RICARDO BASSINI SILVA

**Ácaros trombiculídeos (Trombidiformes: Trombiculidae) de aves do
sudeste brasileiro: estudos morfológicos e investigação da presença de
Rickettsia spp.**

São Paulo

2017

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I dedicate to my parents, Ivone and Carlos,
best parents in the world

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***“What we do for us dies with us.
What we do for others and for the world,
continues and is imortal” (Albert Pine)***

RESUMO

BASSINI-SILVA, R. **Ácaros trombiculídeos (Trombidiformes: Trombiculidae) de aves do sudeste brasileiro:** estudos morfológicos e investigação da presença de *Rickettsia* spp. [Chigger mites (Trombidiformes: Trombiculidae) of birds from Brazilian southeastern: morphological studies and investigation of the presence of *Rickettsia* spp.]. 2017. 298 f. Dissertação (Mestrado em Ciências) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, 2017.

O Brasil possui 58 espécies de ácaros trombiculídeos parasitando diferentes grupos animais. E destas, somente 6 espécies foram reportadas para aves, sendo 1 de *Apolonia*, 2 de *Eutrombicula*, 1 de *Neoschoengastia* e 2 de *Parasecia*. As larvas de trombiculídeos provocam lesões profundas e reações cutâneas no hospedeiro, sendo por muitas vezes citados como vetores de agentes patogênicos. Nos Estados Unidos, os departamentos de saúde pública se depararam com a necessidade de catalogação e conhecimento da biologia desses ácaros por serem considerados potenciais vetores de *Rickettsia* spp. No Brasil, os primeiros casos de Febre Maculosa Brasileira (FMB) diagnosticados em São Paulo, foram associados a esses ácaros porque terem sido encontrados em focos da doença. No entanto, o seu papel na epidemiologia da riquetsiose não foi confirmado. Outra preocupação é a dermatite causada pela mordida desses ácaros, popularmente conhecida como trombiculíase. Como é bem conhecido, trombiculídeos não são específicos e vários casos de mordidas em humanos já foram relatados. Dessa forma, a proposta do presente estudo é conhecer a situação atual dos trombiculídeos de aves, esclarecer os aspectos de sua complexidade taxonômica, bem como fornecer informações sobre sua participação na epidemiologia de riquetsias em algumas localidades da região sudeste do país. Do material examinado no presente estudo foram identificadas 8 espécies: *Blankaartia shatrovi* sp. n., *Blankaartia sinnamaryi*, *Microtrombicula* sp. n., *Eutrombicula tinami*, *Eutrombicula goeldii*, *Parasecia* sp. n.1, *Parasecia* sp. n.2, *Parasecia* sp. n.3. Os ácaros mantidos em álcool absoluto foram submetidos à extração de DNA e investigação da presença de *Rickettsia*. Uma das amostras apresentou 100% para *Rickettsia felis*. Portanto, para o Brasil agora, temos 13 espécies descritas para todo o território nacional, com exceção da região Centro-Oeste, e, além disso, o primeiro registro da presença de *Rickettsia* em ácaros trombiculídeos da América do Sul.

Palavras-chave: trombiculídeos, taxonomia, riquetsioses, aves

ABSTRACT

BASSINI-SILVA, R. **Chigger mites (Trombidiformes: Trombiculidae) of birds from Brazilian southeastern:** morphological studies and investigation of the presence of *Rickettsia* spp. [Ácaros trombiculídeos (Trombidiformes: Trombiculidae) de aves do sudeste brasileiro: estudos morfológicos e investigação da presença de *Rickettsia* spp.]. 2017. 298 f. Dissertação (Mestrado em Ciências) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, 2017.

Brazil has 58 species of chigger mites parasitizing different animal groups. Of these, only 6 species were reported for birds, being 1 of *Apolonia*, 2 of *Eutrombicula*, 1 of *Neoschoengastia* and 2 of *Parasecia*. The larvae of chiggers cause deep lesions and cutaneous reactions in the host, and are often cited as vectors of pathogens. In the United States, public health departments have come across the need for cataloging and knowledge of the biology of these mites as potential vectors of *Rickettsia* spp. In Brazil, the first cases of Brazilian Macular Fever (BMF) diagnosed in São Paulo were associated with these mites because they were found in outbreaks of the disease. However, its role in the epidemiology of rickettsial disease has not been confirmed. Another concern is dermatitis caused by the bite of these mites, popularly known as trombiculiasis. As it is well known, trombiculid mites are not specific and several cases of bites in humans have been reported. Thus, the purpose of the present study is to know the current situation of chigger mites parasitizing birds, to clarify aspects of its taxonomic complexity, as well as to provide information about its participation in the epidemiology of *Rickettsia* in some localities in the southeastern region of the country. From the material examined in the present study were identified 8 species: *Blankaartia shatrovi* n. sp., *Blankaartia sinnamaryi*, *Microtrombicula* n. sp., *Eutrombicula tinami*, *Eutrombicula goeldii*, *Parasecia* n. sp.1, *Parasecia* n. sp.2, *Parasecia* n. sp.3. The mites were kept in absolute alcohol, were submitted to DNA extraction and investigation of the presence of *Rickettsia*. One of the samples showed 100% for *Rickettsia felis*. Therefore, for Brazil now, we have 13 species described for the entire national territory, with the exception of the Midwest region, and, in addition, the first record of the presence of *Rickettsia* in chigger mites on South America.

Keywords: chigger mites, taxonomy, rickettsiosis, birds

LIST OF ABBREVIATIONS

1a: anterior sternal setae

2a: posterior sternal setae

A: adenine

A: amplified

AL: anterolateral setae

AM: anteromedial setae

AMNH: American Museum of Natural History

ANIC: Australian National Insect Collection

AP: distance from anterolateral setal base to posterolateral setal base on one side

APEG: Área de Pesquisa Ecológica do Guamá

ARS: Agricultural Research Service

ASB: distance from sensillary bases to extreme anterior margin

AW: anterior width

BARC: Beltsville Agricultural Research Center

bp: base pairs

BPBM: Bernice Pauahi Bishop Museum (currently housed in the NMNH collection)

BSF: Brazilian Spotted Fever

C: cytosine

CAPES: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

CEEA: Ethics Committee on Animal Experimentation

CNHM: Chicago Natural History Museum (new name Field Museum of Natural History)

CNPq: Conselho Nacional de Desenvolvimento Científico e Tecnológico

COBEA Brazilian College of Animal Experimentation

COI: cytochrome c oxidase subunit I

coll: collectors

DMAX: maximum length of dorsal idiosomal setae

DMBB: Dr. Darci Moraes Barros-Battesti

DMIN: minimum length of dorsal idiosomal setae

DNA: deoxyribonucleic acid

ED: Dr. Erik Daemon

FMNH: Field Museum of Natural History (earlier name and acronym: CNHM - Chicago Natural History Museum)

FMVZ: Faculdade de Medicina Veterinária e Zootecnia

G: guanine

gltA: gene citrate synthase

GML: Gorgas Memorial Laboratory

Guanidine Isothoianate (**GT**

H: humeral setae

I: length of Leg I

IBSP: Coleção Acarológica do Insituto Butantan

II: length of Leg II

III: length of Leg III

Ip: sum of leg lengths

IPG: L`Institut Pasteur de la Guyane (IPG)

IPP: L`Institut Pasteur de Paris (IPP)

kb: kilo base pairs

KU: The University of Kansas

MD: Maryland

MG: Minas Gerais (State)

MTa: mastitarsala setae

MTi: mastitibiala setae

MZUSP: Museu de Zoologia da Universidade de São Paulo

N: nude setae

NA: not amplified

NMNH: United States National Museum of Natural History (earlier acronym USNM)

NY: New York

OMNH: Sam Noble Oklahoma Museum of Natural History

OmpA: gene Outer membrane protein A

PCR: reação em cadeia da polimerase

PL: posterolateral setae

P-PL: distance from posterolateral to extreme posterior margin

PSB: distance from sensillary bases to extreme posterior margin

PW: posterior width

RJ: Rio de Janeiro (state)

RML: Rocky Mountain Laboratory (currently housed in the NMNH collection)

S: south

S: trichobothria

SAM: South Australian Museum

SB: distance between sensillary bases

SD: ASB + PSB

SD: standard deviation

SEM: Scanning Electron Microscopy

SFG: Spotted Fever Group

SISBIO: Sistema de Autorização e Informação em Biodiversidade

SP: São Paulo (state)

spp.: many species

T: thymine

TaIII: length of tarsus I

TaW: width of tarsus I

UFJF: Universidade Federal de Juiz de Fora

UGCA: The University of Georgia Collection of Arthropods

USA or US: United State of America

USDA: United States Department of Agriculture

USNM: United States National Museum of Natural History (new acronym NMNH)

USP: Universidade de São Paulo

VMAX: maximum length of ventral idiosomal setae

VMIN: minimum length of ventral idiosomal setae

W: adenine or thymine

w: west

Y: cytosine or thymine

LIST OF SYMBOLS

%: percentage

μm: micrometer

mm: millimeter

ng: nanogram

μl: microliter

z: companion seta of dorsal eupathid on the leg I

ε: famulus I and II

ζ: eupathid of palpal tarsus, dorsal eupathid of the leg I, subterminal eupathid of the legs I and II

κ: microsetae on genu and tibia

σ: solenidia of the genu I, II and III

Φ: solenidia of the tibia I, II and III

ω: solenidium of palpal tarsus

ω I: length of solenidium I

SUMMARY

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1. INTRODUCTION

1.1. Taxonomic history and the current situation of the chigger mites

The first chigger mite described was *Eutrombicula batatas* (Linnaeus, 1758). Berlese (1905) gathered together representative species in the genus *Trombicula* that were later transferred by Oudemans (1912) to Trombidiidae family. With the description of new species, Ewing (1929, 1931) separated these mites in a subfamily: Trombiculinae; and after a few years, the subfamily was elevated to the family category by Ewing (1944). The trombiculidae family, originally comprised 26 species, and now has been divided into two subfamilies, Trombiculinae and Hemitrombiculinae. A year later the subfamily Leeuwenhoekinae was included in the family Trombiculidae (WOMERSLEY, 1945), which now comprises three subfamilies. However, Ewing (1949) added a fourth subfamily, Walchiinae, and was the first to propose a terminology of morphological features used in taxonomy larvae. After two years, Wharton (1947) added Apoloniinae, this being the fifth subfamily within Trombiculidae. The subfamily Walchiinae became synonymy of Gahrlepiinae because the genus type *Walchia* (which was Walchiinae) was synonymized with *Gahrlepieia* (WORMERSLEY, 1952).

To standardize the nomenclature and descriptions of new species Wharton et al. (1951) improved the terminology of characters proposed by Ewing (1949), and also unified the nomenclature for both, larvae as well as adults. In addition, those authors presented a new classification, excluding the subfamily Hemitrombiculinae which did not fit in Trombiculidae family. Radford (1946), Audy (1954), Vercammen-Grandjean (1968), Vercammen-Grandjean and Langston (1976), Welbourn (1991) and Kolebinova

(1992), included Leeuwenhoekinae and Apoloniinae in the family Leeuwenhoekidae. However, other taxonomists maintained these two subfamilies in the Family Trombiculidae (BRENNAN, 1949; WHARTON et al., 1951; WHARTON; FULLER, 1952; HOFFMANN, 1970; LAKSHANA, 1973; NADCHATRAM; DOHANY, 1974; GOFF et al., 1982; DOMROW; LESTER, 1985). According to these authors, Trombiculidae is represented by four subfamilies (Leeuwenhoekinae, Gahrlepiinae, Apoloniinae and Trombiculinae).

Wharton and Fuller (1952) compiled the first list of chigger mites of the world. In the list, Brazil was represented by eight genera and 18 species. Fonseca (1955) added another record to the country, including bites reported in humans. Brennan and Goff (1977) listed 87 species of the family Trombiculidae for Nearctic and Neotropical regions, of which 18 were cited for Brazil. Between 70's and 90's, new species were described by foreign researchers, from specimens collected mainly in the northern and center-western Brazilian regions. Subsequently, Gazeta et al. (2006) described another taxon that was collected in rodent in the Rio de Janeiro. Recently, the species *Trombewingia bakeri* (Fonseca, 1955) that occurs in rodent in São Paulo was again collected after more than half a century of silence. Thus, the species could be redescribed, including the designation of lectotype and paralectotype (JACINAVICIUS et al., 2015). Until now, Brazil has 58 trombiculid species recorded parasitizing different animal groups: Amphibians, Reptiles, Birds and Mammals (JACINAVICIUS, F.C., 2015). And of these only 6 species were reported for birds, 1 species of the genus *Apolonia* (TORRES; BRAGA, 1939), 2 of *Eutrombicula* (OUDEMANS, 1910; Ewing, 1925), 1 of *Neoschoengastia* (BRENNAN, 1971) and 2 of *Parasecia* (BRENNAN, 1969). Aside from *Apolonia tigipioensis* Torres & Braga, 1939, which was cited for the

second time in the country by Ornelas-Almeida et al. (2007), virtually nothing has been noted of chiggers parasitizing birds in Brazil.

1.2. Epidemiological importance

The larvae of the family Trombiculidae cause deep lesions and severe skin reactions in the host (Hase et al., 1978). According to these authors, the species *Leptotrombidium intermedium* (Nagayo, Mitamura & Tamiya, 1920), *Leptotrombidium fletcheri* (Womersley & Heaslip, 1943), *Leptotrombidium arenicola* Traub, 1960 and *Leptotrombidium deliense* (Walch, 1922) are vectors of *Orientia tsutsugamushi*. In Japan, Takahashi et al. (2004b) described the larvae of *Leptotrombidium pallidum* (Nagayo, Mitamura & Tamiya, 1920) also responsible for the spread of *O. tsutsugamushi* causing a human rickettsiose - The tsutsugamushi. The rodents are natural reservoirs of this bacteria, and after feeding, the infected larvae transmit the pathogen to the following stages and subsequent generations (transtadial and transovarial transmission) (RAPPAMUND et al., 1969; PHASOMKUSOLSIL et al., 2009). Thus, public health departments were faced with the need for cataloging and understanding the biology of these mites due to their potential vector role of *Rickettsia* spp. (WHARTON and FULLER, 1952). Recently in Slovakia, two other species of *Rickettsia*, *Rickettsia monacensis* and *Rickettsia helvetica* were found in *Hirsutiella zachvatkini* (Schluger, 1948), and the bacteria *R. monacensis* was found in *Keptatrombicula storkani* (Daniel, 1956) (MITKOVA et al., 2015).

However, the actual role of chigger mites in the epidemiology of rickettsiosis is still unknown in the Neotropics (AZAD; BEARD, 1998; POINAR; POINAR, 1998).

But there are records that other bacteria besides *Rickettsia* have been found in these chiggers. In Panama, Brennan and Yunker (1966) detected bacteria *Coxiella burneti* in the species *Intercutestrix mondolfi* (Brennan & Yunker, 1969). Subsequently, Yunker et al. (1975) were able to isolate *C. burneti* from the *I. mondolfi* collected on *Proechimys semispinosus* (Rodentia: Echimyidae) and also found serological evidence that the mite *Tecomatlana sandovali* Hoffmann, 1947 collected from bat *Saccopteryx bilineata* (Chiroptera: Emballonuridae) could be infected with that bacteria. In Spain, the species *Neotrombicula autumnalis* (Shaw, 1790) was found naturally infected by *Anaplasma phagocytophilum* (FERNANDEZ-SOTO et al., 2001). In Germany, *N. autumnalis* was found infected with *Borrelia burgdorferi* sensu lato (KAMPEN et al., 2004). In the Czech Republic, the chiggers *N. autumnalis*, *Neotrombicula carpathica* Schluger & Vysotzkaja, 1970 and *Neotrombicula inopinata* (Oudemans, 1909) collected from birds were infected with *B. garinii* and *B. valaisiana* (LITERAK et al., 2008). Kabeya et al. (2010) detected *Bartonella tamiae* in some species of the genus *Leptotrombidium* collected from wild rodents in Thailand.

According to Varma (1964), in general, birds that migrate from Africa to Europe during the spring are infested with chigger mites. Once in Europe, the engorged chiggers drop from the hosts as the spring gets hotter. In early fall, adults are now ready to give birth to larvae that will infect other birds. These, in turn, migrate to Africa to escape the European winter. Therefore, migration provides the spread of pathogens between the continents. Dietsch (2005) observed that the feeding of the larvae Trombiculidae coincides with the bird migration process, at least in the region of Chiapas, México. In Brazil, the first cases of Brazilian Spotted Fever (BSF) were diagnosed in São Paulo, the tick species *Amblyomma sculptum* Berlese (cited at the time

as *Amblyomma cajennense*)¹ and *Amblyomma aureolatum* (Pallas) were appointed infested with *Rickettsia rickettsii*. Currently, besides these tick species, there are others involved in the transmission cycle (LABRUNA, 2009). But Fonseca (1932) emphasized the importance of the bloodsucking mites as potential vectors in the epidemiological cycle of this rickettsial disease, but the role of these mites as vectors has never been confirmed.

Another concern that these mites can bring are the dermatitis caused by their bites, popularly known as trombiculiasis. As it is well known, chiggers are not host specific and several cases of human bites have been reported. Heyne et al. (2001) reported for Africa a record of human trombiculiasis caused by *Leptotrombidium subquadratum* (Lawrence, 1951). In Asia and Oceania, the species *Eutrombicula wichmanni* (Oudemans, 1905) is the main species associated with human bites. In addition to this species, *Eutrombicula sarcina* (Womersley, 1944), *Neotrombicula nagayoi* (Sasa et al., 1950) and some species of the genera *Odontacarus* and *Schoengastia* have also been reported (TAKAHASHI et al., 2004a; BURNS, 2010). Four species have already been reported to Europe, *N. autumnalis*, *Blankaartia acuscutellaris* (Walch, 1922), *Kepkatrombicula desaleri* (Methlagl, 1928) and *Trombicula toldti* (Winkler, 1953). It stands out *N. autumnalis* as the most frequent of the European continent (RIPKA; STEKOLNIKOV, 2006; SHATROV; STEKOLNIKOV, 2011).

Mullen and O'Connor (2002) reported cases of human trombiculiasis caused by *Eutrombicula alfreddugesi* (Oudemans, 1910), *Eutrombicula lipovskyana*

¹The species *Amblyomma cajennense* (Fabricius) forms a complex of species that currently comprises 6 taxa (BEATI et al., 2013; NAVA et al., 2014). In Brazil, *A. cajennense* sensu strictu is distributed from the Amazon region to the state of Mato Grosso, while *A. sculptum* occurs in the rest of Brazil, northern Argentina, Bolivia and Paraguay.

(Wolfenbarger, 1952) and *Eutrombicula splendens* (Ewing, 1913) for North America. For tropical countries, such as Bolivia, Brazil, Peru and Venezuela, chigger mites occur all year round, since the favorable environment is always present, and the main species reported for these South American countries are *E. alfreddugesi* and *E. batatas*, with the exception of Peru. In this country the trombiculiasis is caused by *N. autumnalis* (CHACCOUR, 2005). In recent years the case reports are increasing, and for Brazil, Martens et al. (2012) reported that near of the Tapajós River in the Amazon region there was a case of trombiculiasis caused by *E. alfreddugesi*. A Swedish traveler also had persistent skin reactions following chigger bites on a trip to the state of Mato Grosso (EITREM; JAENSON, 2012). Bronshteyn et al. (2016) reported that Russian tourists were bitten by chiggers and presented trombiculiasis when they visited natural areas, also in the Amazonian region of Brazil. They had contact with parrots and capybaras (*Hydrochoerus hydrochaeris*). Faccini et al. (2017) reports cases of trombiculiasis in goats and humans in regions of Maranhão.

1.3. Biology

The mites of the family Trombiculidae have varied color, and may be red, yellow, white or orange and popularly known as "thalzahuates" and "coloradillas" in Mexico, "chiggers mites" in the United States, "red bugs" in England, "Herbstgrassmilben" in Germany and "tsutsugamunhi" or "akamushi" in Japan (HOFFMANN, 1990). The coloring of the larva depends on the type of food ingested by the nymph or adult (NADCHATRAM, 1970). A tube known as stylostome, formed on the skin during feeding due to the salivary secretions of the mite and the host

immunological reactions. The stylostome enables the mite reach deeper layers of skin tissue (SHATROV, 2000), and specimens for some species can be enveloped by host tissue remaining in capsules for six months (WHARTON; FULLER, 1952). The maintenance studies of colonies of chigger mites to pathogen research purposes began in the early twentieth century (WHARTON; FULLER, 1952). These mites can have up to seven stages of development: egg, larva or pre-deutegg larva protonymph, deutonymph, tritonymph and adults. Only larval phases, deutonymph and adults are active, and the remaining quiescent. The larva has parasitism behavior, occurring in vertebrates, while the other stages are arthropod predators (MIYAJIMA; OKUMURA, 1917). These authors were the first to provide information about each stage of the life cycle of *Leptotrombidium akamushi* (Brumpt, 1910) (then called *Trombidium akamushi*). Ewing (1944) disregarded the inactive stages as properly "stage", terming them as cuticular peels of the exuvia.

The larvae have up to 1 mm in length when they are engorged. During parasitism, they liquify and suck the epithelial tissue of the host by the enzymatic action of their saliva. Although blood intake is not part of this process, blood cells can be found in the chigger's stomach (JONES, 1950). The deutonymph and adults are predators. Jenkins (1947) studied the form of typhus transmission and production of new miticides to control *Trombicula alleei* Ewing, 1926, and succeeded in rearing this species for several generations. This mite became a plague in the US in the 40's. Liposvky (1954) tested some food items to maintain colonies of *Eutrombicula alfreddugesi* (Oudemans, 1910) and *Eutrombicula splendens* (Ewing, 1913), as insect eggs of Coleoptera, Collembola, Diptera and Lepidoptera. This author found cannibalism within the colonies to the quiescent phases, and noted that the feeding preference varies according to the species of chigger. In the case of the species *E.*

alfreddugesi and *E. splendens*, both prefer to feed of Collembola eggs, as well as *Culex* and *Aedes*. Neal and Barnett (1961) worked with the species *Trombicula akamushi* Brumpt, 1910, reporting the importance for controlling the humidity and lighting. In Brazil, Jacinavicius et al., 2017² obtained nymphs *Quadraseta brasiliensis* Goff and Gettinger, 1989 in laboratory conditions from engorged larvae. The morphological description of the nymphs is already underway; however, the maintenance of these colonies remains a challenge. But once standardized the colonies will know the life cycle of these mites, serving as a template for the creation of other species, and to experimental infection studies.

1.4. Justification

Because of the fragmentary state of records and taxonomic complexity of the chiggers and the scarcity of information about the performance of these mites in be the bioagents transmission, this study contributes to the knowledge of species that parasitize birds. Considering that there are indications of the possibility of chiggers be potential vectors of *Rickettsia* in other regions of the world, investigative analysis of the presence of this bacteria in these mites, it will be important to clarify their role in the epidemiological chain of the disease.

²Jacinavicius, F. C.; Bassini-Silva, R.; Mendoza-Roldan, J. A.; Hingst-Zaher, E.; Ochoa, R.; Bauchan, G. R. & Barros-Battesti, D. M. *Quadraseta brasiliensis* Goff & Gettinger, 1989 (Acari: Trombiculidae): neotype designation, redescription of larva and description of deutonymph, 2017. Journal Medical Entomology (Submitted).

1.5. Chapters presentation

This dissertation is written in chapters. Chapter 1 entitled “Description of *Blankaartia shatrovi* n. sp. (Acari: Trombiculidae) from Brazil” provides a description of a new species, and the first record for the genus to the national territory of Brazil. In addition to new records for the country, locality and hosts for the species *Blankaartia sinnamaryi* (Floch & Fauran, 1956) were added. This chapter is already published as follows: BASSINI-SILVA, R.; JACINAVICIUS, F. C.; MENDOZA-ROLDAN, J. A.; DAEMON, E.; BARROS-BATTESTI, D. M. Description of *Blankaartia shatrovi* n. sp. (Acari: Trombiculidae) From Brazil. Journal of Medical Entomology, v. 54, n. 1, p. 82-90, 2017 (ATTACHMENT).

Chapter 2, “Species of the genus *Blankaartia* Oudemans, 1911 (Trombidiformes: Trombiculidae) of the Nearctic and Neotropical regions”, based wherein was presented in Chapter 1, shows a general parameter of species of the genus *Blankaartia* of the Nearctic and Neotropical regions, furthermore, we are presenting the redescrptions and a key species (larvae) of the genus.

Chapter 3, “Description of *Microtrombicula* n. sp. (Trombidiformes: Trombiculidae) from Brazil”, describes a new species for the genus *Microtrombicula*, and the first record of a species from this genus parasitizing birds in South America. Chapter 4, “Revision of the genus *Parasecia* Loomis 1966 (Trombidiformes: Trombiculidae)”, presents a review, with redescrptions and key species (larvae) for the genus *Parasecia*. In addition, we are describing three new species and a new combination. According to the studies of chapters 1, 2, 3 and 4, we wrote the chapter 5, entitled “A checklist of chigger mites parasitizing birds and new records of two species of *Eutrombicula* (Trombidiformes: Trombiculidae)”, showing the general distribution

for Brazil of the chiggers that parasitizing birds. And to finish, we detected some dermatitis in birds, caused by chiggers' bites. Then, we wrote the Chapter 6, "Cases of trombiculiasis in birds and assessment of *Rickettsia* spp. in chigger mites (Trombidiformes: Trombiculidae) from southeastern Brazil". In addition, specimens recently collected were subjected to DNA extraction and PCRs for *Rickettsia* spp.

All chapters will be submitted to The Journal of Medical Entomology with the following co-authors: Chapter 2 – Fernando de Castro Jacinavicius, Ronald Ochoa, Gary Bauchan and Darci Moraes Barros-Battesti; Chapter 3 – Fernando de Castro Jacinavicius, Ralph Maturano, Erik Daemon, Ronald Ochoa, Gary Bauchan and Darci Moraes Barros-Battesti; Chapter 4 and Chapter 5 – Fernando de Castro Jacinavicius, Ralph Maturano, Erik Daemon, Luciano Moreira Lima, Erika Hingst-Zaher, Ronald Ochoa, Gary Bauchan and Darci Moraes Barros-Battesti; Chapter 6 - Fernando de Castro Jacinavicius, Jairo Alfonso Medoza-Roldan; Ralph Maturano, Erik Daemon, Ronald Ochoa, Gary Bauchan, Marcelo Bahia Labruna and Darci Moraes Barros-Battesti.

2. OBJECTIVES

2.1. General

Catalogue species of the family Trombiculidae parasitizing birds, in some parts of southeastern Brazil, and investigate the presence of *Rickettsia* spp. in the mites collected.

2.2. Specific

- Catalogue the types and material of the chigger mites of the southeastern Brazilian region parasitizing birds, housed in the main Brazilian and international collections;
- Check the distribution of species based on material deposited in the collections, as well as those obtained in recent collections, and literature records;
- Describe the types, if necessary;
- Investigate the presence of *Rickettsia* spp. on chigger mites collected in the field.

CHAPTER 1: Description of *Blankaartia shatrovi* n. sp. (Acari: Trombiculidae) from Brazil

Abstract. The chigger mite genus *Blankaartia* includes 28 known species, of which 10 are distributed in the Nearctic and Neotropical regions. These species preferentially parasitize birds, but occasionally they can also be found on rodents, bats and reptiles, showing low host selectivity. In the present study, we report the presence of this genus in Brazil for the first time, including the first report of *Blankaartia sinnamaryi* (Floch & Fauran) and the description of a new species of *Blankaartia* collected from birds (Order Passeriformes).

Key words: new species, chigger mites, bird, Brazil

3.1. Introduction

The genus *Blankaartia* Oudemans (1911) includes 28 species worldwide. Ten are distributed in the Nearctic and Neotropical regions (Table 1). Since the description of *Blankaartia pauli* Crossley and Atyeo (1972), no new taxa have been described.

In the monograph by Wharton and Fuller (1952), a list of chiggers around the world was compiled. In that list, Brazil was represented by eight genera and 18 species. Fonseca (1955) added another record to the country, including bites reported in humans. Brennan and Goff (1977) listed 87 genera of chiggers in the Nearctic and Neotropical regions, of which 18 were cited as present in Brazil, including 53 species of chigger mites. Of these, five species are parasites on amphibians, six species on birds, four species on reptiles, 25 species on rodents, eight species on marsupials and 12 species on other mammals such as primates, horses, anteaters and humans (Brennan and Goff 1977).

A new species of *Blankaartia* found in the Acari Collection of Instituto Butantan, São Paulo (IBSP), is described here. We also report the presence of *B.*

sinnamaryi on Brazilian birds for the first time. Additional material from the new species was collected from birds in the state of Minas Gerais, southeastern Brazil.

Table 1. Species of the genus *Blankaartia* (in alphabetic order) of the family Trombiculidae, distributed in the Nearctic and Neotropical regions.

Species	Localities	References
<i>Blankaartia alleei</i> (Ewing, 1926)	Surinam	Brennan and Bronswijk (1975)
	Panama	Ewing (1926)
		Michener (1946)
		Brennan and Yunker (1966)
<i>Blankaartia amersoni</i> Brennan, 1965	USA	Brennan (1965a)
		Brennan and Amerson (1971)
	Trinidad	Brennan (1967)
<i>Blankaartia arremonops</i> (Brennan & Jones, 1961)	Panama	Brennan and Jones (1961a)
<i>Blankaartia attenuata</i> (Michener, 1946)	Panama	Michener (1946)
<i>Blankaartia avis</i> (Floch & Abonnenc, 1941)	French Guiana	Floch and Abonnenc (1941)
<i>Blankaartia marui</i> Brennan & Yunker, 1966	Panama	Brennan and Yunker (1966)
<i>Blankaartia pauli</i> Crossley & Atyeo, 1972	USA	Crossley and Atyeo (1972)
<i>Blankaartia sinnamaryi</i> (Floch & Fauran, 1956)	Costa Rica	Arnold (1970)
		Stekolnikov et al. (2007)
	French Guiana	Floch and Fauran (1956)
	Jamaica	Brennan (1953)
	Panama	Brennan and Yunker (1966)
	Peru	Brennan and Jones (1961b)
	Surinam	Brennan and Bronswijk (1975)
	Trinidad	Brennan and Jones (1960)
	USA	Brennan (1965b)
		Spalding et al. (1997)
	Venezuela	Brennan and Reed (1975)
<i>Blankaartia velascoi</i> (Boshell & Kerr, 1942)	Colombia	Boshell and Kerr (1942)
	Panama	Michener (1946)
<i>Blankaartia wetmorei</i> Brennan & Yunker, 1966	Panama	Brennan and Yunker (1966)

3.2. Material and Methods

The specimens of the new species (holotype and paratypes) were collected in 1932 and were preserved in ethanol (70%). These specimens were slide-mounted in

Hoyer's medium, according to Walter and Krantz (2009). Recently, additional material was collected from a bird in Minas Gerais, and was also mounted on slides in Hoyer's medium. Specimens of *B. sinnamaryi* were also mounted on slides. The hosts of both species were collected by means of mist nets, and shortly thereafter, biometric examination was conducted. The mites were removed from the birds, using light scarification according to Fain (1964) and Lizaso (1981), and the birds were then released.

Morphological examination was performed and measurements and drawings were made using a Leica DFC 500 digital camera coupled to a Leica DM4000B optical microscope. Extended focal range images were composed using the Leica Application Suite version 2.5.0. Images of the dorsal idiosomal setae, odontus and galealae from the new species and from *B. sinnamaryi* were made using Nikon Eclipse 80i. The confocal images of the odontus were made using Zeiss LSM 510 Meta. The figures were prepared using Adobe Photoshop v. 13.0 and Inkscape V. 2. All the measurements were made in micrometers (μm), followed by mean and standard deviation. The holotype and paratype measurements are highlighted.

The new species was compared with the original descriptions of known *Blankaartia* species, and with types and other material deposited (Appendix) in the NMNH (National Museum of Natural History) Smithsonian Acari Collection, which is housed at the Systematic Entomology Laboratory (BARC-USDA-ARS).

We partly followed the terminology of Goff et al. (1982), with adaptations proposed by Stekolnikov (2008) and Stekolnikov & Daniel (2012) for the general nomenclature of trombiculid mites. On the other hand, in order to standardize the nomenclature of the specialized setae of the Prostigmata group, we adopted the terminology that was proposed by Kethley (1990) and subsequently used by Wohltmann

et al. (2006). The specialized setae are as follows: solenidia – genu: sigma (σ) (= genualae); tibia: phi (ϕ) (= tibialae); tarsus: omega (ω) (= tarsalae); microsetae – genu: k (= microgenuala); tibia: k (= microtibiala); famulus: epsilon (ϵ) (= microtarsala); eupathidia – tarsus: zeta (ζ) (= pretarsala or subterminal eupathid), zeta (ζ) (= subterminal or dorsal eupathid); and other specialized setae – z (= parasubterminala). The host nomenclature followed Remsen et al. (2015) for South American birds. For North and Central American birds, we used the checklist of the American Ornithologists Union (2015).

Ethical approval

The birds were caught and handled in accordance with the recommendations of the Ethical Principles for Animal Experimentation adopted by the Brazilian College of Animal Experimentation (COBEA). The procedures were approved by the Ethics Committee on Animal Experimentation (CEEa) of the Universidade Federal de Juiz de Fora, MG (UFJF), under no. 042/2012.

3.3. Results

The morphometric data on *Blankaartia shatrovi* n. sp. are shown in Table 2. For the sample size, the data are as follows: I, II, III, IP, TaIII, TaW and ω I, n = 13; AP, AW, PW and PL, n = 11; AL and SB, n = 10; ASB, PSB, SD, P-PL, Vmin and Vmax, n = 9; AM, Dmin, Dmax and 2a, n = 8; and S, H and 1a, n = 6. Drawings of the holotype are shown in Figures 1 and 2. The morphometric data on Brazilian *B. sinnamaryi* are shown in Table 3. For the sample size, the data are as follows: PW, P-PL and AP, n = 12; AW, SB, PSB and AL, n = 11; ASB, SD, PL and II, n = 9; H, DMIN, DMAX, VMIN, VMAX, III, TaIII, TaW, 1a and 2a, n = 8; AM, S, I, ω I, n = 7; and IP, n = 6.

3.3.1. *Blankaartia shatrovi* n. sp. Bassini-Silva & Barros-Battesti

Diagnosis

SIF: 3B4NS-N-3-3111.1000; fPp: B/B/NNB; fCx: 1.1.1; fSt: 2-2; fSC: PL > AM > AL, IP: 1071 [958-1253]; fD: 6-6-4-2; fV: 2-4-2-2-4-2; DS: 20; VS: 16; NDV: 36.

Description

Larva (Figures 1 and 2). **Gnathosoma** - palpal setal formula B/B/NNB/3B4NS, B = branched seta on femur; B = branched seta on genu; NNB = nude dorsal, nude lateral and branched ventral tibial setae, respectively; 3B4NS = three branched setae, four nude setae with ω and ζ on tarsus; the three prongs of the odontus are separated along entire length; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Figure 1). **Idiosoma** - heart-shaped, length 526 μm , width 451 μm ; eyes 2/2, anterior larger, on ocular plate; *scutum* subpentagonal, one pair of AL, one pair of PL and a single AM seta; PL > AM > AL; one pair of flagelliform trichobothria (Figure 1). Thirty-eight idiosomal setae, including one pair of humeral, 18 dorsal arranged 6-6-4-2, two pairs of sternal (1a and 2a) and 16 ventral setae arranged 2-4-2-2-4-2 (Figure 2). All idiosomal setae: carved and nude. **Legs** - seven-segmented; femur divided into basifemur and telofemur, with a pair of claws and a claw-like empodium; onychotriches absent. *Leg I* - coxa with a single branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω (15 μm), ε , dorsal eupathidium, ζ and subterminal eupathidium (Figure 2). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε and subterminal eupathid (Figure 2). *Leg III* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ ; tibia 6B, Φ ; tarsus 14B, mastitarsala (Figure 2).

Figure 1. Morphological details of *Blankaartia shatrovi* n. sp. A. dorsal view of gnathosoma; B. ventral view of gnathosoma; C. scutum; Symbols: ζ = subterminala of palpal tarsus; tarsala of palpal tarsus = ω ; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria. Scale bars: A-C 50 μ m.

Figure 2. Morphological details of *Blankaartia shatrovi* n. sp. A. leg I; B. leg II; C. leg III; D. dorsal view of idiosoma; E. ventral view of idiosoma. In A, B and C, the black circles are the ventral setae and the white circles are the dorsal setae. Symbols: σ = sigma I, II and III; κ = microsetae on genu and tibia; Φ = phi I, II and III; ω = omega I and II; ε = famulus I and II; ζ = subterminala I, pretarsala I, II; z = parasubterminala I; MTa = mastitarsala; 1a = anterior sternal setae; 2a = posterior sternal setae. Scale bars: A-C 50 μ m; D-E 100 μ m.

Table 2. Standard measurements of *Blankaartia shatrovi* n. sp.

