an equal opportunity provider and employer.

Authors' contribution

RB-S, FCJ and DMB-B writing and development of the entire manuscript. AP and GFSRF collected material and aided in reporting on the case report of trombiculiasis, providing crucial information for this record. CL, AF, LM-L and EH-Z collected the recent material, with them it was possible to make the SEM images. In addition, identified all the hosts, of the recent collections as of the old collections. CW and RO contributed to the organization and improved the English and provided valuable insights from their experiences for this manuscript.

References

- Bassini-Silva R., Jacinavicius F.C., Muñoz-Leal S., Maturano R., Welbourn C., Ochoa R., Bauchan G., Barros-Battesti D.M. 2018. A new species of the genus *Eutrombicula* Ewing, 1938 (Trombidiformes: Trombiculidae) and new records for the species *Eutrombicula batatas* (Linnaeus, 1758) in Brazil. *Acarologia*, 58: 976-986.
- Brennan J.M., Lukoschus F. 1971. Parasitic of Surinam. VIII. A new genus and species of chigger, *Fauranius atecmartus*, and additional records of species (Acarina: Trombiculidae). *Bull. South. Calif. Acad. Sci.*, 70: 42-45.
- Brennan J.M., Reed J.T. 1974. The genus *Eutrombicula* in Venezuela (Acarina: Trombiculidae). *J. Parasitol.*, 60: 699-711. doi:10.2307/3278741
- Brennan J.M., Reed J.T. 1975. A list of Venezuela chiggers, particularly of small mammalian hosts (Acarina: Trombiculidae). *Brigham Young Univ Sci Bull*, 20: 45-75.
- Buitendijk A.M. 1945. Voorloopige catalogus van de acari in de Collectie-Oudemans. *Zool. Med. (Leiden)*, 24: 281-391.
- Ewing H.E. 1931. A catalogue of the Trombiculinae, or chigger Mites, of the New World, with new genera and species and a key to the genera. *Proc. U. S. Nat. Mus.*, 80: 1-23. doi:10.5479/si.00963801.80-2908.1
- Ewing H.E. 1938. A key to the genera of chiggers with descriptions of new genera and species. *J. Wash. Acad. Sci.*, 28: 288-295.
- Chaccour C.J. 2005. Trombiculiasis: reporte de dos casos y revisión de la literatura. *Rev. Der. Ven.*, 43: 18-21.
- Faccini J.L.H., Santos A.C.G., Santos S.B., Jacinavicius F.C., Bassini-Silva R., Barros-Battesti D.M. 2017. Trombiculiasis in domestic goats and humans in the state of Maranhão, Brazil. *Rev. Bras. Parasitol.*, 26: 104-109. doi:10.1590/s1984-29612016088
- Fonseca F. 1932. Notas de Acareologia V. *Trombicula butantanensis* sp. n. (Acarina, Trombidiidae). *Mem. Inst. Butantan (São Paulo)*, 7: 148-150.
- Fuller H.S. 1952. The mite larvae of the family Trombiculidae in the Oudemans collection: Taxonomy and medical importance). *Zool. Verhand. (Leiden)*, 18: 1-261.
- Jacinavicius F.C., Bassini-Silva R., Mendoza-Roldan J.A., Pepato A.R., Ochoa R., Welbourn C., Barros-Battesti D.M. 2018a. A checklist of chiggers from Brazil, including new records (Acari: Trombidiformes: Trombiculidae and Leeuwenhoekiidae). *ZooKeys*, 743: 1-41. doi:10.3897/zookeys.743.22675
- Jacinavicius F.C., Bassini-Silva R., Amorim M., Gazêta G.S., Siqueira L.R., Welbourn C., Barros-Battesti D.M. 2018b. Description of *Parasecia fernandae* sp. n. (Trombidiformes: Trombiculidae) and new records of chiggers from rodents in Rio de Janeiro State, Brazil. *Acarina*, 26: 205-211. doi:10.21684/0132-8077-2018-26-2-205-211
- Jenkins D.W. 1949. Trombiculid mites affecting man. IV. Revision of *Eutrombicula* in the American Hemisphere. *Ann. Entomol. Soc. Am.*, 42: 289-318. doi:10.1093/aesa/42.3.289
- Loomis R.B., Wrenn W.J. 1984. Systematics of the pest chigger genus *Eutrombicula* (Acari: Trombiculidae). In: Griffiths D.A., Bowman C.E. (Eds). *Proceedings of the VI International Congress of Acarology*. Ellis Horwood, Chichester. p. 152-159.
- Methlagl A. 1928. Über die Trombidiose in den Österreichischen Alpenländern. *Denkschriften Österreichischen Akademie der Wissenschaften (Wien). Math.-Naturwiss. Kl.*, 101: 213-250.
- Mullen G.R., OConnor B.M. 2002. Mites (Acari). In: Durden L., Mullen G. (Eds). *Veterinary Entomology*. Academic Press/Elsevier, Amsterdam. p. 449-516. doi:10.1016/B978-0-12510451-7/50025-6
- Oudemans A.C. 1910. Acarologische aantekeningen XXXIII. *Entomol. Ber. (Amsterdam)*, 3: 83-90. doi:10.5962/bhl.part.1133
- Oudemans A.C. 1912. Die bis jetzt bekannten larven von Trombidiidae and Erythraeidae mit besonderer berucksichtigung der fur den menschen schadlichen Arten. *Zoologische Jahrbucher: Supplement*, 1: 1-230.
- Shatrov A.B. 2000. Trombiculid mites and their parasitism on vertebrate hosts. *Tr. Zool. Inst.*, 285: 1-328.
- Radford C. D. 1942. The larval Trombiculinae (Acarina, Trombidiidae) with descriptions of twelve new species. *J. Parasitol.*, 34: 55-81. doi:10.1017/S0031182000015997

- Stekolnikov A.A., González-Acuña D. 2010. Four new species of chigger mites (Acari: Trombiculidae) of the genus *Eutrombicula* from Chile. *Int. J. Acarol.*, 36: 313-325. doi:[10.1080/01647951003685667](https://doi.org/10.1080/01647951003685667)
- Vercammen-Grandjean P.H. 1965. Trombiculinae of the World: synopsis with generic, subgeneric, and group diagnoses (Acarina, Trombiculidae). George Williams Hooper Foundation, University of California, San Francisco, CA.
- Walter D.E., Krantz G.W. 2009. Chapter 7: Collecting, rearing, and preparing specimens. In: Krantz G.W., Walter D.E. (Eds). *A manual of acarology*. Lubbock, Texas: Tech University Press. p. 83-96.