	AW	PW	SB	ASB	PSB	SD	P-PL	AP	AM	AL	PL	S	H	1a	2a	DMIN	DMAX	VMIN	VMAX	I	II	III	Ip	TaIII	TaW	ω I
Holotype	83	88	44	17	16	33	30	33	39	34	60	58	63	32	34	45	66	29	60	359	340	395	1094	101	20	14
Paratypes	78	83	43	16	16	32	34	30	38	33	60	57	68	31	36	51	66	31	56	343	307	359	1007	110	18	15
Minimum	66	73	41	12	12	28	30	27	33	30	53	53	62	26	26	45	60	23	31	306	273	224	803	95	14	14
Maximum	85	90	46	17	18	34	39	34	41	37	67	67	71	35	37	56	76	43	61	428	384	443	1253	171	27	17
Mean	78	85	43	15	16	31	33	30	39	33	60	61	66	30	34	51	65	31	54	351	320	371	1039	110	18	15
SD	5.5	4.6	1	1.8	1.6	2	2.4	3	2.5	3	4	4	3	3	3	4	4.6	5.3	8.6	28	31	44	90.9	17.5	2.6	0.7

Legend: AW = anterior width; PW = posterior width; SB = distance between sensillary bases; ASB = distance from sensillary bases to extreme anterior margin; PSB = distance from sensillary bases to extreme posterior margin; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance from anterolateral setal base to posterolateral setal base on one side; AM = anteromedial; AL = anterolateral setae; PL = posterolateral setae; S = trichobothria; H = humeral setae; 1a = anterior sternal setae; 2a = posterior sternal setae; DMIN = minimum length of dorsal idiosomal setae; DMAX = maximum length of dorsal idiosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae; I = length of Leg I; II = length of Leg I; III = length of Leg I; Ip = sum of leg lengths; TaIII = length of tarsus I; TaW = width of tarsus I; ω I = length of omega I.

Table 3. Standard measurements of Brazilian *Blankaartia sinnamaryi*.

	AW	PW	SB	ASB	PSB	SD	P-PI	AP	AM	AL	PL	S	H	1a	2a	DMIN	DMAX	VMIN	VMAX	I	II	III	Ip	TaIII	TaW	ω I
Minimum	78	79	38	15	11	28	26	24	35	28	60	46	57	32	34	49	57	31	36	318	293	346	1013	93	16	15
Maximum	84	87	44	18	16	33	41	36	46	38	65	57	60	34	38	54	67	38	44	372	333	380	1068	109	22	16
Mean	81	85	41	16	14	31	34	31	42	33	62	52	59	33	36	51	61	33	41	351	313	363	1041	101	19	16
SD	2,3	3,1	1,8	1,2	2,0	1,6	4,3	3,1	3,5	3,0	1,9	4,3	1,0	0,8	1,4	1,9	4,4	2,8	3,6	14,3	11,2	10,5	17,8	4,8	2,5	0,5

Legend: AW = anterior width; PW = posterior width; SB = distance between sensillary bases; ASB = distance from sensillary bases to extreme anterior margin; PSB = distance from sensillary bases to extreme posterior margin; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance from anterolateral setal base to posterolateral setal base on one side; AM = anteromedial; AL = anterolateral setae; PL = posterolateral setae; S = trichobothria; H = humeral setae; 1a = anterior sternal setae; 2a = posterior sternal setae; DMIN = minimum length of dorsal idiosomal setae; DMAX = maximum length of dorsal idiosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae; I = length of Leg I; II = length of Leg I; III = length of Leg I; Ip = sum of leg lengths; TaIII = length of tarsus I; TaW = width of tarsus I; ω I = length of omega I.

Type data

HOLOTYPE: larva, municipality of São Paulo, state of São Paulo, Brazil, 04-VI-1932, “Bird” (Order Passeriformes), Joaquim Cavaleiro coll., deposited in the Acari Collection of the Instituto Butantan (IBSP 367). PARATYPES: 4 larvae, same data (IBSP 367); 5 larvae, same data, deposited in the NMNH Smithsonian Acari Collection. Additional material: 3 larvae (IBSP 12375), Fazenda Continente, Coronel Pacheco, state of Minas Gerais (21°35'16" S, 43°15'57" W), Brazil, 18-XII-2005, *Trichothraupis melanops* (= *Lanio melanops*); Erik Daemon coll.

Etymology

The name of the species is a tribute to Andrey B. Shatrov (Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia), a specialist in the morphology and biology of trombiculids.

Remarks

Species of the genus *Blankaartia* share the following characteristics: pentagonal scutum, one or more mastitarsala III, trifurcate odontus and unisetose coxae. These are all present in *Blankaartia shatrovi* n. sp. However, the new species can be separated from all other Neotropical species of *Blankaartia* by the carved and nude idiosomal setae (Figure 3), the well-separated prongs of the odontus (Figure 1 and 4) and the presence of 3 branched setae and 4 nude setae on the palpal tarsus (Figure 1).

The species *B. sinnamaryi* (Figures 3 and 4) is the one that is most similar to the new species, in that it has the same dorsal and ventral setal arrangement and heart-shaped body. However, in *B. shatrovi* n. sp., the prongs of the odontus are separated along the entire length and the galealae are nude, while in *B. sinnamaryi* they are only

separated midway and the galealae are branched (Figure 4). All 13 specimens of *Blankaartia shatrovi* n. sp. were compared with 144 specimens of *B. sinnamaryi*, but there was no significant difference in the measurements, because of wide variation in *B. sinnamaryi*. Therefore, we did not use these measurements as diagnostic characteristics for separating these two species. For the Brazilian *B. sinnamaryi*, the difference was very small, and also not significant. On the other hand, the idiosomal setae of the new species and *B. sinnamaryi* were different (Figure 3).

The new species is also similar to *B. pauli* and *B. amersoni*, in having a 3 σ on genu I and a mastitarsala on leg III. *Blankaartia pauli* differs from the new species, in having a long ω I (> 60), whereas in *B. shatrovi* n. sp. omega I averaged 15 (14-17). The new species has 2 pairs of sternal setae (1a and 2a) and trichobothria with setules, while *B. amersoni* has 3 pairs of sternal setae (1a, 2a and 3a) and nude trichobothria. *Blankaartia marui* and *B. wetmorei* are similar to the new species in having 1 branched seta on the palpal femur. In addition, *B. wetmorei* has 16 ventral setae and a trichobothria similar to *B. shatrovi* n. sp., while only the nude galealae of the *B. marui* is similar. Moreover, *B. shatrovi* n. sp. can be separated from *B. marui* in having a branched seta on the ventral surface of the palptibia (fPp = B/B/NNB) whereas *B. marui* has a nude seta on the ventral surface of the palptibia (fPp = B/N/NNN). The species *B. wetmorei* is distinguished from the new species by a longer ω I (> 60), similar to *B. pauli*. In *B. wetmorei*, there are 4 branched and 2 nude setae on the palpal tarsus (4B2N), while *B. shatrovi* n. sp. has 3B4N.

Other species similar to *B. shatrovi* n. sp. include: *B. arremonops*, *B. avis*, *B. alleei*, *B. attenuata* and *B. velascoi*. The species *B. arremonops* is similar, in having 1 mastitarsala III, 3 σ I, nude galealae and B/B/NNB, but differs from the new species in having 12 ventral setae, longer ω I (similar to *B. pauli* and *B. wetmorei*), whereas *B.*

shatrovi n. sp. has 16 ventral setae and a shorter ω I. *Blankaartia avis* is similar to *B. shatrovi* n. sp., in having a shorter ω I and a heart-shaped idiosoma, but it differs in having 12 ventral setae and a dorsal setal formula (6-6-4-2) similar to *B. sinnamaryi*. The species *B. alleei*, *B. attenuata* and *B. velascoi* are similar to the new species in having a trifurcate odontus and B/B/NNB, but they differ from *B. shatrovi* n. sp. in having 12 ventral setae and a dorsal setal formula similar to *B. sinnamaryi* and *B. avis*.

Figure 3. Details of the idiosomal setae. A. *Blankaartia shatrovi* n. sp. (Holotype), carved and nude idiosomal setae of the 1st row; B. *Blankaartia sinnamaryi* (RML 36691), branched idiosomal setae of the 1st row; C. *Blankaartia shatrovi* n. sp. (Paratype), carved and nude idiosomal setae of the 2nd row; D. *Blankaartia sinnamaryi* (RML 36687), branched setae of the 2nd and 3rd rows; E. *Blankaartia shatrovi* n. sp. (Paratype), carved and nude idiosomal setae of the 4th row; F. *Blankaartia sinnamaryi* (IBSP 12315), example of idiosomal seta that lost the barbs; Scale Bars: A-B 25 μ m and C-F 50 μ m.

Figure 4. Details of the gnathosoma. A. *Blankaartia shatrovi* n. sp. (Paratype), trifurcate odontus with the prongs separated along the entire length; B. *Blankaartia sinnamaryi* (RML 12323A), trifurcate odontus with the prongs separated midway; C. *Blankaartia shatrovi* n. sp. (Paratype), nude galeal seta. D. *Blankaartia sinnamaryi* (RML 36687), branched galeal seta; Abbreviations: Od = Odontus; Ti = Tibia. Scale bars: A-D 20 μ m.

3.4. Discussion

Blankaartia alleei, *B. attenuata* and *B. velascoi* are the only species described both from adults and from reared larvae (Michener, 1946). Shatrov and Kudryashova (2008) noted that chiggers may have a preferred host, but this does not imply host specificity. Therefore, many chiggers seem to have microhabitat specificity. Shatrov and Kudryashova (2008) also commented that *Blankaartia* species have some

preference for water birds, but the present study showed that *B. shatrovi* n. sp. parasitized birds in terrestrial habitats, as also did *B. sinnamaryi*.

Regarding host preferences of the genus *Blankaartia* in South America, *B. alleei*, *B. avis* and *B. velascoi* have been collected exclusively from birds, but *B. sinnamaryi* has been found to parasitize birds, bats, lizards and rodents.

Only six chigger species have been described on birds in Brazil: *Apolonia tigipioensis* Torres & Braga, 1939, which was collected on *Gallus gallus domesticus* (Torres and Braga 1939), *Struthio camelus* and *Passer domesticus* (Ornelas-Almeida et al. 2007), and also on humans (Torres and Braga 1939); *Eutrombicula batatas* (Linnaeus, 1758), collected on *Gallus gallus domesticus* and *Meleagris gallopavo* (Ewing, 1925); *Eutrombicula tinami* (Oudemans, 1910), collected on *Crypturellus noctivagus* (= *Crypturus noctivagus*) (Oudemans 1910); *Neoschoengastia esorhina* Brennan, 1971, collected on *Automolus infuscatus* (Brennan 1971); *Parasecia fundata* Brennan, 1969, collected on *Glyphorhynchus spirurus* (Brennan 1969); and *Parasecia thalurania* Brennan, 1969, collected on *Thalurania furcata* (Brennan, 1969). All of these species were found in the northern and northeastern regions of Brazil.

Blankaartia shatrovi n. sp. was originally found in the state of São Paulo and was also found in the recent material collected in the region of Coronel Pacheco, in the state of Minas Gerais. *Blankaartia sinnamaryi* was collected in Juiz de Fora, also in the state of Minas Gerais, and has been found in Paraty, state of Rio de Janeiro. These species were not collected in the same regions and did not share the same host: they were only in adjacent municipalities in the state of Minas Gerais. Thus, we are reporting the presence of this genus in Brazil for the first time, with the first report of *Blankaartia sinnamaryi* (Floch and Fauran) and the description of a new species of *Blankaartia* that was collected on birds (order Passeriformes).

Unfortunately, there was not enough material from *B. shatrovi* n. sp. for molecular preparations at this time, but future samples from the type locality will be used to acquire molecular sequences.

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Appendix

Comparative material and types examined in NMNH Smithsonian Acari Collection.

Blankaartia alleei – Material: PANAMA - 10 larvae (RML 40415) in Cerro Pirre, Darién, 7-II-1961, *Hydrochoerus hydrochaeris*; 2 larvae (#160), in Juan Mima, Canal Zone, 29-II-1944, *Crotophaga ani*; 1 larva (#130), in same locality, 3-II-1944, *Egretta caerulea* (= *Florida caerulea caerulea*); 1 larva (#34), near the Chagres River, Canal Zone, 29-X-1945, “drift log”; Charles D. Michener coll.

Blankaartia amersoni - Material: TRINIDAD - 2 larvae (RML 45755), Soldado Rock, 9-V-1965, *Anous stolidus*; USA: 1 larva (RML 45767), at the Sand Island, Johnston Atoll, 6-I-1965, *Anous stolidus*; 1 larva (RML 46205), same locality, 11-VII-1965, *Onychoprion fuscatus* (= *Sterna fuscata*); 3 larvae (RML 46207), same locality and host, 12-VII-1963; 2 larvae (RML 46208), same locality and host, 30-VII-1965; 1 larvae (RML 46206), same locality, VIII-1965, *Bulweria bulwerii*, Thomas H. G. Aitken coll.

Blankaartia arremonops - HOLOTYPE: larva (RML 35280), at the Coco Plantation, Panama, 4-V-1955, *Arremonops conirostris*, Gordon Field coll.

Blankaartia marui - HOLOTYPE: larva (RML 40982), in Cerro Azul, Panama, 29-V-1961; *Nycticorax nycticorax*. PARATYPES: 2 larvae (RML 40983), same data.

Blankaartia sinnamaryi – Material: BRAZIL - 1 larva (IBSP 12315), Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, state of Minas Gerais (21°43'50.0" S, 43°22'20.3" W), 8-III-2013, *Turdus rufiventris*; 1 larva (IBSP 12325), same locality and host, 24-V-2013; 2 larvae (IBSP 12317), same locality, 26-III-2013, *Thamnophilus caerulescens*; 1 larva (IBSP 12318A), same locality, 27-III-2013, *Tachyphonus coronatus*; 1 larva (IBSP 12322), same locality and host, 10-IV-2013, 3 larvae (IBSP 12323A), same locality and host, 21-V-2013; 1 larva (IBSP 12329), same locality, 3-XII-2013, *Picumnus cirratus*; 1 larva (IBSP 12327), Sítio Vista Alegre, Juiz de Fora, state of

Minas Gerais (21°48'23.0" S, 43°15'45.7" W), 15-X-2013, *Turdus rufiventris*; 2 larvae (IBSP 12377), Fazenda Continente, Coronel Pacheco, state of Minas Gerais (21°35'16" S, 43°15'57" W), 9-I-2006, *Conopophaga lineata*; 1 larva (IBSP 12382), same locality, 24-VI-2006, *Turdus albicollis*, Ralph Maturano coll.; 3 larvae (IBSP 12201), Paraty, state of Rio de Janeiro (23°13'21" S, 44°42'50" W), 20-III-2015, *Manacus manacus*, Luciano Lima coll.;

JAMAICA: 3 larvae (AP23876), St. Thomas, Corn Puss Gap, 14-XI-1946, *Myadestes genibarbis*;

PANAMA - 2 larvae (RML 44025), Gamboa, Canal Zone, 26-X-1961, *Baryphthengus ruficapillus*; 5 larvae (RML 35309), Coiba Island, 3-I-1956 to 13-II-1956, "Bird"; 1 larva (RML 35330), same locality, 3-I-1956 to 13-II-1956, "Bird"; 1 larva (RML 35313), same locality, 3-I-1956 to 13-II-1956, "Bird"; 4 larvae (RML 40638), Almirante, Bocas del Toro, 23-I-1961, *Myiozetetes* sp.; 16 larvae (RML 40639), same locality and host, 24-I-1961; 1 larva (RML 40640), same data; 1 larva (RML 40641), same data; 2 larvae (RML 40642), same locality and host, 25-I-1961; 1 larva (RML 40647), same locality and host, 3-II-1961; 2 larvae (RML 40644), same locality, 27-I-1961, *Piranga rubra*; 22 larvae (RML 40646), same locality, 2-II-1961, *Sporophila corvina*; 3 larvae (RML 40648), same locality, 14-II-1961, *Aramides cajaneus* (= *Aramides cajanea*); 1 larva (RML 40649), same locality, 16-II-1961, *Bucconidae*; 7 larvae (RML 40636), same locality, 9-I-1961, *Taraba major*; 2 larvae (RML 40645), same locality, 27-I-1961, *Aratinga finschi*; 1 larva (RML 43831), same locality, 25-IX-1961, *Geothlypis formosa* (= *Oporornis formosus*); 1 larva (RML 43284), same locality, 4-VIII-1961, *Xiphorhynchus guttatus*; 1 larva (RML 40650), same locality, 3-II-1961, *Zentrygon lawrencii* (= *Geotrygon lawrencii*); 1 larva (RML 43767), Rio Changena, Bocas del Toro, 22-IV-1961, *Catharus ustulatus* (= *Hylocichla ustulata*); 1 larva (43975), same locality, IX-1961, *Trogon massena*; 1 larva (RML 43702), same locality, 20-IX-1961, *Zentrygon lawrencii* (= *Geotrygon lawrencii*);

TRINIDAD: 4 larvae (#33810), Melajo Forest, Sangre Grande, I-1956, *Pitangus sulphuratus*; 1 larva (#33898), same locality and host, 24-

IV-1954; 1 larva (#33831), same locality, 20-XII-1955, *Thamnophilus doliatus* (= *Thamnophilus fraterculus*); 1 larva (#33839), same data; 6 larvae (#33883), same locality, 28-III-1956, *Tachyphonus rufus*; 2 larvae (#34137), same locality, 10-VII-1956, *Crotophaga ani*; 1 larva (#33840), same locality, 29-XI-1956, *Tyrannus melancholicus*; 6 larvae (#33842), same locality, 4-I-1956, *Galbula ruficauda*; 1 larva (#33843), same locality, 6-XII-1956, *Myiopagis gaimardii*; 5 larvae (#33802), same locality, 1-III-1956, *Amazona amazonica*; 3 larvae (#33839), same locality, 20-XII-1956, *Thamnophilus doliatus*; 1 larva (#34047), same locality and host, 3-VII-1956; 1 larva (#34135), same locality, 10-VII-1956, *Myiodynastes maculatus*; 1 larva (#34669), same locality, 24-XII-1959, *Xiphorhynchus guttatus*; 1 larva (#37051), Churchill-Roosevelt Highway, 29-XI-1956, *Tyrannus savana* (= *Muscivora tyrannus*); 1 larva (#35073), William Tr. Foster Rd., 1-I-1959, *Myiophobus fasciatus*; 2 larvae (#36681), Elgin Trace, Vega de Oropouche, 2-II-1960, *Tolmomyias flaviventris*; 2 larvae (#36674), same locality, 29-XII-1959, *Myiophobus fasciatus*; 2 larvae (#36684), same locality and host, 2-II-1960; 1 larva (#36673), same locality, 29-XII-1959, *Tolmomyias flaviventris*; 2 larvae (#36681), same locality and host, 2-II-1960; 1 larva (#38214), Vega de Oropouche, 10-I-1961, *Campephilus melanoleucos* (= *Phloeceastes melanoleucos*); 1 larva (#35052), same locality, 7-X-1959, *Cyclarhis gujanensis*; 2 larvae (#36771), same locality, 15-XII-1959, *Pipra erythrocephala*; 3 larvae (#36688), same locality and host, 8-XII-1959; 1 larva (#36690), Fort Reid, 16-II-1960, *Myiophobus fasciatus*; 1 larva (#33660), same locality, 26-V-1955, *Tyrannus melancholicus*; 1 larva (#35092), 3-V-1959, *Columbina talpacoti* (= *Columbigallina talpacoti*); 1 larva (#36690), same locality, 2-III-1960, *Thamnophilus doliatus*; 3 larvae (#34682), Granville, 12-III-1956, *Ciccaba virgata*; USA: 2 larvae (#45011), Cameron Co., Texas, 7-V-1962, *Dumetella carolinensis*; 1 larva (#38715), same locality, 23-IV-1963, *Hylocichla mustelina*, Richard B. Eards coll.

Blankaartia wetmorei - HOLOTYPE: larva (RML 43234), at Fort Kobbe, Canal Zone, Panama, 20-VII-1961, *Nyctanassa violacea*. PARATYPES: 2 larvae (RML 43234), same data, Frank Todd coll.

CHAPTER 2: Species of the genus *Blankaartia*
Oudemans, 1911 (Trombidiformes: Trombiculidae) of
the Nearctic and Neotropical regions

Abstract. The genus *Blankaartia* includes 25 known species, 10 of them distributed in the Nearctic and Neotropical regions. The chigger species of this genus preferentially parasitize birds, thus occasionally they can be found also on rodents and reptiles, even in humans, showing low host specificity. In the present study, we redescribe the species of the Nearctic and Neotropical regions. Five of these species that were already assigned to the genus continued in the genus, three species were removed from the genus because they did not have characteristics that would fit into the genus and two species were synonymized.

Key words: chigger mites, bird, Brazil

4.1. Introduction

The genus *Blankaartia* was described by Oudemans (1911) based on *Trombidium niloticum* Tragardh, 1904, designated as type-species by original description. Oudemans (1912) made a correct combination of genus and epithet feminine as *Blankaartia nilotica*, redescribing the larva.

Womersley (1948) noticed that the larva described by Oudemans (1912) was not of the Trombiculidae family and could not be associated with the adults (*T. niloticum*) described by Tragardh (1904). Nevertheless, he suggested that larva of *Trombidium ardeae* Tragardh, 1904, collected on the same day and locality could be associated with adults of *T. niloticum*. In addition, Womersley (1948) placed the genus *Blankaartia* as synonymy of the genus *Tragardhula* Berlese, 1912. However, Fuller and Wharton (1951) retained the genus *Tragardhula* Berlese, 1912, after examining the type species (*T. niloticum*). They also considered the genera *Pentagonella* Thor, 1936 and *Megatrombicula* Michener, 1946 as synonymy of *Blankaartia*, and they lowered the taxonomic status of *Blankaartia* to subgenus of *Trombicula*.

One year after, Wharton and Fuller (1952) compiled and listed the species of the subgenus *Trombicula* (*Blankaartia*), which to date consisted of eight species: *Trombicula* (*Blankaartia*) *acuscuteellaris* (Walch, 1922), *Trombicula* (*Blankaartia*) *allei* (Ewing, 1926),

Trombicula (Blankaartia) ardeae (Tragardh, 1904), *Trombicula (Blankaartia) attenuata* (Michener, 1946), *Trombicula (Blankaartia) peruviana* (Ewing, 1926), *Trombicula (Blankaartia) niloticum* (Tragardh, 1904) and *Trombicula (Blankaartia) velascoi* (Boshell & Kerr 1942).

Radford (1954), in agreement with Womersley (1948), placed *Tragardhula* as synonymy of *Blankaartia*. However, Floch and Fauran (1956), in disagreement with those authors, described *Trombicula (Tragardhula) sinnamaryi* and transferred *Trombicula avis* to this subgenus. Floch and Fauran (1957) redescribed these two species retaining them in the same subgenus.

Chen and Hsu (1957) described the species *Tragardhula kwanacara* not mentioning the subgenus. A year later, Chen and Hsu (1958) transferred *Trombicula (Blankaartia) acuscutellaris* to the genus *Tragardhula*, and again, they did not mention any subgenus. Nevertheless, Radford (1957) considered *Blankaartia* as a genus, placed *Tragardhula* as synonymy, and described *Blankaartia laniarius* Radford, 1957.

Vercammen-Grandjean (1960a) proposed the subgenus *Blankaartia (Megaciella)*, describing two new species, *Blankaartia (Megaciella) gracilis* and *Blankaartia (Megaciella) cristifera*, and including two species for this subgenus, *Blankaartia rageaui rageaui* Taufflieb & Mouchet, 1959 and *Blankaartia rageaui ardeolae* Taufflieb & Mouchet, 1959, Brennan and Jones (1960, 1961a) and Brennan (1965a), in agreement with Floch and Fauran (1956), maintained *T. sinnamaryi* in the subgenus *Trombicula (Tragardhula)*.

Crossley (1960) using the generic status for *Blankaartia*, such as previously proposed by Radford (1957), and included *B. alleei* and *B. velascoi*, to adjust the new status of *Blankaartia*. Brennan (1965b) described the species *Blankaartia amersoni* Brennan, 1965, collected in the intraoral region of aquatic birds. Subsequently, Nadchatram (1980) transferred *B. amersoni* in the genus *Iguanacarus* (Vercammen-Grandjean).

Vercammen-Grandjean (1965) listed 20 species that he assumed belonged to the "*Blankaartia* complex" that he divided into two existing subgenera: *Blankaartia* (*Blankaartia*) - 16 species; *Blankaartia* (*Megaciella*) - 4 species. In the list, this author reorganized the species, according to Wharton and Fuller (1952), with the exception of *T. (Blankaartia) peruviana*. He also transferred *T. avis* and *T. sinnamaryi* to the subgenus *Blankaartia* (*Blankaartia*), and proposed new combinations to *Comatacarus atollensis*, Radford, 1953 and *Trombicula centropodis* Ewing, 1928 transferring them to *Blankaartia* (*Blankaartia*).

Brennan and Yunker (1966) did not consider any subgenera, describing *Blankaartia marui* Brennan & Yunker, 1966 and *Blankaartia wetmorei* Brennan & Yunker, 1966. They also transferred *Trombicula arremmonops* Brennan & Jones, 1961 to the genus *Blankaartia*.

Taufflieb (1972) maintained the subgenus *Blankaartia* (*Blankaartia*) and described *Blankaartia* (*Blankaartia*) *corneti* Taufflieb, 1972, following the line proposed by Vercammen-Grandjean (1965). However, this subgenus were not used anymore, and the latest described species to the genus *Blankaartia* was *Blankaartia pauli* Crossley & Atyeo, 1972.

Vercammen-Grandjean (1973a) and Vercammen-Grandjean and Kolebinova (1985) reinforced that the type species of the genus *Blankaartia* be represented by the adult species *T. niloticum*, and the species *T. ardeae* was synonymyzed with *T. niloticum* (Vercammen-Grandjean 1973a)

In the 80's another species, *Blankaartia* (*Megaciella*) *dohanyi* Nadchatram and Goff, 1980 was described. But it was only a few years later that Vercammen-Grandjean and Kolebinova (1985) synonymyzed *Blankaartia* (*Megaciella*) with *Blankaartia* (*Blankaartia*), and finally they decided not to use subgenera for the genus *Blankaartia*, because they found unpublished Tragardh material. The authors also realized that the type species *B. gracilis* was actually *T. ardeae*, but this species had already been previously synonymyzed with *T.*

niloticum. So, they synonymized *B. gracilis* with *T. niloticum*. Still they synonymized *B. cristifera* with *B. rageaui ardeolae*. Despite of this, Özdikmen (2008) proposed the subgenus *Blankaartia* (*Neomegaciella*) to replace the subgenus *Blankaartia* (*Megaciella*), because this was already pre-occupied in the Porifera Order. Currently the subgenera of *Blankaartia* are not valid anymore (Vercammen-Grandjean and Kolebinova, 1985).

Recently a new species has been described *Blankaartia shatrovi* Bassini-Silva & Barros-Battesti, 2017 increasing the list of species for the genus *Blankaartia*. Therefore, up to the present study, we have 25 species of *Blankaartia* described and distributed worldwide. In the Nearctic and Neotropical region we have 10 species described so far, these are: *Blankaartia alleei* (Ewing, 1926), *Blankaartia arremonops* (Brennan & Jones, 1961b), *Blankaartia attenuata* (Michener, 1946), *Blankaartia avis* (Floch & Abonnenc, 1941), *B. marui*, *B. pauli*, *B. shatrovi*, *Blankaartia sinnamaryi* (Floch & Fauran, 1956), *Blankaartia velascoi* (Boshell & Kerr, 1942), *B. wetmorei*, as follow in the Table 1.

4.2. Material and Methods

Seven species (types and material) of Nearctic and Neotropical regions were found housed in the collections and examined. The following collections were consulted for types and materials: National Museum of Natural History (USNM, now NMNH) Smithsonian Acari Collection, which is housed at the Systematic Entomology Laboratory (BARC-USDA-ARS); American Museum of Natural History, New York, NY, USA (AMNH); Field Museum of Natural History, Chicago, USA, (FMNH, earlier name and acronym of Chicago Natural History Museum - CNHM); The University of Georgia Collection of Arthropods, Athens, Georgia, USA (UGCA); L'Institut Pasteur de Paris, Paris, France (IPP); Australian National Insect Collection, Canberra, Australia (ANIC); Gorgas Memorial Laboratory, Panama city,

Panama (GML); L'Institut Pasteur de la Guyane, Cayenne, French Guiana (IPG); Coleção Acarológica do Instituto Butantan, São Paulo, Brazil (IBSP).

Table 1. Species of the genus *Blankaartia* (Trombidiformes: Trombiculidae) of the Nearctic and Neotropical regions (Alphabetic order)

Species	Distribution	References
<i>Blankaartia alleei</i> (Ewing, 1926)	Surinam	Brennan and Bronswijk (1975)
	Panama	Ewing (1926) Michener (1946) Brennan and Yunker (1966)
<i>Blankaartia arremonops</i> (Brennan & Jones, 1961)	Panama	Brennan and Jones (1961b)
<i>Blankaartia attenuata</i> (Michener, 1946)	Panama	Michener (1946)
<i>Blankaartia avis</i> (Floch & Abonnenc, 1941)	French Guiana	Floch and Abonnenc (1941)
<i>Blankaartia marui</i> Brennan & Yunker, 1966	Panama	Brennan and Yunker (1966)
<i>Blankaartia pauli</i> Crossley & Atyeo, 1972	USA	Crossley and Atyeo (1972)
<i>Blankaartia shatrovi</i> Bassini-Silva & Barros-Battesti, 2017	Brazil	Bassini-Silva et al. (2017)
<i>Blankaartia sinnamaryi</i> (Floch & Fauran, 1956)	Brazil	Bassini-Silva et al. (2017)
	Costa Rica	Arnold (1970) Stekolnikov et al. (2007)
	Cuba	Daniel and Stekolnikov (2003)
	French Guiana	Floch and Fauran (1956)
	Jamaica	Brennan (1953)
	Panama	Brennan and Yunker (1966)
	Peru	Brennan and Jones (1961a)
	Surinam	Brennan and Bronswijk (1975)
	Trinidad	Brennan and Jones (1960)
	USA	Brennan (1965a) Spalding et al. (1997)
	Venezuela	Brennan and Reed (1975)
<i>Blankaartia velascoi</i> (Boshell & Kerr, 1942)	Colombia	Boshell and Kerr (1942)
	Panama	Michener (1946)
<i>Blankaartia wetmorei</i> Brennan & Yunker, 1966	Panama	Brennan and Yunker (1966)

In addition, recent collections were made in the states of Minas Gerais and Rio de Janeiro, initially the chigger specimens were stored in ethanol (100%). Later they were slide-

mounted in Hoyer's medium according to Walter and Krantz (2009) for identification. Some specimens were also prepared for Scanning Electron Microscopy (SEM) according to Walter and Krantz (2009) with a Digital Scanning Microscope FEI, Quanta 250, at the Laboratory of Cell Biology, Butantan Institute.

For all species were made drawings using Leica DFC 500 digital camera coupled to the optical microscope Leica DM4000B. Extended focal range images were composed with Leica Application Suite version 2.5.0. The images were prepared with Adobe Photoshop v. 13.0, and Inkscape V. 2. The redescrptions were made comparing with the original descriptions. Diagnosis and redescrptions we followed the terminology proposed by Goff et al. (1982) with adaptations proposed by Stekolnikov (2008) and Stekolnikov and Daniel (2012), and for the specialized setae proposed by Bassini-Silva et al. (2017).

To standardize the redescrptions, the quantity of the setae of the legs, as well as the position of the setae in the coxae III, position of the microsetae in relation to solenidia from the tarsus of leg I and II, and the presence or absence the striations in the coxae, were used.

For host nomenclature and classification, we used Remsen et al. (2015) for South American birds, and for northern and mid-american birds we used the checklist of The American Ornithologists Union (2015). The distribution maps of the species will be prepared by the DIVA-GIS 7.5 program.

Ethical approval

The animals were caught and manipulated in accordance with the recommendations of the Ethical Principles in Animal Experimentation adopted by the Brazilian College of Animal Experimentation (COBEA), and it was approved by the Ethics Committee on Animal Experimentation (CEEa) of the Dean of the Universidade Federal de Juiz de Fora, MG (UFJF) – nº042/2012

4.3. Results

After examination of types and materials of the genus *Blankaartia*, five species that were already assigned to the genus, continue in the genus, three species were removed from the genus *Blankaartia* because they do not have characteristics that would fit into the genus, and two species were synonymized.

Genus *Blankaartia* Oudemans, 1911

Blankaartia Oudemans, 1911, 123; Oudemans, 1912: 118; Vercammen-Grandjean, 1960b, 469; 1968, 61 1973a: 112; 1973b: 118; Vercammen-Grandjean, et al., 1973: 55; Nadchatram and Dohany, 1974: 59; Kolebinova and Vercammen-Grandjean, 1978, 102; Vercammen-Grandjean and Kolebinova, 1985: 66; Fernandes and Kulkarni, 2003: 70.

Trombicula (Tragardhulla): Berlese, 1912: 4.

Trombicula (Blankaartia): Berlese, 1912, 95; Fuller and Wharton, 1951: 87; Wharton and Fuller, 1952: 42.

Pentagonella Thor, 1936: 30.

Trombicula (Megatrombicula) Michener, 1946: 432.

Tragardhula: Womersley 1948, 83; 1952: 19.

Type species: *Trombidium niloticum* Tragardh, 1904

Diagnosis.

Seven setae on palpal tarsus, one or two setae with different shape, with ζ ; branched seta on the palpal femur; branched seta on palpal genu; nude dorsal palpal tibial setae, branched lateral and ventral palpal tibial setae (B/B/NNB); odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of chelicera; galealae branched or nude; eyes 2/2 on ocular plate; *scutum* pentagonal, with a evagination in the posterior margins, PL>AM>AL; PLs intrascutals; one pair of humeral, six setae in the first row of idiosomal dorsal setae and two pair of sternals and; seven-segmented; coxae unisetose striate; empodium present and onychondrites absent; Leg I and II with subterminal eupathid; Tarsus of the Leg I with dorsal eupathid and ζ ; microsetae proximal to the ω on the leg II, mastitarsala on the leg III present.

4.3.1. *Blankaartia alleei* (Ewing, 1926)

Trombicula alleei Ewing, 1926: 111; Ewing, 1931: 6.

Trombicula (Megatrombicula) alleei: Michener, 1946: 434.

Trombicula (Megatrombicula) attenuata Michener, 1946: 440 *New synonymy*

Tragardhula alleei: Womersley 1948, 89; 1952: 319; Radford, 1954: 262.

Tragardhula attenuata: Womersley 1948, 89; 1952: 322; Radford, 1954: 262 *New synonymy*

Trombicula (Blankaartia) alleei: Wharton and Fuller, 1952: 43.

Trombicula (Blankaartia) attenuata: Wharton and Fuller, 1952: 43 *New synonymy*

Blankaartia (Blankaartia) attenuata: Vercammen-Grandjean, 1965: 22. *New synonymy*

Blankaartia alleei: Crossley, 1960: 210; Brennan and Yunker, 1966: 249; Brennan and Bronswijk, 1975: 243.

Blankaartia (Blankaartia) alleei: Vercammen-Grandjean, 1965: 22

Blankaartia attenuata: Brennan and Yunker, 1966: 249. *New synonymy*

Larva (Figure 1, Table 2)

Diagnosis. Palpal tarsus with seven branched setae, galealae setae branched, odontus trifurcated; posterior margin of *scutum* with one V-shaped evagination; the first three rows of dorsal idiosomal setae with 6 setae each; genu with three solenidia, tarsus of the leg I with 21 branched setae and the base of microseta is proximal to the base of solenidium, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae with mastitarsala setae.

Redescription. (Fig. 1) **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal tibial setae, branched lateral and ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of chelicera; gnathobase punctate, galeala branched (Fig. 1A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one V-shaped evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 1C. Forty one to Thirty nine idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 6

setae plus 2 setae, totalizing 20 dorsal setae, 2 pairs of sternal, and 8 or 9 preanals and 4, 5 or 6 postanals, totalizing 13, 14 or 15 ventral setae (Fig. 1G and H, Table 2). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ε , dorsal eupathid, z and subterminal eupathid, base of ε proximal to base of ω (Fig. 1D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 1E). *Leg III* – coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala present (Fig. 1F).

Note. In the original description it was mentioned that there were 22 dorsal setae and 12 ventral setae, with a total of 40 idiosomal setae. However, we observed a variation in the number of idiosomal ventral setae as showed in the Table 2.

Table 2. Number of idiosomal setae of *Blankaartia alleei*

Identification	Humeral	1 st row	2 nd row	3 rd row	Other dorsals	Dorsals	Esternals	Preanals	Postanals	Ventrals	Total
#130	2	6	6	6	2	20	4	8	6	14	40
#130	2	6	6	6	2	20	4	9	5	14	40
#160	2	6	6	6	2	20	4	9	4	13	39
#160	2	6	6	6	2	20	4	9	6	15	41

Distribution (Fig. 2). PANAMA (Ewing, 1926; Michener 1946; Brennan and Yunker, 1966) and SURINAM (Brennan and Bronwijk, 1975).

Hosts. Birds: *Anas discors* (Anseriformes: Anatidae); *Crotophaga ani*, *Piaya cayana* (Cuculiformes: Cuculidae); *Gallus gallus* (Galliformes: Phasianidae); *Porphyrio*

martinicus (**Gruiformes: Rallidae**); *Saltator atriceps* (**Passeriformes: Cardinalidae**); *Amblycercus holosericeus*, *Leistes militaris* (**Passeriformes: Icteridae**); *Thamnophilus doliatus* (**Passeriformes: Thamnophilidae**); *Cantorchilus leucotis* (= *Thryothorus leucotis*) (**Passeriformes: Troglodytidae**); *Myiarchus ferox*, *Myiochanes* sp., *Myiozetetes cayanensis*, *Myiozetetes similis*, *Tyrannus melancholicus* (**Passeriformes: Tyrannidae**); *Egretta caerulea* (= *Florida caerulea*), *Casmerodius albus* (**Pelecaniformes: Ardeidae**); *Anhinga anhinga* (**Suliformes: Anhingidae**); *Trogon massena* (**Trogoniformes: Trogonidae**). **Mammals:** *Sylvilagus brasiliensis* (= *Sylvilagus gabbi*) (**Lagomorpha: Leporidae**); *Hydrochaeris hydrochaeris* (**Rodentia: Caviidae**).

Material examined. PANAMA - 2 larvae (#160), in Juan Mima, Canal Zone, 29-II-1944, *Crotophaga ani*; 1 larva (#130), in same locality, 3-II-1944, *Egretta caerulea* (= *Florida caerulea*); 1 larva (#34), near the Chagres River, Canal Zone, 29-X-1945, “drift log”; Charles D. Michener coll. 10 larvae (RML 40415) in Cerro Pirre, Darién, 7-II-1961, *Hydrochoerus hydrochaeris*.

4.3.2. *Blankaartia avis* (Floch & Abonnenc, 1941)

Trombicula avis Floch and Abonnenc, 1941: 10; Radford, 1954: 250.

Trombicula (Trombicula) avis: Wharton and Fuller, 1952: 62.

Trombicula (Tragardhula) avis: Floch and Fauran, 1956: 6; 1957: 16.

Trombicula arremmonops Brennan and Jones 1961b: 114 *New synonymy*

Blankaartia (Blankaartia) avis: Vercammen-Grandjean, 1965: 22.

Blankaartia arremmonops: Brennan and Yunker, 1966: 249 *New synonymy*

Larva (Figure 3)

Diagnosis. Palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; posterior margin of *scutum* with one half-moon shape evagination; genu with three solenidia, tarsus of the leg I with 21 branched setae and the base of microseta is distal to the base of

solenidium, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae with mastitarsala setae.

Figure 1. Morphological details of *Blankaartia alleei* (#160). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ϵ = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa = mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μ m; G-H 100 μ m.

Figure 2. Geographical distribution of *Blankaartia alleei*

Redescription. (Fig. 3). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral and branched ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of chelicera; gnathobase punctate, galeala nude (Fig 3A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one half-moon shape evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 3C. Thirty nine idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 4 setae plus 2 setae, totalizing 18 dorsal setae, 2 pairs of sternal, and 9 preanals and 6 postanals, totalizing 15 ventral setae (Fig. 3G and H). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B,

σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, z and subterminal eupathid, base of ϵ distal to base of ω (Fig. 3D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 3E). *Leg III* - coxa 1B in the middle, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala present (Fig. 3F).

Note. In the original description it is stated that the types of *B. avis* that exist would be in the IPG collection, but were not found, there was also the possibility that this type would have been transferred to IPP, but neither was found. After examining the type of *B. arremonops*, we noticed that it had been described wrongly, that the galealae are nude and that there are at least 15 ventrals setae, unlike what was observed in the original description that described the galealae branched and 12 ventrals setae. For this reason we synonymize this species with *B. avis*, since both species share the same characteristics. It was observed and added the description of the species a subapical tooth in the inner region of chelicera.

Distribution (Fig. 4). FRENCH GUIANA (Floch and Abonnenc, 1941), PANAMA (Brennan and Jones, 1961a).

Hosts. Birds: *Arremonops conirostris* (**Passeriformes: Passerellidae**); *Turdus* sp. (**Passeriformes: Turdidae**).

Type examined. HOLOTYPE of *Trombicula arremonops*: larva (RML 35280), at the Coco Plantation, Panama, 4-V-1955, *Arremonops conirostris*, Gordon Field coll.

Figure 3. Morphological details of *Trombicula arremonops* (= *Blankaartia avis*). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 4. Geographical distribution of *Blankaartia avis*

4.3.3. *Blankaartia shatrovi* Bassini-Silva & Barros-Battesti, 2017

Blankaartia shatrovi Bassini-Silva and Barros-Battesti, 2017: 83.

Distribution (Fig. 5). BRAZIL (Bassini-silva et al., 2017).

Host. Birds: *Trichothraupis melanops* (Passeriformes: Thraupidae).

Types and material examined. HOLOTYPE: larva (IBSP 367), São Paulo municipality, São Paulo, Brazil, 04-VI-1932, “Bird” (Order Passeriformes), Joaquim Cavalheiro coll. PARATYPES: 9 larvae (IBSP 367), same data. Material – BRAZIL: 3 larvae (IBSP 12375), Fazenda Continente, Coronel Pacheco, Minas Gerais, 18-XII-2005, *Trichothraupis melanops* (= *Lanio melanops*); Erik Daemon coll.

Figure 5. Geographical distribution of *Blankaartia shatrovi*

4.3.4. *Blankaartia sinnamaryi* (Floch & Fauran, 1956)

Trombicula (*Tragardhula*) *sinnamaryi* Floch and Fauran, 1956: 3; 1957: 17; Brennan and Jones, 1960: 531; Brennan and Jones, 1961a: 202.

Tragardhula sinnamaryi: Brennan, 1965a: 83.

Blankaartia (*Blankaartia*) *sinnamaryi*: Vercammen-Grandjean, 1965: 22.

Blankaartia sinnamaryi: Brennan and Yunker, 1966: 250; Arnold, 1970: 262; Brennan and Bronswijk, 1975: 244; Brennan and Reed, 1975: 49; Spalding *et al.*, 1997: 768; Daniel and Stekolnikov, 2003: 150; Stekolnikov *et al.*, 2007: 66; Walters *et al.*, 2011: 9.

Larva (Figure 6)

Diagnosis. Palpal tarsus with seven branched setae, galealae setae branched, odontus trifurcated; the shape of posterior margin of the *scutum* is intermediate, slightly V-shaped, accentuated more at the tip, but also rounded; the first two rows of dorsal idiosomal setae with 6 setae each; genu with three solenidia, tarsus of the leg I with 21 branched setae and the base of microseta is proximal to the base of solenidium, tarsus of the leg II with 15 branched setae, tarsus of the leg III with 15 branched setae with mastitarsala setae.

Redescription. (Fig. 6). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral, and branched ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus; odontus

trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of chelicera; gnathobase punctate, galeala branched (Fig 6A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, the shape of posterior margin is intermediate, slightly V-shaped, accentuated more at the tip, but also rounded and anterior margin with one invagination both turned to the base of trichobothria, as Figure 6C. Forty idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 4 setae plus 2 setae, totalizing 18 dorsal setae, 2 pairs of sternal, and 10 preanals and 6 postanals, totalizing 16 ventral setae (Fig. 6G and H). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, z and subterminal eupathid, base of ϵ distal to base of ω (Fig 6D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 15B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 6E). *Leg III* – coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B, mastitarsala present (Fig. 6F).

Note. The same as happened with the types of *B. avis*, in the original description it says that the types that exist would be in the IPG collection, but it was consulted and not found. The same possibility that would be in the IPP, but it was not found either. According to the original description, quantities of setae on the Legs I-III were different from what we observed. Floch and Fauran (1956) observed 6B on tibia I, 14B on tarsus I, 3B on telofemur II, 12B on tarsus II, 4B on telofemur III, 12B on tarsus III, here we observed 8B, 21B, 4B,

15B, 15B, respectively. In addition, we added the description a subapical tooth in the inner region of chelicera.

Distribution (Fig. 8). BRAZIL (Bassini-Silva et al., 2017), COSTA RICA (Arnold, 1970; Stekolnikov et al., 2007), CUBA (Daniel and Stekolnikov, 2003), FRENCH GUYANE (Floch and Fauran, 1956), JAMAICA (Brennan, 1953), PANAMA (Brennan and Yunker, 1966), PERU (Brennan and Jones, 1961), SURINAM (Brennan and Bronswijk, 1975), TRINIDAD (Brennan and Jones, 1960), USA (Brennan, 1965; Spalding et al., 1997), VENEZUELA (Brennan and Reed, 1975).

Hosts. Reptiles: *Leptophis ahaetulla* (Serpentes: Colubridae). **Birds:** *Antrostomus rufus* (= *Caprimulgus rufus*), *Nyctidromus albicollis* (= *Hydropsalis albicollis*) (Caprimulgiformes: Caprimulgidae); *Columbina talpacoti* (= *Columbigallina talpacoti*), *Zentrygon lawrencii* (= *Geotrygon lawrencii*) (Columbiformes: Columbidae); *Baryphthengus ruficapillus* (Coraciiformes: Momotidae); *Crotophaga ani* (Cuculiformes: Cuculidae); *Bucconidae* sp., *Monasa morphoeus* (Galbuliformes: Bucconidae); *Galbula ruficauda* (Galbuliformes: Galbulidae); *Grus canadensis pratensis* (Gruiformes: Gruidae); *Aramides cajaneus* (Gruiformes: Rallidae); *Cyanocompsa cyanoides*, *Piranga rubra* (Passeriformes: Cardinalidae); *Conopophaga lineata* (Passeriformes: Conopophagidae); *Lepidocolaptes souleyetii compressus*, *Xiphorhynchus guttatus* (Passeriformes: Dendrocolaptidae); *Oryzoborus funereus*, *Sporophila aurita corvina* (Passeriformes: Emberizidae); *Dendrocincla homochroa*, *Glyphorhynchus spirurus*, *Sclerurus guatemalensis*, *Synallaxis spixi*, *Xiphorhynchus susurrans* (Passeriformes: Furnariidae); *Cacicus cela*, *Icterus mesomelas* (Passeriformes: Icteridae); *Dumetella carolinensis* (Passeriformes: Mimidae); *Arremon semitorquatus* (Passeriformes: Passerellidae); *Geothlypis formosus* (= *Oporornis*

formosus), *Geothlypis semiflava*, *Parkesia motacilla* (= *Seiurus motacilla*) (**Passeriformes: Parulidae**); *Ceratopipra erythrocephala* (= *Pipra erythrocephala*), *Ceratopipra mentalis* (= *Pipra mentalis*), *Chiroxiphia caudata*, *Manacus manacus* (**Passeriformes: Pipridae**); *Tolmomyias sulphurescens cinereiceps* (**Passeriformes: Pipromorphidae**); *Microbates cinereiventris* (**Passeriformes: Polioptilidae**); *Cymbilaimus lineatus*; *Dysithamnus mentalis*, *Epinecrophylia fulviventris* (= *Myrmotherula fulviventris*), *Myrmoderus squamosus*, *Taraba major*, *Thamnistes anabatinus*, *Thamnophilus bridgesi*, *Thamnophilus caerulescens*, *Thamnophilus doliatus*, *Thamnophilus doliatus* (**Passeriformes: Thamnophilidae**); *Coereba flaveola*, *Ramphocelus passerinii*, *Pyriglena leucoptera*, *Sporophila americana*, *Tachyphonus coronatus*, *Tachyphonus delattrei*, *Tachyphonus rufus*, *Tangara episcopus* (= *Thraupis virens*), *Volatinia jacarina* (**Passeriformes: Thraupidae**); *Cantorchilus modestus* (= *Thryothorus modestus*), *Cantorchilus nigricapillus* (= *Thryothorus nigricapillus*), *Henicorhina leucosticta*, *Pheugopedius fasciatoventris melanogaster* (= *Thryothorus fasciatoventris melanogaster*), *Pheugopedius genibarbis* (= *Thryothorus genibarbis*), *Thryothorus pleurostictus rufus*, *Pheugopedius rutilus hyperythrus* (= *Thryothorus rutilus hyperythrus*), *Troglodytes musculus* (**Passeriformes: Troglodytidae**); *Catharus mexicanus*, *Catharus ustulata* (= *Hylocichla ustulata*), *Hylocichla mustelina*, *Myadestes genibarbis*, *Turdus albicollis*, *Turdus leucomelas*, *Turdus nudigenis*, *Turdus rufiventris* (**Passeriformes: Turdidae**); *Attila spadiceus*, *Lathrotriccus euleri*, *Myiarchus ferox*, *Myiodynastes maculatus*, *Myiopagis gaimardii*, *Myiophobus fasciatus*, *Myiozetetes* sp., *Oncostoma cinereigulare*, *Pitangus sulfuratus*, *Tyrannus melancholicus*, *Tyrannus savana* (= *Muscivora tyrannus*) (**Passeriformes: Tyrannidae**); *Cyclarhis gujanensis* (**Passeriformes: Vireonidae**); *Campephilus melanoleucos* (= *Phloeceastes melanoleucos*), *Colaptes melanochloros*, *Melanerpes pucherani*, *Picumnus cirratus* (**Piciformes: Picidae**); *Amazona amazonica*, *Aratinga finschi* (**Psittaciformes: Psittacidae**); *Megascops guatemalae* (= *Otus guatemalae*),

Strix virgata (= *Ciccaba virgata*) (**Strigiformes: Strigidae**); *Anhinga anhinga* (**Suliformes: Anhingidae**); *Trogon massena*, *Trogon rufus* (**Trogoniformes: Trogonidae**). **Mammals:** *Phyllostomus hastatus* (**Chiroptera: Phyllostomidae**); *Hydrochoerus hydrochaeris* (**Rodentia: Caviidae**).

Material examined. Material: BRAZIL: larva (IBSP 12315), Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais, 8-III-2013, *Turdus rufiventris*; 1 larva (IBSP 12325), same locality and host, 24-V-2013; 2 larvae (IBSP 12317), same locality, 26-III-2013, *Thamnophilus caerulescens*; 1 larva (IBSP 12318A), same locality, 27-III-2013, *Tachyphonus coronatus*; 1 larva (IBSP 12322), same locality and host, 10-IV-2013, 4 larvae (IBSP 12323A), same locality and host, 21-V-2013; 1 larva (IBSP 12329), same locality, 3-XII-2013, *Picumnus cirratus*; 1 larva (IBSP 12327), Sítio Vista Alegre, Juiz de Fora, Minas Gerais, 15-X-2013, *Turdus rufiventris*; 2 larvae (IBSP 12377), Fazenda Continente, Coronel Pacheco, Minas Gerais, 9-I-2006, *Conopophaga lineata*; 1 larva (IBSP 12382), same locality, 24-VI-2006, *Turdus albicollis*, Ralph Maturano coll.; 3 larvae (IBSP 12201), Paraty, Rio de Janeiro, 20-III-2015, *Manacus manacus*, Luciano Lima coll. JAMAICA: 3 larvae (AP23876), St. Thomas, Corn Puss Gap, 14-XI-1946, *Myadestes genibarbis*. PANAMA - 2 larvae (RML 44025), Gamboa, Canal Zone, 26-X-1961, *Baryphthengus ruficapillus*; 5 larvae (RML 35309), Coiba Island, 3-I-1956 to 13-II-1956, “Bird”; 1 larva (RML 35330), same locality, 3-I-1956 to 13-II-1956, “Bird”; 1 larva (RML 35313), same locality, 3-I-1956 to 13-II-1956, “Bird”; 4 larvae (RML 40638), Almirante, Bocas del Toro, 23-I-1961, *Myiozetetes* sp.; 16 larvae (RML 40639), same locality and host, 24-I-1961; 1 larva (RML 40640), same data; 1 larva (RML 40641), same data; 2 larvae (RML 40642), same locality and host, 25-I-1961; 1 larva (RML 40647), same locality and host, 3-II-1961; 2 larvae (RML 40644), same locality, 27-I-1961, *Piranga rubra*; 22 larvae (RML

40646), same locality, 2-II-1961, *Sporophila corvina*; 3 larvae (RML 40648), same locality, 14-II-1961, *Aramides cajaneus*; 1 larva (RML 40649), same locality, 16-II-1961, Bucconidae; 7 larvae (RML 40636), same locality, 9-I-1961, *Taraba major*; 1 larva (RML 43831), same locality, 25-IX-1961, *Geothlypis formosa* (= *Oporornis formosus*); 1 larva (RML 43284), same locality, 4-VIII-1961, *Xiphorhynchus guttatus*; 1 larva (RML 43767), Rio Changena, Bocas del Toro, 22-IV-1961, *Catharus ustulatus* (= *Hylocichla ustulata*); 1 larva (43975), same locality, IX-1961, *Trogon massena*; 1 larva (RML 43702), same locality, 20-IX-1961, *Zentrygon lawrencii* (= *Geotrygon lawrencii*). TRINIDAD: 4 larvae (#33810), Melajo Forest, Sangre Grande, I-1956, *Pitangus sulphuratus*; 1 larva (#33898), same locality and host, 24-IV-1954; 1 larva (#33831), same locality, 20-XII-1955, *Thamnophilus doliatus* (= *Thamnophilus fraterculus*); 1 larva (#33839), same data; 6 larva (#33883), same locality, 28-III-1956, *Tachyphonus rufus*; 2 larva (#34137), same locality, 10-VII-1956, *Crotophaga ani*; 1 larva (#33840), same locality, 29-XI-1956, *Tyrannus melancholicus*; 6 larvae (#33842), same locality, 4-I-1956, *Galbula ruficauda*; 1 larva (#33843), same locality, 6-XII-1956, *Myiopagis gaimardii*; 5 larvae (#33802), same locality, 1-III-1956, *Amazona amazonica*; 3 larvae (#33839), same locality, 20-XII-1956, *Thamnophilus doliatus*; 1 larva (#34047), same locality and host, 3-VII-1956; 1 larva (#34135), same locality, 10-VII-1956, *Myiodynastes maculatus*; 1 larva (#34669), same locality, 24-XII-1959, *Xiphorhynchus guttatus*, 1 larva (#37051), Churchill–Roosevelt Highway, 29-XI-1956, *Tyrannus savana* (= *Muscivora tyrannus*); 1 larva (#35073), William Tr. Foster Rd., 1-I-1959, *Myiophobus fasciatus*; 2 larva (#36681), Elgin Trace, Vega de Oropouche, 2-II-1960; *Tolmomyias flaviventris*; 2 larvae (#36674), same locality, 29-XII-1959; *Myiophobus fasciatus*; 2 larvae (#36684), same locality and host, 2-II-1960; 1 larva (#36673), same locality, 29-XII-1959, *Tolmomyias flaviventris*; 2 larvae (#36681), same locality and host, 2-II-1960; 1 larva (#38214), Vega de Oropouche, 10-I-1961, *Campephilus melanoleucos* (= *Phloeceastes melanoleucos*); 1 larva (#35052), same

locality, 7-X-1959, *Cyclarhis gujanensis*; 3 larvae (#36688), same locality and host, 8-XII-1959; 1 larva (#36690), Fort Reid, 16-II-1960, *Myiophobus fasciatus*; 1 larva (#33660), same locality, 26-V-1955, *Tyrannus melancholicus*; 1 larva (#35092), 3-V-1959, *Columbina talpacoti* (= *Columbigallina talpacoti*); 1 larva (#36690), same locality, 2-III-1960, *Thamnophilus doliatus*; 3 larvae (#34682), Granville, 12-III-1956, *Ciccaba virgata*. USA: 2 larvae (#45011), Cameron Co., Texas, 7-V-1962, *Dumetella carolinensis*; 1 larva (#38715), same locality, 23-IV-1963; *Hylocichla mustelina*, Richard B. Eards coll.

New records

BRAZIL - 13 larvae (IBSP 10711), Fundação Animalia, São Sebastião, São Paulo, (23°45'59.99"S, 45°25'00.07"W), 26-I-2011, *Baryphthengus ruficapillus*. Fabiana Morse coll.; 1 larva (IBSP 12316), Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°43'50.0" S, 43°22'20.3" W), 26-III-2013, *Turdus rufiventris*; 1 larva (IBSP 12339), same locality and host, 24-II-2014; 1 larva (IBSP 12729), same locality and host, 10-IV-2015; 1 larva (IBSP 12350), same locality and host, 24-III-2014; 1 larva (IBSP 12324), same locality, 24-V-2013, *Thamnophilus caerulescens*; 1 larva (IBSP 12358), same locality and host, 27-III-2014; 1 larva (IBSP 12331), same locality, 04-XII-2013, *Chiroxiphia caudata*; 1 larva (IBSP 12336), same locality and host, 23-II-2014; 1 larva (IBSP 12730), same locality, 9-IV-2014, *Tachyphonus coronatus*; 1 larva (IBSP 12340), same locality and host, 24-II-2014; 1 larva (IBSP 12342), same data; 1 larva (IBSP 12343), same data; 1 larva (IBSP 12350), same locality and host, 24-III-2014; 5 larvae (IBSP 12354), same locality and host, 25-III-2014; 1 larva (12319), same locality, 8-IV-2013, *Arremon semitorquatus*; 1 larva (12320), same data; 1 larva (IBSP 12332), same locality, 6-XII-2013, *Colaptes melanochloros*; 1 larva (IBSP 12338), same locality, 24-II-2014, *Manacus manacus*; 3 larvae (IBSP 12344A), same locality, 25-II-2014, *Troglodytes musculus*; 4 larvae (IBSP 12345A), same data; 1 larva (IBSP 12346), same locality and date, *Lathrotriccus euleri*; 1

larva (IBSP 12348), same locality and host, 24-III-2014; 1 larva (IBSP 12362), same locality, 14-IV-2014, *Synallaxis spixi*; 1 larva (IBSP 12335), Sítio Vista Alegre, Juiz de Fora, Minas Gerais, (21°43'50" S, 43°21'44" W), 30-I-2014, *Troglodytes musculus*; 1 larva (IBSP 12379), Fazenda Continente, Coronel Pacheco, Minas Gerais (21°35'16" S, 43°15'57" W), 9-I-2006, *Turdus albicollis*, Ralph Maturano coll. 3 larvae (IBSP 12198), Paraty, Rio de Janeiro, (23°13'21" S, 44°42'50" W), 19-III-2015, *Manacus manacus*; 3 larvae (IBSP 12214), same locality and date, *Tachyphonus coronatus*; 2 larva (IBSP 12211), same locality, 20-III-2015, *Myrmoderus squamosus*; 3 larva (IBSP 12731), same locality and host; 2 larvae (IBSP 12216A), same locality and date, *Pyriglena leucoptera*; 1 larva (IBSP 12791), same locality and host, Luciano Lima coll. PANAMA - 2 larvae (RML 40645), Almirante, Bocas del Toro (9°18'0" N, 82°24'0" W), 27-I-1961, *Aratinga finschi*; 1 larva (RML 40650), same locality, 3-II-1961, *Zentrygon lawrencii* (= *Geotrygon lawrencii*). VENEZUELA - 2 larvae (#36771), Vega de Oropouche (10°38'33.8"N, 61°11'12.6"W), 15-XII-1959, *Pipra erythrocephala*;

4.3.5. *Blankaartia velascoi* (Boshell & Kerr, 1942)

Trombicula velascoi Boshell and Kerr, 1942: 9.

Trombicula (Megatrombicula) velascoi: Michener, 1946: 438.

Tragardhula velascoi: Womersley 1948, 89; 1952: 320; Radford, 1954: 262.

Trombicula (Blankaartia) velascoi: Wharton and Fuller, 1952: 44.

Blankaartia velascoi: Crossley, 1960: 211; Brennan and Yunker, 1966: 250.

Blankaartia (Blankaartia) velascoi: Vercammen-Grandjean, 1965: 22.

Note. The types were not found in the NMNH and BMNH museums as recorded in the original description (Boshell and Kerr, 1942), but also would not serve because they are adults and do not fit into the proposed revision. The additional material that would be the larvae that Michener (1946) described, which we believe were from the same collections as the ones of *B. alleei* and *B. attenuata* larvae (AMNH, NMNH, GML) were also not found.

Distribution (Fig. 9). COLOMBIA (Boshell and Kerr, 1942) and PANAMA (Michener, 1946).

Figure 6. Morphological details of *Blankaartia sinnamaryi* (RML 36687). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ϵ = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae; Scales: A-C 50 μ m; G-H 100 μ m.

Figure 7. Morphological details of *Blankaartia sinnamaryi*. A. leg I; B. leg III; C. dorsal idiosomal setae; D. palpal genu, tibia and tarsus. The white arrows highlight the specialized setae of the segments of the legs I and III and the striate coxae III. The Scale bars: A and B 50µm, C 300µm, D 20µm.

Figure 8. Geographical distribution of *Blankaartia sinnamaryi*

Hosts. Birds: *Crotophaga ani* (**Cuculiformes: Cuculidae**); *Falco sparverius* (**Falconiformes: Falconidae**); *Gallus gallus* (**Galliformes: Phasianidae**); *Saltator albicollis*, *Saltator atriceps* (**Passeriformes: Cardinalidae**); *Xiphorhynchus guttatus* (**Passeriformes: Dendrocolaptidae**); *Sporophila corvina* (= *Sporophila aurita*) (**Passeriformes: Emberizidae**); *Amblycerus holosericeus* (**Passeriformes: Icteridae**); *Dendroica* sp. (**Passeriformes: Parulidae**); *Arremonops conirostris* (**Passeriformes: Passerellidae**); *Manacus vitellinus* (**Passeriformes: Pipridae**); *Myrmeciza longipes*, *Thamnophilus doliatus* (**Passeriformes: Thamnophilidae**); *Habia gutturalis* (**Passeriformes: Thraupidae**); *Cantorchilus leucotis* (= *Thryothorus leucotis*), *Cantorchilus modestus* (= *Thryothorus modestus*), *Troglodytes musculus* (**Passeriformes: Troglodytidae**); *Elaenia flavogaster*, *Empidonax* sp., *Myiarchus ferox*, *Myiochanes* sp., *Myiochanes cinereus*, *Myiozetetes cayanensis*, *Myiozetetes granadensis*, *Myiozetetes similis*, *Philohydor lictor* (= *Pitangus lictor*), *Tyrannus melancholicus* (**Passeriformes: Tyrannidae**); *Hylophilus aurantiifrons* (**Passeriformes: Vireonidae**); *Notharchus pectoralis* (**Piciformes: Bucconidae**); *Melanerpes rubricapillus* (= *Centurus subelegans*) (**Piciformes: Picidae**); *Amazilia tzacatl* (**Trochiliformes: Trochilidae**). **Mammals:** *Sylvilagus brasiliensis* (= *Sylvilagus gabbi*) (**Lagomorpha: Leporidae**).

Figure 9. Geographical distribution of *Blankaartia velascoi*

Incertae sedis*¹**Blankaartia marui* Brennan & Yunker, 1966***Blankaartia marui* Brennan and Yunker, 1966: 249**Distribution.** PANAMA (Brennan and Yunker, 1966).**Host. Birds:** *Nycticorax nycticorax* (Pelecaniformes: Ardeidae).**Types examined.** HOLOTYPE: larva (RML 40982), in Cerro Azul, Panama, 29-V-1961;*Nycticorax nycticorax*. PARATYPES: 2 larvae (RML 40983), same data.***Blankaartia pauli* Crossley & Atyeo, 1972***Blankaartia pauli* Crossley and Atyeo, 1972: 243; Rohani and Cromroy, 1979: 366; Walters et al., 2011: 9**Distribution.** USA (Crossley and Atyeo, 1972).**Host. Birds:** *Rallus longirostris* (Gruiformes: Rallidae).**Note.** The types were not found in the UGCA and there is no additional material cited.***Blankaartia wetmorei* Brennan & Yunker, 1966***Blankaartia wetmorei* Brennan and Yunker, 1966: 250**Distribution.** PANAMA (Brennan and Yunker, 1966).**Host. Birds:** *Nycticorax violacea* (Pelecaniformes: Ardeidae).

¹*Incertae sedis*: is a Latin term used in Taxonomy to indicate the inability to establish the exact position of a taxon within the classification. "With uncertain position".

Types examined. HOLOTYPE: larva (RML 43234), at Fort Kobbe, Canal Zone, Panama, 20-VII-1961, *Nyctanassa violacea*. PARATYPES: 2 larvae (RML 43234), same data, Frank Todd coll.

Key to the species of the genus *Blankaartia* Oudemans, 1911

1. Galealae branched.....2
 Galealae nude.....4
2. The first two rows of dorsal setae with 6 setae each, the microsetae of the leg I proximal to the ω I, 15B and a mastitarsala setae on the leg III.....*B. sinnamaryi* (Fig. 6 and 7)
 The first three rows of dorsal setae with 6 setae each, the microsetae of the leg I distal to the ω I, 14B and mastitarsala setae on the leg III.....3
3. Posterior margin of *scutum* with one half-moon shape evagination.....*B. velascoi*²
 Posterior margin of *scutum* with one V-shaped evagination.....*B. alleei* (Fig. 1)
4. Seven branched setae on palpal tarsos, posterior margin of *scutum* with one half-moon shape evagination.....*B. avis* (Fig. 3)
 With at least two nude setae on palpal tarsus, posterior margin of *scutum* has a V shape, but the tip is rounded.....*B. shatrovi*³

² Michener, C. D. 1946. The taxonomy and bionomics of a new subgenus of chigger mites (Acarina, Trombiculinae). *Annals Entomological Society of America* 39: 441.

³ Bassini-Silva, R., F. C. Jacinavicius, J. A. Mendoza-Roldan, E. Daemon, and D. M. Barros-Battesti. 2017. Description of *Blankaartia shatrovi* n. sp. (Acari: Trombiculidae) from Brazil. *Journal of Medical Entomology* 54: 84-85.

4.4. Discussion

Due to so many confusions with the history of the genus *Blankaartia*, in the present study, we reaffirm the taxonomic position to the genus in accordance with Brennan and Yunker (1996).

Three types (*Blankaartia arremonops*, *B. marui*, *B. wetmorei*) that were deposited at NMNH and one type (*B. shatrovi*) deposited in the IBSP, were examined. The other types were not found. The species *B. avis*, *B. pauli* and *B. sinnamaryi* were not found in the collections cited in the original descriptions (Floch and Abonnenc, 1941; Crossley and Atyeo, 1972; Floch and Fauran, 1956), except *B. sinnamaryi* that were found in the additional material from NMNH.

Three species, *B. alleei*, *B. attenuata* and *B. velascoi*, were originally described by the adult stage, so these species have allotypes. The typical series is not composed of larvae which would be normal for this family since the taxonomy of the group is made entirely based on the larval stage. But Michener (1946) described the larvae of these three species, thus comparing them with the rest of the family. Despite this, it was not possible to find the larvae of *B. attenuata* and *B. velascoi*, limiting the comparisons. Only the redescription of the species *B. alleei* was made by the same slide that Michener (1946) used when this author described the larva of this species for the first time, reared from adult specimens.

After analyzing the 10 species of *Blankaartia*, there was a division into two groups, due to the odontotus being different, those with bifurcated odontus (four species) and those species that had the odontus trifucate (seven species). But we noticed that there were other features that separated these two groups, which had already been also observed by Brennan and Amersoni (1971). The species *B. amersoni* was transferred to another genus, *Iguanacarus*, because they share common morphological characteristics, besides of their habit for parasitizing the intranasal region of their hosts, like other species of *Iguanacarus*

(Nadchatram (1980). Nevertheless, *I. amersoni* is an intranasal parasite of aquatic birds whereas the other species of *Iguanacarus* parasitize the intranasal cavity of some species of iguanas that inhabit the Galapagos Islands. The author considered the possibility that the species *B. marui* and *B. wetmorei* could also belong to that genus, but since that there was no evidence that they would be intranasal, he preferred did not to place them in *Iguanacarus*. Therefore, we decided to remove the species *B. marui*, *B. wetmorei* and *B. pauli* to the “*Incertae sedis*” until that their taxonomic position could be solve when more evidences about their habit could be observed. These species shared the following features: bifurcate odontus, the posterior margin of the *scutum* never angulate, generally broad and convex or slightly sinuous, with shoulders at the anterior margins and all pontuations of the coxal distributed at random.

Thusfore, for the Nearctic and Neotropical regions we have seven species, which presented very subtle differences, allowing them to be separated into two groups proposed here: galealae nude (three species) and galealae branched (four species). Brennan and Jones (1961a) observed that *B. arremonops* has 12 ventral setae and galealae branched, separating it from the other species. But, we decided to synonymyzed it with *B. avis*, because the type species of *B. arremonops* has, in fact, 15 ventral setae and galealae nude. Both characters are very close to what has been described for *B. avis* (16 ventral setae). Indeed there is variation of the number of idiosomal setae (Table 2) and because of this we believe they are synonymy.

The type series of *B. attenuata* was found in AMNH, but the type specimens were not examined because they are adults and do not fall under the proposal of this study. The larva reared in laboratory and described by Michener (1946), was not found. But after examination of the same material (larvae) that Michener identified as *B. alleei* (deposited at the NMNH), we noticed that the posterior margin of the *scutum* is angular similarly as described for *B. attenuata*. Adults of *B. attenuata* and *B. alleei* have slightly differences in their morphology,

as observed by Michener (1946). Nevertheless this author commented that is very difficult to identify larvae of these species. So, we decide to synonymyze *B. attenuata* with *B. alleei*.

Regarding to the hosts, the only species that parasite exclusively birds are *B. avis* and *B. shatrovi*. The species *B. velascoi* and *B. alleei* have already been found parasitizing rodents in addition to birds and *B. sinnamaryi* has been found parasitizing reptiles, birds and mammals. This may explain why this species has most of the records in the America's, from Brazil to the USA (Fig. 8).

The remaining four species have a smaller geographical distribution. In Central America, with the exception of *B. shatrovi*, the other species have already been reported to Panama. In South America, *B. alleei* has records in Suriname (Fig. 2), *B. avis* for French Guiana (Fig. 4) and *B. velascoi* for Colombia (Fig. 9). The species *B. shatrovi* has only records for Brazil (Fig. 5). In addition to *B. sinnamaryi*, no other species were reported beyond Panama.

In the present study we are adding a new record of locality (São Sebastião, São Paulo) and bird hosts (*Arremon semitorquatus*, *Chiroxiphia caudata*, *Colaptes melanochloros*, *Lathrotriccus euleri*, *Myrmoderus squamosus*, *Pyriglena leucoptera*, *Synallaxis spixi*, *Troglodytes musculus*) for the species *B. sinnamaryi*. In addition, three other new host records (*Aratinga finschi*, *Ceratopipra erythrocephala*, *Zentrygon lawrencii*) are being reported for this species, these records are part of slides housed at the NMNH, which had not been previously published.

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CHAPTER 3: Description of *Microtrombicula*
n. sp. (Trombidiformes: Trombiculidae) from
Brazil

Abstract. The genus *Microtrombicula* has more than 150 known species, and about 31 described from the Nearctic and Neotropical regions. The chigger species of this genus parasite mainly mammals, and can also parasitize birds and reptiles. In the present study, we describe a new species of *Microtrombicula* collected on *Myiozetetes similis* (Order Passeriformes), increasing the number of chigger species to Brazil.

Key words: new species, chigger mite, bird, Brazil

5.1. Introduction

The genus *Microtrombicula* Ewing (1950) includes 166 species around the world and 31 in the Nearctic and Neotropical regions, most of them have records for North America, and 19 species are distributed between Mexico and USA. For Central America 11 species have already been recorded, and only six species have register for South America, being *Microtrombicula mapuche* Stekolnikov & González-Acuña, 2015 from Chile, *Microtrombicula pearsoni* Goff & Whitaker, 1984 and *Microtrombicula nicaraguae* Webb & Loomis, 1970 from Paraguay.

In Brazil there are three known species as follows: *Microtrombicula brachytrichia* Brennan, 1971 recorded in the city of Belem in state of Para; *Microtrombicula brennani* Goff, Whitaker & Dietz, 1986 registered in Poço das Antas Biological Reserve in state of Rio de Janeiro; and *Microtrombicula rhipidomysi* Goff, Whitaker & Dietz, 1983 recorded in the Serra da Canastra National Park, Minas Gerais. With the exception of the species *Microtrombicula nicaraguae*, all other species of *Microtrombicula* from South America are unique records.

In the present study, we describe the larva of a new species of the genus *Microtrombicula* collected from a bird *Myiozetetes similis* (Order: Passeriformes) in State of Minas Gerais, southeastern Brazil.

5.2. Material and Methods

The specimens (n= 6) of the new species (holotype and paratypes) were collected from *M. similis* at the Fazenda Volta Grande, Santa Bárbara do Monte Verde, Minas Gerais in September 2014. Initially the specimens were stored in ethanol (100%). In this sample four slides were mounted in Hoyer's medium according to Walter and Krantz (2009) for identification. Another part of this material was prepared for Scanning Electron Microscopy.

Morphological details were made from specimens mounted in slides. The drawings were made by using Leica DFC 500 digital camera coupled to the optical microscope Leica DM4000B. Extended focal range images were composed with Leica Application Suite version 2.5.0. The images were prepared with Adobe Photoshop v. 13.0, and Inkscape V. 2. All the measurements were made in micrometers (μm), followed by mean and standard deviation. The holotype measurements are highlighted. Some specimens were also prepared for Scanning Electron Microscopy (SEM) according to Walter and Krantz (2009) with a Digital Scanning Microscope FEI, Quanta 250, at the Laboratório de Biologia Celular, Instituto Butantan. The new species here described were compared to the original descriptions of known *Microtrombicula* spp. We followed the terminology proposed by Goff et al. (1982) with adaptations proposed by Stekolnikov (2008) and Stekolnikov and Daniel (2012), and for the specialized setae proposed by Bassini-Silva et al. (2017).

For host nomenclature we followed Remsen et al. (2015) for South American birds, and for northern and mid-american birds we used the checklist of The American Ornithologists Union (2015).

Ethical approval

The animals were caught and manipulated in accordance with the recommendations of the Ethical Principles in Animal Experimentation adopted by the Brazilian College of Animal Experimentation (COBEA), and it was approved by the Ethics Committee on Animal Experimentation (CEEa) of the Dean of the Universidade Federal de Juiz de Fora, MG (UFJF) – nº042/2012

5.3. Results

5.3.1. *Microtrombicula* n. sp. Bassini-Silva & Jacinavicius

Larva (Figures 1 and 2, Table 1 and 2)

Diagnosis. Nude dorsal and lateral setae, and branched ventral palpal tibia setae, palpal tarsus with six branched setae, galealae setae nude, odontus bifurcated; the first three rows of dorsal idiosomal setae with 8 setae each; genu with three solenidia, tarsus of the leg I with 21 branched setae and the base of microseta is distal to the base of solenidium, tarsus of the leg II with 15 branched setae, tibia of the leg III with 4 branched setae and two mastitibiala, tarsus of the leg III with 12 branched setae four mastitarsala setae.

Description (Figs. 1 and 2). **Gnathosoma** - palpal setal formula B/B/NNB/6BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral, and branched ventral tibial setae, respectively 6BS = seven branched with ω and ζ on tarsus; odontus bifurcate; quelicer al blade unknown; gnathobase punctate, galeala nude (Figs. 1A-B and 2D). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform

trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one slight evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figures 1C and 2C. Sixty two to sixty six idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 8 setae, 2nd row with 8 setae, 3rd row with 8 setae plus 6 setae, totalizing 30 dorsal setae, 2 pairs of sternal, and 16 to 18 preanals and 10 to 12 postanals, totalizing 26 to 30 ventral setae (Figs. 1G and H and 2E, Table 1). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, z and subterminal eupathid, base of ϵ distal to base of ω (Figs. 1D and 2A). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 15B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 1E). *Leg III* - coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 4B, Φ ; 2 mastitibiala; tarsus 12B, 4 mastitarsala (Fig. 1F and 2B).

Type data (IBSP 12374B)

HOLOTYPE: larva, Fazenda Volta Grande, Santa Bárbara do Monte Verde, Minas Gerais (21°57'32"S, 43°42'7"W), 25-IX-2014, *Myiozetetes similis* (Order Passeriformes), Ralph Maturano coll. PARATYPES: 3 larvae, same data.

Table 1. Number of idiosomal setae of *Microtrombicula* n. sp. (Type series)

Identifications	Humeral	1 st row	2 nd row	3 rd row	Other dorsals	Dorsals	Esternals	Prenals	Postanals	Ventrals	Total
IBSP 12374B (1)*	2	8	8	8	6	30	4	17	11	28	64
IBSP 12374B (3)*	2	8	8	8	6	30	4	18	12	30	66
IBSP 12374B (4)*	2	8	8	8	6	30	4	16	10	26	62

*The number in parenthesis represents a collection code.

Figure 1. Morphological details of *Microtrombicula* n. sp. (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTi: mastitibiala; MTa: mastitarsala; 1a = anterior sternal setae; 2a = posterior sternal setae; Scales: A-C 50 μm; G-H 100 μm.

Figure 2. Morphological details of *Microtrombicula* n. sp. A. leg I; B. leg III; C. scutum; D. palpal tibia and tarsus; E. dorsal idiosomal setae. The black arrows highlight the specialized setae of the segments of the legs I and III. Abreveviations: AL: anterolateral setae; AM: anteromedian seta; PL: posteriorlateral setae; S: trichobothria. The Scale bars: A 50µm, B-D 40µm, E 100µm.

Table 2. Standard measurements of *Microtrombicula* n. sp.

	AW	PW	SB	ASB	PSB	SD	P-PI	AP	AM	AL	PL	S	H	1a	2a	DMIN	DMAX	VMIN	VMAX	I	II	III	Ip	TaIII	TaW	ω I
Holotype	62	59	23	16	5	21	13	20	32	33	49	57	44	40	38	38	45	26	32	228	216	255	699	65	15	17
Minimum	59	56	22	14	5	21	10	20	32	30	48	55	43	40	38	37	44	25	30	225	210	250	691	63	15	17
Maximum	62	60	24	16	8	22	13	21	35	33	51	57	45	42	39	40	46	26	32	231	222	259	706	67	17	19
Mean	61	58	23	15	6	22	12	21	34	31	50	56	44	41	38	38	45	25	31	227	216	253	696	65	16	18
SD	1,3	1,3	0,6	0,6	0,8	0,5	0,8	0,6	0,8	1,3	0,8	0,7	0,6	0,6	0,5	1,1	0,7	0,4	0,7	2,5	3,9	3,5	6,1	1,4	0,6	0,5

Legend: AW = anterior width; PW = posterior width; SB = distance between sensillary bases; ASB = distance from sensillary bases to extreme anterior margin; PSB = distance from sensillary bases to extreme posterior margin; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance from anterolateral setal base to posterolateral setal base on one side; AM = anteromedial; AL = anterolateral setae; PL = posterolateral setae; S = trichobothria; H = humeral setae; 1a = anterior sternal setae; 2a = posterior sternal setae; DMIN = minimum length of dorsal idiosomal setae; DMAX = maximum length of dorsal idiosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae; I = length of Leg I; II = length of Leg I; III = length of Leg I; Ip = sum of leg lengths; TaIII = length of tarsus I; TaW = width of tarsus I; ω I = length of solenidium I.

Remarks

The main character of the genus *Microtrombicula* is the *scutum* with the same shape, palpal tarsus with six branched setae.

The new species could be separated from the other species by combination of mastisetae in the leg III, having two mastitibiala and four mastitarsala. And even more, when compared, the new species with the other three Brazilian species of *Microtrombicula*, the following differences may be noted. The species *Microtrombicula brachytrichia* Brennan, 1970 and *Microtrombicula brennani* Goff, Whitaker & Dietz, 1986, have in common with the new species, the presence of eight setae in the first row of dorsal idiosomal setae, but differ in some characteristics, the new species presents two nude setae in the palpal tibia (dorsal and lateral setae) while *M. brachytrichia* possesses all the setae of the palp branched as well as *M. brennani*. With the exception of the palpal tarsus in *M. brachytrichia*, that some setae may be nude, unlike the new species that has six branched setae. In addition, the new species of *Microtrombicula* has the bifurcated odontus, while *M. brachytrichia* has the trifurcated odontus. The species *M. brennani* and *Microtrombicula rhipidomysi* Goff, Whitaker & Dietz, 1983 have the bifurcated odontus in the same way as the new species. The species *M. rhipidomysi* has still in common with *Microtrombicula* n. sp. the dorsal setae of the palpal tarsus nude, but the new species differs by having the lateral setae nude of the palpal tarsus and by having the three first rows of dorsal setae of the idiosome composed of eight setae each, whereas in *M. rhipidomysi*, are six setae in each row.

All specimens of the typical series of *Microtrombicula* n.sp. presented the cheliceral blade broken. Anyway the genus has a cheliceral blade with tricuspid cap.

The genus *Microtrombicula* has already been found parasitizing reptiles, birds and mammals. For South America records, the species *M. mapuche* were found parasitizing a reptile (*Liolaemus chillanensis*), while the species *M. pearsoni* and *M. nicarague* were found

parasitizing rodents (*Andalgalomys pearsoni* for the first species and *Sciurus variegatoides* and *Graomys Griseoflavus* for the second species).

The Brazilian *Microtrombicula* species were found parasitizing primates and rodents. The species *M. brennani* and *M. rhipidomysi* were found on *Lentopithecus rosalia* and on *Rhipidomys mastacalis*, respectively, both from southeastern region. The species *M. brachytrichia* was collected from *Proechimys guyannensis* in the northern region. Therefore *Microtrombicula* n.sp. is the first record parasitizing bird for South America, increasing the number of chigger species to Brazil.

Unfortunately, there was not enough material from *Microtrombicula* n. sp. for molecular preparations at this time, but samples from the type locality are in progress, and they will be used to acquire molecular sequences as well.

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CHAPTER 4: Revision of the genus *Parasecia*
Loomis 1966 (Trombidiformes: Trombiculidae)

Abstract. The genus *Parasecia* includes 18 known species, all of them from the Nearctic and Neotropical regions. Species of this genus parasitize birds, mammals and reptiles. In the present study, there are 16 species that had been previously included in the genus, two species that were removed because they have characteristics that would not fit in the genus, one new combination that was previously in *Trombicula* genus was transferred to the *Parasecia*, and three new species here described.

Key words: chigger mites, new species, ectoparasites, new records

6.1. Introduction

The genus *Parasecia* was created by Loomis (1966) as a subgenus of *Fonsecia* Radford, 1942. The author designated as a type species, *Trombicula gurneyi* Ewing, 1937, and included 8 other species, *Trombicula aitkeni* Brennan & Jones, 1960; *Trombicula chara* Wharton, 1948; *Trombicula gurneyi campestris* Loomis, 1955; *Trombicula kansasensis* Loomis, 1955; *Trombicula longicalcar* Brennan & Jones, 1960; *Trombicula manueli* Brennan & Jones, 1960; *Trombicula psittaci* Floch & Abonnenc, 1949; *Trombicula universitatis* Hoffmann, 1963.

One year later, Vercammen-Grandjean (1967) made a mess, creating the subgenus *Euneocula* for the same species of *Parasecia* proposed by Loomis (1966). That author divided the subgenus into two groups: “*gurneyi* group”, including the species *T. gurneyi*, *T. campestris* and *T. kansasensis* and the “*manueli* group”, including the species *T. aitkeni*, *T. chara*, *T. longicalcar*, *T. manueli* and *T. psittaci*. The species *T. universitatis* was transferred to the genus *Neotrombicula* Hirst, 1925.

Later, Brennan (1969) added another species, *Trombicula soucouyanti* Brennan & Yunker, 1966, and described three more new species from Brazil, *Fonsecia (Parasecia) fundata*, *Fonsecia (Parasecia) thalurania* and *Fonsecia (Parasecia) valida*. The author

also included a key of species for the genus. Brennan (1971) elevated the subgenus *Fonsecia* (*Parasecia*) to genus, and also described a new species, *Parasecia orphana* Brennan, 1971. Until that time 13 species of *Parasecia* were known. Brennan and Bronswijk (1975) proposed a new combination for *Trombicula palmigera* Fauran, 1960, designating it also to the genus *Parasecia*. Goff and Gettinger (1991) described *Parasecia lasiurus*, from Brazil, and Goff (1992) described another species for the genus, *Parasecia bulbocalcar*, collected in Mexico. Due to the addition of many new species, Goff (1992) proposed a new key, including 15 species of *Parasecia*, excluding *Parasecia gurneyi campestris* and *Parasecia palmigera*. However he did not consider the new combination of *Trombicula universitatis* (as *Neotrombicula universitatis*) proposed by Vercammen-Grandjean (1967), and placed this species like *Parasecia*, in that key. Hoffmann (1990) agreed with Vercammen-Grandjean (1967), and kept *T. universitatis* in the genus *Neotrombicula*. It was described two other species, *Parasecia argentinensis* Goff & Gettinger, 1995 and *Parasecia neuquenensis* Goff & Gettinger, 1995. But Stekolnikov and Gonzalez-Acuña (2012) transferred *Parasecia neuquenensis* to the genus *Paratrombicula*.

Stekolnikov and González-Acuña (2015) described another species for the genus, *Parasecia molini*. To the present time, there are 18 species for the genus *Parasecia* distributed only in the Nearctic and Neotropical regions, as follow in the Table 1.

Table 1. Species of the genus *Parasecia* (Trombidiformes: Trombiculidae) in alphabetic order.

Species	Distribution	References
<i>Parasecia aitkeni</i> (Brennan & Jones, 1960)	Bolivia	Brennan, 1970b
	Brazil	Whitaker and Dietz, 1987
	Surinam	Brennan and Lukochus, 1971
	Trinidad	Brennan and Jones, 1960 Brennan, 1969
	Venezuela	Brennan and Reed, 1975
<i>Parasecia argentinensis</i> Goff & Gettinger 1995	Argentina	Goff and Gettinger, 1995
<i>Parasecia bulbocalcar</i> Goff 1992	Mexico	Goff, 1992
<i>Parasecia campestris</i> (Loomis, 1955)	USA	Loomis, 1955
<i>Parasecia chara</i> (Wharton, 1948)	Peru	Wharton, 1948 Brennan and Jones, 1961
<i>Parasecia fundata</i> Brennan, 1969	Brazil	Brennan, 1969
	Costa Rica	Stekolnikov <i>et al.</i> , 2007
<i>Parasecia gurneyi</i> (Ewing, 1937)	Canada	Johnston and DeGiusti, 1961
	Mexico	Loomis, 1969
	USA	Ewing, 1937 Ewing, 1943 Loomis, 1955 Loomis and Crossley, 1963 Wrenn, 1974 Dood and Kurta, 1988 Wilson and Durden, 2003 Reeves, Durden and Wrenn, 2004 Walters <i>et al.</i> , 2011
<i>Parasecia kansasensis</i> (Loomis, 1955)	Mexico	Loomis, 1956
	USA	Loomis, 1955
<i>Parasecia lasiurus</i> Goff & Gettinger 1991	Brazil	Goff and Gettinger, 1991
<i>Parasecia longicalcar</i> (Brennan & Jones, 1960)	Guyana	Brennan, 1969
	Panama	Brennan and Yunker, 1966
	Surinam	Brennan and Bronswijk, 1975
	Trinidad	Brennan and Jones, 1960 Brennan, 1967
	Venezuela	Brennan and Reed, 1975

Table 1. (Continued)

Species	Distribution	References
<i>Parasecia manueli</i> (Brennan & Jones, 1960)	Colombia	Brennan, 1968
	Cuba	Daniel and Stekolnikov, 2003
	Peru	Brennan and Jones, 1961
	Surinam	Brennan and Lukoschus, 1971;
		Brennan and Bronswijk, 1975
	Trinidad	Brennan and Jones, 1960
	Venezuela	Brennan and Reed, 1975
<i>Parasecia molini</i> Stekolnikov et al., 2015	Chile	Stekolnikov et al., 2015
<i>Parasecia orphana</i> Brennan 1971	Brazil	Brennan, 1971
<i>Parasecia palmigera</i> (Fauran 1960)	French Guiana	Fauran, 1960
	Surinam	Brennan, 1970a
		Brennan and Bronswijk, 1975
<i>Parasecia psittaci</i> (Floch & Abonnenc, 1949)	French Guiana	Floch and Abonnenc, 1949
	Trinidad	Brennan and Jones, 1960
	Venezuela	Brennan and Reed, 1975
<i>Parasecia soucouyanti</i> (Brennan & Yunker, 1966)	Panama	Brennan and Yunker, 1966
	Venezuela	Brennan and Reed, 1975
<i>Parasecia thalurania</i> Brennan, 1969	Brazil	Brennan, 1969
<i>Parasecia valida</i> Brennan 1969	Brazil	Brennan, 1969
	Surinam	Brennan and Lukoschus, 1971

6.2. Material and Methods

Thirteen species (types and material) of Nearctic and Neotropical regions were found housed in the studied collections: National Museum of Natural History (NMNH, now USNM) Smithsonian Acari Collection, which is housed at the Systematic Entomology Laboratory (BARC-USDA-ARS) and South Australian Museum (SAM). Other collections were consulted in search of types: Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP); Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA

(BPBM); Sam Noble Oklahoma Museum of Natural History, Norman, Oklahoma, USA (OMNH); Snow Entomological Museum, University of Kansas, Kansas, USA (KU).

In addition, recent collections were made in the states of Minas Gerais and Rio de Janeiro, initially the specimens were stored in ethanol (100%). Later, they were slide-mounted in Hoyer's medium according to Walter and Krantz (2009) for identification. Some specimens were also prepared for Scanning Electron Microscopy (SEM) according to Krantz and Walter (2009) with a Digital Scanning Microscope FEI, Quanta 250, at the Laboratory of Cell Biology, Butantan Institute.

All the species were made and drawings using Leica DFC 500 digital camera coupled to the optical microscope Leica DM4000B. Extended focal range images were composed with Leica Application Suite version 2.5.0. The images were prepared with Adobe Photoshop v. 13.0, and Inkscape V. 2. For the new species here described, they were measured by using Leica DFC 500 digital camera coupled to the optical microscope Leica DM4000B. Extended focal range images were composed with Leica Application Suite version 2.5.0. All the measurements were made in micrometers (μm), followed by mean and standard deviation. The scanning electron micrographs (SEM) were obtained with a Digital Scanning Microscope FEI, Quanta 250, at the Laboratório de Biologia Celular, Instituto Butantan.

The redescrptions were made comparing with the original descriptions and for the diagnosis we followed the terminology proposed by Goff et al. (1982) with adaptations proposed by Stekolnikov (2008) and Stekolnikov and Daniel (2012), and for the specialized setae proposed by Bassini-Silva et al. (2017).

We standardize the redescrptions, adding the quantity of the setae of the legs, position of the setae in the coxae III, position of the microsetae in relation to solenidium

from the tarsus of leg I and II, and the presence or absence the striations in the coxae. The Table 2 is in the Appendix.

For host nomenclature, we used Remsen et al. (2015) for South American birds, and for northern and mid-american birds we used the checklist of The American Ornithologists Union (2015). The distribution maps of the species will be prepared by the DIVA-GIS 7.5 program.

Ethical approval

The animals were caught and manipulated in accordance with the recommendations of the Ethical Principles in Animal Experimentation adopted by the Brazilian College of Animal Experimentation (COBEA), and it was approved by the Ethics Committee on Animal Experimentation (CEEa) of the Dean of the Universidade Federal de Juiz de Fora, MG (UFJF) – n°042/2012

6.3. Results

After examining the types, additional material and the original description, we have below the list of species belonging to genus *Parasecia*, which fall under the diagnosis described below. These listed species, 16 species had been previously marked for the genus, two were taken from the genus *Parasecia* because they have characteristics that would fit in the genus, one that was previously in *Trombicula* was added to the *Parasecia* and three new species were described as follow. The morphometric data for *Parasecia* n. sp.1 are shown in the table 3. For the sample size, we have this data: AW, PW, SB, ASB, PSB, SD, P-PL, AP, AM, AL, PL, Dmin, Dmax, I II, III, IP, TaIII, TaW and ω I, n= 7; st2, Vmim, Vmax, n= 6; S and H, n= 4; 1a, n= 3.

Genus *Parasecia* Loomis, 1966

Fonsecia (*Parasecia*) Loomis, 1966: 191; Brennan, 1969: 662.

Fonsecia (*Euneocula*) Vercammen-Grandjean, 1967: 129.

Parasecia: Brennan and Reed, 1975: 48; Brennan and Goff, 1977: 561; Goff, 1992: 965; Hoffmann, 1990: 107; Stekolnikov and González-Acuña, 2015: 14.

Type species: *Trombicula gurneyi* Ewing, 1937

Diagnosis (Larvae): Seven setae on palpal tarsus, with ζ ; setae branched on palpal femur; odontus trifurcate; cheliceral blade with tricuspid cap; galealae branched or nude; eyes 2/2 on ocular plate (eyes 1/1 only on *P. kansasensis*); *scutum* retangular, with or not sinous anterior and posterior margins, $PL > AM > AL$; PLs intrascutal; one pair of humeral and two pair of sternals; seven-segmented; coxae unisetose not striate; empodium present and onychondrites absent; Leg I and II with subterminal eupathid; tarsus of the leg I with dorsal eupathid and ζ ; mastitarsala present or absent.

6.3.1. *Parasecia aitkeni* (Brennan & Jones, 1960)

Trombicula aitkeni Brennan and Jones, 1960: 510.

Fonsecia (*Parasecia*) *aitkeni*: Loomis, 1966: 191; Brennan, 1969: 664.

Fonsecia (*Euneocula*) *aitkeni*, Vercammen-Grandjean, 1967: 130.

Parasecia aitkeni: Brennan, 1970a: 811; Brennan and Lukoschus, 1971: 44; Brennan and Reed, 1975: 59; Brennan and Bronswijk, 1975: 246; Whitaker and Dietz, 1987; Goff, 1992: 967; Whitaker and Wrenn, 1993: 411.

Larva (Figure 1, Table 2)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with eight setae and the total of idiosomal setae about 70-74; trichobothria with two-thirds covered with long and slender setules; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae.

Redescription (Fig. 1). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, nude lateral and nude ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 1A and B). **Idiosoma** – eyes 2/2, same size, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 1C. Seventy to Seventy four idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 8 setae, 2nd row with 8 setae, 3rd row with 6 setae plus 16, 18 or 20 setae, totalizing 38, 40 or 42 dorsal setae, 2 pairs of sternal, and 8 or 9 preanals and 15, 19 or 20 postanals, totalizing 23, 24, 27 or 28 ventral setae (Fig. 1H and G, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not straited. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 1D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 1E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B (Fig. 1F).

Note. In the original description, holotype presents 60 total idiosomal setae, but we observed at least 10 setae more. There is variation in the idiosomal setae of paratypes

(**Table 2**). Moreover, the position of the microseta of tarsus I was described in the wrong place, since we observed this microseta in the proximal position.

Distribution (Fig. 2). BOLIVIA (Brennan, 1970a), BRAZIL (Whitaker and Dietz, 1987), SURINAM (Brennan and Lukoschus, 1971), TRINIDAD (Brennan and Jones, 1960; Brennan, 1969c) and VENEZUELA (Brennan and Reed, 1975).

Hosts. Mammals: *Saccopteryx bilineata* (**Chiroptera: Emballonuridae**); *Artibeus lituratus* (**Chiroptera: Phyllostomidae**); *Histiotus* sp. (**Chiroptera: Vespertilionidae**); *Marmosa* sp., *Marmosa robinsoni*, *Monodelphis domestica*, *Philander opossum* (**Didelphimorphia: Didelphidae**); *Culicus paca* (= *Agouti paca*) (**Rodentia: Cuniculidae**); *Calomys laucha tenor*, *Hylaeamys megacephalus* (= *Oryzomys capito*), *Nectomys squamipes*, *Rhipidomys venezuelae*, *Sigmodon hispidus*, *Sigmomys alstoni*, *Thalpomys lasiotis* (= *Akodon reinhardti*); (**Rodentia: Cricetidae**); *Dasyprocta variegata* (**Rodentia: Dasyproctidae**); *Echimys armatus*, *Proechimys semispinosus*, *Proechimys semivillosus* (**Rodentia: Echimyidae**); *Heteromys* sp. (**Rodentia: Heteromyidae**).

Type and material examined. HOLOTYPE: larva (RML 33628), Cumaca, Trinidad, 8-VI-1954, *Nectomys squamipes*. PARATYPE: 4 larvae (RML 33628), same data; 1 larva (RML 33633), same data; 1 larva (RML 33620), same locality and host, 2-VI-1954; 3 larvae (RML 33621), same data; 1 larva (RML 33623), same data; 4 larvae (RML 33626), same host and locality, 5-VI-1954. Material: BOLIVIA – 4 larvae (RML 50182), mouth of Baures River, Beni, 10-X-1964, *Hylaeamys megacephalus* (= *Oryzomys capito*); Dr. Richard G. Van Gelder coll. SURINAM – 1 larva (RML 55418), Coronie, 2-V-1970,

Philander opossum. TRINIDAD – 6 larva (RML 38263), Bush Bush Forest, Nariva Swamp, 24-IX-1961, *Marmosa* sp. T. H. G. Aitken coll.

6.3.2. *Parasecia argentinensis* Goff & Gettinger, 1995

Parasecia argentinensis Goff and Gettinger, 1995: 445.

Note. The type series was not examined. All collections (NMNH, BPBM, OMNH) that should included the holotype and paratype were consulted, but in none of them the typical series was found. We noticed that there is a misconception in the original description; we have seen that there is a pattern in the number of branched setae in the tarsus of the leg II (six branched setae), different from what was presented in the original description (eight branched setae). This fact is proven, since in the drawings of the original description the six branched setae of the species were presented.

Distribution (Fig. 3). ARGENTINA (Goff and Gettinger, 1995).

Host. Mammals: *Phyllotius xanthopygus* (Rodentia: Cricetidae).

6.3.3. *Parasecia campestris* (Loomis, 1955)

Trombicula gurneyi campestris Loomis, 1955: 258; Loomis, 1956: 1317; Brennan and Jones, 1959: 12.

Fonsecia (Parasecia) gurneyi campestris: Loomis, 1966: 191; Brennan, 1969: 665.

Fonsecia (Euneocula) campestris: Vercammen-Grandjean, 1967: 129.

Larva (Figure 4, Table 2)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven propably branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae and the third row of dorsal idiosomal setae with 2 setae and a total of idiosomal setae about 42-44; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Figure 1. Morphological details of *Parasecia aitkeni* (Paratype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 2. Geographical distribution of *Parasecia aitkeni*

Figure 3. Geographical distribution of *Parasecia argentinensis*

Redescription (Fig. 4). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, nude lateral and nude ventral tibial setae, respectively 7BS = probably 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 4A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate faint; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one half-moon shape evagination and anterior margin with two smooth invaginations both turned to the base of trichobothria, as Figure 4C. Forty two or Forty four idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 4 or 6 setae, totalizing 18 or 20 dorsal setae, 2 pairs of sternal, and 10 or 12 preanals and 6 or 8 postanals, totalizing 16 or 20 ventral setae (Fig. 4G na H, Table 2). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with a κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω (Fig. 4D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 4E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 4F).

Note. We observe that the odontus are trifurcated and the setae of the palpal genu are branched, differently seen by Loomis (1955) in the original description, which had seen the

odontus bifurcate and the setae nude on palpal genu. There is variation in the idiosomal setae (**Table 2**) not observed by the author.

Distribution (Fig. 5). USA (Loomiss, 1955).

Hosts. Reptiles: *Arizona elegans*, *Heterodon nasicus*, *Lampropeltis triangulum*, *Masticophis flagellum* (**Squamata: Colubridae**); *Heterodon platirhinos* (**Squamata: Dipsadidae**); *Plestiodon obsoletus* (= *Eumeces obsoletus*) (**Squamata: Scincidae**); *Crotalus viridis* (**Squamata: Viperidae**). **Birds:** *Melanerpes erythrocephalus* (**Piciformes: Picidae**); *Speotyto cunicularia* (**Strigiformes: Strigidae**). **Mammals:** *Sylvilagus floridanus* (**Lagomorpha: Leporidae**); *Neotoma micropus*, *Onychomys leucogaster*, *Peromyscus leucopus*, *Peromyscus maniculatus* (**Rodentia: Cricetidae**); *Chaetodipus hispidus* (= *Perognathus hispidus*), *Dipodomys ordii* (**Rodentia: Heteromyidae**); *Citellus tridecemlineatus*, *Cynomys ludovicianus* (**Rodentia: Sciuridae**).

Type and material examined. PARATYPE: 2 larvae (RL 490807-9), Rawlins County, Kansas, USA, 7-VIII-1949, *Citellus tridecemlineatus*; R. B. Loomis and Robert E. Elbel coll.

Figure 4. Morphological details of *Parasecia campestris* (Paratype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 5. Geographical distribution of *Parasecia campestris*

6.3.4. *Parasecia chara* (Wharton, 1948)

Trombicula chara Wharton, 1948: 98; Radford, 1954: 250; Brennan and Jones, 1961: 194.

Trombicula (Trombicula) chara: Wharton and Fuller, 1952: 63.

Fonsecia (Parasecia) chara: Loomis, 1966: 191; Brennan, 1969: 665.

Fonsecia (Euneocula) chara: Vercammen-Grandjean, 1967: 130.

Parasecia chara: Goff, 1992: 967.

Larva (Figure 6)

Diagnosis. Branched dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae branched, odontus trifurcated, and a subapical tooth in the outer region of the chelicera; the first row of dorsal idiosomal setae with 10 setae; genu with two solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Redescription (Fig. 6). **Gnathosoma** - palpal setal formula B/B/BBB/7BS, B = branched seta on the femur; B = branched seta on genu; BBB = branched dorsal lateral and ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the outer region of the chelicera; gnathobase punctate, galeala branched (Fig. 6A and B). **Idiosoma** – eyes 2/2,

same size, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 6C. Eight five idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 10 setae, 2nd row with 7 setae, 3rd row with 6 setae plus 15 setae, totalizing 38 dorsal setae, 2 pairs of sternal, and 20 preanals and 21 postanals, totalizing 41 ventral setae (Fig. 6H and G). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, .coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 2, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, z and subterminal eupathid, base of ϵ distal to base of ω (Fig. 6D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 6E). *Leg III* - coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 6F).

Note. *P. chara* was described with three σ in the leg I and mastitarsala in the leg III, and still no ocular plate and ζ in the palpal tarsus. After examining the types, It was observed that in fact, *P. chara* has ζ in the palpal tarsus, two σ in the leg I, ocular plate and has no mastitarsala in the leg III. In addition we observed a subapical tooth in the outer region of the chelicera and we not found six idiosomal setae, in the original description sad 91 setae, buta we observed 85 setae.

Distribution (Fig. 7). PERU (Wharton, 1948; Brennan and Jones, 1961).

Hosts. Mammals: *Auliscomys boliviensis* (= *Phyllotis boliviensis*), *Chinchillula sahamae*, *Neotomys ebriosus*, *Phyllotis osilae*, *Punomys lemminus* (**Rodentia: Cricetidae**); *Phyllotis darwini* (**Rodentia: Muridae**).

Type and material examined. PARATYPE: larva, Caccachara, 50 mi SW of Ilave, Peru, 5-X-1946, *Phyllotis darwini*, Pearson O. P. coll. Material: PERU – 3 larvae (RML 31546), Heda, Pairumani, Puno, 15-IV-1951, *Phyllotis osilae*; 7 larvae (RML 31547), 13 km SSW of Limbani, Puno; 22-IX-1951, *Chinchillula sahamae*; 8 larva (RML 31550), same locality and host, 11-VI-1951; 5 larvae (RML 31553), same locality and host, 19-VI-1951; 2 larvae (RML 31560), same locality and host, 12-VII-1951; 4 larvae (RML 31551), same data; 18 larvae (RML 31554), same locality, 14-VI-1951, *Neotomys ebriosus*; 2 larvae (RML 31558), same locality, 31-VIII-1951, *Punomys lemminus*;

New records.

PERU - 2 larvae (RT B-15352), Rio Santa Rosa, Puno (15°50'36"S, 70°01'25"W), 16-XII-1951, *Hesperomys* sp.; 2 larvae (RT B-15356), Tacna (18°0'36"S, 70°14'24"W), 28-I-1952, *Phyllotis darwini*.

Figure 6. Morphological details of *Parasecia chara* (Paratype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 7. Geographical distribution of *Parasecia chara*

6.3.5. *Parasecia dunni* (Ewing, 1931) *new combination*

Trombicula dunni Ewing, 1931: 12; Fuller, 1952: 99; Brennan and Jones, 1960: 515; Brennan and Jones, 1961: 195; Brennan and Yunker, 1966: 253; Brennan, 1968: 684; Brennan, 1970b: 811.

Eutrombicula dunni: Ewing, 1938: 294; Radford, 1942: 67.

Trombicula sensu lato dunni: Brennan and Bronswijk, 1975: 246; Brennan and Reed, 1975: 65.

Trombicula canis Floch and Abonnenc, 1941: 6 (syn. Brennan and Jones, 1960).

Trombicula landazuri Boshell and Kerr, 1942: 14 (syn. Brennan and Jones, 1960).

Trombicula (Trombicula) dunni: Wharton and Fuller, 1952: 65.

Trombicula (Trombicula) agutii Floch and F'auran, 1957: 5 (syn. Brennan and Yunker, 1966: 253).

Trombicula paragoga Brennan and Jones, 1960: 524 (syn. Brennan and Yunker, 1966: 253).

Larva (Figure 8)

Diagnosis. Nude dorsal and lateral setae and branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae; genu with two solenidia, tarsus of the leg I with 23 branched setae, tarsus of the leg II with 15 branched setae, tarsus of the leg III with 15 branched setae.

Redescription (Fig. 8). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral, and branched ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus;

odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 8A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one smooth half-moon shape evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 8C. Thirty six idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 4 setae, totalizing 18 dorsal setae, 2 pairs of sternal, and 8 preanals and 4 postanals, totalizing 12 ventral setae (Fig. 8G and H). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 2, with κ ; tibia 8B, Φ 2, with κ ; tarsus 23B, with ω , ϵ , dorsal eupathid, z and subterminal eupathid, base of ϵ distal to base of ω (Fig. 8D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 15B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 8E). *Leg III* – coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ ; tibia 6B, Φ ; tarsus 15B (Fig. 8F).

Note. This species has a total of 36 idiosomal setae, the variation occurs depending on the degree of engorgement of the specimen, as well as dorsal and ventral setae of the posterior region may mix.

Distribution (Fig. 9). BOLIVIA (Brennan, 1970b), COLOMBIA (Boshell and Kerr, 1942; Brennan, 1968), FRENCH GUIANA (Floch and Abonnenc, 1941, Floch and Fauran, 1957), PANAMA (Ewing, 1931, Brennan and Yunker, 1966), PERU (Brennan and Jones,

1961), SURINAM (Brennan and Bronswijk, 1975), TRINIDAD (Brennan and Jones, 1960) and VENEZUELA (Brennan and Reed, 1975).

Hosts. Birds: *Leptotila cassinii* (**Columbiformes: Columbidae**); *Neomorphus geoffroyi salvini* (**Cuculiformes: Cuculidae**); *Odontophorus erythrops* (**Galliformes: Odontophoridae**); *Microbates cinereiventris* (**Passeriformes: Polioptilidae**). **Mammals:** *Tayassu tajacu* (**Artiodactyla: Tayassuidae**); *Canis lupus familiaris* (**Carnivora: Canidae**); *Felis pardalis* (**Carnivora: Felidae**); *Nasua nasua*, *Nasua narica panamensis* (**Carnivora: Procyonidae**); *Vampyressa pusilla* (**Chiroptera: Phyllostomidae**); *Dasypus novemcinctus* (**Cingulata: Dasypodidae**); *Didelphis marsupialis*, *Marmosa fuscata*, *Marmosa robinsoni*, *Metachirus nudicaudatus*, *Philander opossum*, *Philander* sp. (**Didelphimorphia: Didelphidae**); *Sylvilagus brasiliensis* (**Lagomorpha: Leporidae**); *Homo sapiens* (**Primates: Hominidae**); *Aepeomys fuscatus* (= *Thomasomys fuscatus*), *Handleyomys alfaroi* (= *Oryzomys alfaroi*), *Holochilus brasiliensis*, *Hylaeamys megacephalus* (= *Oryzomys capito*), *Melanomys caliginosus* (= *Oryzomys caliginosus*), *Nectomys squamipes*, *Nephelomys albigularis* (= *Oryzomys albigularis*), *Nephelomys keaysi* (= *Oryzomys keaysi*), *Oecomys concolor* (= *Oryzomys concolor*), *Oligoryzomys fulvescens* (= *Oryzomys fulvescens*), *Peromyscus flavidus*, *Peromyscus mexicanus* (= *Peromyscus nudipes*), *Sigmodon hispidus*, *Sigmomys alstoni*, *Zygodontomys brevicauda microtinus* (**Rodentia: Cricetidae**); *Cuniculus paca* (**Rodentia: Cuniculidae**); *Dasyprocta aguti*, *Dasyprocta punctata*, *Dasyprocta punctata nuchalis* (**Rodentia: Dasyproctidae**); *Echimys armatus*, *Hoplomys gymnurus*, *Proechimys* sp., *Proechymis chrisaeolus*, *Proechimys semispinosus* (**Rodentia: Echimyidae**); *Heteromys australis*, *Heteromys desmarestianus* (**Rodentia: Heteromyidae**); *Microsciurus alfari*, *Sciurus granatensis* (**Rodentia: Sciuridae**); *Bradypus infuscatus* (**Pilosa: Bradypodidae**);

Type and material examined. LECTOTYPE: larva (USNM 1019), Chiriquí, Panama, 26-X-1929, *Dasyprocta punctata*, L. H. Dunn coll. PARALECTOTYPES: 7 larvae (USNM 1019), same data; 1 larva (RML 35166), same locality and host; 2 larvae (RML 35167), same locality, no date, *Nasua panamensis*, L. H. Dunn coll. Material: BOLIVIA – 1 larva (RML 50185), Department of Beni, 25-VI-1964, *Philander* sp. ; COLOMBIA – 7 larvae (RML 46976), Cali, 1-VIII-1965, *Handleyomys alfaroi* (= *Oryzomys alfaroi*); 1 larva (RML 47668), Santa Marta, 11-III-1967, *Nephelomys albigularis* (= *Oryzomys albigularis*), Trapido coll. PANAMA – 12 larvae (RML 40085), Piña, Canal Zone, 29-XII-1960, *Philander opossum*; 1 larva (RML 40081), same locality and date, *Proechimys guyannensis*; 12 larvae (RML 40046), same locality, 15-XII-1960, *Didelphis marsupialis*; 1 larva (RML 40047), same data; 14 larvae (RML 40050), same data; 10 larvae (RML 40052), same data; 15 larvae (RML 40053), same data; 1 larva (RML 35892), same locality and host, 12-I-1960; 7 larvae (RML 35908), same locality and host, 12-II-1960; 7 larvae (RML 40048), same locality and date, *Heteromys desmarestianus*; 4 larvae (RML 40128), same locality and host, 13-XII-1960, H. Keenan coll. 2 larvae (RML 35342), same locality, 2-III-1966, *Marmosa mitis*; 5 larvae (RML 35912), same locality and host, 17-III-1960; 9 larvae (RML 35913), same locality and host, 22-III-1960; 7 larvae (RML 40118), same locality, 7-XII-1960, *Transandinomys talamancae* (= *Oryzomys talamancae*); 6 larvae (RML 35328), same locality, 2-III-1960, *Proechimys semispinosus*; 2 larvae (RML 35331), same locality and host, 7-III-1956; 3 larvae (RML 44411), same locality and host, 9-II-1962; 3 larvae (RML 35299), same locality and host, 21-III-1952; 1 larva (RML 40657), same locality and host, 25-III-1960; 1 larva (RML 35335), same locality, 15-IX-1953, “opossum”; 2 larvae (RML 35229), Galeta Point, 23-II-1954, same host; 1 larva (RML 40016), Summit, Canal Zone, 7-XII-1960, same host, C. E. Yunker coll. 3 larvae (RML 43549), Canal Zone, 20-XII-1961, *Sigmodon hispidus*; 2 larvae (RML 35322), same

locality, 8-III-1955, *Proechimys semispinosus*; 8 larvae (RML 35281), same locality and host, 27-I-1955; 8 larvae (RML 35259), Fort Kobbe, Canal Zone, 13-I-1954, same host; 8 larvae (RML 35277), same locality and host, 25-I-1955; 5 larvae (RML 35264), same locality, 10-II-1954, “spiny rat”; 4 larvae (RML 35232), same locality, 10-III-1954, *Pygmy possum*; 1 larva (RML 35260), Fort Clayton, Canal Zone, 25-I-1954, *Sigmodon hispidus*; 2 larvae (RML 44485), Los Santos, 11-II-1962, *Peromyscus floridanus*; 5 larvae (RML 35839), Bocas del Toro, 24-I-1960, *Dasyprocta punctata*; 5 larvae (RML 35841), same locality, 26-I-1960, *Sciurus granatensis*; 1 larva (RML 35846), same locality and host, 9-II-1960; 3 larvae (RML 35914), same locality, 23-I-1960, *Philander opossum*; 1 larva (RML 40341), Cerro Pina, Provincia del Darien, 2-II-1961, *Neomorphus salvini*; 1 larva (RML 40499), Sulick, 2-III-1961, *Marmosa robinsoni*; 3 larvae (RML 35294), National Forest, Colón, 11-I-1955, *Proechimys semispinosus*; 5 larvae (RML 35255), same locality, 3-I-1955, *Didelphis marsupialis*; 1 larva (RML 35239), same locality, 20-IV-1955, *Sigmodon hispidus*; 19 larvae (RML 35266), same locality and host, 3-II-1955; 1 larva (RML 35301), same locality, 4-III-1955, *Marmosa mitis*; 15 larvae (RML 35283), same locality and host, 3-II-1955; 8 larvae (RML 35289), same locality and host, 3-II-1955; 1 larva (RML 35320), same locality and host, 4-III-1955; 1 larva (RML 35300), Fort Davis, 23-II-1955, *Proechimys semispinosus*; 5 larvae (RML 35272), no specify locality, 25-I-1954, same host; 12 larvae (RML 35303), Blue Mountain Beach, Panama city, 18-I-1956, “rat”; 6 larvae (RML 35311), Cerro azul, 21-II-1956, same host; 1 larva (RML 35312), same locality, 26-I-1956, *Oryzomys caliginosus*; 8 larvae (RML 35337), same locality, 15-II-1956, *Sigmodon hispidus*; 1 larva (RML 35921), Chiriqui, 3-II-1960, *Peromyscus nudipes*; 11 larvae (RML 35293), no specify locality, 25-I-1955, *Proechimys semispinosus*; 8 larvae (RML 35269), no specify locality, 26-I-1955, rat”, Field coll.; 5 larvae (RML 35282), no specify locality, 2-II-1955, *Marmosa mitis*; 5 larvae (RML 35285), no specify

locality, 1-II-1955, *Sigmodon hispidus*; Field coll.; 2 larvae (RML 35326), no specify locality, 10-III-1955, *Transandinomys talamancae* (= *Oryzomys talamancae*); 1 larva (RML 35238), no specify locality, 10-III-1954, *Pygmy possum*; 1 larva (RML 35340), no specify locality, 16-III-1955, *Philander opossum*; 1 larva (RML 35302), no specify locality and host, 17-III-1955; 2 larvae (RML 44450), no specify locality, 15-II-1960, “armadillo”, C. E. Yunker coll.; PERU – 1 larva (RML 39861), Department of Loreto, 10-XII-1946; 1 larva (RML 33551), Cuzco, 10-VIII-1953, *Nephelomys keaysi* (= *Oryzomys keaysi*).

6.3.6. *Parasecia fundata* Brennan, 1969

Fonsecia (Parasecia) fundata Brennan, 1969: 664.

Parasecia fundata: Goff, 1992: 967; Stekolnikov et al., 2007: 66.

Larva (Figure 10, Table 2)

Diagnosis. Nude dorsal and lateral setae and branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae and the total of idiosomal setae about 49-52; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Figure 8. Morphological details of *Parasecia dunni* (Lectotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 9. Geographical distribution of *Parasecia dunni*

Redescription (Fig. 10). **Gnathosoma** - palpal setal formula B/B/NNB/7B, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral, branched ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 10A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 10C. Forty nine to Fifty two idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae plus 9, 10, 12 or 16 setae, totalizing 21, 22, 24 or 28 dorsal setae, 2 pairs of sternal, and 10 or 12 preanals and 6, 12 or 14 postanals, totalizing 18, 22 or 24 ventral setae (Fig. 10G and H, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3,

with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ε , dorsal eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig. 10D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 10E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 10F).

Note. We observed a variation on the idiosomal setae (Table 2), differently described by Brennan (1969). He observed 48 idiosomal setae. In addition, the lateral setae of the palpal tarsus were described nude or branched, but in the keys of the *Parasecia* spp. (Brennan, 1969 and Goff, 1992) the lateral setae was cited as nude. After the exam of the types, we confirm that the setae are nude.

Distribution (Fig. 11). BRAZIL (Brennan 1969) and COSTA RICA (Stekonilkov et al., 2007).

Hosts. Birds: *Melanerpes pucherani* (**Piciformes: Picidae**); *Glyphorhynchus spirurus* (**Passeriformes: Dendrocolaptidae**); *Xiphorhynchus susurrans* (**Passeriformes: Furnariidae**). **Mammals:** *Caluromys philander*, *Didelphis marsupialis* (**Didelphimorphia: Didelphidae**); *Proechimys guyannensis* (**Rodentia: Echimyidae**).

Type and material examined. HOLOTYPE: larva (RML 49323), Utinga Forest, Belém, Pará, Brazil, 5-I-1968, *Caluromys philander*; PARATYPE: 6 larvae (RML 49323), same data; Material: BRAZIL – 1 larva (RML 49354), Serra do Navio, Amapá, 6-III-1968, *Proechimys guyannensis*; 9 larvae (RML 49373), Área de Pesquisa Ecológica do Guamá (APEG forest), Belém, Pará, 12-III-1968, *Glyphorhynchus spirurus*; 3 larvae (RML 50344),

same locality and host, 13-VI-1968; 9 larvae (RML 49098), Utinga Forest, Belém, Pará, 8-IV-1968, *Didelphis marsupialis*.

6.3.7. *Parasecia gurneyi* (Ewing, 1937)

Trombicula gurneyi Ewing, 1937: 169; Crossley, 1960: 261; Johnston and DeGiusti, 1961: 12; Loomis and Crossley, 1963: 379; Brennan and White, 1960: 350.

Trombicula gurneyi gurneyi: Loomis, 1955: 252; Loomis, 1956: 1312; Brennan and Jones, 1959: 12.

Eutrombicula gurneyi: Ewing, 1938: 294; Radford, 1942: 67.

Trombicula hamertoni Radford, 1942: 62; Radford, 1946: 589; Radford, 1947: 275; (*Syn.* Loomiss, 1955: 252).

Acariscus gurneyi: Ewing, 1943: 58.

Trombicula (Eutrombicula) gurneyi: Thor and Willmann, 1947: 291; Vercammen-Grandjean and Audy, 1965: 283.

Trombicula (Trombicula) gurneyi: Wharton and Fuller, 1952: 65; Fuller, 1952: 99.

Trombicula (Trombicula) hamertoni: Wharton and Fuller, 1952: 66; Fuller, 1952: 99.

Fonsecia (Parasecia) gurneyi: Loomis, 1966: 191; Brennan, 1969: 665.

Fonsecia gurneyi: Wrenn, 1974: 233.

Fonsecia (Euneocula) gurneyi: Vercammen-Grandjean, 1967: 129.

Fonsecia (Parasecia) gurneyi gurneyi Loomis: 1969: 9; Dohany and Cromroy, 1976: 186.

Parasecia gurneyi: Hoffmann, 1990: 108; Goff, 1992: 967; Whitaker and Wrenn, 1993: 409; Dood and Kurta, 1988: 116; Wilson and Durden, 2003: 1210; Reeves, Durden and Wrenn, 2004: 6; Walters *et al.*, 2011: 41.

Larva (Figure 12)

Diagnosis. Nude seta of palpal genu, nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae; genu with three solenidia, tarsus of the leg I with 22 branched setae, tarsus of the leg II with 14 branched setae, tarsus of the leg III with 14 branched setae.

Figure 10. Morphological details of *Parasecia fundata* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 11. Geographical distribution of *Parasecia fundata*

Description of Material (Fig. 12). **Gnathosoma** - palpal setal formula B/N/NNN/7BS, B = branched seta on the femur; N = nude seta on genu; NNN = nude dorsal, lateral and ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 12A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with one smooth invagination both turned to the base of trichobothria, as Figure 12C. Forty idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 4 setae plus 2 setae, totalizing 18 dorsal setae, 2 pairs of sternal, and 10 preanals and 6 postanals, totalizing 16 ventral setae (Fig. 12G and H). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with a κ ; tibia 8B, Φ

2, with κ ; tarsus 22B, with ω , ε , dorsal eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig. 12D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with σ ; tibia 6B, Φ 2; tarsus 14B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 12E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B (Fig. 12F).

Note. The type was not examined. In the NMNH that should include the holotype and paratypes were consulted, but none of the typical series was found. Loomis (1955) made a redescription for this species, and the comparison was based on it. The author states in his redescription that the species present 5BS, 20B in tarsus of leg I and 16B in tarsus of leg II, our observation was that this species has 7BS, 22B and 14B in legs I and II, respectively. There are still differences in the idiosomal setae. In the original description two setae were seen less on each side (18 dorsals setae and 16 ventrals setae). In addition, the odontus is trifurcated, differently from what was redescribed in the original description.

Distribution (Fig. 13). CANADA (Johnston and DeGiusti, 1961), MEXICO (Loomis, 1969) and USA (Ewing, 1937; Ewing, 1943; Loomis, 1955; Loomis and Crossley, 1963; Wrenn, 1974; Dood and Kurta, 1988; Wilson and Durden, 2003; Reeves, Durden and Wrenn, 2004; Walters et al., 2011).

Hosts. Reptiles: *Lampropeltis getula*, *Lampropeltis triangulum*, *Nerodia sipedon* (= *Natrix sipedon*), *Pantherophis guttatus* (= *Elaphe gutatta*), *Pantherophis obsoletus* (= *Elaphe obsoleta*), *Thamnophis sirtalis* (**Squamata: Colubridae**); *Coleonyx brevis* (**Squamata: Gekkonidae**); *Sceloporus undulatus*, *Urosaurus ornatus* (= *Uta ornata*) (**Squamata: Phrynosomatidae**); *Plestiodon fasciatus* (= *Eumeces fasciatus*), *Plestiodon inexpectatus*

(=*Eumeces inexpectatus*), *Plestiodon laticeps* (= *Eumeces laticeps*) (**Squamata: Scincidae**), *Crotalus horridus*, *Crotalus viridis* (**Squamata: Viperidae**). **Birds:** *Ortalis vetula* (**Galliformes: Cracidae**); *Toxostoma rufum* (**Passeriformes: Mimidae**), *Strix varia* (**Strigiformes: Strigidae**). **Mammals:** *Eptesicus fuscus*, *Nycticeius humeralis* (**Chiroptera: Vespertilionidae**); *Blarina brevicauda* (**Eulipotyphla: Soricidae**); *Neotoma floridana*, *Peromyscus eremicus*, *Peromyscus leucopus*, *Peromyscus maniculatus*, *Peromyscus yucatanicus*, *Sigmodon hispidus* (**Rodentia: Cricetidae**); *Dipodomys merriami*, *Heteromys gaumeri*, *Perognathus merriami* (**Rodentia: Heteromyidae**); *Otolyomys phyllotis* (**Rodentia: Muridae**); *Ammospermophilus interpres*, *Cynomys ludovicianus*, *Sciurus niger*, *Sciurus carolinensis*, *Xerospermophilus spilosoma* (= *Spermophilus spilosoma*) (**Rodentia: Sciuridae**); *Scalopus aquaticus* (**Talpidae: Scalopinae**).

Material examined. Material: USA - 1 larva (RL 520630-6), Natural History Museum, University of Kansas, Douglas Count, Kansas, 20-VI-1952, *Plestiodon fasciatus*; 1 larva (RML 40472), Brownsville, Cameron Count, 20-VII-1960, *Peromyscus leucopus*; 1 larva (RML 40486), same locality and host, 2-XII-1960. R. B. Eads coll.; 2 larvae (RML 34952), Tuscaloosa Count, Alabama, 14-VIII-1956, *Nycticeius humeralis*;

Figure 12. Morphological details of *Parasecia gurneyi* (RL 520630-6). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 13. Geographical distribution of *Parasecia gurneyi*

6.3.8. *Parasecia kansasensis* (Loomis, 1955)

Trombicula kansasensis Loomis, 1955: 260; Loomis, 1956: 1319; Brennan and Jones, 1959: 12; Crossley, 1960: 262.

Trombicula (Eutrombicula) kansasensis: Vercammen-Grandjean and Audy, 1965: 283.

Fonsecia (Parasecia) kansasensis: Loomis, 1966: 191; Brennan, 1969: 665.

Fonsecia (Euneocula) kansasensis: Vercammen-Grandjean, 1967: 129.

Parasecia kansasensis: Loomis and Wrenn, 1984: 155; Hoffmann, 1990: 109; Goff, 1992: 967.

Note. The type series was not examined. In the KU that should include the holotype and paratypes were consulted, but it was not found.

Distribution (Fig. 14). MEXICO (Loomis, 1956) and USA (Loomis, 1955).

Hosts. Reptiles: *Coluber constrictor*, *Pituophis catenifer*, *Thamnophis sirtalis* (Squamata: Colubridae); *Crotalus horridus* (Squamata: Viperidae). **Mammals:** *Neotoma micropus*, *Peromyscus leucopus*, *Peromyscus maniculatus* (Rodentia: Cricetidae).

Figure 14. Geographical distribution of *Parasecia kansasensis*

6.3.9. *Parasecia lasiurus* Goff & Gettinger, 1991

Parasecia lasiurus Goff and Gettinger, 1991: 401; Goff, 1992: 967

Note. The type series was not examined. All collections (MZUSP, USNM, BPBM, OMNH) that should include the holotype and paratypes were consulted, but in none of them the type series was found.

Distribution (Fig. 15). BRAZIL (Goff and Gettinger, 1991).

Hosts. Mammals: *Necomys lasiurus* (= *Bolomys lasiurus*), *Oxymycterus* sp. (**Rodentia: Cricetidae**).

Figure 15. Geographical distribution of *Parasecia lasiurus*

6.3.10. *Parasecia longicalcar* (Brennan & Jones, 1960)

Trombicula longicalcar Brennan and Jones, 1960: 517; Brennan and Yunker, 1966: 255; Brennan, 1967: 155.

Fonsecia (Parasecia) longicalcar: Loomis, 1966: 191; Brennan, 1969: 665.

Fonsecia (Euneocula) longicalcar: Vercammen-Grandjean, 1967: 130.

Parasecia longicalcar: Brennan and Bronswijk, 1975: 245; Brennan and Reed, 1975: 59; Goff, 1992: 967.

Larva (Figure 16, Table 2)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, length of the solenidium of the palpal tarsus twice the length of palpal tarsus, galealae setae nude, odontus trifurcated and a subapical tooth in the inner region of chelicera; the first row of dorsal idiosomal setae with 6 setae and the total of idiosomal setae about 50-53; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Redescription (Fig. 16). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, lateral and ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; length of ω twice the length of palpal tarsos; odontus trifurcate; cheliceral blade with tricuspid cap and a

subapical tooth in the inner region of chelicera; gnathobase punctate, galeala nude (Fig. 16A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 16C. Fifty to Fifty three idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae plus 12 or 15 setae, totalizing 24 or 27 dorsal setae, 2 pairs of sternal, and 8 or 10 preanals and 10 or 12 postanals, totalizing 18, 20 or 24 ventral setae (Fig. 16G and H, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω (Fig. 16D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 16E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 16F).

Note. There was a difference in the number of idiosomal setae. In addition, we observe a subapical tooth in the inner region of chelicerae.

Distribution (Fig. 17). GUYANA (Brennan, 1969), PANAMA (Brennan and Yunker, 1966), SURINAM (Brennan and Bronswijk, 1975), TRINIDAD (Brennan and Jones, 1960; Brennan, 1967), VENEZUELA (Brennan and Reed, 1975).

Hosts. Reptiles: *Leptophis ahaetulla*, *Pseustes sulphureus* (**Squamata: Dipsadidae**). **Birds:** *Amazona amazonica* (**Psittaciformes: Psittacidae**). **Mammals:** *Artibeus lituratus*, *Desmodus rotundus*, *Phyllostomus hastatus*, *Vampyrum spectrum* (**Chiroptera: Phyllostomidae**); *Saccopteryx bilineata* (**Chiroptera: Emballonuridae**); *Myotis nigricans* (**Chiroptera: Vespertilionidae**); *Didelphis marsupialis* (**Didelphimorphia: Didelphidae**); *Rhipidomys Venezuela*, *Zygodontomys brevicauda* (**Rodentia: Cricetidae**); *Proechimys semispinosus* (**Rodentia: Echimyidae**); *Coendou rothschildi* (**Rodentia: Erethizontidae**); *Sciurus granatensis* (**Rodentia: Sciuridae**).

Type and material examined. HOLOTYPE: larva (RML 33916), Melajo Forest, Trinidad, 24-IV-1956, *Amazona amazonica*; PARATYPES: 5 larvae (RML 33802), Melajo Forest, Trinidad, 6-III-1956, *Amazona amazonica*; 4 larvae (RML 33916), same locality and host, 24-IV-1956; 1 larva (RML 34144), Rio Grande Forest, Tinidad, 16-VII-1956, *Pseustes sulphureus*; 7 larvae (RML 34171), Melajo Forest, Trinidad, 08-X-1956, *Sciurus granatensis*; 2 larvae (RML 34685), Tabaquite Road, Trinidad, 18-III-1956, *Desmodus rotundus*; 2 larvae (RML 34776), La brea, Trinidad, 14-IV-1958, same host. Material: GUYANA – 4 larvae (RML 39055), Bartica, 24-X-1963, *Artibeus lituratus*, J. N. Davis coll. PANAMA - 3 larvae (RML 43751), Río Changena, Bocas del Toro, 23-IX-1961, *Vampyrum spectrum*; 4 larvae (RML 44295), Summit, Canal Zone, 23-I-1962, *Didelphis marsupialis*; 7 larva (RML 44506), Las Palmitas, Los Santos, 27-I-962, *Desmodus rotundus*; 9 larvae (RML 44496) Pedro Miguel River, Canal Zone, 21-II-1962, *Coendou rothschildi*; 5 larvae (RML 44512-2), same locality and host, 28-II-1962; Thomas H. G. Aitken coll. VENEZUELA – 7 larvae (RML 48355), 19 km NW Urama, Yaracuy, 12-XI-1965, *Proechimys semispinosus*; 2 larvae (RML 48454), same locality, 8-XI-1965, *Saccopteryx bilineata*; 3 larvae (RML 48341), Puerto Tuy, 6 km SSE Rio Chico, Miranda,

15-XI-1966, same host; 4 larvae (RML 53274), Hacienda Socopito, 20 km S 98 km E Maracaibo, Falcon, 20-V-1968, *Zygodontomys brevicauda*; 2 larvae (RML 53395), same locality and host, 22-V-1968; 2 larvae (RML 53405), same locality and host, 28-V-1968; 1 larva (RML 53396), same locality, 22-V-1968, *Rhipidomys venezuelae*, Smithsonian Army coll.

New Records

VENEZUELA - 9 larva (RML 55947), Apure (7°54'0"N, 67°28'0"W), 22-I-1968, *Mimon crenulatum*.

6.3.11. *Parasecia manuely* (Brennan & Jones, 1960)

Trombicula manuely Brennan and Jones, 1960: 520; Brennan and Jones, 1961: 197; Brennan and Yunker, 1966: 255.

Fonsecia (Parasecia) manuely: Loomis, 1966: 191; Brennan, 1968: 684; Brennan, 1969: 666.

Fonsecia (Euneocula) manuely: Vercammen-Grandjean, 1967: 130.

Parasecia manuely: Brennan and Lukoschus, 1971: 44; Brennan and Reed, 1975: 59; Brennan and Bronswijk, 1975: 246; Goff, 1992: 967; Whitaker and Wrenn, 1993: 410; Daniel and Stekonilkov, 2003: 149.

Larva (Figure 18)

Diagnosis. Nude dorsal and lateral setae, and branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae and the third row of dorsal idiosomal setae with 2 setae and a total of idiosomal setae about 41; genu with three solenidia, tarsus of the leg I with 22 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae.

Figure 16. Morphological details of *Parasecia longicalcar* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 17. Geographical distribution of *Parasecia longicalcar*

Redescription (Fig. 18). Gnathosoma - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; N = nude seta on genu; NNN = nude dorsal, lateral and ventral tibial setae, respectively 7BS = seven branched with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Figs. 18A and B). Idiosoma – eyes 2/2, on a ocular plate; 1 pair of AL, 1 pair of PL and a single AM seta; PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evagination and anterior margin with two invaginations both turned to the base of trichobothria (Figs. 18C). Forty one idiosomal setae, including 1 pair of humeral, 1st row of dorsal idisomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 6 setae, totalizing 20 dorsal setae, 2 pairs of sternal, and 9 preanals and 6 postanals, totalizing 15 ventral setae (Figs. 18G and H). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. Leg I - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 22B, with ω , ϵ , dorsal

eupathid, z and subterminal eupathid, base of ε distal to base of ω (Fig. 18D). Leg II - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 18E). Leg III – coxa 1B on anterior margin, trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B (Fig. 18F).

Note. We found a total number of setae almost similar to the original description, differing only in the ventral number of setae. Brennan and Jones (1960) observed 14 setae, while we observed 15. In the paratype, the trichobothria is not present, but observing other material and comparing with the original description, we believe that there is one pair of flagelliform trichobothria, two-thirds covered with long and slender setules.

Distribution (Fig. 19). BRAZIL (present study), COLOMBIA (Brennan, 1968), CUBA (Daniel and Stekonilov, 2003), PANAMA (Brennan and Yunker, 1966), PERU (Brennan and Jones, 1961), SURINAM (Brennan and Lukoschus, 1971; Brennan and Bronswijk, 1975), TRINIDAD (Brennan and Jones, 1960) and VENEZUELA (Brennan and Reed, 1975).

Hosts. Reptiles: *Gonatodes vittatus* (Sauria: Sphaerodactylidae); *Liophis reginae* (= *Leimadophis reginae*) (Squamata: Colubridae). **Birds:** *Dendrocincla fuliginosa* (Passeriformes: Furnariidae); *Tolmomyias flaviventris* (Passeriformes: Rhynchocyclidae); *Cyanerpes caeruleus* (Passeriformes: Thraupidae); *Megarynchus pitangua*, *Myiarchus tuberculifer* (Passeriformes: Tyrannidae); *Colaptes rubiginosus* (= *Piculus rubiginosus*), *Phloeceastes melanoleucus* (= *Campephilus melanoleucus*), *Veniliornis kirkii* (Piciformes: Picidae). **Mammals:** *Molossus* sp., *Neoplatymops*

matogrossensis (**Chiroptera: Molossidae**); *Pteronotus macleayii* (**Chiroptera: Mormoopidae**); *Carollia perspicillata*, *Erophylla sezekorni*, *Mimon crenulatum* (**Chiroptera: Phyllostomidae**); *Didelphis marsupialis*, *Marmosa robinsoni* (= *Marmosa mitis*), *Philander opossum* (**Didelphimorphia: Didelphidae**); *Hylaeamys laticeps* (= *Oryzomys laticeps*), *Necomys urichi* (= *Akodon urichi*), *Nectomys squamipes*, *Nephelomys albigularis* (= *Oryzomys albigularis*), *Nephelomys keaysi* (= *Oryzomys keaysi*), *Sigmomys alstoni*, *Rhipidomys leucodactylus*, *Zygodontomys brevicauda* (**Rodentia: Cricetidae**); *Cuniculus paca* (= *Agouti paca*) (**Rodentia: Cuniculidae**); *Echimys armatus*, *Proechimys guyannensis*, *Proechimys semispinosus* (**Rodentia: Echimyidae**); *Heteromys anomalus* (**Rodentia: Heteromyidae**); *Rattus rattus* (**Rodentia: Muridae**); *Sciurus granatensis* (**Rodentia: Sciuridae**).

Type and material examined. PARATYPE: larva (RML 33783), Maingot Estate, Trinidad, 9-IV-1956, *Zygodontomys brevicauda*. Material: VENEZUELA – 2 larvae (RML 48155), Carabobo, 10km NW Urama, 11-III-1966, 1 larva (RML 48460), same locality and host, 15-III-1966; 1 larva (RML 48477), same locality and host, 21-III-1966; 1 larva (RML 53651), Amazonas, Tamatana, 14-V-1967, *Rhipidomys* sp. Smithsonian Army coll.

New records

BRAZIL – 6 larvae (RML 50354), Utinga Forest, Belém, Pará (1°25'22.94"S, 48°25'34.7"W), 1-XI-1968, *Nectomys squamipes*; 6 larvae (RML 50355), same locality and host, 10-XI-1968.

Figure 18. Morphological details of *Parasecia manuely* (Paratype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 19. Geographical distribution of *Parasecia manuela*

6.3.12. *Parasecia molini* Stekolnikov & González-Acuña, 2015

Parasecia molini Stekolnikov and González-Acuña, 2015: 15.

Note. The types were not examined yet.

Distribution (Fig. 20). CHILE (Stekolnikov and González-Acuña, 2015).

Hosts. Reptiles: *Liolaemus chillanensis*, *Phymaturus palluma* (= *Phymaturus flagellifer*)
(Squamata: Liolaemidae).

Figure 20. Geographical distribution of *Parasecia molini*

6.3.13. *Parasecia orphana* Brennan, 1971

Parasecia orphana Brennan, 1971: 212; Goff, 1992: 967.

Larva (Figure 21, Table 2)

Diagnosis. Nude dorsal and lateral setae and branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae; genu with two solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae with mastitarsala.

Redescription (Fig. 21). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal, nude lateral and branched ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 21A and B). **Idiosoma** – small eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL = AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with one evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 10C. Thirty seven or Thirty eight idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 4 setae, totalizing 18 dorsal setae, 2 pairs of sternal, and 8 or 9 preanals and 4 or 6 postanals, totalizing 13 or 14 ventral setae (Fig. 10G and H, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 2, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal

eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig 10D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 10E). *Leg III* - coxa 1B in the middle; trochanter 1B; basifemur 2B; telofemur 3B; genu 4B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala present (Fig. 10F).

Note. All the paratypes present a pattern for both, dorsal and ventral setae; the holotype has the only with one less seta, and we think that this is not a variation.

Distribution (Fig. 22). BRAZIL (Brennan, 1971).

Host. *Proechimys guyannensis* (Rodentia: Echimyidae).

Type examined. HOLOTYPE: larva (RML 50351), Área de Pesquisa Ecológica do Guamá (APEG Forest), Belém, Pará, Brazil, 11-IX-1968, *Proechimys guyannensis*; PARATYPES: 4 larvae (RML 50351), same data. Thomas H. G. Aitken coll.

6.3.14. *Parasecia psittaci* Floch & Abonnenc, 1949

Trombicula psittaci Floch and Abonnenc, 1949: 1; Radford, 1954: 250; Fauran, 1960: 17; Brennan and Jones, 1960: 528;

Trombicula (Trombicula) psittaci: Wharton and Fuller, 1952: 69

Fonsecia (Euneocula) psittaci: Vercammen-Grandjean, 1967: 130;

Fonsecia (Parasecia) psittaci: Loomis, 1966: 191; Brennan, 1969: 666;

Parasecia psittaci: Brennan and Reed, 1975: 59; Goff, 1992: 967

Larva (Figure 23, Table 2)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated and a subapical tooth in the inner region of the chelicera; the first row of dorsal idiosomal setae with 10 setae; genu with

three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae with two mastitarsala.

Figure 21. Morphological details of *Parasecia orphana* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 22. Geographical distribution of *Parasecia oprhana*

Redescription (Fig. 23). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, nude lateral and nude ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of the chelicera; gnathobase punctate, galeala nude (Fig. 23A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 23C. Seventy six or Eight two idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 10 setae, 2nd row with 10 setae, 3rd row with 10 setae plus 16 or 20 setae, totalizing 46 or 50 dorsal setae, 2 pairs of sternal, and 8 or 10 preanals and 10 or 22 postanals, totalizing 20 or 30 ventral setae (Fig. 23G and H, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium,

onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with a ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω (Fig. 23D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, with σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 23E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala 2 (Fig. 23F).

Note. We examined the type and material, and we noticed that there is ζ in the palpal tarsus and a subapical tooth in the inner region of the chelicerae, not described by Floch and Abonnenc (1949). And in all the tarsus of the legs, we observed difference of the number of setae, since the other species present a certain pattern. In the original description it was seen that in the tarsus of the leg I there was 18B, in the tarsus of leg II there were 15B, in the tarsus of leg III there were 10B. However we observed that, in fact, there are 21B, 16B, 14B, respectively. The authors cited 34 to 38 ventral and 46 dorsal setae, while we observed 20 ventral and 50 dorsal setae, resulting in 12 extra idiosomal setae.

Distribution (Fig 24). FRENCH GUIANA (Floch and abonnenc, 1949; Fauran, 1960), TRINIDAD (Brennan and Jones, 1960) and VENEZUELA (Brennan and Reed, 1975).

Hosts. Birds: *Amazona amazonica* (**Psittaciformes: Psittacidae**); *Selenidera* sp. (**Piciformes: Ramphastidae**). **Mammals:** *Homo sapiens* (**Primates: Hominidae**); *Dasyprocta aguti* (**Rodentia: Dasyproctidae**).

Type and material examined. HOLOTYPE: larva (n° 357), no locality specify, French Guiana, 20-V-1948, “Perroquet”. Material: TRINIDAD – 24 larvae (RML 34185), Biche,

20-I-1957, *Amazona amazonica*; 8 larva (RML 38238), Bush Bush Forest, Nariva Swamp,
5-V-1961, same host.

Figure 23. Morphological details of *Parasecia psittaci* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 24. Geographical distribution of *Parasecia psittaci*

6.3.15. *Parasecia soucouyanti* (Brennan & Yunker, 1966)

Trombicula soucouyanti Brennan and Yunker, 1966: 256.

Fonsecia (Parasecia) soucouyanti: Brennan, 1969: 666.

Parasecia soucouyanti Brennan and Reed, 1975: 59; Goff, 1992: 967.

Larva (Figure 25, Table 2)

Diagnosis. Nude lateral setae, dorsal and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae with mastitarsala.

Redescription (Fig. 25). **Gnathosoma** - palpal setal formula B/B/BNB/7BS, B = branched seta on the femur; B = branched seta on genu; BNB = branched dorsal, nude lateral and branched ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 25A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved

inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 25C. Forty seven idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 6 setae, totalizing 20 dorsal setae, 2 pairs of sternal, and 15 preanals and 6 postanals, totalizing 21 ventral setae (Fig. 25G and H, Table 2). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ε , dorsal eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig. 25D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 25E). *Leg III* - coxa 1B, on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala present (Fig. 25F).

Note. Differences in the total number of idiosomal setae were observed. In the original description, it was mentioned 48 to 56 setae, while we observed 46 to 49 setae (Table 2).

Distribution (Fig 26). PANAMA (Brennan and Yunker, 1966) and VENEZUELA (Brennan and Reed, 1975).

Hosts. Mammals: *Sturnira ludovici* (Chiroptera: Phyllostomidae); *Myotis* sp. (Chiroptera: Vespertilionidae); *Rhipidomys venustus* (Rodentia: Cricetidae).

Type and material examined. HOLOTYPE: larva (RML 40711), Cerro Punta, Chiriquí, Panamá, 24-IV-1961, *Sturnira ludouzi*; PARATYPES: 5 larvae (RML 40711), same data.

C. E. Yunker coll. Material: PANAMA - 2 larvae (RML 40915), Cerro Punta, Chiriquí, 5-V-1961, *Myotis* sp. C. E. Yunker coll. VENEZUELA - 2 larvae (RML 48764), 5 km NNE Caracas (Pico Avila), 8-IX-1965, *Rhipidomys venustus*. Sm./Army coll.

Figure 25. Morphological details of *Parasecia soucouyanti* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 26. Geographical distribution of *Parasecia soucouyanti*

6.3.16. *Parasecia thalurania* Brennan, 1969

Fonsecia (Parasecia) thalurania Brennan, 1969: 663.

Parasecia thalurania: Goff, 1992: 967.

Larva (Figure 27)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated and a subapical tooth in the inner region of chelicera; the first row of dorsal idiosomal setae with 8 setae and the total of idiosomal setae about 110; genu with three solenidia, tarsus of the leg I with 22 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Redescription (Fig. 27). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, nude lateral and nude ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap and a subapical tooth in the inner region of chelicera; gnathobase punctate; gnathobase punctate, galeala nude (Fig. 27A and B).

Idiosoma – eyes 2/2, anterior larger with ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 27C. One hundred and ten idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 8 setae, 2nd row with 10 setae, 3rd row with 8 setae plus 28 setae, totalizing 54 dorsal setae, 2 pairs of sternal, and 10 preanals and 40 postanals, totalizing 50 ventral setae (Fig. 27G and H). **Legs** - seven-segmented, femur divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 22B, with ω , ε , dorsal eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig. 27D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 27E). *Leg III* - coxa 1B in the middle; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 27F).

Note. The difference between what was described by Brennan (1969) and in the present redescription is only the arrangement of dorsal and ventral setae. The first dorsal three rows show a pattern in all specimens, but there is not a pattern to the other rows. In addition, we observed that this species has a subapical tooth in the inner region of chelicerae.

Distribution (Fig. 28). BRAZIL (Brennan, 1969).

Hosts. Birds: *Thalurania furcata* (Apodiformes: Trochilidae); *Glyphorynchus spirurus* (Passeriformes: Dendrocolaptidae).

Type and material examined. HOLOTYPE: larva (RML 49374), Mocambo Forest, Belém, Pará, Brazil, 15-IV-1968, *Thalurania furcata*;

New Records

BRAZIL – 2 larvae (RML 50343), Mocambo Forest, Belém, Pará (1°28'7S, 48°27'W), 24-V-1968, *Glyphorynchus spirurus*; 7 larvae (RML 50344), Área de Pesquisa Ecológica do Guamá (APEG forest), Belém, Pará (1°25'22.94"S, 48°25'34.7"W), 13-VI-1968, same host. Thomas H. G. Aitken coll.

6.3.17. *Parasecia valida* Brennan, 1969

Fonsecia (*Parasecia*) *valida* Brennan, 1969: 663.

Parasecia valida: Brennan and Lukoschus, 1971: 44; Brennan and Bronswijk, 1975: 246; Goff, 1992: 967.

Larva (Figure 29, Table 2)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae, genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 14 branched setae, tarsus of the leg III with 14 branched setae with mastitarsala.

Figure 27. Morphological details of *Parasecia thalurania* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 28. Geographical distribution of *Parasecia thalurania*

Redescription (Fig. 29). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, lateral and ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 29A and B). **Idiosoma** – eyes 2/2, same size, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, two-thirds covered with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 29C. Forty two, Forty three, Forty four or Forty six idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 4 or 6 setae, totalizing 18 or 20 dorsal setae, 2 pairs of sternal, and 10, 11 or 12 preanals and 6, 7, 8, 9 or 12 postanals, totalizing 17, 18, 19, 20 or 22 ventral setae (Fig. 29G and H). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ;

tarsus 21B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω (Fig. 29D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 14B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Fig. 29E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B, mastitarsala present (Fig. 29F).

Note. The author only reported that there were 42 idiosomal setae, and did not comment that there could be a variation of the number of total idiosomal setae in the type series. Here we are showing this variation (Table 2).

Distribution (Fig. 30). BRAZIL (Brennan, 1969) and SURINAM (Brennan and Lukoschus, 1971).

Hosts. Mammals: *Monodelphis brevicaudata* (**Didelphimorphia: Didelphidae**); *Proechimys guyannensis* (**Rodentia: Echimyidae**); *Hylaeamys megacephalus* (= *Oryzomys capito*), *Necromys lasiurus* (= *Zygodontomys lasiurus fuscinus*) (**Rodentia: Cricetidae**).

Type and material examined. HOLOTYPE: larva (RML 49092), Jandiai, Caratateua, Bragança, Belém, Pará, Brazil, 1-IV-1968, *Hylaeamys megacephalus* (= *Oryzomys capito*); PARATYPE: 8 larvae (RML 49092), same data. Material: BRAZIL – 1 larva (RML 49364), Jandiai, Caratateua, Bragança, Belém, Pará, 15-III-1968, *Zygodontomys lasiurus fuscinus*; 5 larvae (RML 49370), same locality and host, 23-III-1968; 1 larva (RML 49372), Serra do Navio, Amapá, 23-III-1968, *Monodelphis brevicaudata*. Thomas H. G. Aitken coll.

Figure 29. Morphological details of *Parasecia valida* (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; MTa: mastitarsala seta; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 30. Geographical distribution of *Parasecia valida*

6.3.18. *Parasecia* n. sp.1 Bassini-Silva & Jacinavicius

Larva (Figure 31 and 32, Table 3)

Diagnosis. Nude dorsal and lateral setae, branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae and the total of idiosomal setae about 48; trichobothria with two-thirds covered with long and slender setules, genu with three solenidia, tarsus of the leg I with 22 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 15 branched setae.

Description (Fig. 31 and 32). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral setae, and branched ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 31A and B; 32A). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of

flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with smooth one evagination and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 31C and 32B. Forty eight idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 8 setae, totalizing 22 dorsal setae, 2 pairs of sternal, and 9 preanals and 11 postanals, totalizing 22 ventral setae (Figs. 31G-H and 32D). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 22B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω (Fig. 31D and 32C). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ϵ , and subterminal eupathid, base of ϵ proximal to base of ω (Figs. 31E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 31F and 32E-F).

Type Data

HOLOTYPE: larva (IBSP 12326), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), Brasil, 24-V-2013, *Xiphorhynchus fuscus*; deposited in the Acari Collection of the Instituto Butantan
PARATYPES: 5 larvae (IBSP 12326), same data and 5 larvae, same data, deposited in the NMNH Smithsonian Acari Collection (Fig. 33).

Table 3. Standard measurements of *Parasecia* n. sp.1.

	AW	PW	SB	ASB	PSB	SD	P-PL	AP	AM	AL	PL	S	H	1a	2a	DMIN	DMAX	VMIN	VMAX	I	II	III	Ip	TaIII	TaW	ω I
Holotype	59	70	28	27	17	44	17	18	37	27	49	59	46	33	35	37	45	28	36	229	201	230	559	58	16	14
Paratypes	59	70	25	25	19	44	15	20	36	27	47	45	44	32	34	32	43	29	37	219	197	227	642	54	17	15
Minimum	56	68	24	21	17	40	12	16	33	24	44	44	41	29	30	31	40	27	35	192	175	206	591	49	15	14
Maximum	60	76	28	29	25	49	18	22	39	30	51	59	46	36	39	37	50	31	41	231	209	241	674	58	19	15
Mean	59	70	26	25	19	44	16	19	36	27	47	49	43	34	34	33	43	29	37	218	199	226	641	54	17	14
SD	1,4	2,7	1,3	2,5	2,5	2,4	1,8	1,7	2,0	1,7	1,9	5,8	1,8	2,6	2,9	1,9	3,2	1,3	2,2	12,1	9,7	10,1	29,5	2,8	1,1	0,5

Legend: AW = anterior width; PW = posterior width; SB = distance between sensillary bases; ASB = distance from sensillary bases to extreme anterior margin; PSB = distance from sensillary bases to extreme posterior margin; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance from anterolateral setal base to posterolateral setal base on one side; AM = anteromedial; AL = anterolateral setae; PL = posterolateral setae; S = trichobothria; H = humeral setae; 1a = anterior sternal setae; 2a = posterior sternal setae; DMIN = minimum length of dorsal idiosomal setae; DMAX = maximum length of dorsal idiosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae; I = length of Leg I; II = length of Leg I; III = length of Leg I; Ip = sum of leg lengths; TaIII = length of tarsus I; TaW = width of tarsus I; ω I = length of solenidium I.

Additional material. BRAZIL - 1 larva (IBSP 12328), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), 3-XII-2013, *Myiarchus ferox*; 2 larvae (IBSP 12330), same locality, 4-XII-2013, *Troglodytes musculus*; 2 larvae (IBSP 12337), same locality and host, 24-II-2014; 3 larvae (IBSP 12344B), same locality and host, 25-II-2014; 4 larvae (IBSP 12345B), same data; 3 larvae (IBSP 12369), same locality, 17-IV-2014, *Xiphorhynchus fuscus*; 2 larvae (IBSP 12373), same locality, 28-V-2014, *Sittasomus griseicapillus*; 2 larvae (IBSP 12334), Sítio Vista Alegre, Juiz de Fora, Minas Gerais, (21°43'50"S 43°21'44"W), 28-I-2014; 1 larva (IBSP 12374A), Fazenda Volta Grande, Santa Bárbara do Monte Verde, Estado de Minas Gerais, (21°57'32"S, 43°42'07"W), Brazil, 25-IX-2014, *Myiozetetes similis*, Ralph Maturano coll. 2 larvae (IBSP 12208), Paraty, Rio de Janeiro, (23°13'21"S, 44°42'50"W), 19-III-2015, *Dencrocincla turdina*, Luciano Lima coll (Fig. 33).

6.3.19. *Parasecia* n. sp.2 Bassini-Silva & Barros-Battesti

Larva (Figure 34 and 35, Table 4)

Diagnosis. Nude dorsal, lateral and ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 8 setae and the total of idiosomal setae about 48; trichobothria covered in the distal half with long and slender setules, genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 16 branched setae, tarsus of the leg III with 14 branched setae.

Figure 31. Morphological details of *Parasecia* n. sp.1 (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. scutum; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 32. Morphological details of *Parasecia* n. sp.1. A. tarsus and tibia of leg I; B. scutum; C. genu of leg I; D. dorsal idiosomal setae; E. coxa unisetose of leg III; F. leg III; The black arrows highlight the specialized setae of the segments of the legs I and III. Abreveviations: AL: anterolateral setae; AM: anteromedian seta; PL: posterolateral setae; S: trichobothria. The Scale bars: A and E 20µm, B 30µm, C 10µm, D 100µm, F 50µm.

Figure 33. Geographical distribution of *Parasecia* n. sp.1

Description (Fig. 34). **Gnathosoma** - palpal setal formula B/B/NNN/7BS, B = branched seta on the femur; B = branched seta on genu; NNN = nude dorsal, lateral and ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 34A and B). **Idiosoma** – eyes 2/2, same size, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, PL > AM > AL; 1 pair of flagelliform trichobothria, covered in the distal half with long and slender setules; the lateral margins curved inside the *scutum*, posterior margin with two evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 34C. Forty eight idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 8 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 6 setae, totalizing 22 dorsal setae, 2 pairs of sternal, and 8 preanals and 12 postanals, totalizing 22 ventral setae (Fig. 34G and H). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B,

σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ε , dorsal eupathid, ζ and subterminal eupathid, base of ε distal to base of ω (Fig. 34D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 16B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 34E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 14B (Fig. 34F).

Type Data

HOLOTYPE: larvae (IBSP 12349), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), 24-III-2014, *Xiphorhynchus fuscus*, Ralph Maturano coll. PARATYPE: 1 larva (IBSP 12349), same data (Fig. 35).

6.3.20. *Parasecia* n. sp.3 Bassini-Silva & Barros-Battesti

Larva (Figure 36)

Diagnosis. Nude dorsal and lateral setae and branched ventral palpal tibia setae, palpal tarsus with seven branched setae, galealae setae nude, odontus trifurcated; the first row of dorsal idiosomal setae with 6 setae and the total of idiosomal setae about 59; genu with three solenidia, tarsus of the leg I with 21 branched setae, tarsus of the leg II with 15 branched setae, tarsus of the leg III with 15 branched setae.

Table 4. Standard measurements of *Parasecia* n. sp.2.

	AW	PW	SB	ASB	PSB	SD	P-Pl	AP	AM	AL	PL	S	H	1a	2a	DMIN	DMAX	VMIN	VMAX	I	II	III	Ip	TaIII	TaW	ω I
Holotype	53	64	22	20	16	36	11	17	37	26	43	49	40	33	36	33	38	26	28	199	189	212	600	46	15	14
Paratype	53	65	21	21	15	36	12	18	36	25	44	51	39	33	37	32	39	26	29	200	190	211	599	46	16	15

Legend: AW = anterior width; PW = posterior width; SB = distance between sensillary bases; ASB = distance from sensillary bases to extreme anterior margin; PSB = distance from sensillary bases to extreme posterior margin; SD = ASB + PSB; P-PL = distance from posterolateral to extreme posterior margin; AP = distance from anterolateral setal base to posterolateral setal base on one side; AM = anteromedial; AL = anterolateral setae; PL = posterolateral setae; S = trichobothria; H = humeral setae; 1a = anterior sternal setae; 2a = posterior sternal setae; DMIN = minimum length of dorsal idiosomal setae; DMAX = maximum length of dorsal idiosomal setae; VMIN = minimum length of ventral idiosomal setae; VMAX = maximum length of ventral idiosomal setae; I = length of Leg I; II = length of Leg I; III = length of Leg I; Ip = sum of leg lengths; TaIII = length of tarsus I; TaW = width of tarsus I; ω I = length of solenidium I.

Figure 34. Morphological details of *Parasecia* n. sp.2 (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 35. Geographical distribution of *Parasecia* n. sp.2

Description (Fig. 36). **Gnathosoma** - palpal setal formula B/B/NNB/7BS, B = branched seta on the femur; B = branched seta on genu; NNB = nude dorsal and lateral, and branched ventral tibial setae, respectively 7BS = 7 branched setae with ω and ζ on tarsus; odontus trifurcate; cheliceral blade with tricuspid cap; gnathobase punctate, galeala nude (Fig. 36A and B). **Idiosoma** – eyes 2/2, anterior larger, on ocular plate; *scutum* with 1 pair of AL, 1 pair of PL and a single AM seta, **PL** > **AM** > **AL**; trichobothria unknown; the lateral margins curved inside the *scutum*, posterior margin with one evaginations and anterior margin with two invaginations both turned to the base of trichobothria, as Figure 36C. Fifty nine idiosomal setae, including 1 pair of humeral, 1st row of dorsal idiosomal setae with 6 setae, 2nd row with 6 setae, 3rd row with 2 setae plus 14 setae, totalizing 28 dorsal setae, 2 pairs of sternal, and 9 preanals and 16 postanals, totalizing 25 ventral setae (Fig. 36G and H). **Legs** - seven-segmented, the femur is divided in basifemur and telofemur, with a pair of claws and a clawlike empodium, onychotriches absent, coxae not striate. *Leg I* - coxa with 1 branched seta (1B); trochanter 1B; basifemur 1B; telofemur 5B; genu 4B, σ 3, with κ ; tibia 8B, Φ 2, with κ ; tarsus 21B, with ω , ϵ , dorsal eupathid, ζ and subterminal eupathid, base of ϵ distal to base of ω

(Fig. 36D). *Leg II* - coxa 1B; trochanter 1B; basifemur 2B; telofemur 4B; genu 3B, σ ; tibia 6B, Φ 2; tarsus 15B, with ω , ε , and subterminal eupathid, base of ε proximal to base of ω (Fig. 36E). *Leg III* - coxa 1B on anterior margin; trochanter 1B; basifemur 2B; telofemur 3B; genu 3B, σ , tibia 6B, Φ ; tarsus 15B (Fig. 36F).

Note. A specimen of a mixed type series was misidentified by Brennan and Jones (1960) and labelled as paratypes of *Parasecia manuely* (Brennan & Jones). However, after examination of the slides, we noticed that it is similar to the *Parasecia* n. sp.3

Type data

HOLOTYPE: larva (RML 35055), Vega de Oropouche, Trinidad, 30-IX-1958, *Thraupis palmarum* (Fig.. 37).

Figure 36. Morphological details of *Parasecia* n. sp.3 (Holotype). A. ventral view of palpal tarsus; B. dorsal view of gnathosoma; C. *scutum*; D. Leg I; E. Leg II; F. Leg III; G. dorsal view of idiosoma; H. ventral view of idiosoma. Black spots = ventral setae of the idiosoma; white spots = dorsal setae of the idiosoma. Symbols: ζ = eupathid of palpal tarsus; ω = solenidium of palpal tarsus; AL = anterolateral; PL = posterolateral; AM = anteromedial; S = trichobothria; σ = solenidia of the genu I, II and III; κ = microsetae on genu and tibia; Φ = solenidia of the tibia I, II and III; ω = solenidium I and II; ε = famulus I and II; ζ = dorsal eupathid I, subterminal eupathid of the legs I and II; z = companion seta of dorsal eupathid on the leg I; 1a = anterior sternal setae; 2a = posterior sternal setae. Scales: A-C 50 μm; G-H 100 μm.

Figure 37. Geographical distribution of *Parasecia* n. sp. 3

*Incertae sedis*¹

***Parasecia bulbocalcar* Goff, 1992**

Parasecia bulbocalcar Goff, 1992: 965

Distribution. Mexico (Goff, 1992)

Hosts. Mammals: *Sturnira ludovici* (Chiroptera: Phyllostomidae)

Type examined. HOLOTYPE: larva, San Pablo Hidalgo, Tlaltizapan, Morelos, Mexico, 11-V-1988, *Sturnira ludouzei*; PARATYPES: 10 larvae, same data; 3 larvae, same locality and host, 20-III-1989. A. Losoya coll.

***Parasecia palmigera* (Fauran, 1960)**

Trombicula palmigera Fauran, 1960: 12; Brennan, 1970: 36;

Trombicula (s. l.) *palmigera*: Brennan and Lukoschus, 1971: 45

Parasecia palmigera: Brennan and Bronswijk, 1975: 246; Goff, 1992: 967

¹*Incertae sedis*: is a Latin term used in Taxonomy to indicate the inability to establish the exact position of a taxon within the classification. "With uncertain position".

Distribution. FRENCH GUIANA (Fauran, 1960) and SURINAM (Brennan, 1970; Brennan and Bronswijk, 1975).

Hosts. Mammals: *Didelphis marsupialis*, *Philander opossum* (**Didelphimorphia: Didelphidae**); *Zygodontomys brevicauda microtinus* (**Rodentia: Cricetidae**); *Dasyprocta aguti* (**Rodentia: Dasyproctidae**); *Rattus frugivorus* (**Rodentia: Muridae**).

Type and material examined. PARATYPE: larva (A406), Montabo, French Guiana, 24-V-1960, *Dasyprocta aguti*. Material: SURINAM – 2 larvae (RML 48881), Mount Wilhelmina, Nickerie, X-1961, *Didelphis marsupialis*; 24 larvae (RML 58019), Lelydorp, 15-VII-1971, *Rattus frugivorus*; 27 larvae (RML 58020), same locality, 17-VII-1971, *Zygodontomys brevicauda microtinus*.

Keys of species to the Genus *Parasecia* Loomis, 1966

1. Mastitarsala present on leg III.....2
 - Mastitarsala absent on leg III7
2. With one mastitarsala.....3
 - With two martitasala.....*Parasecia psittaci* (Fig. 23)
3. 1st row of dorsal idisomal setae with 6 setae.....4
 - 1st row of dorsal idisomal setae with 8 setae.....*Parasecia argentinesis*²
4. Two σ on genu of Leg I.....5
 - Three σ on genu of Leg I.....6
5. Nude ventral seta of the palpal tibia.....*Parasecia lasiurus*³

² Goff, M. L., and D. Gettinger. 1995. New genus and six new species of chiggers (Acari: Trombiculidae and Leeuwenhoekiidae) collected from small mammals in Argentina. *Journal of Medical Entomology* 32: 444.

³ Goff, M. L., and D. Gettinger. 1991. Two new species of chiggers (Acari: Trombiculidae) from small mammals collected in Brazil. *Journal of Medical Entomology* 28: 403.

- Branched ventral seta of the palpal tibia.....*Parasecia orphana* (Fig. 21)
6. Nude dorsal seta of the palpal tibia.....*Parasecia valida* (Fig. 29)
- Branched dorsal seta of the palpal tibia.....*Parasecia soucouyanti* (Fig. 25)
7. 1st row of dorsal idiosomal setae with 8 or 10 setae.....8
- 1st row of dorsal idiosomal setae with 6 setae.....11
8. Dorsal, lateral and ventral palpal tibia setae are nude; 1st row of dorsal idiosomal setae with 8 setae.....9
- Dorsal, lateral and ventral palpal tibia setae are branched; 1st row of dorsal idiosomal setae with 10 setae.....*Parasecia chara* (Fig. 6)
9. Tarsus I with 21 branched setae and tarsus III with 14 branched setae, without subapical inner tooth in the cheliral blade and around 40 to 80 total idiosomal setae.....10
- Tarsus I with 22 branched setae and tarsus III with 15 branched setae, with subapical inner tooth in the cheliral blade and more than 100 total idiosomal setae.....*Parasecia thalurania* (Fig. 27)
10. Total of idiosomal setae about 70-74 and trichobothria with two-thirds covered with long and slender setules.....*Parasecia aitkeni* (Fig. 1)
- Total of idiosomal setae about 48 setae and the trichobothria covered in the distal half with long and slender setules.....*Parasecia* n sp.2 (Figs. 34 and 35)
11. Branched seta of the palpal genu.....12
- Nude seta of the palpal genu.....*Parasecia gurneyi* (Fig. 12)
12. Eyes 2/2 plus trifurcate odontus.....13
- Eyes 1/1 plus bifurcate odontus.....*Parasecia kansasensis*⁴
13. Three σ on genu of on Leg I.....14

⁴ Loomis, R. B. 1955. *Trombicula gurneyi* Ewing and two new related chigger mites (Acarina, Trombiculidae). Science Bulletin XXXVII: 267.

- Two σ on genu of on Leg I.....*Parasecia dunni* (Fig. 8)
14. Nude lateral and ventral seta of the palpal tibia.....15
- Nude lateral and branched ventral seta of the palpal tibia.....17
15. Length of ω of the palpal tarsus has the same length of palpal tarsus; dorsals setae never more than 20; two setae in the third row of dorsals setae; total idiosomal setae variation of 40 to 44.....16
- Length of ω of the palpal tarsus twice the length of palpal tarsus; dorsals setae always more than 20; without pattern after the second row of dorsal setae; total idiosomal setae variation of 50 to 53.....*Parasecia longicalcar* (Fig. 16)
16. Tarsus of the Leg I with 21B and tarsus of the leg III with 15B.....*Parasecia campestris* (Fig. 4)
- Tarsus of the Leg I with 22B and tarsus of the leg III with 14B.....*Parasecia manuela* (Fig. 18)
17. Tarsus of the Leg I with 22B.....18
- Tarsus of the Leg I with 21B.....19
18. Thirty eight total idiosomal setae, trichobothria with one-thirds covered with long and slender setules, $AL > PL$ and $PL = AM$*Parasecia molini*⁵
- Forty eight total idiosomal setae, trichobothria with two-thirds covered with long and slender setules, $AL < PL$ and $PL > AM$*Parasecia* sp. n.1 (Figs. 31 and 32)
19. Tarsus of the Leg II with 16B, $AL > PL$ and 49 to 52 total idiosomal setae.....*Parasecia fundata* (Fig. 10)
- Tarsus of the Leg II with 15B, $AL < PL$ and 59 total idiosomal setae.....*Parasecia* sp. n.3 (Fig. 36)

⁵ Stekolnikov, A. A., and D. González-Acuña. 2015. A review of Chilean chiggers (Acari: Trombiculidae), with the description of a new genus and ten new species. Zootaxa 3964: 16-17.

6.4. Discussion

In total, 16 species of the genus *Parasecia* had their type series examined. The species *P. argentinensis*, *P. gurneyi*, *P. lasiurus* and *P. molini* were not found in any collection cited in their original descriptions, so they were placed in the key here proposed for species based on the original descriptions. Only for *P. gurneyi* was possible to find additional material. The type of *Trombicula psitacci* was not good enough to draw it completely, so we used additional material to make clear the structures in the draw of the species.

After reviewing the original diagnosis of *Neotrombicula universitatis*, we agree with the synonymy made by Vercammen-grandjean (1967) and confirmed by Hoffmann (1990). So we kept this species in the genus *Neotrombicula* and we did not include it the genus *Parasecia*.

Goff (1992) had already managed much of the ambiguities of the diagnosis created by some misrepresentations over the years. But with this present review we can confirm other morphological characteristics that have been wrong cited during a long time, such as the ζ in palpal tarsus, that are always present, the odontus for the whole genus is trifurcated instead of bifurcated, and the ζ and z in leg I are always present.

We noticed an intraspecific variation in the number of the idiosomal dorsal and ventral setae, and we can see that these variations are common, since the other characteristics do not change. What we have as a tendency of a pattern of the number of idiosomal setae is the number of dorsal setae of the first, second and third rows. Probably the other rows can change due to the degree of ingugitation, changing the setal positions of the distal setae of the idiosome (Table 2).

After reviewing and examining most of the *Parasecia* types, we confirmed that the species *P. bulbocalcar* and *P. palmigera* do not have the characteristics to be in this genus. The species *P. bulbocalcar* has a trapezoidal *scutum*, five setae in palpal tarsus, and the leg I

does not present ζ and z . The species *P. palmigera*, despite having the seven setae in palpal tarsus, it presents the expanded sensilla without definite shape. Then, with this set of characteristics the two species were removed from the genus and considered “*Incertae sedis*” for instance.

Brennan and Jones (1960) redescribed *P. dunni* (cited as *Trombicula dunni*), and designated a lectotype and paralectotypes, and they mentioned that the odontus are trifurcate, such as observed in the present study. Along with this feature, plus the seven setae of the palpal tarsus and slightly rectangular *scutum* (similar to *P. orphana*), we confirmed that this species belongs to the genus *Parasecia*.

The species *P. campestris* has always been cited at subspecies level, but after examination of the two types deposited in the NMNH, and comparison with material of *P. gurneyi*, we believe that these two taxa are different. For *P. campestris* species, regarding to the branched setae, we noted that the tarsus of the leg I has 21, tarsus of the leg II has 16 and the tarsus of the leg III has 15, while *P. gurneyi* has 22, 14 and 14, respectively. And yet only *P. gurneyi* possesses nude setae on the palpal genu, characteristic before this present redescription, shared with *P. campestris*.

In addition, in the original description of the species *P. campestris* and *P. kansasensis* and the redescription of *P. gurneyi*, the three species presented bifurcated odontus and six setae in palpal tarsus. These characteristics would place them outside the genus *Parasecia* from the diagnosis re-made in this paper, but by reviewing the material of *P. gurneyi* and two paratypes of *P. campestris* housed in the NMNH. We have seen that on both occasions, the odontus is trifurcated and that in reality, there are seven setae in the palpal tarsus. Then these species must remain in the genus *Parasecia*, and, although we have not examined any specimens of *P. kansasensis*, we believe that, this species may have been misconceived described, as well as *P. campestris* and *P. gurneyi*.

Only two slides of the type series of the species *P. manueli* were found in the SAM. After examining these two specimens, we realized that they did not share characteristics and one of them is not *P. manueli*. The specimen (RML 33783) collected by parasitizing a rodent (*Zygodontomys brevicauda*) presented characteristics closer to that described by Brennan and Jones (1960), as the total number of idiosomal setae (we observed 41 setae and in the original description was observed 40) and the same palpal formula (B/B/NNN), thus remaining in the *P. manueli*. While the specimen (RML 35055) collected parasitizing a bird (*Thraupis palmarum*) did not present all the characteristics that were described for *P. manueli*, such as the total number of idiosomal setae (we have seen that in this paratype there were 59 setae, whereas in the original description was described 40 setae), and the ventral setae of the palpal tibia is branched, differently than described by the original description. When this slide was compared with other species, we realized that it had unique characteristics that did not fit into any other species. So we are here describing a new species for this specimen (RML 35055). Unfortunately the other slides of the type series were not found in any examined collection. Because of this, we can not confirm for the rest of the specimens, whether or not they are part of *P. manueli*.

The genus *Parasecia* is registered only for the American continent. Three species have been recorded for North America, and the species *P. gurneyi* has records for Canada, Mexico and USA (Fig. 13). The species *P. kansasensis* was registered to the USA and Mexico (Fig. 14), while *P. campestris* has records only in the USA (Fig. 5). In Central America there are seven known species. The species *P. dunni*, *P. longicalcar* and *P. manueli* were registered for Panama and Trinidad (Figs. 9, 17 and 19, respectively). The species *P. soucouyanti* was also registered for Panama (Fig. 26), while *P. aitkeni* and *P. psittaci* were recorded to Trinidad (Figs. 2 and 24). The only record for Cuba is *P. manueli* (Fig. 19), and recently, *P. fundata* was found in Costa Rica (Fig. 11).

South America has the largest number of species recorded, and of the 13 countries of this continent, 10 presented record for species of *Parasecia*. The country with the highest number of registered species is Venezuela, with the species *P. aitkeni*, *P. dunni*, *P. longicalcar*, *P. manueli*, *P. psittaci* and *P. soucouyanti* (Figs. 2, 9, 17, 19, 24 and 26, respectively), followed by Surinam, with five species registered, *P. aitkeni*, *P. dunni*, *P. longicalcar*, *P. manueli* and *P. valida* (Figs. 2, 9, 17, 19 and 30, respectively). For Peru, three species have already been reported, *P. chara*, *P. dunni* and *P. manueli* (Figs. 7, 9 and 19, respectively). *P. aitkeni* and *P. dunni* were reported to Bolivia (Figs. 2 and 9), the latter species together with *P. manueli* were found in Colombia (Fig. 19). In addition to these two records, *P. dunni* was found in French Guiana (Fig. 9), as well as *P. psittaci* (Fig. 24). The only record for Guyana was that of *P. longicalcar* (Fig. 17). The species *P. argentinensis* and *P. molini* were found only in Argentina (Fig. 3) and Chile (Fig. 20), respectively.

Brazil together with Venezuela and Surinam have a large part of the representatives species of this genus. Before this study there were six species registered for the Brazil, *P. aitkeni*, *P. fundata*, *P. lasiurus*, *P. orphana*, *P. thalurania* and *P. valida* (Figs. 2, 11, 15, 22, 28 and 30, respectively), and three of these species (*P. lasiurus*, *P. orphana* and *P. thalurania*) have only these records.

According to the literature, none of the species of the genus *Parasecia* were found associated parasitizing amphibians. The records that exist so far are that the species *P. molini* was collected parasitizing reptiles, while *P. thalurania* has records only for birds. The species *P. aitkeni*, *P. argentinensis*, *P. chara*, *P. lasiurus*, *P. orphana*, *P. soucouyanti* and *P. valida* were collected parasitizing mammals. The species *P. kansasensis* is the only species that has parasitism records for reptiles and mammals, while *P. dunni*, *P. fundata* and *P. psittaci* have been collected parasitizing birds and mammals. It is noteworthy that these two last species have already been found on the skin of humans, possibly biting them. And only four species,

P. campestris, *P. gurneyi*, *P. longicalcar*, and *P. manueli*, have been found parasitizing reptiles, birds and mammals, of these species *P. longicalcar* presents only one record of parasitism in reptile and one in bird.

Because, there is no specificity to parasite for some species of chigger mites, see that many species were collected in different animal groups, this can be explained, since the habit of these hosts is similar, mainly terrestrial and arboreal, as verified by Stekonikov et al. (2007) where he noticed the presence of *P. fundata* in birds, rodents and marsupials.

In addition to these records, new records of locality and hosts for the species *P. chara*, *P. longicalcar* and *P. thalurania* were added. These new records come from material found deposited in the NMNH, which had never before been published. For the species *P. manueli* is being registered for the first time in Brazil with new host records. This material was collected by HG Aitken in 1968 in Belém do Pará, also deposited in NMNH. And in recent collections in the southeastern region of the country made in the present study, two new species were found and described. Currently, there are 20 species for the genus *Parasecia*. There are two new species and new records for *P. manueli*, totalizing nine species to Brazil.

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Appendix

Table 2. Number of idiosomal setae of species of the genus *Parasecia*

Species	Identifications	Humeral	1 st row	2 nd row	3 rd row	Other dorsals	Dorsals	Externals	Preanals	Postanals	Ventrals	Total
<i>Parasecia aitkeni</i>	RML 33628	2	8	8	6	16	38	4	8	19	27	71
	RML33628(1)*	2	8	8	6	18	40	4	9	15	24	70
	RML33628(2)*	2	8	8	6	20	42	4	8	15	23	71
	RML33628(4)*	2	8	8	-	-	-	4	-	-	-	74
	RML33628(5)*	2	8	8	6	16	38	4	8	20	28	72
<i>Parasecia campestris</i>	RL4908079(1)*	2	6	6	2	4	18	4	12	8	20	44
	RL4908079(2)*	2	6	6	2	6	20	4	10	6	16	42
<i>Parasecia fundata</i>	RML49323	2	6	6	-	16	28	4	12	6	18	52
	RML4932(1)*	2	6	6	-	10	22	4	10	12	22	50
	RML49323(2)*	2	6	6	-	9	21	4	10	12	22	49
	RML49323(3)*	2	6	6		12	24	4	10	12	22	52
	RML49323(4)*	2	6	6	-	10	22	4	10	12	22	50
	RML49323(5)*	2	6	6	-	10	22	4	10	14	24	52
<i>Parasecia longicalcar</i>	RML 33416	2	6	6	-	15	27	4	10	10	20	53
	RML33416(2)*	2	6	6	-	15	27	4	8	10	18	51
	RML33416(5)*	2	6	6	-	12	24	4	8	12	24	50

*The number in parenthesis represents a collection code

Table 2. (Continued)

Species	Identifications	Humeral	1 st row	2 nd row	3 rd row	Other dorsals	Dorsals	Esternals	Preanals	Postanals	Ventrals	Total
<i>Parasecia orphana</i>	RML 50351	2	6	6	2	4	18	4	9	4	13	37
	RML50351(1)*	2	6	6	2	4	18	4	8	6	14	38
	RML50351(2)*	2	6	6	2	4	18	4	8	6	14	38
	RML50351(3)*	2	6	6	2	4	18	4	8	6	14	38
	RML50351(4)*	2	6	6	2	4	18	4	8	6	14	38
<i>Parasecia psittaci</i>	#257	2	10	10	10	20	50	4	10	10	20	76
	RML34185	2	10	10	10	16	46	4	8	22	30	82
<i>Parasecia soucouyanti</i>	RML40711	2	6	6	-	8	20	4	15	6	21	47
	RML40711(1)*	2	6	6	-	8	20	4	11	12	23	49
	RML40711(2)*	2	6	6	-	6	18	4	10	12	22	46
	RML40711(4)*	2	6	6	-	6	18	4	10	13	23	47
	RML40711(5)*	2	6	6	-	7	19	4	10	11	21	46

*The number in parenthesis represents a collection code

Table 2. (Continued)

Species	Identifications	Humeral	1 st row	2 nd row	3 rd row	Other dorsals	Dorsals	Esternals	Prenals	Postanals	Ventrals	Total
<i>Parasecia valida</i>	RML49092	2	6	6	2	4	18	4	10	12	22	46
	RML49092(1)*	2	6	6	2	6	20	4	11	6	17	43
	RML49092(2)*	2	6	6	2	4	18	4	12	8	20	44
	RML49092(3)*	2	6	6	2	4	18	4	10	9	19	43
	RML49092(4)*	2	6	6	2	4	18	4	11	7	19	43
	RML49092(5)*	2	6	6	2	6	20	4	12	8	20	46
	RML49092(6)*	2	6	6	2	4	18	4	10	8	18	42
	RML49092(7)*	2	6	6	2	4	18	4	10	9	19	43
	RML49092(8)*	2	6	6	2	4	18	4	10	8	18	42

*The number in parenthesis represents a collection code

CHAPTER 5: A checklist of chigger mites parasitizing birds and new records (Trombidiformes: Trombiculidae)

Abstract. In the middle of the last century, the first list of chigger mites to the world was compiled. In this list, Brazil was represented by eight genera and 18 species. Until now, Brazil has 60 species recorded parasitizing different animal groups: amphibians, reptiles, birds and mammals. Currently we have 12 species of bird parasites in Brazil. In recent collections, the species *Eutrombicula tinami* were found parasitizing birds in southeastern Brazil, before it had only been reported to southern Brazil.

Key words: chiggers, new records, birds, southeastern Brazil

7.1. Introduction

The mites of the family Trombiculidae have varied color, may be red, yellow, white or orange and popularly known as "thalzahuates" and "coloradillas" in Mexico, "chiggers mites" in the United States, "red bugs" in England, "Herbstgrassmilben" in Germany and "tsutsugamunhi" or "akamushi" in Japan (Hoffmann, 1990). The first chigger was described *Eutrombicula batatas* (Linnaeus, 1758). Berlese (1905) brought together representatives species in genus *Trombicula* that was later transferred by Oudemans (1912) for Trombidiidae family.

Wharton and Fuller (1952) compiled the first list of chigger mites to the world. In this list, Brazil was represented by eight genera and 18 species. Fonseca (1955) added another record to the country, including bites reported in humans. Brennan and Goff (1977) listed 87 species of the family Trombiculidae for Nearctic and Neotropical regions, 18 of these were cited for Brazil. Between the years 70 and 90, new species have been described by foreign researchers, from specimens collected mainly in the north and center-west of the country.

Subsequently, Gazeta et al. (2006) described another taxon that was collected in rodent in Rio de Janeiro. Recently, the species *Trombewingia bakeri* (Fonseca, 1955) that occurs on rodent, collected in São Paulo, was again collected after more than half a century of silence. Thus, the species can be redescribed, including the designation of lectotype and paralectotype

(Jacinavicius et al., 2015). Until now, Brazil has 60 species recorded parasitizing different animal groups: amphibians, reptiles, birds and mammals (Bassini-Silva et al., 2017). And of these only eight species were reported for birds, 1 species of the genus *Apolonia* (Torres & Braga, 1939), 2 of *Blankaartia* (Bassini-Silva et al., 2017), 2 of *Eutrombicula* (Oudemans, 1910; Ewing, 1925), 1 of *Neoschoengastia* (Brennan, 1971) and 2 of *Parasecia* (Brennan, 1969). Aside from *Apolonia tigipioensis* Torres & Braga, 1939, which was cited for the second time in the country by Ornelas-Almeida et al. (2007), virtually nothing has been noted of chiggers parasitize birds in Brazil until last year. Recently was added to this list one new species of *Microtrombicula* and two new species of the genus *Parasecia*, besides that *Parasecia manueli* (Brennan & Jones, 1960), increases the number of species parasitizing birds to twelve.

For the genus *Eutrombicula*, in addition to the two species reported for birds, *Eutrombicula batatas* (Linnaeus, 1758) and *Eutrombicula tinami* (Oudemans, 1910), we have three other brazilian species parasitic of reptiles and/or mammals: *Eutrombicula alfreddugesi* s.l. (Oudemans, 1910); *Eutrombicula bruyanti* (Oudemans, 1910); *Eutrombicula goeldii* (Oudemans, 1910);

7.2. Material and Methods

Types and material on slides deposited in the NMNH, which are housed at the Systematic Entomology Laboratory (BARC-USDA-ARS) and in the Acari Collection from Butantan Institute, Sao Paulo, Brazil (IBSP), were examined.

Besides that, recent collections were made in the states of Minas Gerais, Rio de Janeiro and São Paulo, and initially the specimens were stored in ethanol (100%). And later they were slide-mounted in Hoyer's medium according to Walter and Krantz (2009) for identification.

We partly followed the terminology of Goff et al. (1982), with adaptations proposed by Stekolnikov (2008) and Stekolnikov and Daniel (2012) for the general nomenclature of larval stage of chigger mites to identify the specimens.

For host nomenclature and classification, we used Remsen et al. (2015) for South American birds, and for northern and mid-american birds we used the checklist of The American Ornithologists Union (2015).

Ethical approval

The animals were caught and manipulated in accordance with the recommendations of the Ethical Principles in Animal Experimentation adopted by the Brazilian College of Animal Experimentation (COBEA), and it was approved by the Ethics Committee on Animal Experimentation (CEEa) of the Dean of the Universidade Federal de Juiz de Fora, MG (UFJF) – nº042/2012

7.3. Results

Family **Trombiculidae** Ewing, 1944

Subfamily **Apoloniinae** Wharton, 1947

Genus *Apolonia* Torres & Braga 1939

Type-species: *Apolonia tigipioensis* Torres & Braga, 1939

7.3.1. *Apolonia tigipioensis* Torres & Braga, 1939

Apolonia tigipioensis Torres and Braga, 1939: 171; Carneiro, 1949: 1; Brennan and Reed, 1975: 48; Ornelas-Almeida et al., 2007: 375

Localities. Pernambuco (Torres and Braga, 1939; Carneiro, 1949); Petrolina, Pernambuco (Ornelas-Almeida et al., 2007).

General distribution. Venezuela.

Birds hosts. *Gallus gallus domesticus* (Galliformes: Phasianidae), *Struthio camelus*, (Struthioniformes: Struthionidae), *Passer domesticus* (Passeriformes: Passeridae).

Subfamília **Trombiculinae** Ewing, 1929

Genus ***Blankaartia*** Oudemans, 1911

Type-species: *Trombidium niloticum* Tragardh, 1904

7.3.2. *Blankaartia shatrovi* Bassini-Silva & Barros-Battesti, 2017

Blankaartia shatrovi Bassini-Silva et al., 2017: 83

Localities. São Paulo, São Paulo; Fazenda Continente, Coronel Pacheco, Minas Gerais (Bassini-Silva et al., 2017).

Birds hosts. *Trichothraupis melanops* (Passeriformes: Thraupidae).

Specimens examined. HOLOTYPE: larva (IBSP 367), São Paulo municipality, São Paulo, Brazil, 04-VI-1932, “Bird” (Order Passeriformes), Joaquim Cavalheiro coll. PARATYPES: 9 larvae (IBSP 367), same data. Material – BRAZIL: 3 larvae (IBSP 12375), Fazenda Continente, Coronel Pacheco, Minas Gerais, 18-XII-2005, *Trichothraupis melanops* (= *Lanio melanops*).

7.3.3. *Blankaartia sinnamaryi* (Floch & Fauran, 1956)

Trombicula (*Tragardhula*) *sinnamaryi* Floch and Fauran, 1956: 3; 1957: 17; Brennan and Jones, 1960: 531; Brennan and Jones, 1961: 202.

Tragardhula sinnamaryi: Brennan, 1965: 83.

Blankaartia (*Blankaartia*) *sinnamaryi*: Vercammen-Grandjean, 1965: 22.

Blankaartia sinnamaryi: Brennan and Yunker, 1966: 250; Arnold, 1970: 262; Brennan and Bronswijk, 1975: 244; Brennan and Reed, 1975: 49; Spalding *et al.*, 1997: 768; Daniel and Stekolnikov, 2003: 150; Stekolnikov *et al.*, 2007: 66; Walters *et al.*, 2011: 9; Bassini-Silva *et al.*, 2017: 87.

Localities. Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais; Sítio Vista Alegre, Juiz de Fora, Minas Gerais; Fazenda Continente, Coronel Pacheco, Minas Gerais; Paraty, Rio de Janeiro (Bassini-Silva *et al.*, 2016).

General distribution. Costa Rica, Cuba, French Guyane, Jamaica, Panama, Peru, Surinam, Trinidad, Usa, Venezuela.

Birds hosts. *Antrostomus rufus* (= *Caprimulgus rufus*), *Nyctidromus albicollis* (= *Hydropsalis albicollis*) (**Caprimulgiformes: Caprimulgidae**); *Columbina talpacoti* (= *Columbigallina talpacoti*), *Zentrygon lawrencii* (= *Geotrygon lawrencii*) (**Columbiformes: Columbidae**); *Baryphthengus ruficapillus* (**Coraciiformes: Momotidae**); *Crotophaga ani* (**Cuculiformes: Cuculidae**); *Bucconidae* sp., *Monasa morphoeus* (**Galbuliformes: Bucconidae**); *Galbula ruficauda* (**Galbuliformes: Galbulidae**); *Grus canadensis pratensis* (**Gruiformes: Gruidae**); *Aramides cajaneus* (**Gruiformes: Rallidae**); *Cyanocompsa cyanooides*, *Piranga rubra* (**Passeriformes: Cardinalidae**); *Conopophaga lineata* (**Passeriformes: Conopophagidae**); *Lepidocolaptes souleyetii compressus*, *Xiphorhynchus guttatus* (**Passeriformes: Dendrocolaptidae**); *Oryzoborus funereus*, *Sporophila aurita corvina* (**Passeriformes: Emberizidae**); *Dendrocincla homochroa*, *Glyphorhynchus spirurus*, *Sclerurus guatemalensis*, *Synallaxis spixi*, *Xiphorhynchus susurrans* (**Passeriformes: Furnariidae**); *Cacicus cela*, *Icterus mesomelas* (**Passeriformes: Icteridae**); *Dumetella carolinensis* (**Passeriformes: Mimidae**); *Arremon semitorquatus* (**Passeriformes: Passerellidae**); *Geothlypis formosus* (= *Oporornis formosus*), *Geothlypis semiflava*, *Parkesia motacilla* (= *Seiurus motacilla*) (**Passeriformes: Parulidae**); *Ceratopipra erythrocephala* (=

Pipra erythrocephala), *Ceratopipra mentalis* (= *Pipra mentalis*), *Chiroxiphia caudata*
Manacus manacus (**Passeriformes: Pipridae**); *Tolmomyias sulphurescens cinereiceps*
(Passeriformes: Pipromorphidae); *Microbates cinereiventris* (**Passeriformes:**
Poliophtilidae); *Cymbilaimus lineatus*; *Dysithamnus mentalis*, *Epinecrophylia fulviventris* (= *Myrmotherula fulviventris*), *Myrmoderus squamosus*, *Taraba major*, *Thamnistes anabatinus*,
Thamnophilus bridgesi, *Thamnophilus caerulescens*, *Thamnophilus doliatus*, *Thamnophilus doliatus* (**Passeriformes: Thamnophilidae**); *Coereba flaveola*, *Ramphocelus passerinii*,
Pyriglena leucoptera, *Sporophila americana*, *Tachyphonus coronatus*, *Tachyphonus delatarii*,
Tachyphonus rufus, *Tangara episcopus* (= *Thraupis virens*), *Volatinia jacarina*
(Passeriformes: Thraupidae); *Cantorchilus modestus* (= *Thryothorus modestus*),
Cantorchilus nigricapillus (= *Thryothorus nigricapillus*), *Henicorhina leucosticta*,
Pheugopedius fasciatoventris melanogaster (= *Thryothorus fasciatoventris melanogaster*),
Pheugopedius genibarbis (= *Thryothorus genibarbis*), *Thryothorus pleurostictus rufus*,
Pheugopedius rutilus hyperythrus (= *Thryothorus rutilus hyperythrus*), *Troglodytes musculus*
(Passeriformes: Troglodytidae); *Catharus mexicanus*, *Catharus ustulata* (= *Hylocichla ustulata*), *Hylocichla mustelina*, *Myadestes genibarbis*, *Turdus albicollis*, *Turdus leucomelas*,
Turdus nudigenis, *Turdus rufiventris* (**Passeriformes: Turdidae**); *Attila spadiceus*,
Lathrotriccus euleri, *Myiarchus ferox*, *Myiodynastes maculatus*, *Myiopagis gaimardii*,
Myiophobus fasciatus, *Myiozetetes* sp., *Oncostoma cinereigulare*, *Pitangus sulfuratus*,
Tyrannus melancholicus, *Tyrannus savana* (= *Muscivora tyrannus*) (**Passeriformes:**
Tyrannidae); *Cyclarhis gujanensis* (**Passeriformes: Vireonidae**); *Campephilus melanoleucos* (= *Phloeceastes melanoleucos*), *Colaptes melanochloros*, *Melanerpes pucherani*, *Picumnus cirratus* (**Piciformes: Picidae**); *Amazona amazonica*, *Aratinga finschi*
(Psittaciformes: Psittacidae); *Megascops guatemalae* (= *Otus guatemalae*), *Strix virgata* (=

Ciccaba virgata) (**Strigiformes: Strigidae**); *Anhinga anhinga* (**Suliformes: Anhingidae**); *Trogon massena*, *Trogon rufus* (**Trogoniformes: Trogonidae**).

Specimens examined. BRAZIL - 13 larvae (IBSP 10711), Fundação Animalia, São Sebastião, São Paulo, (23°45'59.99"S, 45°25'00.07"W), 26-I-2011, *Baryphthengus ruficapillus*. Fabiana Morse coll.; 2 larva (IBSP 12315), Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais, 8-III-2013, *Turdus rufiventris*; 1 larva (IBSP 12316), same locality and host, 26-III-2013; 1 larva (IBSP 12325), same locality and host, 24-V-2013; 1 larva (IBSP 12339), same locality and host, 24-II-2014; 1 larva (IBSP 12350), same data; 1 larva (IBSP 12729), same locality and host, 10-IV-2015; 2 larvae (IBSP 12317), same locality, 26-III-2013, *Thamnophilus caerulescens*; 1 larva (IBSP 12324), same locality and host, 24-V-2013; 1 larva (IBSP 12358), same locality and host, 27-III-2014; 1 larva (IBSP 12331), same locality, 04-XII-2013, *Chiroxiphia caudata*; 1 larva (IBSP 12336), same locality and host, 23-II-2014; 1 larva (IBSP 12318A), same locality, 27-III-2013, *Tachyphonus coronatus*; 1 larva (IBSP 12322), same locality and host, 10-IV-2013, 4 larvae (IBSP 12323A), same locality and host, 21-V-2013; ; 1 larva (IBSP 12340), same locality and host, 24-II-2014; 1 larva (IBSP 12342), same data; 1 larva (IBSP 12343), same data; 1 larva (IBSP 12350), same locality and host, 24-III-2014; 5 larvae (IBSP 12354), same locality and host, 25-III-2014; 1 larva (IBSP 12730), same locality and host, 9-IV-2014; 1 larva (12319), same locality, 8-IV-2013, *Arremon semitorquatus*; 1 larva (12320), same data; 1 larva (IBSP 12329), same locality, 3-XII-2013, *Picumnus cirratus*; 1 larva (IBSP 12332), same locality, 6-XII-2013, *Colaptes melanochloros*; 1 larva (IBSP 12338), same locality, 24-II-2014, *Manacus manacus*; 3 larvae (IBSP 12344A), same locality, 25-II-2014, *Troglodytes musculus*; 4 larva (IBSP 12345A), same data; 1 larva (IBSP 12346), same locality and date, *Lathrotriccus euleri*; 1 larva (IBSP 12348), same locality and host, 24-III-2014; 1 larva (IBSP 12362), same locality, 14-IV-2014, *Synallaxis spixi*; 1 larva (IBSP 12327), Sítio Vista Alegre,

Juiz de Fora, Minas Gerais, 15-X-2013, *Turdus rufiventris*; 1 larva (IBSP 12335), same locality, 30-I-2014, *Troglodytes musculus*; 2 larvae (IBSP 12377), Fazenda Continente, Coronel Pacheco, Minas Gerais, 9-I-2006, *Conopophaga lineata*; 1 larva (IBSP 12379), same locality, 9-I-2006, *Turdus albicollis*; 1 larva (IBSP 12382), same locality, 24-VI-2006, *Turdus albicollis*, Ralph Maturano coll.; 3 larvae (IBSP 12201), Paraty, Rio de Janeiro, 20-III-2015, *Manacus manacus*; 3 larvae (IBSP 12198), same locality and host, 19-III-2015, *Manacus manacus*; 3 larvae (IBSP 12214), same locality and date, *Tachyphonus coronatus*; 2 larva (IBSP 12211), same locality, 20-III-2015, *Myrmoderus squamosus*; 3 larva (IBSP 12731), same locality and host; 2 larvae (IBSP 12216A), same locality and date, *Pyriglena leucoptera*, 1 larva (IBSP 12791), same locality and host, Luciano Lima coll. JAMAICA: 3 larvae (AP23876), St. Thomas, Corn Puss Gap, 14-XI-1946, *Myadestes genibarbis*. PANAMA - 2 larvae (RML 44025), Gamboa, Canal Zone, 26-X-1961, *Baryphthengus ruficapillus*; 5 larvae (RML 35309), Coiba Island, 3-I-1956 to 13-II-1956, "Bird"; 1 larva (RML 35330), same locality, 3-I-1956 to 13-II-1956, "Bird"; 1 larva (RML 35313), same locality, 3-I-1956 to 13-II-1956, "Bird"; 4 larvae (RML 40638), Almirante, Bocas del Toro, 23-I-1961, *Myiozetetes* sp.; 16 larvae (RML 40639), same locality and host, 24-I-1961; 1 larva (RML 40640), same data; 1 larva (RML 40641), same data; 2 larva (RML 40642), same locality and host, 25-I-1961; 1 larva (RML 40647), same locality and host, 3-II-1961; 2 larvae (RML 40644), same locality, 27-I-1961, *Piranga rubra*; 22 larvae (RML 40646), same locality, 2-II-1961, *Sporophila corvina*; 3 larvae (RML 40648), same locality, 14-II-1961, *Aramides cajaneus*; 1 larva (RML 40649), same locality, 16-II-1961, *Bucconidae*; 7 larvae (RML 40636), same locality, 9-I-1961, *Taraba major*; 2 larva (RML 40645), same locality, 27-I-1961, *Aratinga finschi*; 1 larva (RML 43831), same locality, 25-IX-1961, *Geothlypis formosa* (= *Oporornis formosus*); 1 larva (RML 43284), same locality, 4-VIII-1961, *Xiphorhynchus guttatus*; 1 larva (RML 40650), same locality, 3-II-1961, *Zentrygon lawrencii*

(= *Geotrygon lawrencii*); 1 larva (RML 43767), Rio Changena, Bocas del Toro, 22-IV-1961, *Catharus ustulatus* (= *Hylocichla ustulata*); 1 larva (43975), same locality, IX-1961, *Trogon massena*; 1 larva (RML 43702), same locality, 20-IX-1961, *Zentrygon lawrencii* (= *Geotrygon lawrencii*). TRINIDAD: 4 larvae (#33810), Melajo Forest, Sangre Grande, I-1956, *Pitangus sulphuratus*; 1 larva (#33898), same locality and host, 24-IV-1954; 1 larva (#33831), same locality, 20-XII-1955, *Thamnophilus doliatus* (= *Thamnophilus fraterculus*); 1 larva (#33839), same data; 6 larva (#33883), same locality, 28-III-1956, *Tachyphonus rufus*; 2 larva (#34137), same locality, 10-VII-1956, *Crotophaga ani*; 1 larva (#33840), same locality, 29-XI-1956, *Tyrannus melancholicus*; 6 larvae (#33842), same locality, 4-I-1956, *Galbula ruficauda*; 1 larva (#33843), same locality, 6-XII-1956, *Myiopagis gaimardii*; 5 larvae (#33802), same locality, 1-III-1956, *Amazona amazonica*; 3 larvae (#33839), same locality, 20-XII-1956, *Thamnophilus doliatus*; 1 larva (#34047), same locality and host, 3-VII-1956; 1 larva (#34135), same locality, 10-VII-1956, *Myiodynastes maculatus*; 1 larva (#34669), same locality, 24-XII-1959, *Xiphorhynchus guttatus*, 1 larva (#37051), Churchill–Roosevelt Highway, 29-XI-1956, *Tyrannus savana* (= *Muscivora tyrannus*); 1 larva (#35073), William Tr. Foster Rd., 1-I-1959, *Myiophobus fasciatus*; 2 larva (#36681), Elgin Trace, Vega de Oropouche, 2-II-1960; *Tolmomyias flaviventris*; 2 larvae (#36674), same locality, 29-XII-1959; *Myiophobus fasciatus*; 2 larvae (#36684), same locality and host, 2-II-1960; 1 larva (#36673), same locality, 29-XII-1959, *Tolmomyias flaviventris*; 2 larvae (#36681), same locality and host, 2-II-1960; 1 larva (#38214), Vega de Oropouche, 10-I-1961, *Campephilus melanoleucos* (= *Phloeceastes melanoleucos*); 1 larva (#35052), same locality, 7-X-1959, *Cyclarhis gujanensis*; 2 larvae (#36771), same locality, 15-XII-1959, *Pipra erythrocephala*; 3 larvae (#36688), same locality and host, 8-XII-1959; 1 larva (#36690), Fort Reid, 16-II-1960, *Myiophobus fasciatus*; 1 larva (#33660), same locality, 26-V-1955, *Tyrannus melancholicus*; 1 larva (#35092), 3-V-1959, *Columbina talpacoti* (= *Columbigallina talpacoti*); 1 larva

(#36690), same locality, 2-III-1960, *Thamnophilus doliatus*; 3 larvae (#34682), Granville, 12-III-1956, *Ciccaba virgata*. USA: 2 larvae (#45011), Cameron Co., Texas, 7-V-1962, *Dumetella carolinensis*; 1 larva (#38715), same locality, 23-IV-1963; *Hylocichla mustelina*, Richard B. Eards coll.

Genus *Eutrombicula* Ewing, 1938

Type-species: *Microthrombidium alfreddugesi* Oudemans, 1910

7.3.4. *Eutrombicula batatas* (Linnaeus, 1758)

Acarus batatas Linnaeus, 1758: 617.

Trombicula (Eutrombicula) batatas Linnaeus, 1758: 617; Brennan, 1953: 294; Brennan and Dalmat, 1960: 188.

Trombicula brasiliensis Ewing, 1925: 91-92; Bequaert, 1926: 152-157; Ewing, 1928: 77; Stiles and Nolan, 1929: 485; André, 1930: 109; Van Theil, 1930: 353; Ewing, 1931: 7; 1933: 6; Torres and Braga, 1939: 38; Thor and Wilman, 1947: 284-291.

Eutrombicula butantanensis: Ewing, 1938: 294; Radford, 1942: 66 (*Syn Jenkins*, 1949: 300).

Acariscus brasiliensis: Ewing, 1943: 61-62 (*Syn Jenkins*, 1949: 300).

Trombicula (Eutrombicula) batatas: Jenkins, 1949: 300.

Eutrombicula batatas: Brennan and Jones, 1960: 508; Brennan and Jones, 1964a: 698; Brennan and Yunker, 1966: 236; Brennan, 1967: 154; Arnold, 1970: 262; Brennan and Lukoschus, 1971: 44; Bennett and Loomis, 1980: 286; Brennan, 1970a: 811; Brennan and Reed, 1974: 709; Brennan and Reed, 1975: 51; Brennan and Bronswijk, 1975: 244; (*Syn Jenkins*, 1949: 300).

Localities. Manaus and Carvoeiro, Amazonas; Belem, Para (Ewing, 1925).

General distribution. Argentina, Bolivia, Costa Rica, Curaçao, Guatemala, Jamaica, Mexico, Panama, Surinam, Trinidad, USA, Venezuela.

Birds hosts. *Buteogallus urubitinga* (= *Hypomorphnus urubitinga*) (**Accipitriformes: Accipitridae**); *Nyctidromus albicollis* (= **Caprimulgiformes: Caprimulgidae**); *Columbigallina passerina*, *Collumbigallina talpacoti*, *Leptotila verreauxi* (**Columbiformes: Columbidae**); *Crotophaga ani*, *Crotophaga sulcirostris*, *Tapera naevia* (**Cuculiformes: Cuculidae**); *Caracara plancus* (**Falconiformes: Falconidae**); *Gallus gallus domesticus*, *Meleagris gallopavo* (**Galliformes: Phasianidae**); *Cissilopha melanocyanea* (**Passeriformes:**

Corvidae); *Zonotrichia capensis septentrionalis* (**Passeriformes: Passerellidae**); *Coereba luteola*, *Ramphocelus carbo*, *Sporophila angolensis* (= *Oryzoborus angolensis*) (**Passeriformes: Thraupidae**); *Catharus mexicanus* (**Passeriformes: Turdidae**); *Myiozetetes* sp., *Pitangus sulfuratus* (**Passeriformes: Tyrannidae**); *Glaucidium brasilanum* (**Strigiformes: Strigidae**).

Specimens examined. Material: BOLIVIA – 2 larvae (#39140), San Joaquin, Beni, 20-V-1963, “horse”; 1 larva (RML50156), Beni, 19-VIII-1964, *Holochilus* sp.; 1 larva (RML50156), same locality and host, 29-VIII-1964; 2 larvae (RML50170), same locality and host, 12-IX-1964; 1 larva (RML50182), same locality, 10-X-1964, *Oryzomys* sp.; 1 larva (RML50151), same locality and host, 31-VIII-1964; 1 larva (RML50184), same locality, 8-X-1964, *Glossophaga* sp.; 4 larvae (RML50197). Van Gelder coll. COLOMBIA – 2 larvae (lot 52-9728), Cartagena, 8-IX-1952, “grasses”. CURAÇAO – 1 larva (#45473), 8-III-1949, *Sylvilagus floridanus*; DOMINICAN REPUBLIC – 3 larvae (lot 51-8471), Rio San Juan, Cano Azul, 15-IX-1951, “pigs”, “chickens” and “man”. GUATEMALA – 1 larva (ap 29931), Finca la Torre, Acatenango, Chimaltenango, 3-VIII-1951, “bird”; 1 larva (ap 29967), same locality and host, 11-VII-1951; 2 larvae (#25007), Yepucapo, Chimaltenango, 18-XII-1949, *Cissilopha melanocyanea*; 1 larva (#30303), Chimaltenango, 27-IX-1951, “bird”; JAMAICA – 4 larvae (ap 23628), 16-I-1947, *Columbigallina jamaicensis*; 2 larvae (ap 23921), 15-III-1947, “mangoose”; 4 larvae (ap 23586), same host, 21-I-1947. MEXICO – 1 larva (lot 56-8408), San Luis Potosí, 2-VII-1956, “orchid”. Watt coll. PANAMA – 1 larva (RML35161), Gatun Lake, “chicken”. L. H. Dunn 1 larva (RML35274), Fort Clayton, Canal Zone, 13-XII-1954, *Sigmodon hispidus*; 1 larva (#40643), Almirante, Bocas Del Toro, 25-I-1961, *Myiozetetes* sp.; 1 larva (#43912), same locality, 2-IX-1960, *Crotophaga ani*; 1 larva (#43917), same locality, 14-IX-1960, *Sigmodon hispidus*; 1 larva (#43504), France Field,

Canal Zone, 6-IX-1961, *Zygodontomys microtinus*; 1 larva (#43517), same locality and host, 8-IX-1961; 1 larva (#43545), Miraflores, Canal Zone, 18-IX-1961, *Sigmodon hispidus*; 1 larva (#43582), Curundu, Canal Zone, 3-X-1961, same host; 1 larvae, Pacora, 31-X-1960, *Homo sapiens*; PARAMARIBO – 2 larvae (#55404), 13-I-1970, *Rattus novergicus*. PARAGUAY – 2 larvae (DBA130), Parque Nacional Defensores del Chaco, 6-VI-1981, *Calomys laucha*. PERU – 2 larvae (RML 46988), Loreto, 18-VIII-1965, “chicken”. PUERTO RICO – 21 larvae (#34201), 18-II-1957, “cattle”. Dr. Toro coll. 11 larva (#34208), Rio Branco, Naguabo, 16-X-1956, “dairy cow”; TRINIDAD – 2 larvae (#33672), Matura, 15-VI-1955, “rat”; 1 larva (#33806), Melajo Forest, Sangre Grande, 21-II-1956, *Oryzoborus angolensis*; 5 larvae (#33799), same locality, 28-II-1956, *Crotophaga ani*; 9 larvae (#33838), same locality and host, 4-I-1956; 9 larvae (#33841), same data; 1 larva (#33898), same locality, 24-IV-1956, *Pitangus sulfuratus*; 1 larva (#33899), same locality, 19-IV-1956, *Coereba luteola*; 2 larvae (#33913), same locality, 17-IV-1956, *Rhamphocelus carbo*; 1 larva (#34174), same locality, 6-XI-1956, “chicken”; 13 larvae (#34038), Tractor Trace, Melajo Forest, Sangre Grande, 26-VI-1956, *Glaucidium brasilianum*; 3 larvae (#36652), Laventille Swamp, Port of Spain, 13-XI-1959, *Erolia melanotus*. USA – 1 larva (lot 36-20984), Pike Couty, Arkansas, 10-VI-1936, “sailim peach orchard”. W. F. Turner coll. VENEZUELA – 1 larva (#53624), El Tocuyo, 19-VII-1968, *Sigmodon hispidus*.

7.3.5. *Eutrombicula goeldii* (Oudemans, 1910)

Microthrombidium göldii Oudemans, 1910: 84; 1912: 13.

Microthrombidium helleri Oudemans, 1911: 120; 1912: 15-18; 1927: 72; Van Theil, 1930: 48 (*Syn.* Jenkins, 1949).

Trombicula goldi: Bequaert, 1926: 178; Methlagl, 1928: 216; André, 1930: 109; Ewing, 1931: 7; Boshell and Kerr, 1942: 6.

Trombicula helleri: Methlagl, 1928: 216; Van Theil, 1930: 346; Ewing, 1931: 8; Schierbeek, 1937: 328; Van Thiel and Van Ommeren, 1940: 1638 (*Syn.* Jenkins, 1949).

Trombicula vanommereni Schierbeek, 1937; Floch and Abonnenc, 1941: 1-22 (*Syn.* Jenkins, 1949).

Eutrombicula göldii: Ewing, 1938: 294; Radford, 1942: 66; Fairchild, 1943: 587; Ewing, 1944: 344a; Michener, 1946a: 101; Brennan and Jones, 1960: 508.

Eutrombicula helleri: Ewing, 1938: 294; Radford, 1942: 66; Michener, 1946b: 411 (*Syn.* Jenkins, 1949).

Otonyssus göldii: Buitendijk, 1945: 338.

Eutrombicula defecta Ewing, 1946: 439 (*Syn.* Jenkins, 1949).

Trombicula (Eutrombicula) göldii: Jenkins, 1949: 312.

Eutrombicula goeldii: Brennan and Yunker, 1966: 236; Brennan, 1967: 154; Brennan, 1968: 684; Arnold, 1970: 262; Brennan, 1970b: 35; Brennan, 1970a: 810; Brennan and Lukoschus, 1971: 44; Brennan and Reed, 1974: 710; Brennan and Reed, 1975: 52; Brennan and Bronswijk, 1975: 244.

Localities. Without specific locality only Brazil (Oudemans, 1910; 1912);

General distribution. Bolivia, Colombia, Costa Rica, Dominica, Panama, Trinidad, Surinam, Venezuela.

Birds hosts. *Collumbigallina talpacoti*, *Leptotila verreauxi* (**Columbiformes: Columbidae**); *Momotus momota* (**Coraciiformes: Momotidae**); *Crotophaga ani*, *Neomorphus geoffroyi salvini* (**Cuculiformes: Cuculidae**); *Malacoptila panamensis* (**Galbuliformes: Bucconidae**); *Dendrocincla fuliginosa* (**Passeriformes: Dendrocolaptidae**); *Euphonia violacea* (= *Tangara violácea*) (**Passeriformes: Fringillidae**); *Formicarius analis umbrosus* (**Passeriformes: Formicariidae**); *Psarocolius decumanus* (**Passeriformes: Icteridae**); *Tolmomyias flaviventris* (**Passeriformes: Rhynchocyclidae**); *Myrmotherula axillaris*, *Thamnophilus doliatus* (**Passeriformes: Thamnophilidae**); *Ramphocelus carbo*, *Tachyphonus rufus*, *Tangara episcopus* (= *Thraupis virens*) (**Passeriformes: Thraupidae**); *Cyphorhinus aradus phaeocephalus*, *Thryothorus rufalbus castanonotus* (**Passeriformes: Troglodytidae**); *Turdus fumigatus* (**Passeriformes: Turdidae**); *Myiarchus tuberculifer*, *Myiodynastes maculatus* (**Passeriformes: Tyrannidae**); *Strix virgata* (= *Ciccaba virgata*) (**Strigiformes: Strigidae**); *Trogon strigilatus* (**Trogoniformes: Trogonidae**).

Specimens examined. Material: BOLIVIA – 2 larvae (RML50142), Guayaramerin, Beni, 26-VI-1964, *Philander opossum*. COLOMBIA – 1 larva (n° 81), Vereda del Retiro, Restrepo, Dept. Meta, 20-VIII-1936, *Dasyprocta variegata*; 1 larva (n° 174), Medina, Dept. Cundinamarca, 22-XII-1936, *Homo sapiens*. J. V. Acuña coll.; 1 larva (n° 698), Landázuri,

10-IX-1937, *Dasyprocta aguti*; 1 larva (n° 1909), Restrepo, Dept. Meta, 14-X-1937, *Didelphis marsupialis*; FRENCH GUIANA – 2 larvae (ap 25746), Mana, II-1944, “partridge”; 1 larva (ap 25747), Cannon, 1941to1956, *Dasyprocta aguti*. PANAMA – 1 larva (n° 628), Parita, Cidade do Panamá, 18-VII-1931, *Marmosa mexicana*; 1 larva (n° 064), same locality, 15-VII-1931, *Didelphis marsupialis*; 1 larva (n° 674), same locality and host, 16-VII-1931; 1 larva (n° 729-A), 8-VIII-1931, *Dasypus novemcinctus*; 1 larva (n° 777), El Real, 10-XI-1931, *Mazama Sartori*; 1 larva (n° 793), Agua Buenas, Los Santos, 14-XII-1931, *Tapirella bairdii*; 1 larva (#4879), Barro Colorado, IX-1941; 5 larvae (RML40007), Fort Clayton, Canal Zone, 24-X-1960, *Pseustes poecilonotus*; 7 larvae (RML40438), Fort Gulick, Canal Zone, 9-II-1961, *Philander opossum*; 6 larvae (RML40439), same data; 4 larvae (RML40515), same locality, 7-III-1961, *Proechimys semispinosus*; 4 larvae (RML40513), Cerro Campana, 7-III-1961, *Didelphis marsupialis*; 2 larvae (#40662), Campina, 28-VII-1960, *Transandinomys talamancae* (= *Oryzomys talamancae*); 5 larvae (#40973), Quebrada Grande, Cermeño capira, 25-V-1961, *Dasyprocta punctata*; 4 larvae (RML43259), Achiote, Colón, 26-VII-1961, *Ameiva* sp.; 2 larvae (RML43489), Piña, 29-VIII-1961, *Proechimys semispinosus*; TRINIDAD – 1 larva (#33470), Plum Mitán, 21-V-1955; 2 larvae (#33602), St. Patrick Estate, 15-X-1953, *Marmosa mitis*; 2 larvae (#33632), Cumaca, 8-VI-1956, “rat”; 1 larva (#33613), same locality and host, 27-V-1954; 5 larvae (#33643), same locality and host, 21-VI-1954; 1 larva (#33657), same locality and host, 3-VIII-1954; 1 larva (#33607), same locality, 21-VI-1956, *Dasyprocta aguti*; 2 larvae (#33608), same locality and host, 20-V-1954; 1 larva (#33610), same locality, 25-V-1954, *Nectomys squamipes*; 1 larva (#33794), Sangre Grande, 21-II-1956, *Zygodontomys brevicauda*; 1 larva (#33793), same locality and host, 7-III-1956; 3 larvae (#33777), same locality and host, 21-V-1956; 3 larvae (#33906), same locality and host, 12-IV-1956; 2 larvae (#33812), same locality and host, 13-II-1956; 1 larva (#33851), same locality and host, 24-X-1955; 2 larvae (#33792), same locality, 29-II-

1956, “rat”; 4 larvae (#33816), same locality and host, 24-I-56; 2 larvae (#33895), same locality and host, 2-V-1956; 3 larvae (#33790), same locality, 16-II-1956, *Hylaeamys laticeps* (= *Oryzomys laticeps*); 1 larva (#33818), same locality and host, 26-I-1956; 2 larvae (#33863), same locality and host, 20-XII-1955; 1 larva (33876), same locality and host, 15-XI-1955; 1 larva (#33877), same locality, 13-III-1956, 1 larva (#33908), same locality and host, 12-IV-1956; *Necromys urichi* (= *Akodon urichi*); 1 larva (#33887), same locality, 15-V-1956, *Leimadophis reginae*; 1 larva (#34428), same locality, 28-V-1957, *Chironius carinatus*; 1 larva (#33801), 16-II-1956, *Tolmomyias flaviventris*; 3 larvae (#34479), 24-VII-1956, “snake”; 1 larva (#33910), same locality, 24-IV-1956, *Rhamphocelus carbo*; 2 larvae (#33903), same locality, *Nectomys squamipes*, 16-IV-1956; 3 larvae (#33903), Maingot Estate, Sangre Grande, 16-IV-1956, *Nectomys squamipes*; 2 larvae (#33825), same locality and host, 9-II-1956; 1 larva (#33783), same locality, 19-V-1956, *Zygodontomys brevicauda*; 1 larva (#33868), same locality and host, 31-X-1955; 1 larva (#33870), same locality and host, 9-XI-1955; 2 larvae (#33891), same locality and host, 25-V-1956; 1 larva (#33777), same locality and host, 21-V-1956; 1 larva (#33797), same locality and host, 13-II-1956; 1 larva (#33897), Toco Road, 3-V-1956, “donkey”; 1 larva (#33922), Rio Grande Forest, Sangre Grande, 6-VI-1956, *Oryzomys laticeps*; 4 larvae (#34030), same locality, 21-VI-1956, *Marmosa mitis*; 1 larva (#34145), same locality and host, 19-VII-1956; 1 larva (#34169), same locality, 14-IX-1956, “rat”; 3 larvae (#34189), same locality, 4-II-1957, *Oxybelis aeneus*; 5 larvae (#34049), Melajo Forest, Sangre Grande, 31-VII-1956, *Momotus momota*; 3 larvae (#34144), same locality, 16-VII-1956, *Pseustes sulphureus*; 1 larva (#33799), same locality, 28-II-1956, *Crotophaga ani*; 2 larvae (#34137), same locality and host, 10-VII-1956; 1 larva (#34041), Tractor Trace, Melajo Forest, Sangre Grande, 26-VI-1956, *Tachyphonus rufus*; 1 larva (#34670), same locality, 31-XII-1957, *Iguana iguana*; 1 larva (#34671), same locality, 8-I-1958, *Myrmotherula axillaris*; 2 larvae (#34426), Diego Martin, Petit Valley, 23-

IV-1957; 1 larva (#34780), same locality, 26-V-1958, *Anolis chrysolepis*; 3 larvae (#34664), Majuba Road, Petit Valley, 17-XI-1957, "bird"; 2 larvae (#34157), Vega de Oropouche, Sangre Grande, 21-VIII-1956, *Leptoptila verreauxi*; 1 larva (#34430), Guayaguayare, 12-IV-1956, *Leptophis ahaetulla*; 2 larvae (#34677), Long Stretch, Sangre Grande, 11-III-1958, *Chironius carinatus*; 1 larva (#34682), Granville, 12-III-1958, *Ciccaba virgata*; 1 larva (#36675), same locality, 19-II-1960, *Tachyphonus rufus*; 1 larva (#36692), Fort Road, 23-II-1960, *Coccyzus minuta* (= *Piaya minuta*); 2 larvae (#34420), Sangre Grande, 22-III-1967, *Leptophis ahaetulla*; 4 larvae (#45787), Cumaca, 25-VI-1965, *Rhipidomys couesi*; 3 larvae (#45780), same locality, 16-V-1965, *Proechimys guyannensis*; 1 larva (#45783), same locality and host, 13-VI-1965; 2 larvae (#45785), same locality and host, 23-VI-1965; 1 larvae (#45786), same data; 2 larvae (#45789), same locality and host, 30-VI-1965; 1 larva (#45791), same locality and host, 7-VII-1965; 9 larvae (RML56201), Chaguaramas, 3to13-III-1970, *Herpestes auropunctatus*. C. O. R. Everard coll.; VENEZUELA – 2 larvae (RML55805), Altamira, Barinas, 22-XII-1967, *Didelphis marsupialis*. Sm./Army coll. DOMINICA – 4 larvae, South Chiltern, St. Luke Parish, 6-VI-1965, *Anolis bimaculatus*. Thomas H. G. Aitken coll. MEXICO – 1 larva (#34936), Tuxtla Gutierrez, Chiapas, 11to16-VII-1956, *Basiliscus vittatus*; PERU – 4 larvae (RML44503), Jungle stag, Loreto, 10-IX-1946. USA – 1 larva, Mendocino Co., California, 23-VII-1941, *Sceloporus occidentalis*; 1 larva (RML54007), Washburn orizon, 24-X-1969, *Chroicocephalus philadelphia* (= *Larus philadelphia*);

7.3.6. *Eutrombicula tinami* (Oudemans, 1910)

Microthrombidium tinami Oudemans, 1910: 84; 1912: 24.

Trombicula tinami: Methlagl, 1928: 216; Ewing, 1931: 10; Thor and Willman, 1947: 279.

Eutrombicula tinami: Ewing, 1938: 294; Radford, 1942: 67; Brennan & Lukoschus, 1971: 44; Brennan & Reed, 1974: 710; Brennan & Bronswijk, 1975: 246; Brennan & Reed, 1975: 52.

Otonyssus tinami: Buitendijk, 1944: 338.

Trombicula (*Eutrombicula*) *göldii*: Jenkins, 1949: 311.

Localities. South of Brasil (Oudemans, 1910; 1912); Fazenda Continente, Coronel Pacheco, Minas Gerais; Paraty, Rio de Janeiro; Instituto Butantan, São Paulo, (this paper).

General distribution. Panama, Surinam, Venezuela.

Birds hosts. *Leptotila verreauxi* (**Columbiformes: Columbidae**); *Formicarius colma* (**Passeriformes: Formicariidae**); *Chiroxiphia caudata* (**Passeriformes: Pipridae**); *Pyriglena leucoptera* (**Passeriformes: Thamnophilidae**); *Tachyphonus coronatus* (**Passeriformes: Thraupidae**); *Turdus albicollis*, *Turdus rufiventris* (**Passeriformes: Turdidae**); *Crypturellus noctivagu* (= *Crypturus noctivagus*) (**Tinamiformes: Tinamidae**)

Specimens examined. PANAMA - 5 larvae (#35229), Galeta Point, 23-II-1954, *Proechimys* sp.

New records

BRAZIL - 7 larvae (IBSP 12017B), Instituto Butantan, São Paulo, (23°34'03,49"S, 46°43'06.55"W), 29-I-2015, *Turdus rufiventris*; 6 larvae (IBSP 12018A), same data; 7 larvae (IBSP 12160), 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 12168A), 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 12182), same data; 6 larvae (IBSP 12184), same date; 6 larvae (IBSP 12165),

same locality and date, *Leptotila verreauxi*; 3 larvae (IBSP 12212), Paraty, Rio de Janeiro, (23°13'21"S, 44°42'50"W), 16-IV-2015, *Tachyphonus coronatus*; 14 larvae (IBSP 12213), same locality, 19-III-2015, *Formicarius colma*; 4 larvae (IBSP 12218), mesma localidade, 19-III-2015, *Turdus albicollis*; 1 larva (IBSP 12216B), same locality, 20-III-2015, *Pyriglena leucoptera*; 1 larva (IBSP 12732), same locality, no date, *Geotrigon montana*; Luciano Lima coll. 3 larvae (IBSP 12378), Fazenda Continente, Coronel Pacheco, Minas Gerais (21°35'16"S, 43°15'57"W), 9-I-2006, *Chiroxiphia caudata*.

Genus *Microtrombicula* Ewing, 1950

Type-species: *Microthrombidium minutissimum* Oudemans, 1910

7.3.7. *Microtrombicula* n. sp. Bassini-Silva & Jacinavicius

Localities. Fazenda Volta Grande, Santa Bárbara do Monte Verde, Minas Gerais.

Birds hosts. *Myiozetetes similis* (Passeriformes: Tyrannidae).

Specimens examined. HOLOTYPE: larva (IBSP 12374B), Fazenda Volta Grande, Santa Bárbara do Monte Verde, Minas Gerais, 25-IX-2014, *Myiozetetes similis* (Order Passeriformes), Ralph Maturano coll. PARATYPES: 3 larvae, same data.

Genus *Neoschoengastia* Ewing, 1929

Type-species: *Schöngastia americana* Hirst, 1921

7.3.8. *Neoschoengastia esorhina* Brennan, 1971

Neoschoengastia esorhina Brennan, 1971: 666

Localities. Ananindeua, Para (Brennan, 1971).

Birds hosts. *Automolus infuscatus* (Passeriformes: Furnariidae).

Specimens examined. HOLOTYPE: larva (RML 56193), Ananindeua, Para, Brazil, 28-VII-1970, *Automolus infuscatus*, Thomas H. G. Aitken coll. PARATYPES: 11 larvae (RML 56193), same data; 1 larva (RML 56194), same data; 1 larva (RML 56195), same data.

Genus *Parasecia* Loomis, 1966

Type-species: *Trombicula gurneyi* Ewing, 1937

7.3.9. *Parasecia fundata* Brennan, 1969

Fonsecia (*Parasecia*) *fundata* Brennan, 1969: 664.

Parasecia fundata: Goff, 1992: 967; Stekonilkov *et al.*, 2007: 66.

Localities. Utinga Forest and "APEG" Forest (Área de Pesquisa Ecológica do Guamá), Belém, Para; Serra do Navio, Amapá (Brennan, 1969).

General distribution. Costa Rica.

Birds hosts. *Melanerpes pucherani* (Piciformes: Picidae); *Glyphorhynchus spirurus* (Passeriformes: Dendrocolaptidae); *Xiphorhynchus susurrans* (Passeriformes: Furnariidae).

Specimens examined. HOLOTYPE: larva (RML 49323), Utinga Forest, Belém, Pará, Brazil, 5-I-1968, *Caluromys philander*; PARATYPE: 6 larvae (RML 49323), same data; Material: BRAZIL – 1 larva (RML 49354), Serra do Navio, Amapá, 6-III-1968, *Proechimys guyannensis*; 9 larvae (RML 49373), Área de Pesquisa Ecológica do Guamá (APEG forest),

Belém, Pará, 12-III-1968, *Glyphorhynchus spirurus*; 3 larvae (RML 50344), same locality and host, 13-VI-1968; 9 larvae (RML 49098), Utinga Forest, Belém, Pará, 8-IV-1968, *Didelphis marsupialis*.

7.3.10. *Parasecia manueli* (Brennan & Jones, 1960)

Trombicula manueli Brennan and Jones, 1960: 520; Brennan and Jones, 1961: 197; Brennan and Yunker, 1966: 255.

Fonsecia (Parasecia) manueli: Loomis, 1966: 191; Brennan, 1968: 684; Brennan, 1969: 666.

Fonsecia (Euneocula) manueli: Vercammen-Grandjean, 1967: 130.

Parasecia manueli: Brennan and Lukoschus, 1971: 44; Brennan and Reed, 1975: 59; Brennan and Bronswijk, 1975: 246; Goff, 1992: 967; Whitaker et al., 1993: 410; Daniel and Stekonilov, 2003: 149.

Localities. Belém, Para (Bassini-Silva et al., 2017).

General distribution. Colombia, Cuba, Panama, Peru, Surinam, Trinidad, Venezuela.

Birds hosts. *Dendrocincla fuliginosa* (**Passeriformes: Furnariidae**); *Tolmomyias flaviventris* (**Passeriformes: Rhynchocyclidae**); *Cyanerpes caeruleus*, *Tangara palmarum* (= *Thraupis palmarum*); (**Passeriformes: Thraupidae**); *Megarynchus pitangua*, *Myiarchus tuberculifer* (**Passeriformes: Tyrannidae**); *Colaptes rubiginosus* (= *Piculus rubiginosus*), *Phloeceastes melanoleucus* (= *Campephilus melanoleucus*), *Veniliornis kirkii* (**Piciformes: Picidae**).

Specimens examined. PARATYPE: larva (RML 33783), Maingot Estate, Trinidad, 9-IV-1956, *Zygodontomys brevicauda*; larva (RML 35055), Vega de Oropouche, Trinidad, 30-IX-1958, *Thraupis palmarum*. Material: BRAZIL – 6 larvae (RML 50354), Utinga Forest, Belém, Pará, 1-XI-1968, *Nectomys squamipes*; 6 larvae (RML 50355), same locality and host, 10-XI-1968; VENEZUELA – 2 larvae (RML 48155), Carabobo, 10km NW Urama, 11-III-1966, 1 larva (RML 48460), same locality and host, 15-III-1966; 1 larva (RML 48477), same

locality and host, 21-III-1966; 1 larva (RML 53651), Amazonas, Tamatana, 14-V-1967, *Rhipidomys* sp. Smithsonian Army coll.

7.3.11. *Parasecia thalurania* Brennan, 1969

Fonsecia (*Parasecia*) *thalurania* Brennan, 1969: 663.

Parasecia thalurania: Goff, 1992: 967.

Localities. Mocambo Forest and Área de Pesquisa Ecológica do Guamá (APEG forest), Belem, Para (Brennan, 1969).

Birds hosts. *Thalurania furcata* (Apodiformes: Trochilidae); *Glyphorhynchus spirurus* (Passeriformes: Dendrocolaptidae).

Specimens examined. HOLOTYPE: larva (RML 49374), Mocambo Forest, Belém, Pará, Brazil, 15-IV-1968, *Thalurania furcata*; Material: BRAZIL – 2 larvae (RML 50343), Mocambo Forest, Belém, Pará, 24-V-1968, *Glyphorhynchus spirurus*; 7 larvae (RML 50344), Área de Pesquisa Ecológica do Guamá (APEG forest), Belém, Pará, 13-VI-1968, same host. Thomas H. G. Aitken coll.

7.3.12. *Parasecia* n. sp.1 Bassini-Silva & Jacinavicius

Localities. Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais; Sítio Vista Alegre, Juiz de Fora, Minas Gerais; Fazenda Volta Grande, Santa Bárbara do Monte Verde, Estado de Minas Gerais; Paraty, Rio de Janeiro.

Birds hosts. *Dendrocincla turdina*, *Sittasomus griseicapillus*, *Xiphorhynchus fuscus* (**Passeriformes: Dendrocolaptidae**); *Troglodytes musculus* (**Passeriformes: Troglodytidae**); *Myiarchus ferox*, *Myiozetetes similis* (**Passeriformes: Tyrannidae**).

Specimens examined. HOLOTYPE: larva (IBSP 12326), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), Brasil, 24-V-2013, *Xiphorhynchus fuscus*; PARATYPES: 10 larvae (IBSP 12326), same data. Material: BRAZIL - 1 larva (IBSP 12328), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), 3-XII-2013, *Myiarchus ferox*; 2 larvae (IBSP 12330), same locality, 4-XII-2013, *Troglodytes musculus*; 2 larvae (IBSP 12337), same locality and host, 24-II-2014; 3 larvae (IBSP 12344B), same locality and host, 25-II-2014; 4 larvae (IBSP 12345B), same data; 3 larvae (IBSP 12369), same locality, 17-IV-2014, *Xiphorhynchus fuscus*; 2 larvae (IBSP 12373), same locality, 28-V-2014, *Sittasomus griseicapillus*; 2 larvae (IBSP 12334), Sítio Vista Alegre, Juiz de Fora, Minas Gerais, (21°43'50"S 43°21'44"W), 28-I-2014; 1 larva (IBSP 12374A), Fazenda Volta Grande, Santa Bárbara do Monte Verde, Estado de Minas Gerais, (21°57'32"S, 43°42'07"W), Brazil, 25-IX-2014, *Myiozetetes similis*, Ralph Maturano coll. 2 larvae (IBSP 12208), Paraty, Rio de Janeiro, (23°13'21"S, 44°42'50"W), 19-III-2015, *Dendrocincla turdina*, Luciano Lima coll.

7.3.13. *Parasecia* n. sp.2 Bassini-Silva & Barros-Battesti

Localities. Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais.

Birds hosts. *Xiphorhynchus fuscus* (Passeriformes: Dendrocolaptidae); *Troglodytes musculus* (Passeriformes: Troglodytidae);

Specimens examined. HOLOTYPE: larvae (IBSP 12349), Botanical Garden of Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais (21°46'29.49"S, 43°22'06.26"W), 24-III-2014, *Xiphorhynchus fuscus*, Ralph Maturano coll. PARATYPE: 1 larva (IBSP 12349), same data.

7.4. Discussion

The genus *Apolonia* has only one species described, *Apolonia tigipioensis*, this species was found twice in the northeast of the country and to date, it has been found parasitizing *Gallus gallus domesticus* in the original description. Besides that *A. tigipioensis* was collected on *Struthio camelus* and *Passer domesticus* (Ornelas-Almeida et al., 2007). The authors reported cases of human bites by these chiggers.

The genus *Blankaartia* comprises almost all the continents, with the exception of Antarctica. With six species for the Neotropical region, recently two were assigned to the country, *Blankaartia shatrovi* and *Blankaartia sinnamaryi* (Bassini-Silva et al., 2017). *B. shatrovi* was found only once and parasitized birds, while *B. sinnamaryi* has records on the entire American continent, parasitizing reptiles, birds and mammals. Both species were found in the southeastern region of Brazil.

The genus *Eutrombicula* includes more than 100 species distributed in the world, of which at least 40 occur in the Neotropical region. This genus does not have a parasitic specificity occurring in any terrestrial vertebrate. From Brazil, six species are known: *E. alfreddugesi*, *E. batatas*, *E. bruyanti*, *E. goeldii*, *E. plaumanni* and *E. tinami*. But only, *E. batatas* and *E. tinami*, has been marked as bird parasites. In the present study, we are

including new localities (Fazenda Continente, Coronel Pacheco, Minas Gerais and Instituto Butantan, São Paulo) and hosts (*Chiroxiphia caudata*, *Formicarius colma*, *Leptotila verreauxi*, *Pyriglena leucoptera*, *Tachyphonus coronatus*, *Turdus albicollis*, *Turdus rufiventris*) for *E. tinami* that now comprises the south and southeast region.

The genus *Microtrombicula*, like *Eutrombicula*, has a large number of species (about 150 species described), also has records all over the world, having records parasitizing reptiles, birds and mammals. In the neotropical region, we have about 31 species and 4 species described for Brazil, *Microtrombicula brachytrichia*, *Microtrombicula brennani*, *Microtrombicula rhipidomysi*, and *Microtrombicula* n. sp. Only *Microtrombicula* n. sp. was found parasitising a species of bird, *Myiozetetes similis*, described for the southeast region of the country (Bassini-Silva et al., 2017).

The genus *Neoschoensgatia* has about 50 species, most of them in the Neotropical region, only one species, *Neoschoensgatia esorhina*, was found in the northern region of the country, parasitizing *Automolus infuscatus*.

The genus *Parasecia* presents 20 species described exclusively for the Neotropical and Neotropical regions, and nine species have been described for Brazil. The species *Parasecia fundata*, *Parasecia manueli*, *Parasecia thalurania*, *Parasecia* n. sp.1 and *Parasecia* n. sp.2 were found parasitizing birds. *P. fundata*, *P. manueli* and *P. thalurania* were assigned to the northern region while *Parasecia* n. sp. 1 and *Parasecia* n. sp. 2 to the southeast region.

To the beginning of the present study, there were 12 species registered to the country that parasitize birds, with the recent collections, we are including *E. goeldii*. Now, with this checklist we can have the current parameter of the species of chigger mites of the country, showing that only the center-west region does not exist records of species that parasitize birds.

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CHAPTER 6: Cases of trombiculiasis in birds and assessment of *Rickettsia* spp. in chigger mites (Trombidiformes: Trombiculidae) from southeastern Brazil

Abstract. The larvae of the family Trombiculidae cause deep lesions and severe skin reactions in the host caused by their bites, which can lead to dermatitis, popularly known as trombiculiasis. For Brazil there are already records of this dermatitis, in the state of Mato Grosso (center-western region), and states of Maranhão and Amazonas (northeastern and northern regions, respectively). In Minas Gerais, 2023 birds were collected, of which at least 94 were parasitized with chiggers (4.6%) and chiggers collected in a bird presented *Rickettsia felis*.

Key words: dermatitis, chiggers, rickettsiosis

8.1. Introduction

The larvae of the family Trombiculidae cause deep lesions and severe skin reactions in the host (Hase et al., 1978) caused by their bites, which can lead to a dermatitis, popularly known as trombiculiasis. As it is well known, chiggers are not host specific and several cases of human bites have been reported. Heyne et al. (2001) reported for Africa a record of human trombiculiasis caused by *Leptotrombidium subquadratum* (Lawrence, 1951). In Asia and Oceania, the species *Eutrombicula wichmanni* (Oudemans, 1905) is the main species associated with human bites. In addition to this species, *Eutrombicula sarcina* (Womersley, 1944), *Neotrombicula nagayoi* (Sasa et al., 1950), some species of the genera *Odontacarus* and *Schoengastia* have also been reported (Takahashi et al., 2004a; Burns, 2010). Four species have already been reported to Europe, *Neotrombicula autumnalis* (Shaw, 1790), *Blankaartia acuscutellaris* (Walch, 1922), *Kepkatrombicula desaleri* (Methlagl, 1928) and *Trombicula toldti* (Winkler, 1953). It stands out *N. autumnalis* as the most frequent of the European continent (Ripka and Stekolnikov, 2006; Shatrov and Stekolnikov, 2011).

Mullen and O'Connor (2002) reported cases of human trombiculiasis caused by *Eutrombicula alfreddugesi* (Oudemans, 1910), *Eutrombicula lipovskyana* (Wolfenbarger, 1952) and *Eutrombicula splendens* (Ewing, 1913) for North America. For tropical countries, such as Bolivia, Brazil, Peru and Venezuela, chigger mites occur all year round, since the

favorable environment is always present, and the main species reported for these South American countries are *E. alfreddugesi* and *E. batatas*, with the exception of Peru. In this country the trombiculiasis is caused by *N. autumnalis* (Chaccour, 2005). In recent years the reported case are increasing, and for Brazil, Martens et al. (2012) reported that near of the Tapajós River in the Amazon region there was a case of trombiculiasis caused by *E. alfreddugesi*. A Swedish traveler also had persistent skin reactions following chigger bites on a trip to the state of Mato Grosso (Eitrem and Jaenson, 2012). Bronshteyn et al. (2016) reported that Russian tourists were bitten by chiggers and presented trombiculiasis when they visited natural areas, also in the Amazonian region of Brazil. They had contact with parrots and capybaras (*Hydrochoerus hydrochaeris*). Faccini et al. (2017) reported cases of trombiculiasis in goats and humans in the state of Maranhão.

Moreover, according to Hase et al. (1978), the species *Leptotrombidium intermedium* (Nagayo, Mitamura and Tamiya, 1920), *Leptotrombidium fletcheri* (Womersley and Heaslip, 1943), *Leptotrombidium arenicola* Traub, 1960 and *Leptotrombidium deliense* (Walch, 1922) are vectors of *Orientia tsutsugamushi*. In Japan, Takahashi et al. (2004) described the larvae of *Leptotrombidium pallidum* (Nagayo, Mitamura and Tamiya, 1920) also responsible for the spread of *O. tsutsugamushi* causing a human rickettsiosis - The tsutsugamushi. The rodents are natural reservoirs of this bacteria, and after feeding, the infected larvae transmit the pathogen to the following stages and subsequent generations (transestadial and transovarial transmission) (Rappmund et al., 1969; Phasomkusolsil et al., 2009). Thus, public health departments were faced with the need for cataloging and understanding the biology of these mites due to their potential vector role of *Rickettsia* spp. (Wharton and Fuller, 1952). Recently in Slovakia, two other species of *Rickettsia*, *Rickettsia monacensis* and *Rickettsia helvetica* were found in *Hirsutiella zachvatkini* (Schluger, 1948), and the bacteria *R. monacensis* was found in *Kepkatrombicula storkani* (Daniel, 1956) (Mitkova et al., 2015).

However, the actual role of chigger mites in the epidemiology of rickettsiosis is still unknown in the Neotropics (Azad and Beard, 1998; Poinar and Poinar, 1998). Despite this fact, there are records of other bacteria found in these chiggers. In Panama, Brennan and Yunker (1966) detected bacteria *Coxiella burneti* in the species *Intercutestrix mondolfi* (Brennan and Yunker, 1969). Subsequently, Yunker et al. (1975) were able to isolate *C. burneti* from the *I. mondolfii* collected on *Proechimys semispinosus* (Rodentia: Echimyidae) and also found serological evidence that the mite *Tecomatlana sandovali* Hoffmann, 1947 collected from bat *Saccopteryx bilineata* (Chiroptera: Emballonuridae) could be infected with that bacteria.

In Spain, the species *Neotrombicula autumnalis* (Shaw, 1790) was found naturally infected by *Anaplasma phagocytophilum* (Fernandez-Soto et al., 2001). In Germany, *N. autumnalis* was found infected with *Borrelia burgdorferi* sensu lato (Kampen et al., 2004). In the Czech Republic, the chiggers *N. autumnalis*, *Neotrombicula carpathica* Schluger and Vysotzkaja, 1970 and *Neotrombicula inopinata* (Oudemans, 1909) collected from birds were infected with *B. garinii* and *B. valaisiana* (Literak et al., 2008). Kabeya et al. (2010) detected *Bartonella tamiae* in some species of the genus *Leptotrombidium* collected from wild rodents in Thailand.

According to Varma (1964), in general, birds that migrate from Africa to Europe during the spring are infested with chigger mites. Once in Europe, the engorged chiggers drop from the hosts as the spring gets hotter. In early fall, adults are now ready to give birth to larvae that will infect other birds. These, in turn, migrate to Africa to escape the European winter. Therefore, migration provides the spread of pathogens between the continents. Dietsch (2005) observed that the feeding of the larvae Trombiculidae coincides with the birds migration process, at least in the region of Chiapas, México. In Brazil, the first cases of Brazilian Spotted Fever (BSF) were diagnosed in São Paulo, the tick species *Amblyomma*

sculptum Berlese, 1888 (cited at the time as *Amblyomma cajennense*)¹ and *Amblyomma aureolatum* (Pallas, 1772) were appointed as infested with *Rickettsia rickettsii* (Gomes, 1933). Currently, besides these tick species, there are others involved in the transmission cycle (Labruna, 2009). But Fonseca (1932) emphasized the importance of the bloodsucking mites as potential vectors in the epidemiological cycle of this rickettsial disease, nevertheless the role of these mites as vectors has never been confirmed.

The proposal of this study was to investigate rickettsiae in mites collected in wild birds from southeastern Brazil.

8.2. Material and Methods

Monthly collections were carried out from March 2013 to December 2015, with each collection corresponding to five-day campaign. Specific localities include: Botanical Garden of the Universidade Federal de Juiz de Fora, Juiz de Fora, Minas Gerais (21°43'50.0"S, 43°22'20.3"W); Fazenda Volta Grande, Santa Bárbara do Monte Verde, Minas Gerais (21°58'51.7"S, 43°41'46.1"W); Sítio Vista Alegre, Juiz de Fora, MG (21°48'23.0"S, 43°15'45.7"W); Site Paraíso da Barra, Chácara, Minas Gerais (21°40'18.2"S, 43°13'14.2"W); Granja Passarada, Juiz de Fora, Minas Gerais (21°48'24.8"S, 43°19'34.1"W). The birds were collected with catch net (mist net), and the mites obtained were stored in absolute alcohol and sent to the Acari collection of Butantan Institute (IBSP) for deposit and molecular studies. In addition to these specimens, some samples from São Paulo and Rio de Janeiro were used too.

These studies started with the extraction of DNA from the larvae collected from all these localities using the Guanidine Isothiocyanate (GIT) lysis protocols following

¹The species *Amblyomma cajennense* (Fabricius) forms a complex of species that currently comprises 6 taxa (BEATI et al., 2013; NAVA et al., 2014). In Brazil, *A. cajennense* sensu strictu is distributed from the Amazon region to the state of Mato Grosso, while *A. sculptum* occurs in the rest of Brazil, northern Argentina, Bolivia and Paraguay.

Chomkzynski (1993). Specimens were assessed individually. Each mite was placed in an Eppendorf mitrotube, later being punctured in the idiosomal region with a sterile needle (1.20 * 40 - 18G). After the DNA extraction the specimens were mounted in slides, as a *voucher* and deposited on IBSP.

For the endogenous control, two genes 18s and COI (cytochrome oxidase I gene) were tested according to table 1, and for detection of the presence of *Rickettsia* spp., each sample of extracted DNA will be tested by PCR using pairs of previously used *primers* in the literature, listed in table 1. Each reaction, positive and negative controls (autoclaved and DNA-free Milli-Q water) were used. For the gene 18s, samples were denatured at 94° C for 1 min and then PCR was carried out for 30 cycles of 20 seconds of denaturation at 94° C, 30 seconds annealing at 50° C and 1.5 min extension at 72° C. For the genes COI, *gltA*, *OmpA*, we followed the protocol suggested by the Greentag leaflet, then samples were denatured at 95° C for 1.5 min and the PCR was carried out for 30, 39 and 35 cycles, respectively of 30 seconds of denaturation at 95° C, 30 seconds annealing at 50°, 50° and 48° C, respectively and 1 min extension at 72° C. The PCR's were repeated three times for all genes tested.

Purification of these samples was performed with commercial Kit Qiagen® MinElute® “For gel extraction of DNA fragments (70 bp to 4 kb) in low elution volumes” following manufacture instructions. Sequencing of the samples was performed in the “Centro de pesquisa sobre Genoma Humano e Células Tronco do Instituto de Biociências da USP”. Sanger sequencing was performed and sequences were analyzed with the software Sequencing Analysis 5.3.1. Sequences were then compared with those deposited in the GenBank and deposited in that database.

Table 1. Nucleotide sequence of the *primers* for endogenous control and detection of *Rickettsia* sp.

Specificity	Genes	Primers and Sequence of <i>primers</i> (5'- 3')	Fragment size	Reference
Chiggers	18S	18S–1R: ATATTGGAGGGCAAGTCTGG 18S-1R : TGGCATCGTTTATGGTTAG	~650pb	Otto and Wilson (2001)
	COI-1	CI-J-175I: GGWGCWCCWGAYATRGCWTTYCC CI-N-219I: GGWARAATTAAAATATAWACTTC	950pb	
		772: TGATTTTTTTGGTCACCCAGAAG 773: TACAGCTCCTATAGATAAAAC	408pb	Navajas et al. (1994)
<i>Rickettsia</i> ssp.	gltA	CS 78 F: GCAAGTATCGGTGAGGATGTAAT CS 323 R: GCTTCCTTAAAATTCAATAAATCAGGAT	401 pb	Labruna et al. (2004)
<i>Rickettsia</i> SFG*	OmpA	Rr 190.70 F: ATGGCGAATATTTCTCCAAAA Rr 190.701 R: GTTCCGTTAATGGCAGCATCT	532 pb	Regnery et al. (1991)

**Rickettsia* of the Spotted Fever Group

8.3. Results

A total of 2023 birds were collected from Minas Gerais, of which at least 94 were parasitized with chiggers (4.6%). These mites were collected from different regions of the body of the birds and all mites collected in the cloaca of the birds were identified as species of the genus *Parasecia*, differently from the chigger mites collected in the flank regions and up in the body of the birds (Fig. 1). Were almost exclusively species of the genus *Blankaartia*, when there were no specimens of this genus, there were specimens of the genus *Microtrombicula*. In the state of São Paulo, 166 birds were collected, of which 22 were parasitized by chiggers (13.2%) and only mites of the genus *Eutrombicula* were found in the auricular region and around the eyes. While in the state of Rio de Janeiro, 116 birds were collected and 16 were parasitized with these mites (13.7%), in these birds the premise that specimens of the genus *Parasecia* are only found in cloaca if it remained, as well as for specimens of *Blankaartia* and *Eutrombicula* (Fig. 1).

The parasitism of two different genus specimens was not observed in the same region on the body of the birds collected. The parasitism of these mites is so remarkable that even after leaving the bird, we can infer that the bird was parasitized by these mites (Fig. 2).

Figure 1. Parasitized regions of chiggers in birds. Region yellow: genus *Blankaartia*; region purple: genus *Parasecia*; region green: genus *Eutrombicula*; and region orange: genus *Microtrombicula*.

Figure 2. Chiggers parasitizing birds. A. *Pyriglena leucoptera* parazited by *Blankaartia*; B. *Turdus rufiventris* parazited by *Eutrombicula*; C. *Troglodytes musculus* parazited by *Blankaartia*; D. *Troglodytes musculus* parazited by *Blankaartia*.

Forty one specimens of these mites were submitted to DNA extraction by GT, and the following quantities of DNA were obtained, according to the Table 2 that is in the Appendix 1. Afterwards, the genes for the endogenous control were tested, only the 18s gene amplified for 29 samples, whereas for all the *primers* tested for the gene COI, none of the samples amplified. Of the samples that amplified for 18s, three sequences were obtained, then when submitted to BLAST analysis, were 99% identical to the corresponding sequence of *Eutrombicula splendens* (KP325057.1). On the other hand, all 41 samples were submitted to PCR for the detection of *Rickettsia* spp., for the gene *gltA*, and we obtained three samples that amplified. These three samples were tested for *Rickettsia* of the Spotted Fever Group, but none of them amplified. Samples were sent to the “Centro de Pesquisa sobre o Genoma Humano e Células Tronco”, and also compared in the BLAST analysis. Results showed 100% similarity with *Rickettsia felis* (AF210692.1, JX402763.1 and JN375498.1).

8.4. Discussion

Several local lesions on the body of the birds were observed due to the large number of chiggers (Fig. 2). Similar injuries have already been observed by Michener (1946), Torres and Braga (1939) and Spalding et al. (1997). In Panama, Michener collected the species *Blankaartia alleei* (Ewing, 1926) parasitizing several injured birds and commented on his possible dermatitis caused by mites in the same way as Torres and Braga (1939) when described *Apolonia tigipioesis* Torres and Braga, 1939 causing nodular lesions on the quill of domestic chickens. The third and most recent report on these lesions was that of Spalding et al. (1997), which reported the species *Blankaartia sinnamaryi* (Floch and Fauran, 1956) causing dermatitis similar to *A. tigipioensis* in domestic chickens in Florida, USA. This is the same species that was found causing deep lesions in the recent material collected in the southeastern region of Brazil, reported in this study.

All sequences for the gene 18s were compatible with the sequence of *E. splendens*. This is probably due to the fact that there are few sequences deposited. Unfortunately, the gene 18s fragment is common for many taxa and we cannot affirm that our species belongs to that genus, mainly because we tested two different chigger genera. Nonetheless, although we still need more sequences in the Genbank for comparisons to be substantiated, the chigger specimens here analyzed are within the Trombiculidae Family, increasing the chigger sequences deposited in the GenBank.

Other species of the bacteria *Rickettsia* were found in chiggers on the European and Asian continent (Hase et al., 1978; Takahashi et al., 2004; Mitkova et al., 2015). In Taiwan and South Korea, the bacteria *Rickettsia felis*, were found in specimens of chiggers collected on rodents (Choi et al., 2007 and Tsui et al., 2007). There are only suppositions that chiggers found with *Rickettsia* spp. were collected from rodents in the American continent (Fonseca, 1932). In this study, one bird (*Tachyphonus coronatus*) was found parasitized with chigger mites infected with *R. felis*. This species of bacteria is found mainly in fleas that parasitize mammals (Pérez-Osorio, et al., 2008). However, the chigger *B. sinnamaryi* has no host specificity, being able to parasite reptiles, birds or mammals that are in the same environment (Spalding et al., 1997). Ticks infected with *Rickettsia* spp. were also collected on birds in the southeastern region of the country (Cardoso et al., 2006; Zeringóta, et al., 2017). In these recent collections, we observed the presence of chiggers and ticks feeding together on the same hosts, although nor mites or ticks showed infection with *Rickettsia* spp.

We believe that *R. felis* was detected in the chiggers parasitizing *T. coronatus* by a possible transovarian and transstadial transmission. These kinds of transmission have already been recorded for other rickettsiosis, *Orientia tsutsugamushi* (Rappmund et al., 1969; Phasomkusolsil et al., 2009).

Thus, this is the first record of *Rickettsia felis* found in mites of the family Trombiculidae for South America.

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Appendix

Table 2. Quantification of DNA in the species investigated in spectrophotometer.

Identification	Species	DNA Quantity (ng/ µl)	18S	gltA	OmpA1
IBSP 12731	<i>Blankaartia sinnamaryi</i>	29,6	A	NA	NA
IBSP 12731	<i>Blankaartia sinnamaryi</i>	18,8	A	NA	NA
IBSP 12211	<i>Blankaartia sinnamaryi</i>	97	A	NA	NA
IBSP 12791	<i>Blankaartia sinnamaryi</i>	73,3	NA	NA	NA
IBSP 12791	<i>Blankaartia sinnamaryi</i>	51,8	A	NA	NA
IBSP 10711	<i>Blankaartia sinnamaryi</i>	137	NA	NA	NA
IBSP 10711	<i>Blankaartia sinnamaryi</i>	320,9	NA	NA	NA
IBSP 10711	<i>Blankaartia sinnamaryi</i>	103,8	NA	NA	NA
IBSP 10711	<i>Blankaartia sinnamaryi</i>	97,3	NA	NA	NA
IBSP 12323A	<i>Blankaartia sinnamaryi</i>	96,4	NA	NA	NA
IBSP 12331	<i>Blankaartia sinnamaryi</i>	140,7	A	NA	NA
IBSP 12336	<i>Blankaartia sinnamaryi</i>	50,9	A	NA	NA
IBSP 12338	<i>Blankaartia sinnamaryi</i>	225,6	A	NA	NA
IBSP 12340	<i>Blankaartia sinnamaryi</i>	125,8	NA	NA	NA
IBSP 12342	<i>Blankaartia sinnamaryi</i>	121,7	A	NA	NA
IBSP 12343	<i>Blankaartia sinnamaryi</i>	130,5	A	NA	NA
IBSP 12344A	<i>Blankaartia sinnamaryi</i>	81,5	A	NA	NA
IBSP 12345A	<i>Blankaartia sinnamaryi</i>	14,7	A	NA	NA
IBSP 12345A	<i>Blankaartia sinnamaryi</i>	74,6	A	NA	NA
IBSP 12345A	<i>Blankaartia sinnamaryi</i>	241,3	A	NA	NA
IBSP 12348	<i>Blankaartia sinnamaryi</i>	193,5	A	NA	NA
IBSP 12350	<i>Blankaartia sinnamaryi</i>	298,5	A	NA	NA
IBSP 12351	<i>Blankaartia sinnamaryi</i>	231,9	A	NA	NA
IBSP 12354	<i>Blankaartia sinnamaryi</i>	178,8	A	A	NA
IBSP 12354	<i>Blankaartia sinnamaryi</i>	117,8	A	NA	NA
IBSP 12354	<i>Blankaartia sinnamaryi</i>	174,4	A	NA	NA
IBSP 12354	<i>Blankaartia sinnamaryi</i>	336,4	A	NA	NA
IBSP 12354	<i>Blankaartia sinnamaryi</i>	368,2	A	A	NA
IBSP 12733	<i>Eutrombicula goeldii</i>	67,6	NA	NA	NA
IBSP 12733	<i>Eutrombicula goeldii</i>	154,4	NA	NA	NA
IBSP 12733	<i>Eutrombicula goeldii</i>	97,3	NA	NA	NA
IBSP 12213	<i>Eutrombicula tinami</i>	127	A	NA	NA
IBSP 12213	<i>Eutrombicula tinami</i>	49,2	A	NA	NA
IBSP 12213	<i>Eutrombicula tinami</i>	227,3	A	NA	NA
IBSP 12218	<i>Eutrombicula tinami</i>	89,9	A	NA	NA
IBSP 12160	<i>Eutrombicula tinami</i>	129,7	A	A	NA
IBSP 12178	<i>Eutrombicula tinami</i>	172	NA	NA	NA
IBSP 12178	<i>Eutrombicula tinami</i>	212,9	A	NA	NA
IBSP 12165	<i>Eutrombicula tinami</i>	70	NA	NA	NA
IBSP 12345B	<i>Parasecia n. sp.1</i>	138,6	NA	NA	NA
IBSP 12345B	<i>Parasecia n. sp.1</i>	120,1	A	NA	NA

A, amplified; NA, not amplified

9. CONCLUSION

- A new species of *Blankaartia* was collected on bird in the region of São Paulo and in Coronel Pacheco, Minas Gerais.
- The species *Blankaartia sinnamaryi* was found for the first time in Brazil, being the localities in the states of Minas Gerais, Rio de Janeiro and São Paulo all new records, and *Arremon semitorquatus*, *Chiroxiphia caudata*, *Colaptes melanochloros*, *Conopophaga lineata*, *Lathrotriccus euleri*, *Manacus manacus*, *Myrmoderus squamosus*, *Picumnus cirratus*, *Pyriglena leucoptera*, *Synallaxis spixi*, *Troglodytes musculus* are new host records.
- Three other new host records (*Aratinga finschi*, *Ceratopipra erythrocephala*, *Zentrygon lawrencii*) are here reported for *B. sinnamaryi*.
- Currently, there are five species for the Nearctic and Neotropical regions, *B. alleei*, *B. avis*, *B. shatrovi*, *B. sinnamaryi* and *B. velascoi*.
- A new species of *Microtrombicula* was collected in the Botanical Garden of the Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, Minas Gerais, Brazil. This is the first record of birds (*Myiozetetes similis*) being parasitized by this chigger mite in South America.
- We provide new records of localities in Peru (Rio Santa Rosa, Puno and Tacna) and a new host (*Hesperomys* sp.) for the species *P. chara*.

- We provide a new record of host (*Mimon crenulatum*) for the species *P. longicalcar*.
- We provide a new record of locality to Brazil (Área de Pesquisa Ecológica do Guamá - APEG forest, Belém, Pará) and a new host (*Glyphorhynchus spirurus*) for the species *P. thalurania*.
- The occurrence of the species *P. manueli* is reported for the first time in Brazil with new host record (*Nectomys squamipes*).
- Two new species of *Parasecia* were collected on birds in the southeastern region of the country.
- Currently, there are 20 species for the genus *Parasecia*: *P. aitkeni*, *P. argentinensis*, *P. campestris*, *P. chara*, *P. dunni*, *P. fundata*, *P. gurneyi*, *P. kansasensis*, *P. lasiurus*, *P. longicalcar*, *P. manueli*, *P. molini*, *P. orphana*, *P. psittaci*, *P. soucouyanti*, *P. thalurania*, *P. valida*, *Parasecia* n. sp.1, *Parasecia* n. sp.2, *Parasecia* n. sp.3. Nine of them have records in Brazil.
- New localities were included of the species *E. tinami*: Coronel Pacheco, Minas Gerais and Instituto Butantan, São Paulo, São Paulo. The species of birds *C. caudata*, *F. colma*, *L. verreauxi*, *P. leucoptera*, *T. coronatus*, *Turdus albicollis*, *T. rufiventris* are new records for hosts.
- The species *E. goeldii* was found for the first time in Brazil parasitizing birds.

- To date, there are 13 species of chigger mites that parasitize birds in Brazil. These species of mites are distributed throughout the country, except for the central west region.
- The species *Blankaartia sinnamaryi* collected from a bird was found with *R. felis*, and this becomes the first finding for the Trombiculidae Family for South America.

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Research article

OXFORD

Morphology, Systematics, Evolution

Description of *Blankaartia shatrovi* n. sp. (Acari: Trombiculidae) From Brazil

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Abstract

The chigger mite genus *Blankaartia* includes 28 known species, of which 10 are distributed in the Nearctic and Neotropical regions. These species preferentially parasitize birds, but occasionally they can also be found on rodents, bats, and reptiles, showing low host selectivity. In the present study, we report the presence of this genus in Brazil for the first time, including the first report of *Blankaartia sinnamaryi* (Floch and Fauran) and the description of a new species of *Blankaartia* collected from birds (Order Passeriformes).

Key words: new species, chigger mite, bird, Brazil

The genus *Blankaartia* Oudemans (1911) includes 28 species worldwide. Ten are distributed in the Nearctic and Neotropical regions (Table 1). Since the description of *Blankaartia pauli* Crossley and Ayres (1972), no new taxa have been described.

In the monograph by Wharton and Fuller (1952), a list of chiggers around the world was compiled. In that list, Brazil was represented by eight genera and 18 species. Fonseca (1955) added another record to the country, including bites reported in humans. Brennan and Goff (1977) listed 87 genera of chiggers in the Nearctic and Neotropical regions, of which 18 were cited as present in Brazil, including 53 species of chigger mites. Of these, 5 species are parasites on amphibians, 6 species on birds, 4 species on reptiles, 25 species on rodents, 8 species on marsupials, and 12 species on other mammals such as primates, horses, anteaters, and humans (Brennan and Goff 1977).

A new species of *Blankaartia* found in the Acari Collection of Instituto Butantan, São Paulo (IBSP), is described here. We also report the presence of *B. sinnamaryi* on Brazilian birds for the first time. Additional material from the new species was collected from birds in the state of Minas Gerais, southeastern Brazil.

Materials and Methods

The specimens of the new species (holotype and paratypes) were collected in 1932 and were preserved in ethanol (70%). These specimens were slide-mounted in Hoyer's medium, according to Walter and Krantz (2009). Recently, additional material was collected from a bird in Minas Gerais, and was also mounted on slides in Hoyer's

medium. Specimens of *B. sinnamaryi* were also mounted on slides. The hosts of both species were collected by means of mist nets, and shortly thereafter, biometric examination was conducted. The mites were removed from the birds, using light scarification according to Fan (1964) and Lizaso (1981), and the birds were then released.

Morphological examination was performed and measurements and drawings were made using a Leica DFC 500 digital camera coupled to a Leica DM4000B optical microscope. Extended focal range images were composed using the Leica Application Suite version 2.5.0. Images of the dorsal idiosomal setae, odontus, and galealae from the new species and from *B. sinnamaryi* were made using Nikon Eclipse 80i. The confocal images of the odontus were made using Zeiss LSM 510 Meta. The figures were prepared using Adobe Photoshop v. 13.0 and Inkscape V. 2. All the measurements were made in micrometers (μm), followed by mean and standard deviation. The holotype and paratype measurements are highlighted.

The new species was compared with the original descriptions of known *Blankaartia* species, and with types and other material deposited (Appendix 1) in the NMNH (National Museum of Natural History) Smithsonian Acari Collection, which is housed at the Systematic Entomology Laboratory (BARC-USDA-ARS).

We partly followed the terminology of Goff et al. (1982), with adaptations proposed by Stekolnikov (2008) and Stekolnikov and Daniel (2012) for the general nomenclature of trombiculid mites. On the other hand, in order to standardize the nomenclature of the specialized setae of the Prostigmata group, we adopted the terminology that was proposed by Kethley (1990) and subsequently used by Wohltmann et al. (2006). The specialized setae are as follows: