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ANÁLISE FILOGENÉTICA MOLECULAR DAS ARANHAS-CARANGUEJO DO GÊNERO *MISUMENOPS* PICKARD-CAMBRIDGE, 1900 — COM A REVISÃO DO GÊNERO *RUNCINIOIDES* MELLO-LEITÃO, 1929 (ARANEAE, THOMISIDAE)

Belo Horizonte

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Orientador: Adalberto José dos Santos

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ATA DE DEFESA DE TESE DE DOUTORADO

Bárbara Teixeira Faleiro

Ao trigésimo dia do mês de abril do ano de dois mil e dezenove, às quatorze horas, na Universidade Federal de Minas Gerais, teve lugar a defesa de Doutorado da Pós-Graduação em Zoologia, de autoria da Doutoranda Bárbara Teixeira Faleiro intitulada: **"Análise filogenética molecular das aranhas-caranguejo do gênero *Misumenops* Pickard-Cambridge, 1900 – com a revisão do gênero *Runcinioides* Mello-Leitão, 1929 (Araneae, Thomisidae)".** Abrindo a sessão, o Presidente da Comissão, Prof. Dr. Adalberto José dos Santos, após dar a conhecer aos presentes o teor das Normas Regulamentares do Trabalho Final, passou a palavra para a candidata para apresentação de seu trabalho.

Esteve presente a Banca Examinadora composta pelos membros: Almir Rogério Pepato, Daniele Polotow Geraldo, Humberto Yoji Yamaguti, Kirstern Lica Follmann Haseyama, e demais convidados. Seguiu-se a arguição pelos examinadores, com a respectiva defesa da candidata.

Após a argüição, apenas os Srs. Examinadores permaneceram na sala para avaliação e deliberação acerca do resultado final, a saber: o trabalho foi:

- [x] Aprovado sem alterações
- [ ] Aprovado com alterações (observações em anexo)
- [ ] Reprovado

Nada mais havendo a tratar, o Presidente da Comisão encerrou a reunião e lavrou a presente ata, que será assinada por todos os membros participantes da Comissão Examinadora.

Belo Horizonte, 30 de abril de 2019.

Comissão Examinadora	Assinatura
Prof. Dr. Adalberto José dos Santos (Orientador)	
Prof. Dr. Almir Rogério Pepato	
Profa. Dra. Daniele Polotow Geraldo	
Prof. Dr. Humberto Yoji Yamaguti	
Profa. Dra. Kirstern Lica Follmann Haseyama	

Advertência

Esta tese não é uma publicação, conforme descrito no capítulo 3 do CÓDIGO INTERNACIONAL DE NOMECLATURA ZOOLÓGICA. Portanto, as mudanças taxonômicas propostas aqui não têm validade para fins de nomenclatura.

Warning

This thesis is not a publication as described in the third chapter of the INTERNATIONAL CODE OF ZOOLOGICAL NOMECLATURE. Hence the taxonomic changes proposed here are not valid for nomeclatural purposes.

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“Há uma limitação desconcertante de nossa mente: nossa confiança excessiva no que acreditamos saber, e nossa aparente incapacidade de admitir a verdadeira extensão da nossa ignorância e a incerteza do mundo em que vivemos. ”

Daniel Kahneman

Rápido e Devagar: Duas Formas de Pensar

Resumo

A família Thomisidae Sundevall, 1833 é constituída por 2163 espécies distribuídas em 170 gêneros. As aranhas dessa família podem ser facilmente reconhecidas por suas pernas I e II serem muito maiores e mais robustas que as demais e por seus olhos laterais localizados em tubérculos. Thomisidae é dividida em seis subfamílias, incluindo Misumeninae, foco desse trabalho. Foi feito uma filogenia molecular do gênero *Misumenops* (capitulo 1) e uma revisão taxonômica do gênero *Runcinioides* (capitulo 2), ambos pertencentes a essa subfamilia. A filogenia de *Misumenops* mostrou que o genero não é monofiletico. Os resultados também demonstraram que as especies do Velho Mundo, atualmente alocadas em *Misumenops*, devem ser transferidas para outros genêros. O genêro *Runcinioides* foi revisado, incluindo a redescrição das espécies *R. argenteus* Mello-Leitão, 1929 and *R. litteratus* (Piza, 1933). O macho de *R. Litteratus* foi descrito e ilustrado pela primeira veze *Misumenops paranensis* (Mello-Leitão, 1932) foi aqui considerado sinônimo júnior de *R. argenteus*. A distribuição geografica das duas espécies foi expandida com a inclusão de novo dados de ocorrência. *Runcinioides pustulatus* Mello-Leitão, 1929 and *Runcinioides souzai* Soares, 1942 não são relacionados com as demais espécies do genêro, e foram provisoriamente consideradas com *incertae sedis.*

Palavras-chave: Misumeninae, filogenia, redescrição.

Abstract

The family Thomisidae Sundevall, 1833 is consists of 2163 species distributed in 170 genera. Spiders of this family can be easily recognized by their legs I and II much larger and more robust than the others and by their lateral eyeslocated in tubercles. Thomisidae is divided into six subfamilies, including Misumeninae, the focus of this work. A molecular phylogeny of the genus *Misumenops* (chapter 1) and a taxonomic review of the genus *Runcinioides* (chapter 2) were carried out, both belonging to this subfamily. The *Misumenops* phylogeny showed that the genus isn't monophyletic. The results also demonstrate that Old World species currently lodged in *Misumenops* should be transferred from the genus. The genus *Runcinioides* is revised, including the redescription of *R. argenteus* Mello-Leitão, 1929 and *R. litteratus* (Piza, 1933). The male of *R. litteratus* is described and illustrated for the first time and *Misumenops paranensis* (Mello-Leitão, 1932) is here considered a junior synonym of *R. argenteus*. The known geographic distribution of both species is expanded with the inclusion of new occurrence data. *Runcinioides pustulatus* Mello-Leitão, 1929 and *Runcinioides souzai* Soares, 1942 are not related to the other species of the genus, and provisionally considered as *incertae sedis*.

Keywords: Misumeninae, phylogeny, redescription.

SUMÁRIO

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Prefacio

A família Thomisidae Sundevall, 1833 é uma das mais antigas famílias de aranhas, perdendo apenas para Araneidae Clerck, 1757 que, obviamente, foi a primeira família a ser descrita. Além de muito antiga, Thomisidae é muito diversificada, constituída por 2163 espécies distribuídas em 170 gêneros (World Spider Catalog, 2019). Apesar dos seus representantes não construírem a clássica teia de captura, elas caçam pelo modo senta-e-espera (Wise, 1993), suas peculiares características morfológicas e ecológicas vêm chamando a atenção dos pesquisadores há décadas. Elas receberam o nome popular de aranha-caranguejo porque, como eles, são capazes de andar de lado, além de suas pernas I e II serem muito maiores e mais robustas que as demais, assemelhando-se às quelas do caranguejo (Foelix, 2011) (Fig. 1a, c–d). Ademais dessa diferença de tamanho entre as pernas, as aranhas da família Thomisidae podem ser facilmente reconhecidas por seus simpáticos olhos laterais localizados em tubérculos (Dondale, 2005) (Fig. 1b). As Thomisidae utilizam suas fortes pernas anteriores e seu poderoso veneno para capturar suas presas, geralmente insetos (Comstock, 1948) (Fig. 1c). Muitas delas, em especial as da tribo Misumenini abordadas nesse trabalho, vivem associadas a flores e possuem uma coloração críptica (Wise, 1993) (Fig. 1c–d). Contudo, o mais incrível é que algumas espécies são capazes de mudarem de cor durante a vida, adaptando-se a cor da flor em que vive (Heckel, 1891; Packard, 1905). Mas não para por aí, estudos mostraram que essas aranhas não só são capazes de se camuflar no espectro da luz visível, com também no ultravioleta, apresentando uma reflectância similar ao da flor (Chittka, 2001). Dessa forma elas conseguem enganar os polinizadores, geralmente abelhas, que enxergam na faixa do ultravioleta e devora-los. Devido a essas características, elas desempenham um importante papel ecológico, defendendo plantas contra insetos herbívoros (Yasuda & Kimura, 2001; Romero e Vasconcellos-Neto, 2007), e para o homem, como predadoras de pragas em agroecossistemas (Agnew & Smith, 1989; Maloney et al., 2003).

Algum tempo depois da família Thomsidae ter sido descrita, ela já possuía vários gêneros, tornando-se necessário organiza-los em grupos. Veremos que a organização e delimitação desses grupos é bastante confusa ao longo dos anos. Começamos pelo aracnólogo francês Eugène Simon (1848–1924) que foi o primeiro a propor divisões acima de gênero para a família. Simon (1895) dividiu Thomisidae em seis subfamílias, entre elas a

subfamília Misumeninae, foco desse trabalho. Misumeninae foi que subdividida por Simon (1895) em 18 grupos, incluindo o grupo Misumeneae. Em 1900 foi finalmente descrito pelo britânico Frederick O. Pickard-Cambridge (1860–1905) o gênero foco do capitulo 1: *Misumenops*, originalmente colocado na subfamília Misumeninae. Somente após 33 anos a classificação de Simon (1895) sofrerá alterações. O aracnólogo russo-americano Alexander I. Petrunkevitch (1875–1964) em seu "*Systema Aranearum*" (Petrunkevitch, 1928) separou parte de Misumeninae, criando a subfamília Dietinae, mas mantem *Misumenops* dentro de Misumeninae, e revogou as subdivisões internas da subfamília. No ano seguinte, o brasileiro Cândido F. de Mello-Leitão (1886–1948) publicou sua monumental monografia dos Thomisidae brasileiros (Mello-Leitão, 1929). Nesta obra, ele descreve o gênero *Runcinioides*, foco do capítulo 2. Mas a estória da classificação dos Misumeninae não parou por aí, já que em 1955 o alemão Karl F. Roewer (1881–1963) publicou um detalhado catálago das aranhas do mundo, e nele retomou a subdivisão de Simon, propondo 14 subgrupos em Misumeninae. Nesta classificação, ele alocou nossos gêneros de interesse, *Misumenops* e *Runcinioides*, no grupo Misumeneae. Finalmente, em 1988 o japonês Hirotsugu Ono propõe uma revisão da classificação dos Thomisidae, alterando o nome da subfamília para Thomisinae, de acordo com o gênero-tipo da família (*Thomisus*), que sempre fez parte dessa subfamília. Ele também separou parte dos gêneros da subfamília, que foram alojados na nova subfamília Bominae. A monografia de Ono (1988) manteve a subdivisões dentro das subfamílias, mas passou a trata- las como tribos. Não deixa de ser curioso que os dois gêneros abordados nesta tese, que já foram considerados sinônimos (veja capítulo 2), tenham sido alocados em tribos diferentes, *Misumenops* permanecendo em Misumenini, e *Runcinioides* transferido para Thomisini. Encerrando nossa história, chegamos em 2005, quando o finlandês Pekka Lehtinen (1934–) revisou e redelimitou a tribo Misumenini para as regiões paleártica e oriental. Nesse trabalho, Lehtinen (2005) reúne na tribo Misumenini 19 gêneros que compartilham algumas características morfológicas, como a presença de um capuz na genitália da fêmea. De fato, a história taxonômica da tribo Misumenini é bem confusa, mas para ajudar pode-se ver o resumo dessas mudanças na Tabela 1.

Como vimos, identificar e classificar os representantes da família Thomisidae, em especial da tribo Misumenini, é algo bem complexo. Isso se deve em grande parte pelo fato da maioria dos gêneros da tribo não terem sido revisados. Muitas espécies contam apenas com o artigo de descrição original, que em geral é muito antigo, apresentando descrições

sucintas e ilustrações pouco informativas, quando presentes. Além disso existem poucos trabalhos filogenéticos focados em Misumenini, e menos ainda focados nos gêneros específicos, deixando a relação entre os gêneros e entre as espécies obscuras. Diante disso, com o objetivo de preencher um pouco da lacuna sistemática da tribo Misumenini, esse trabalho apresenta uma filogenia molecular do gênero *Misumenops* (capitulo 1) e uma revisão taxonômica do gênero *Runcinioides* (capitulo 2).

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Tabela 1. Histórico taxonômico dos gêneros da tribo Misumenini, como delimitado por Letinen (2005). (Gr. = grupo; Sf. = Subfamília; Tr. = tribo)

Gênero	**SIMON, 1895**	**PETRUNKEVITCH, 1928**	**ROEWER, 1955**	**ONO, 1988**	**LEHTINEN, 2005**
Ansiea	_	_	_	_	Tr. Misumenini
Cyriogonus	Gr. Misumeneae	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini
Ebelingia	_	_	_	_	Tr. Misumenini
Ebrechtella	_	_	Sf. Stephanopinae	Tr. Stephanopinae	Tr. Misumenini
Erissoides	_	_	Sf. Stephanopinae	Tr. Stephanopinae	Tr. Misumenini
Henriksenia	_	_	_	_	Tr. Misumenini
Ledouxia	_	_	_	_	Tr. Misumenini
Loxoporetes	_	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini
Mastira	_	_	_	_	Tr. Misumenini
Mecaphesa	_	Sf. Misumeninae	Gr. Diaeae	Tr. Misumenini	Tr. Misumenini
Metadiaea	_	_	Gr. Diaeae	_	Tr. Misumenini
Misumena	Gr. Misumeneae	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini
Misumenoides	_	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini
Misumenops	_	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini
Pistius	Gr. Misumeneae	Sf. Misumeninae	Gr. Misumeneae	Tr. Misumenini	Tr. Misumenini

Runcinia	Gr. Misumeneae	Sf. Misumeninae	Gr. Misumeneae	Tr. Thomisini	Tr. Misumenini
Runcinioides	_	_	Gr. Misumeneae	Tr. Thomisini	Tr. Misumenini
Uraarachene	GENUS INVISUM	Sf. Misumeninae	Gr. Uraarachneae	Tr. Uraarachinini	Tr. Misumenini
Zygometis	_	Sf. Misumeninae	Gr. Misumeneae	Tr. Thomisini	Tr. Misumenini

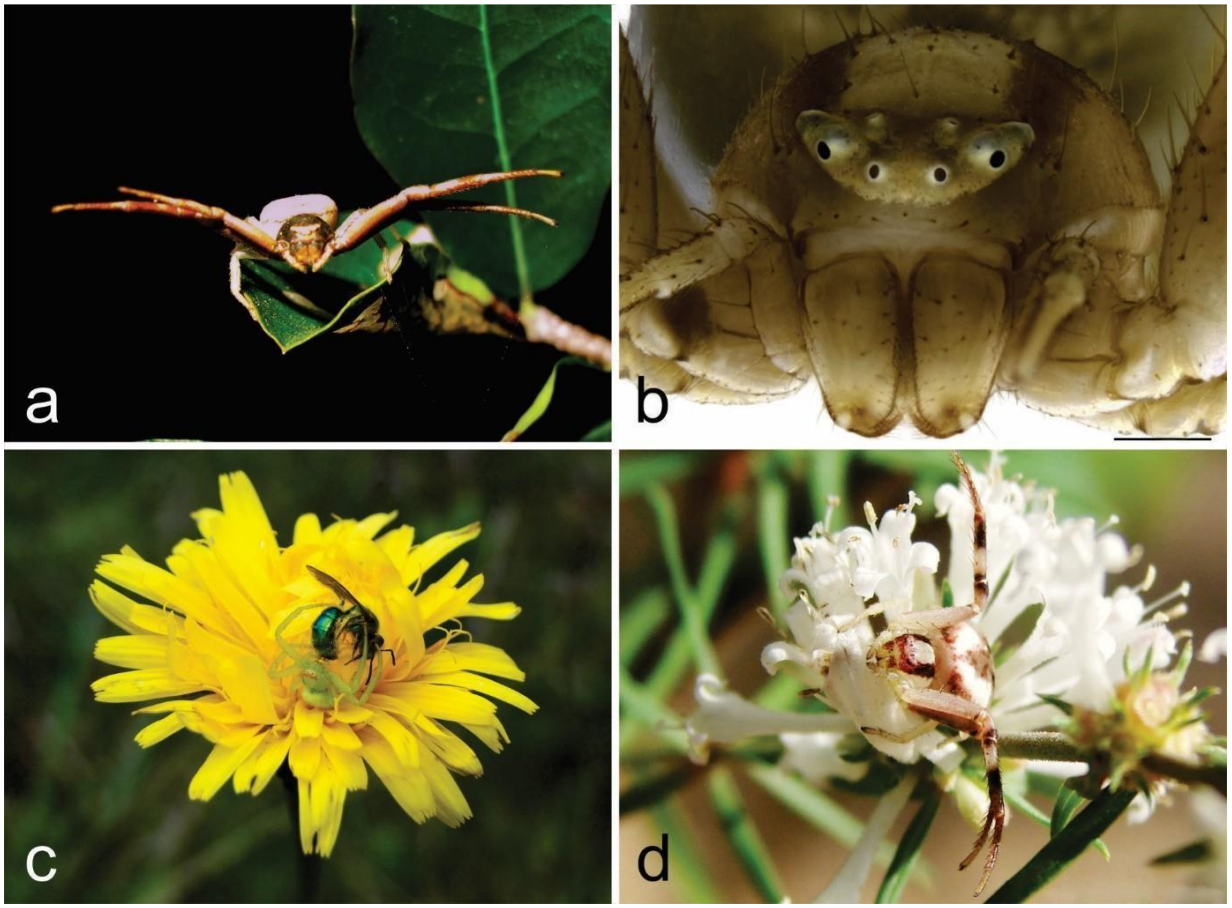

Figura 1. Misumenini live specimens. **a** *Runcinioides litteratus* (Piza, 1933) fêmea (Foto: P.H. Martins); **b** *Misumenops pallidus* (Keyserling, 1880) holótipo fêmea (Foto: B.T. Faleiro); **c** *Misumena* sp. fêmea (Foto: L.S. Carvalho); **d** *Misumenops* sp. fêmea (Foto: U. Oliveira).

Chapter 1

Molecular phylogenetic analyses of the crab-spider genus *Misumenops* Pickard-Cambridge, 1900 (Araneae, Thomisidae)

1. Introduction

The genus *Misumenops* comprises small, usually colorful and sexually-dimorphic, flower-dwelling spiders (Fig. 1). They are distributed worldwide (World Spider Catalog, 2019), though most of their species are concentrated in the Neotropical Region (35 spp., Table 1). Brazil in particular holds 16 species of the genus, including the type-species *Misumenops maculissparsus* (Keyserling, 1891).

The genus *Misumenops* was described by F.O. Pickard-Cambridge (1900) to shelter a group of species originally described in other genera (e.g. *Misumena* Latreille, 1804 and *Diaea* Thorell, 1869). In his paper, Pickard-Cambridge recognized *Misumenops* as a "…purely a genus of convenience, standing between *Misumena* and *Diaea*, instituted to avoid the necessity of lumping these and several other genera together.". In fact, the genus has been treated by different authors as a dumping group for species that do not fit on any other genera. As a result, the genus eventually came to include 126 species (Platnick, 2005), approximately half of them (65 spp.) transferred from other genera. The "species-to-*Misumenops*" tendency reversed recently, when several species were removed from the genus. The most important of those moves were Lehtinen & Marusik´s (2008) transfer of 43 *Misumenops* species to *Mecaphesa* Simon, 1900. As a result, the genus presently comprises 57 species (World Spider Catalog, 2019). Lehtinen & Marusik (2008) also redescribed the type-specie of *Misumenops* and provided a new genus diagnosis, although without any phylogenetic analysis or reasoning. According to them, the representatives of the *Misumenops* can be recognized by the presence of a retrolateral tibial apophysis (RTA) and intermediate tibial apophysis (ITA) fused and by the lack of the central septum in the epigynum. Despite the contributions of Lehtinen & Marusik (2008), the diagnosis of

Misumenops remains based on few informative characters, in practice obscuring the limits of the genus. Despite the fact that Thomisidae is an old spider family and have several common and eye-catching species, just recently the family was the focus of some phylogenetic analyses. These phylogenies, based on molecular (Benjamin *et al*, 2008) or morphological (Benjamin, 2011) data, clarify the deep relationships within the family. However, theses phylogenies do not help to clarify the taxonomic situation of *Misumenops*, since no representative of the genus have been sampled. In addition to works focused on the family, thomisids have been added in many studies of specific problems in spider systematics. Some of them, include *Misumenops* species (Garb & Gillespie, 2006; Su *et al*., 2007; Garb & Gillespie, 2009; Ruch *et al*, 2015; Wheeler *et al*., 2017), however with a small sampling of the group (one to five species, never the type-species). None of these studies are focused on *Misumenops*, so the phylogenetic position of the genus in the family, its monophyly and the relationship between its species remain unclear. Here we present a molecular phylogenetic analysis focused in Misumenops and your relatives, with the aim to clarify the systematic of the group.

2. Material and methods

2.1 Obtainment and edition images

The specimens used for the generation of the images are deposited in the following institutions (abbreviation and curators in parentheses): Centro de Coleções Taxonômicas, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG, A.J. Santos); Muséum National d'Histoire Naturelle, Paris, France (MNHN, C. Rollard); Natural History Museum, London, England (NHM, J. Beccaloni); Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark (NHMD, N. Scharff).

Digital images were taken with a Leica DFC500 digital camera attached to either a Leica M205C or M205AC stereoscopic microscopes. We took pictures in several different focal planes, which were posteriorly assembled as multifocus images with the software Leica Applications Suite Version 3.8.0 (Leica Inc.) or Zerene Stacker Version 1.04 (Zerene Systems).

The SEM images were produced in two different institutions. In Centro de Microscopia da UFMG the specimens were dehydrated in a Leica Bal-tec CPD 030 critical-point dryer, mounted on stubs with adhesive copper tape and sputter-coated with 10 nm of gold-palladium alloy in a Leica Bal-tec MD20 sputter. After this preparation the images were taken under high vacuum in a FEG-Quanta 200 FEI Scanning Electron Microscope. In Natural History Museum of Denmark, the specimens were dehydrated in a Bal-tec CPD-0300 critical-point dryer, mounted on stubs with adhesive copper tape and sputter-coated with 15.5nm of platinum- palladium alloy in a JEOL JFC-2300HR sputter. The images were taken under high vacuum in a JEOL JSM-6335F Scanning Electron Microscope.

All the images were processed to clear the background, and adjust the brightness and contrast in the software Adobe Photoshop CC 2017 (Adobe Systems Inc.). The images were assembled in plates in the software Corel Draw 2017 (Corel Corporation).

2.2 Sampling

Our phylogenetic analysis was based on sequences acquired from 23 specimens of Thomisidae, representing 12 species. Five of those species were identified as members of *Misumenops*, based on comparison with type-material. We also sampled three species of other genera of Misumenini: two *Runcinioides* Mello-Leitão, 1929 and one *Mecaphesa*. Finally, the outgroup included four species from other subfamily and tribes Thomisinae: *Epicadus heterogaster* (Guérin, 1829) (Stphanopinae), *Stephanopoides simoni* Keyserling, 1880 (Stphanopinae), *Synema nigrianum* Mello-Leitão (Talaini), 1929 and *Tmarus* sp. (Tmarini). The specimens were obtained in collecting expeditions in Brazil, Cuba and Mexico from 2014 to 2017. All the specimens were deposited as vouchers in Centro de Coleções Taxonômicas, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG, A.J. Santos curator). Our sampling was then complemented with sequences from 13 species obtained from GenBank (Table 2).

2.3 DNA extraction, amplification and sequencing

We extracted the DNA from the first and/or the second leg tissues of the specimens

preserved in 80% or 100% ethanol. The DNA was extracted from the leg tissue using the Wizard® Genomic DNA extracted Kit (Promega, Madson, WI, USA), following the manufacture's recommended protocol.

We amplified two fragments of the mitochondrial genome (cytochrome oxidase subunit I – COI, and part of the small subunit of the ribosomal RNA - 16S) and one nuclear (Histone – H3) by polymerase chain reaction (PCR). We follow this protocol for PCR reaction mix: 1,8 μL water, 1,0 μL 2,0 mM dNTP (Illustra^{TM}), 2,0 μL 10x buffer, 2,0 μL 17,5 mm $MgCl_2$, .1,0 μL of each primer at 5,0 μM, 0,2 μL of Taq DNA polymerase (Platinum^{TM}) and 1,0 μL of extracted DNA for a 10 μL of solution final volume. The primers used in PCR reactions are listed on Table 3, and the protocols for each marker followed the references listed in the table. The DNA was checked for amplification success through 1,0% agarose gel electrophoresis. We purified the PCR products using the Illustra ExoProStar PCR and Sequence Raection Clean-Up kit (GE Healthcare, Amersham Place, Buckinghamshire, UK), following the manufacturer's protocol.

We sequenced the samples in both directions using the ABI 3130XL automatic sequencer (Applied Biosystems, Foster City, CA, USA) in the Laboratório de Biodiversidade e Evolução Molecular (LEBM) from Universidade Federal de Minas Gerais (UFMG), with the follow sequencing reactions:0,5 (H3) or 1,0 (COI) μL of PCR product, 1,0 μL of either forward or reverse primers, 6,5 (H3) or 4,0 (COI) μL ddH_2O and 2,0 (H3) or 4,0 (COI) μL BigDye® Terminator Cycle Sequencing Kit (Applied Biosystems) for a 10 μL final volume. Some sample we sequenced in Myleus Biotecnologia using the ABI 3730 automatic sequencer (Applied Biosystems, Foster City, CA, USA), with the follow sequencing reactions:0,6 (16S)/0,2 (H3)/0,5 (COI) μL of PCR product, 1,0 μL of either forward or reverse primers, 5,9 (16S)/6,3 (H3)/6,0 (COI) μL ddH_2O and 2,5 (16S)/2,5 (H3 and COI) μL BigDye® Terminator Cycle Sequencing Kit (Applied Biosystems) for a 10 μL final volume.

2.4 Sequence edition

To visualize and edit the sequence chromatograms we used the software Geneious® Version 7.1.3 (Biomatters Ltd.). For alignment the COI and H3 sequences we used the

MUSCLE algorithm version 3.8.31 (Edgar, 2004) implemented in Geneious®. For the 16S sequence alignment we used the Q-INS-i algorithm, which incorporates the secondary structural information, with gap opening cost of 2.0 implemented in the online Mafft Version 7 (Katoh *et al.*, 2017). After the automatic alignment, we made manually adjustments in the sequences.

To test the substitution saturation for the coding markers (COI and H3) we calculated the entropy-based index (Xia *et al.*, 2003; Xia & Lemey, 2009) in DAMBE Version 7.0.48 (Xia, 2013). We concatenated the alignments of all markers (16S+COI+H3) and just the mitochondrial markers (16S+COI) in SequenceMatrix Version 1.8 (Vaidya *et al*., 2011). To evaluate internal sequence heterogeneity, we predefined partition for the sequences: three for COI and H3 (first, second and third codon position) and one for 16S. We then selected the best partitioning schemes and evolutionary models for the data in PartitionFinder2 (Lanfear *et al*., 2016), using the corrected Akaike Information Criterion (AICc) and the PhyML algorithm (Guindon *et al*., 2010) implemented on the CIPRES Science Gateway (Miller *et al.*, 2010) web service. For maximum likelihood we choose one model (GTR+G) for all partitions, because this program works only with a single model of rate heterogeneity in partition analyses. We did the partition analyses for all the markers, for mitochondrial markers only and for the nuclear marker (H3) separately.

2.5 Phylogenetic analyses

We estimated the phylogenetic trees using maximum likelihood (ML) and Bayesian inference (BI) for all markers concatenated, and for just the mitochondrial and the nuclear markers separately.

ML analyses. To estimate the ML tree, we used the software RAxML version 8.2.10 (Stamatakis, 2014) implemented on the CIPRES Science Gateway (Miller *et al.*, 2010), using the GTRGAMMA substitution model and the partitions selected by PartitionFinder2 (Lanfear et al., 2017). We used the analyses that searches for best scoring ML tree in the same run and conducts a rapid bootstrap analysis (option -f a), doing 1000000 of alternative runs on two distinct starting tree. Confidence values were calculated by Rapid Bootstrap with 1000 replication.

BI analyses. For estimate the Bayesian tree, we used the software MrBayes version 3.2.6 (Ronquist *et al*., 2012) implemented on the CIPRES Science Gateway (Miller *et al.*, 2010). We used the partitions and the best-fit models selected by PartitionFinder2 (Lanfear et al., 2017). Metropolis-coupled Monte Carlo Markov chain searches were run with four chains in two independent runs, each of them with 50,000,000 generations, thinning 2,500 and removing the initial 25% of the sampled states as burn-in . MrBayes also calculated the posterior probabilities for the inferred clades. To check stationarity in each analysis and convergence between them, we used the software Tracer Version 1.7.1 (Rambaut *et al.*, 2018), where the the effective sample size (ESS) values were considered acceptable when > 200 for each parameter.

3. Results

We successfully obtained 23 sequences of 16S with 641 bp of length, 18 sequences of COI with 661 bp and 18 sequences of H3 with 300 bp. (Table 2). The saturation tests showed that neither COI or H3 sequences are saturated for any codon position, with the index of substitution saturation (Iss) much lower than the critical value (Issc) and with p-values below 0,05 (Supplementary Information, Table S1).

The concatenated alignment data comprised 1602 base. The PartitionFinder defined six partitions with GTR+G model (preselected) for ML analyses (Table 4) and seven partitions with the best fit model for each one, for BI analyses (Table 5).

All the BI analyses converged and presented EES values high than. The tree topologies resulting from the ML (Fig. 2) and BI (Fig. 3) analyses are congruent. The Thomisinae group was recovered and the Misumenini (except *Misumenops rapaensis*) emerged as monophyletic with high support in BI (0,9435 posterior probability - PP) (Fig. 3), but low in ML (33 bootstrap
- BS) (Fig. 2). *Misumenops rapaensis* appeared outside the clade composed by the remainder Misumenini species, and is closely related to *Synema nigrianum* (Figs 2–3). Just in the mitochondrial ML analyses *M. rapaensis* is closely related to *Pistius truncatus* but with low support (46 BS) (Fig. S1). All the Old Word Misumenini (*Runcinia grammica*, *Misumenops nepenthicola*, *Misumena vatia* (Clerck, 1757) and *Pistius truncatus*) emerged in basal positions within the tribe (Figs 2–3), except in the nuclear MV where the clade *M. vatia* + *P. truncatus* is derivative (Fig. S3). Our analyses show that *Misumenops* is

polyphyletic with respect to *Runcinioides* and some *Mecaphesa* species, and most species of the genus appeared within a large and well-supported clade, sister to *M. vatia* + *P. truncatus* (Figs 2–3). The *Runcinioides* species compose a very well-supported clade (BS = 94, PP = 0,9997) (Figs 2–3), except for a single specimen that emerges as sister-group of *Misumenops bivittatus* in all analyses, except in the nuclear trees, where this specimen is in a polytomy (IB) (Fig. S4) or sister group of *M. vatia* + *P. truncatus* (MV) (Fig. S3). The species from the Marquesan and Society islands, *Misumenops temihana* Garb, 2007, *M. melloleitaoi* Berland, 1942 and *M. delmasi* Berland, 1927, formed a clade, sister to *M. maculissparsus*. This clade (*M. maculissparsus* + Pacific islands) emerged as the sister-group of the Hawaiian *Mecaphesa kanakana* (Karsch, 1880) (Figs 2–3). The remaining South American species of *Misumenops* (*M. bivittatus*, *M. pallens*, and *M. pallidus*) are also not closely related (Figs 2–3).

4. Discussion

Our analysis support the monophyly of the *Thomisus* clade (Figs 2–3), which has been recovered in all recent thomisid phylogenies based either on morphological (Benjamin, 2011) or molecular (Benjamin *et al*., 2008; Ruch, 2015; Wheeler *et al*., 2017) data. The morphological characters that support the group remained consistent throughout these studies, as well as in our results: male palp with a disk-shaped tegulum (Ono, 1988) (Figs 5c, 6c, 8e, 9d, 10d, 11d,g, 12b, 13h) and a tegular ridge (Benjamin, 2011) (Figs 5c–d, 6c–d, 8d–f, 9d–e, 10d–e, 11d–e,g–h, 12b–c, 13h–i), and chelicera with few or no teeth (Ono, 1988) (Figs 5a, 6a,e).

The Misumenini tribe has a very confusing taxonomic history, with several authors (Simon, 1895; Petrunkevitch, 1928; Roewer, 1955; Ono, 1988) proposing internal classifications for the group, without however establishing clear diagnostic characters. Even the most recent delimitation of the tribe (Lehtinen, 2004) are confusing regarding the distinction between Misumenini and the remainder members of Thomisinae. Our results suggest that the tribe could be delimited, and diagnosed, based on the presence of a distinct hood in the female epigynum (Figs 5b,f, 6b, 8b, 9b, 10b, 11b,f, 13d,f). Despite the scarcity of diagnostic morphological characteristics for the group, the tribe monophyly is well supported in all our analyses (Figs 2– 3).

The results of our analyses support a delimitation of Misumenini, with the exclusion of

Misumenops rapaensis (Figs 2–3). Lehtinen (2004) was the first to suggest that *M. rapaensis* was not related to other Misumenini species from Polynesia. This was subsequently supported by phylogenetic analyses (Garb & Gillespie, 2006; Garb & Gillespie, 2009) in which *M. rapaensis* was more closely related to *Diaea* Thorell, 1869 than to other Misumenini species. Indeed, *M. rapaensis* do not have any morphological character proposed for Misumenini: females do not have epigynal hood (Fig. 7b), the abdomen is longer than wide (Fig. 7c), the carapace do not have two longitudinal dark bands (Figs 7a,c), and the legs show no dark rings. Our phylogeny recovers the position of *M. rapaensis* out of the Misumenini clade, being more related with *Synema nigrianum*, despite the fact that they are very distinct biogeographically and morphologically. *M. rapaensis* is endemic to the Austral Archipelago islands and *S. nigrianum* occurs in South America, from Venezuela to Brazil. *S. nigrianum* have the eyes subequal in size (Fig. S1e) and the legs I and II darker then legs III and IV (Fig. S1e), while *M. rapaensis* have the anterior lateral eyes bigger than the others (Fig. 7a) and all legs with the same color (Fig. 7c). The proximity between these species can be result of low sampling of non-Misumenini genera in our analyses. However, the evidence accumulated in the literature and in the current study make it clear that *M. rapaensis* should not belong to *Misumenops*, or even within Misumenini. Future studies with denser taxonomic sampling are necessary to elucidate if *M. rapaensis* should be transferred to another genus (e.g. *Diaea*) or included in a new genus.

The Old World genera sampled herein (*Runcinia*, *Misumena*, and *Pistius*) emerged with *Misumenops nepenthicola* (Figs 5e–f) as the most basal Misumenini (Figs 2–3). More specifically, *M. vatia* + *P. truncatus* (Figs 6a–f) is sister to remaining Misumenini species. The position of *M. nepenthicola* distantly related to other *Miumenops* species can be biogeographically explained. *M. nepenthicola* is known only from Singapore, where it lives associated with carnivorous *Nepenthes* plants (Pocock, 1898; Chua & Lim, 2012). Thus, it is not surprising that it emerges phylogenetically distant from the bulk of the *Misumenops* species, which are restricted to the New Word. Our phylogeny indicates that *N. nepenthicola* should receive the status of new genus or should be transferred to another, possibly Old World thomisid genus. However, this decision would depend on a new analysis with a denser sampling of Asian taxa, such as *Misumenops forcatus* Song & Chai, 1990, *M. humanensis* Yin, Peng & Kim, 2000, *M. khandalaensis* Tikader, 1965, *M. morrisi* Barrion & Litsinger, 1995 and *M. Zhangmuensis* (Hu & Li, 1987).

Our analyses recovered a well-supported clade (BS = 77, PP = 0,9284) composed by *Misumenops* species from Marquesan and Society islands (*M. temihana*, *M. melloleitaoi* and *M. delmasi*) (Figs 2–3). This clade was not recovered by Garb & Gillespie (2006), which found a clade of Hawaiian species within a Marquesan islands (*M. delmasi*) and Society island species (*M. temihana* and *M. melloleitaoi*). However, this clade was recovered in a posterior work with broader sampling (Garb & Gillespie, 2009). These three species have a similar morphology, congruent with diagnostic characters of *Mecaphesa*: embolus finishing in a coiled tip that lies on the retrolateral surface of the cymbium (Figs 9e, 10e), epigynum with a median septum (Figs 9b, 10b, S5b,d,g) and a wider epigynal hood (Figs 9b, 10b, S5b,d,g) (Lehtinen & Marusik, 2008). This suggests that *Misumenops* from Marquesan and Society islands could belong to *Mecaphesa*. However, the sister group of the Marquesan and Society islands clade is *Misumenops maculissparsus*, the type-species of the genus. The literature includes records of *M. maculissparsus* only in Brazil (the type-locality) and Argentina, but we examined specimens from the Caribbean (Cuba, Curaçao, and Bonaire), indicating that the species has large dispersion capacity, probably by ballooning (Fig. 1a). In addition, *M.* m*aculissparsus* live in disturbed habitats, like forest edges, agroecosystems and urban habitats (Personal observations). Since these are characteristic of invasive species (Kobelt & Nentwig, 2008; Nedved *et al*., 2011), so it seems possible that *M. maculissparsus* descends from a Pacific islands ancestor that colonized the continental South America or the Caribbean.

Our results have potential implications for the delimitation of *Mecaphesa*, another relatively species-rich Misumenini genus known from North and Central America, the Caribbean and from the Hawaiian, Galápagos and Juan Fernandez islands (World Spider Catalog, 2019). Our Marquesan and Society *Misumenops* + *M. maculissparsus* clade is sister to Hawaiian *Mecaphesa kanakana*, which also shows the diagnostic characters of the genus (Figs S5f–g). This is intriguing if we consider the position of *M. maculissparsus*, which does not show those diagnostic characters (Fig. 11). These results could mean that *Mecaphesa*, which is not monophyletic in our analyses, should be redelimited in the future. That would require new analyses with a larger taxon sampling, including the type-species of *Mecaphesa*, and combining molecular and morphological data.

The specimens of *Runcinioides* sampled by us composed a well-supported clade (BS = 94, PP = 0,9997) (Figs 2–3), except for a female specimen of *R. litteratus* (Piza, 1933). We have strong evidence that the males and females we recognize as *R. litteratus* are indeed

coespefic, since they have been collected together multiple times. Thus, the anomalous position of these specimen can be an artifact. We intend to test this in the future, by expanding the sampling of *R. litteratus* female specimens. The two species of *Runcinioides* included in our analyses are remarkably distinct morphologically from all other Misumenini species (see chapter 2), thus we think keeping them as separate genus, despite their phylogenetic position, better serves the taxonomy of the tribe.

The New World species of *Misumenops* sampled herein (*M. bivitatus*, *M. maculisparssus*, *M. pallens* and *M. pallidus*) are not closely related, despite sharing morphological characters like: long embolus that runs widely accompanying the edge of the the tegulum (Figs 11d,g, 13h) and a narrow epigynal hood (Figs 11b,f, 13d,f – except *M. bivitatus*, Fig. 13b). Possibly these characters are plesiomorphic, which can be tested in a future analyses with a morphological data. The position of *M. pallidus* between *M. bivitatus* is questionable. We expect, based on morphology that *M. pallidus* (Figs 12c–d) would emerge as closely related to *M. maculissparsus* (Fig. 11), since they are almost indistinguishable. Since the *M. Pallidus* sequences included in this work are from Genbank, we believe it was misidentified. We intend to examine the original specimens in the future.

In conclusion, all results show that the Misumenini phylogeny is much more complex than could be anticipated from the current classification. The fact that neither *Misumenops* or *Mecaphesa* form monophyletic groups shows that additional phylogenetic studies, with expanded taxon sampling, will be necessary to propose a natural classification. However, our results also demonstrate that Old World species currently lodged in *Misumenops* should be transferred from the genus. Regarding the limits of the New World genera, *Misumenops* and *Mecaphesa* in particular, we hope that a combining morphological characters with molecular data would be helpful to find well-supported clades that could guide the delimitation of those genera.

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6. Attachements

Table 1. Number of *Misumenops* species in each continent.

Continent	**Number of species**
Africa	3
South America	34
North America	7
Central America	1
Asia	8
Europe	0
Oceania	4
Total	57

Table 2. Specimens used for molecular analyses, collecting locality, fragments successfully sequenced and GenBank accession number.

Species	**Country / Arch.**	**Locality**	**Sex**	**COI**	**16S**	**H3**	**Reference**
Misumenops bivittatus THO050	Brazil	Espírito Santo	F	OK	OK	NA	This study
Misumenops bivittatus THO061	Brazil	Santa Catarina	F	OK	OK	OK	This study
Misumenops delmasi GG01	Marquesan Arch.	Nuku Hiva Island	NA	FJ590800	FJ590909	NA	Garb & Gillespie, 2
Misumenops delmasi GG02	Marquesan Arch.	Nuku Hiva Island	NA	DQ174367	DQ174324	NA	Garb & Gillespie, 2
Misumenops maculissparsus THO041	Brazil	Minas Gerais	M	OK	OK	OK	This study
Misumenops maculissparsus THO042	Brazil	Minas Gerais	F	OK	OK	OK	This study
Misumenops maculissparsus THO142	Cuba	Santiago de Cuba	M	OK	OK	OK	This study
Misumenops maculissparsus THO143	Cuba	Santiago de Cuba	F	OK	OK	OK	This study
Misumenops melloleitaoi GG03	Society Arch.	Tahiti Island	NA	FJ590796	FJ590905	NA	Garb & Gillespie, 2
Misumenops melloleitaoi GG04	Society Arch.	Tahiti Island	NA	DQ174374	DQ174331	NA	Garb & Gillespie, 2
Misumenops nepenthicola	Singapore	NA	NA	NA	NA	EF419123	Su *et al.* 2007
Misumenops pallens THO035	Brazil	Espírito Santo	M	OK	OK	OK	This study
Misumenops pallens THO034	Brazil	Espírito Santo	F	NA	OK	OK	This study
Misumenops pallidus GG12	Argentina	Carrizo Plain	NA	DQ174397	DQ174354	NA	Garb & Gillespie, 2
Misumenops rapaensis GG05	Austral Arch.	Rurutu Island	NA	DQ174427	FJ590922	NA	Garb & Gillespie, 2
Misumenops rapaensis GG06	Austral Arch.	Rapa Island	NA	DQ174410	DQ174359	NA	Garb & Gillespie, 2
Misumenops temihana GG07	Society Arch.	Raiatea Island	M	DQ174371	DQ174328	NA	Garb & Gillespie, 2
Misumenops temihana GG08	Society Arch.	Raiatea Island	F	FJ590799	FJ590908	NA	Garb & Gillespie, 2

Misumenops sp.38 THO076	Brazil	Minas Gerais	M	OK	OK	OK	This study
Misumenops sp.52 THO137	Cuba	Santiago de Cuba	M	NA	OK	OK	This study
Misumenops sp.52 THO144	Cuba	Santiago de Cuba	F	OK	OK	OK	This study
Runcinioides argenteus THO017	Brazil	São Paulo	M	OK	OK	OK	This study
Runcinioides argenteus THO019	Brazil	São Paulo	F	OK	OK	OK	This study
Runcinioides litteratus THO039	Brazil	Minas Gerais	M	OK	OK	OK	This study
Runcinioides litteratus THO069	Brazil	Minas Gerais	F	OK	OK	OK	This study
Mecaphesa dubia THO067	Mexico	Veracruz	M	NA	OK	OK	This study
Mecaphesa dubia THO068	Mexico	Veracruz	F	OK	OK	NA	This study

Table 2. *Continued*

Mecaphesa kanakana	Hawaii Arch.	Maui Island	NA	NA	FJ590918	NA	Garb & Gillespie, 2
Misumena vatia GG09	Spain	Murcia	NA	NA	KY784071	KY703532	Gawryszewski *et al*
Runcinia grammica GG10	Spain	Aragón	NA	NA	KY784108	KY703528	Gawryszewski *et al*
Pistius truncatus GG11	Hungary	NA	NA	NA	KY784074	KY703568	Gawryszewski *et al*
Epicadus heterogaster THO049	Brazil	Bahia	F	OK	OK	NA	This study
Epicadus heterogaster	Ecuador	Napo	NA	KY017987	NA	NA	Wheeler *et al*., 2017
Stephanopoides sexmaculata W01	Argentina	Misiones	NA	KY017994	NA	KY018492	Wheeler *et al*., 2017
Stephanopoides simoni THO132	Brazil	Pará	F	OK	OK	OK	This study
Synema globosum G02	Spain	Murcia	NA	NA	KY784073	KY703559	Gawryszewski *et al*
Synema nigrianum THO060	Brazil	Santa Catarina	M	NA	OK	OK	This study
Synema nigrianum THO055	Brazil	Espirito Santo	F	OK	OK	NA	This study
Tmarus sp.THO123	Brazil	Piauí	M	NA	OK	NA	This study
Tmarus sp. THO124	Brazil	Piauí	F	OK	OK	OK	This study
Tmarus piger G01	Spain	Extremadura	NA	NA	KY784098	KY703531	Gawryszewski *et al*

Table 3. Primers used in this study.

Locus	**Primer**	**Sequence (5'-3')**	**Reference**
Cytochrome	C1J-1751-“SPID” (F)	GAGCTCCTGATATAGCTTTTCC	Hedin & Maddison, 2001
oxidase I	C1-N- 2568 (R)	GCTACAACATAATAAGTATCATG	Hedin & Maddison, 2001
16S-ND1	LR-N-12945 (F)	CGACCTCGATGTTGAATTAA	Hedin, 1997
	ND1Thom (R)	GAGCTACTCTTCGAATTGATCC	Garb & Gillespie, 2006
Histone	H3a (F)	ATGGTCCGTACCAAGCAGAC(ACG)GC	Colgan *et al.*, 1998
	H3a (R)	ATATCCTT(AG)GGCAT(AG)AT(AG)GTGAC	Colgan *et al.*, 1998

Table 4. The partitions of the concatenated dataset of all markers defined by PartitionFinder2 for analysis in RaxML.

Partitions	Best model	Subset sites
16S	GTR+G	1-641
COI_3	GTR+G	642-1302\3
COI_1	GTR+G	643-1302\3
COI_2, H3_2	GTR+G	644-1302\3 1305-1602\3
H3_3	GTR+G	1303-1602\3
H3_1	GTR+G	1304-1602\3

Table 5. The partitions and best model of the concatenated dataset of all markers defined by PartitionFinder2 for analysis in MrBayes.

Partitions	Best model	Subset sites
16S	GTR+I+G	1-641
COI_3	GTR+G	642-1302\3
COI_1	GTR+G	643-1302\3
COI_2	F81+I	644-1302\3
H3_3	K80+G	1303-1602\3
H3_1	GTR+I	1304-1602\3
H3_2	JC+I	1305-1602\3

Figures chapter 1

Figure 1. *Misumenops maculissparsus* (Keyserling, 1891), live specimens. **a** male preparing for allooning (photo by L.S. Carvalho); **b** female in a flower (photo by L.S. Carvalho).

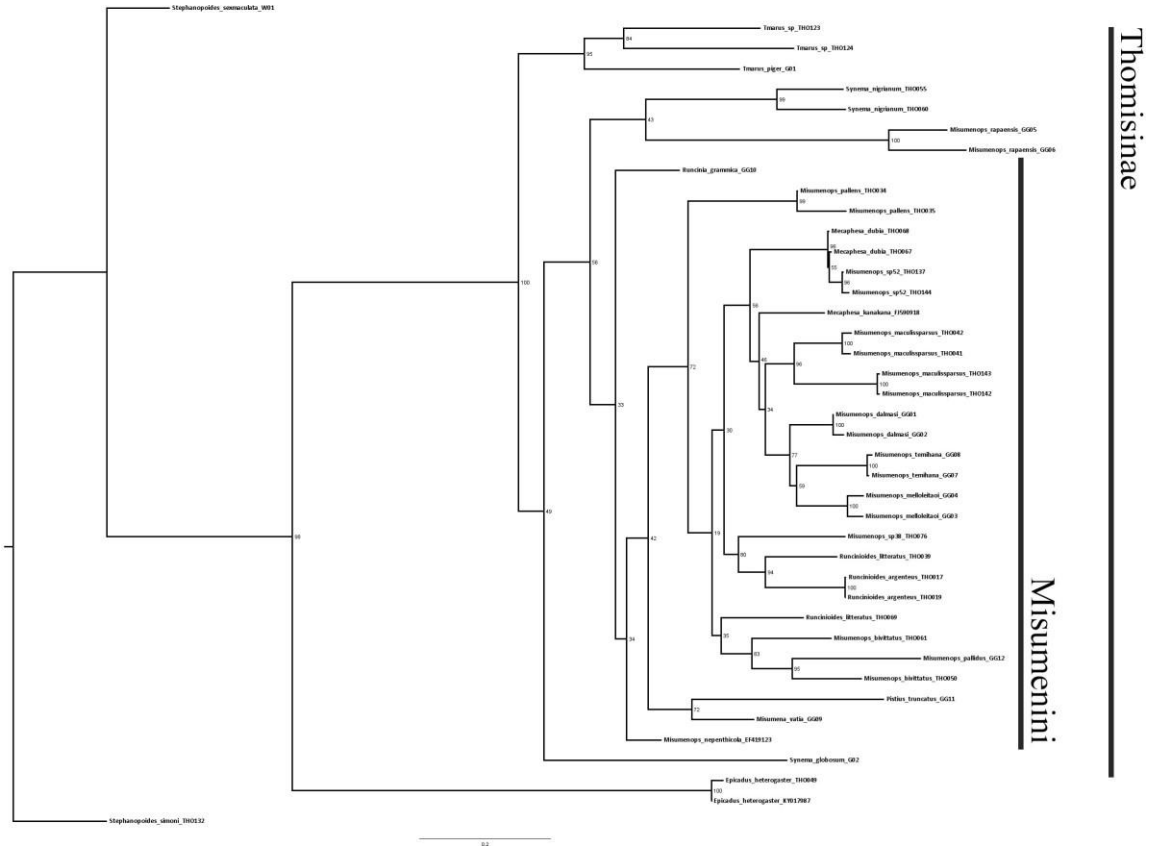
Stephanopoides_sexmaculata_W01
Tmarus_sp_TH0123
Tmarus_sp_TH0124
Tmarus_piger_GB1
Synema_nigrianum_TH0055
Synema_nigrianum_TH0060
Misumenops_rapaensis_GG05
Misumenops_rapaensis_GG04
Runcinia_grammica_GG10
Misumenops_pallens_TH0034
Misumenops_pallens_TH0035
Mecaphesa_dubia_TH0048
Mecaphesa_dubia_TH0067
Misumenops_sp52_TH0137
Misumenops_sp52_TH0144
Mecaphesa_kanakana_FJ969918
Misumenops_maculisparsus_TH0042
Misumenops_maculisparsus_TH0041
Misumenops_maculisparsus_TH0143
Misumenops_maculisparsus_TH0142
Misumenops_dalmasi_GG01
Misumenops_dalmasi_GG02
Misumenops_tembana_GG08
Misumenops_tembana_GG07
Misumenops_melloleitaoi_GG04
Misumenops_melloleitaoi_GG03
Misumenops_sp30_TH0076
Runcinioides_litteratus_TH0030
Runcinioides_argenteus_TH0017
Runcinioides_argenteus_TH0019
Runcinioides_litteratus_TH0069
Misumenops_bivittatus_TH0061
Misumenops_pallidus_GG12
Misumenops_bivittatus_TH0050
Pistius_truncatus_GG11
Misumena_vatia_GG09
Misumenops_nepenthicola_EF419123
Synema_globosum_GB2
Epicadus_heterogaster_TH0049
Epicadus_heterogaster_KY017987
Stephanopoides_simoni_TH0132
Thomisinae
Misumenini

Figure 2. Resulting tree of the maximum likelihood analysis based on all markers. Clade Bootstrap values are reported in front of the branches.

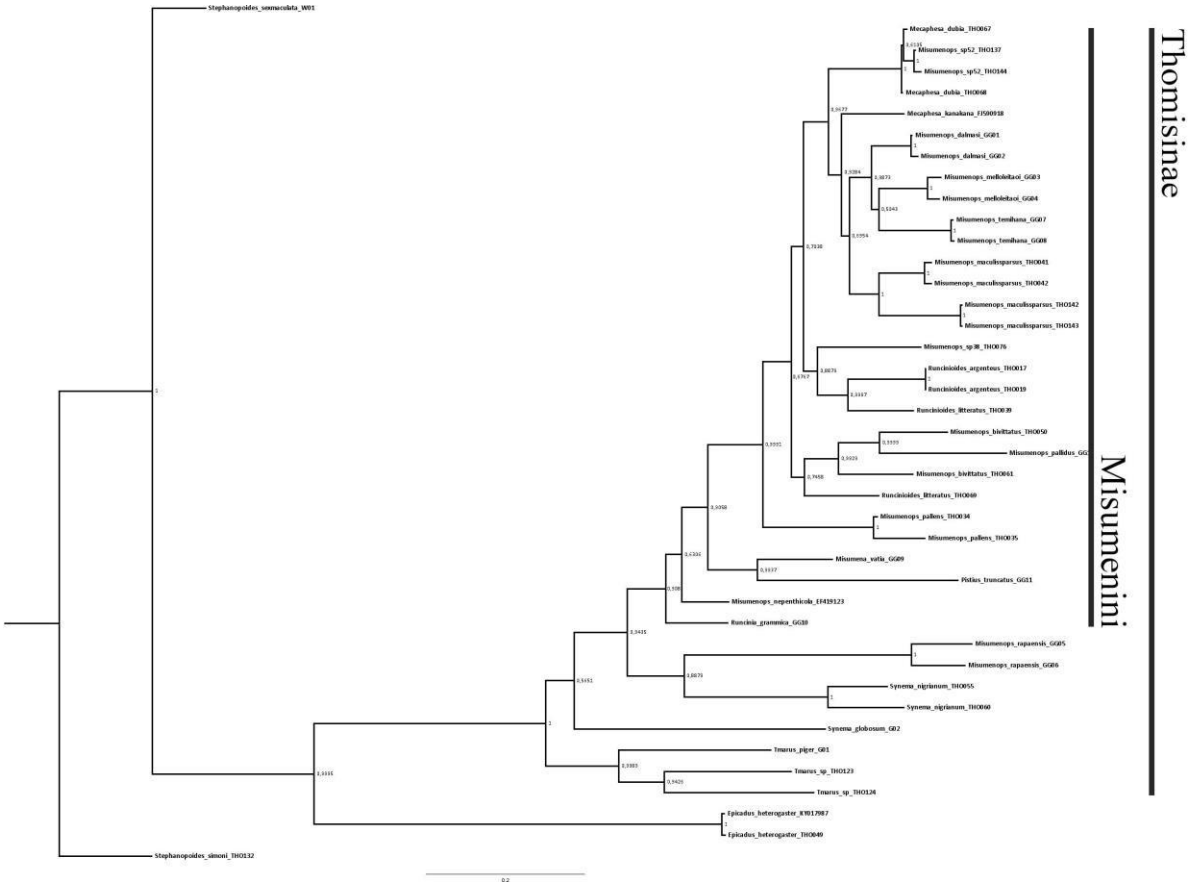

Figure 3. Resulting tree of the Bayesian inference analysis based on all markers. Clade posterior probabilities are reported in front of the branches.

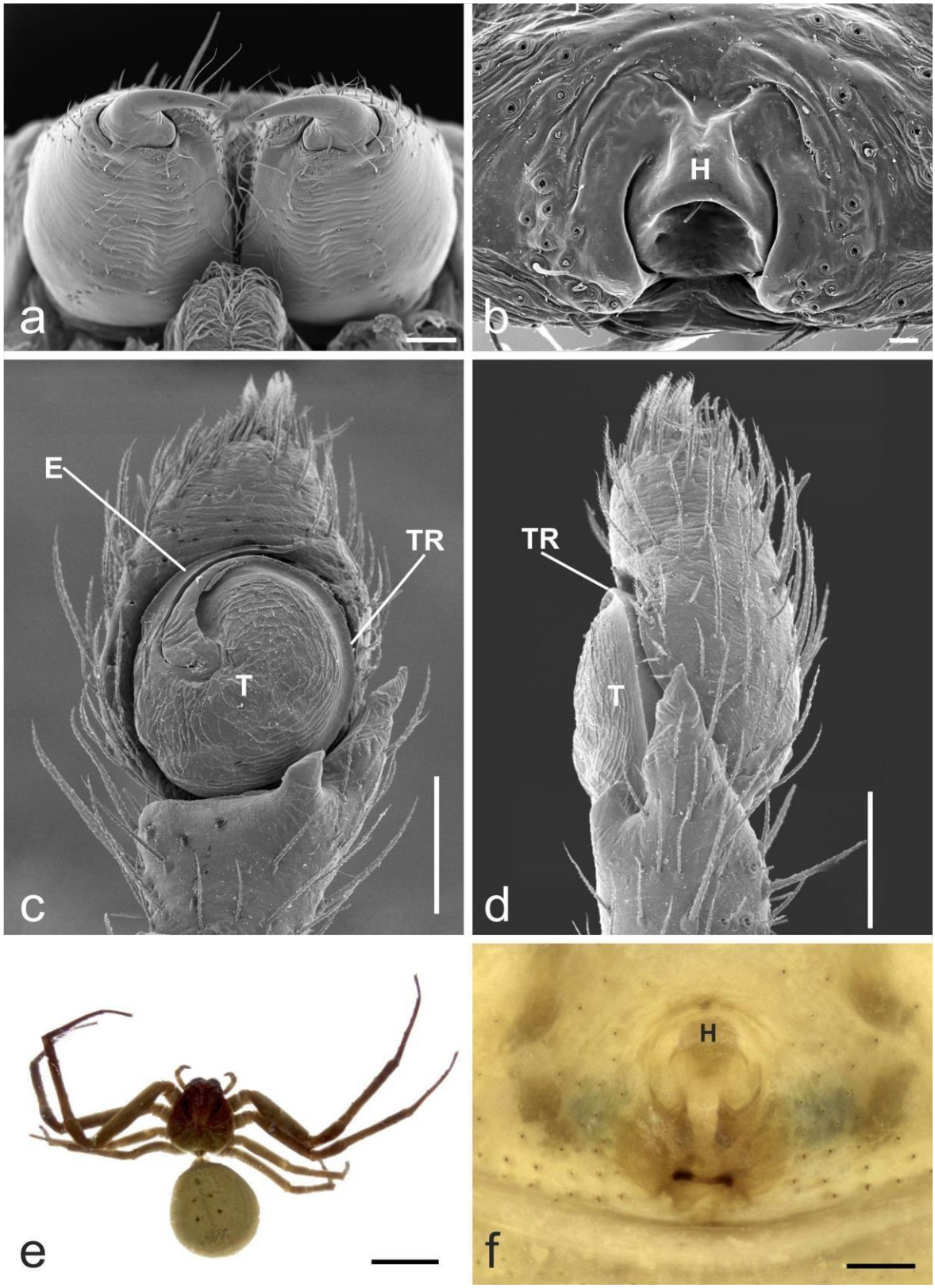

Figure 4. *Runcinia grammica* (C.L. Koch, 1837), SEM images (a–b female, c–d male). **a** chelicerae, ventral; **b** epigynum, ventral; **c–d** left palp (c ventral, d retrolateral). *Misumenops nepenthicola* (e–f female holotype). **e** habitus, dorsal; **f** epigynum, ventral. Abbreviations: E, embolus; H, hood; T, tegulum; TR, tegulum ridge. Scale bars: a, c–d, f 0.1 mm. b, 0.02 mm. e, 2 mm.

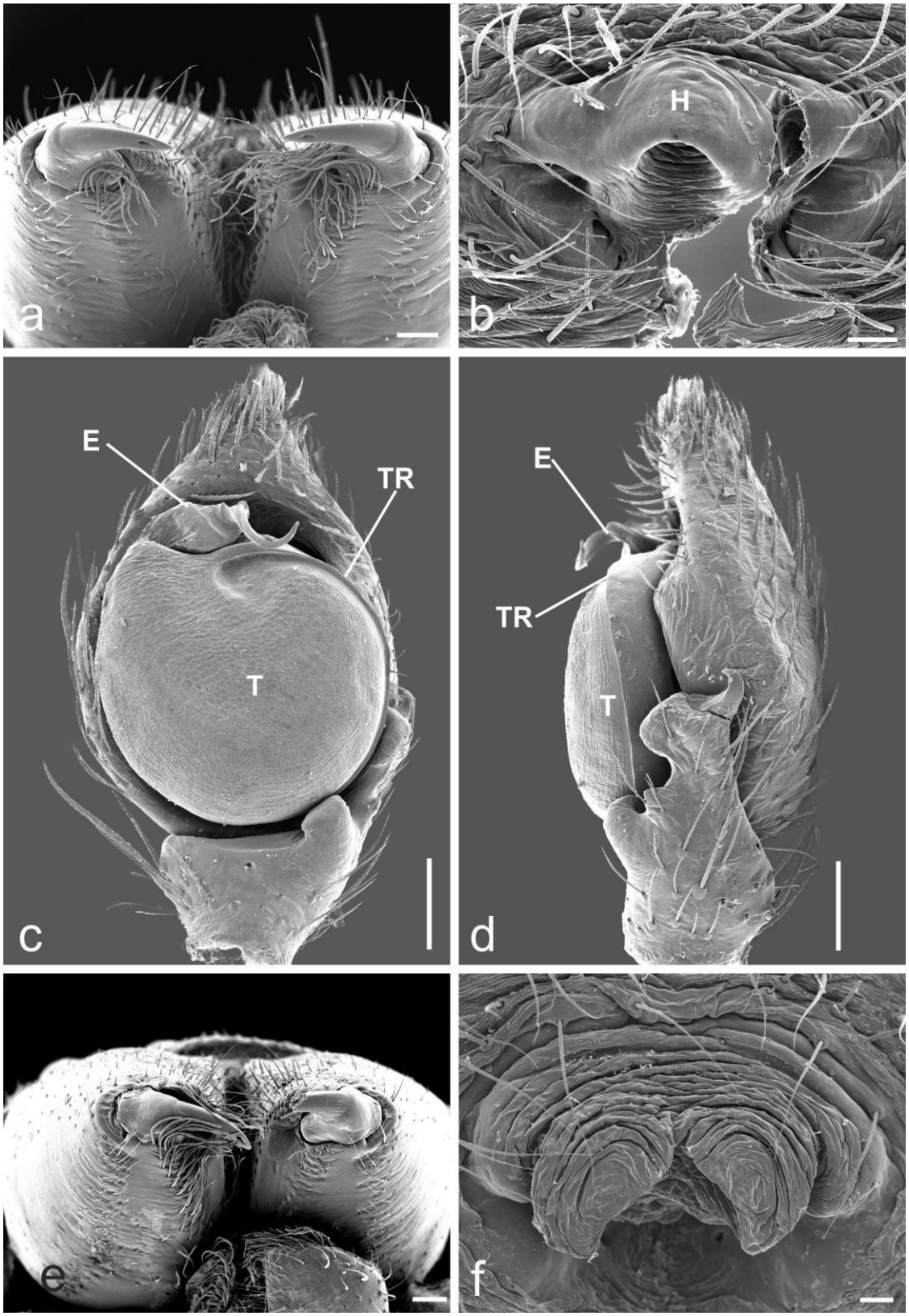

Figure 5. *Misumena vatia* (Clerck, 1757), SEM images (a–b female, c–d male). **a** chelicerae, ventral; **b** epigynum, ventral; **c–d** left palp (c ventral, d retrolateral). *Pistius truncatus* (e–f female). **a** chelicerae, ventral; **b** epigynum, ventral Abbreviations: E, embolus; H, hood; T, tegulum; TR, tegulum ridge. Scale bars: a, c–e, 0.1 mm. b, f 0.02 mm.

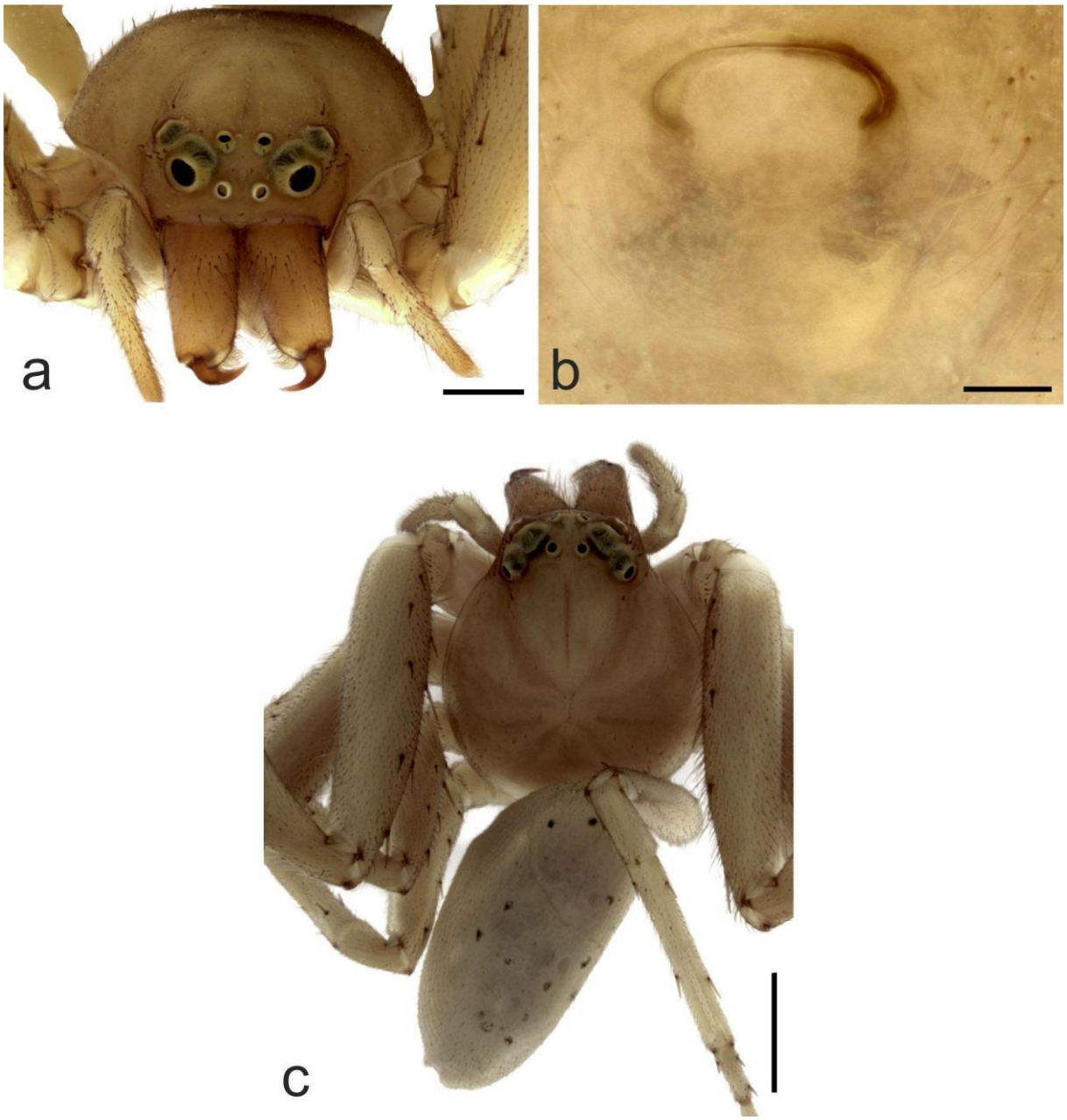

Figure 6a–c. *Misumenops rapaensis* Berland, 1934 (a–c female holotype). **a** prosoma, frontal ; **b** epigynum, ventral; **c** habitus, dorsal. Scale bars: a 1 mm. b, 0.1 mm. c, 2 mm.

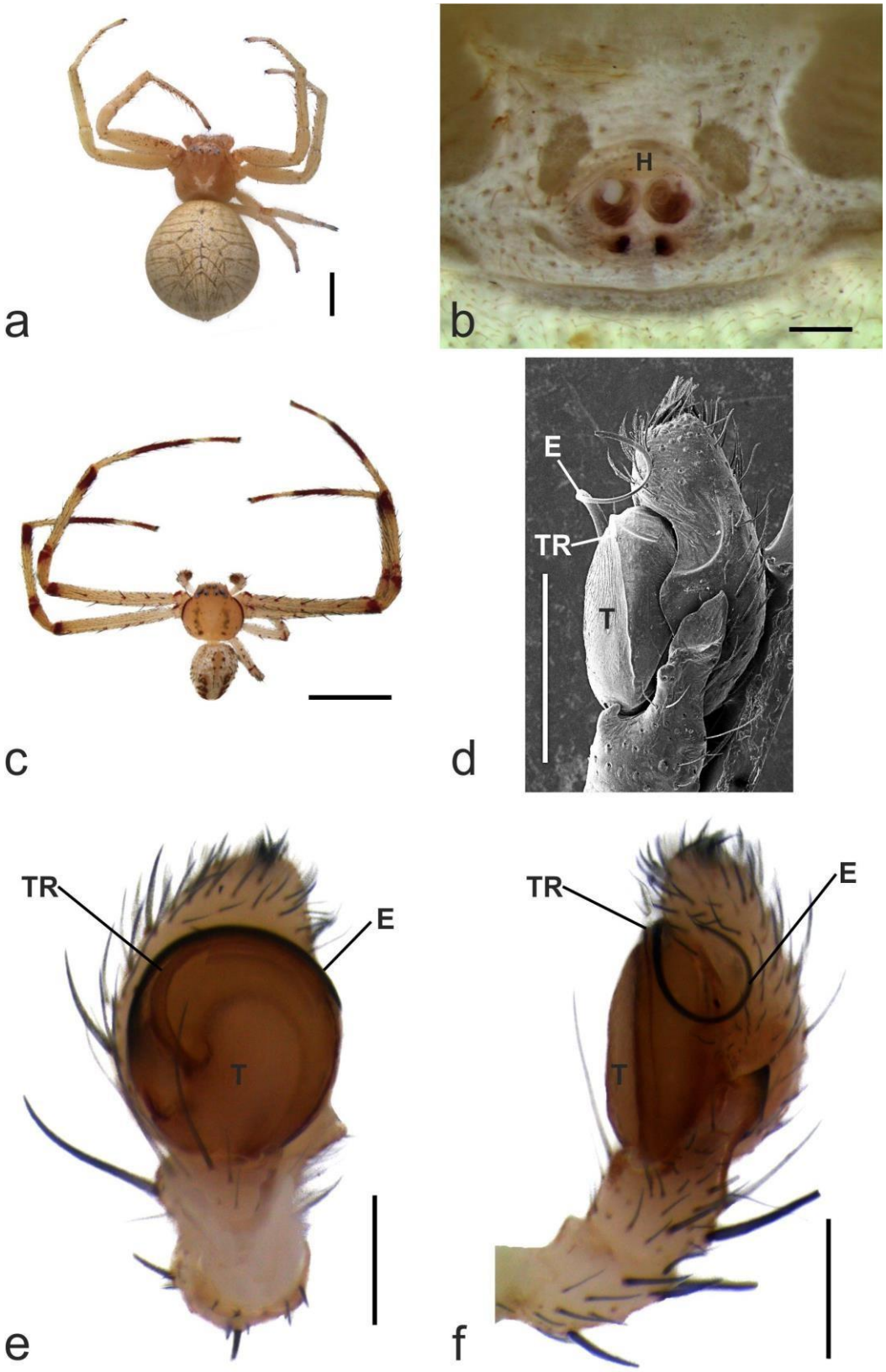

Figure 7. *Misumenops* sp.52 (a–b female, c–f male). **a** habitus, dorsal; **b** epigynum, ventral; **c** habitus, dorsal; **d–f** left palp (d, SEM retrolateral, e ventral, f retrolateral). Abbreviations: E, embolus; H, hood; T, tegulum; TR, tegulum ridge. Scale bars: a, c, 2 mm. b, e, f 0.2 mm. d, 0.3 mm.

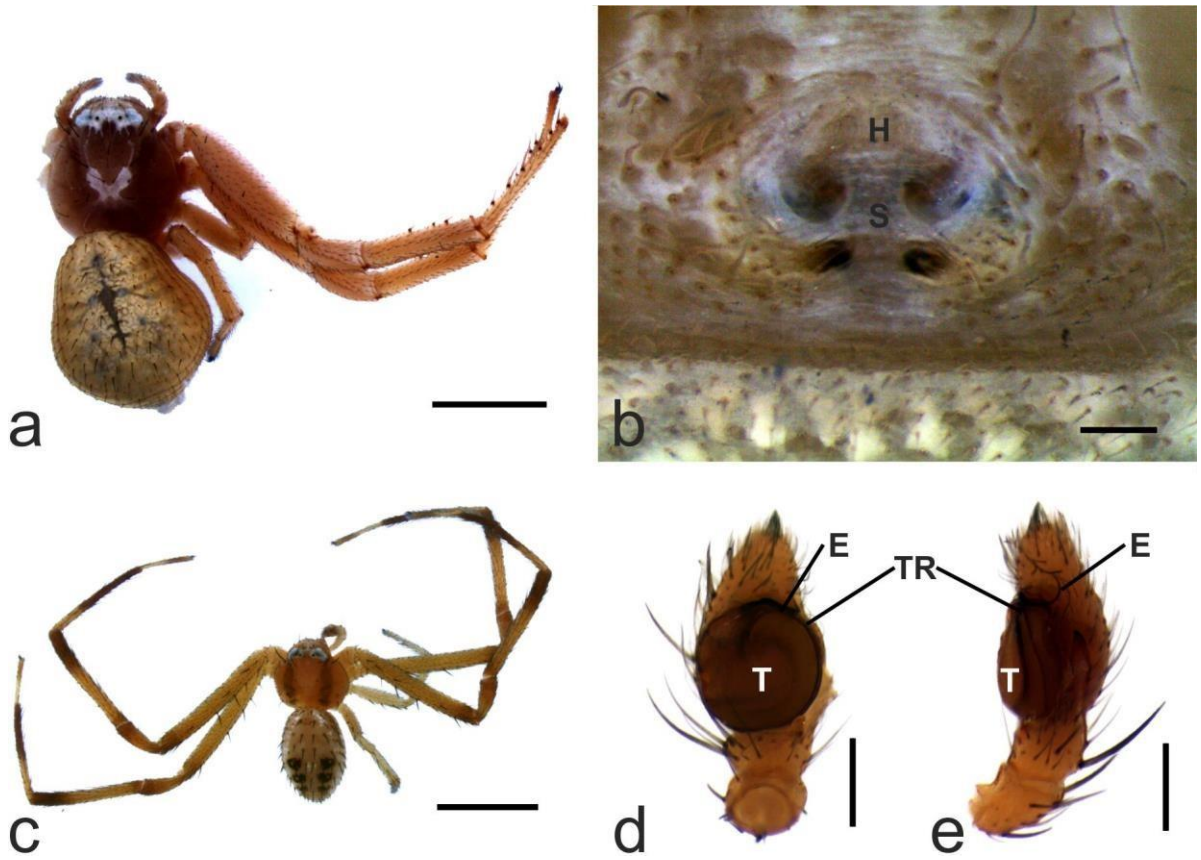

Figure 8. *Mecaphesa dubia* (Keyserling, 1880) (a–b female, c–e male). **a** habitus, dorsal; **b** epigynum, ventral; **c** habitus, dorsal; **d–e** left palp (d ventral, e retrolateral). Abbreviations: E, embolus; H, hood; S, septum; T, tegulum; TR, tegulum ridge. Scale bars: a, c, 2 mm. b, 0.1
mm. d–e, 0.2 mm.

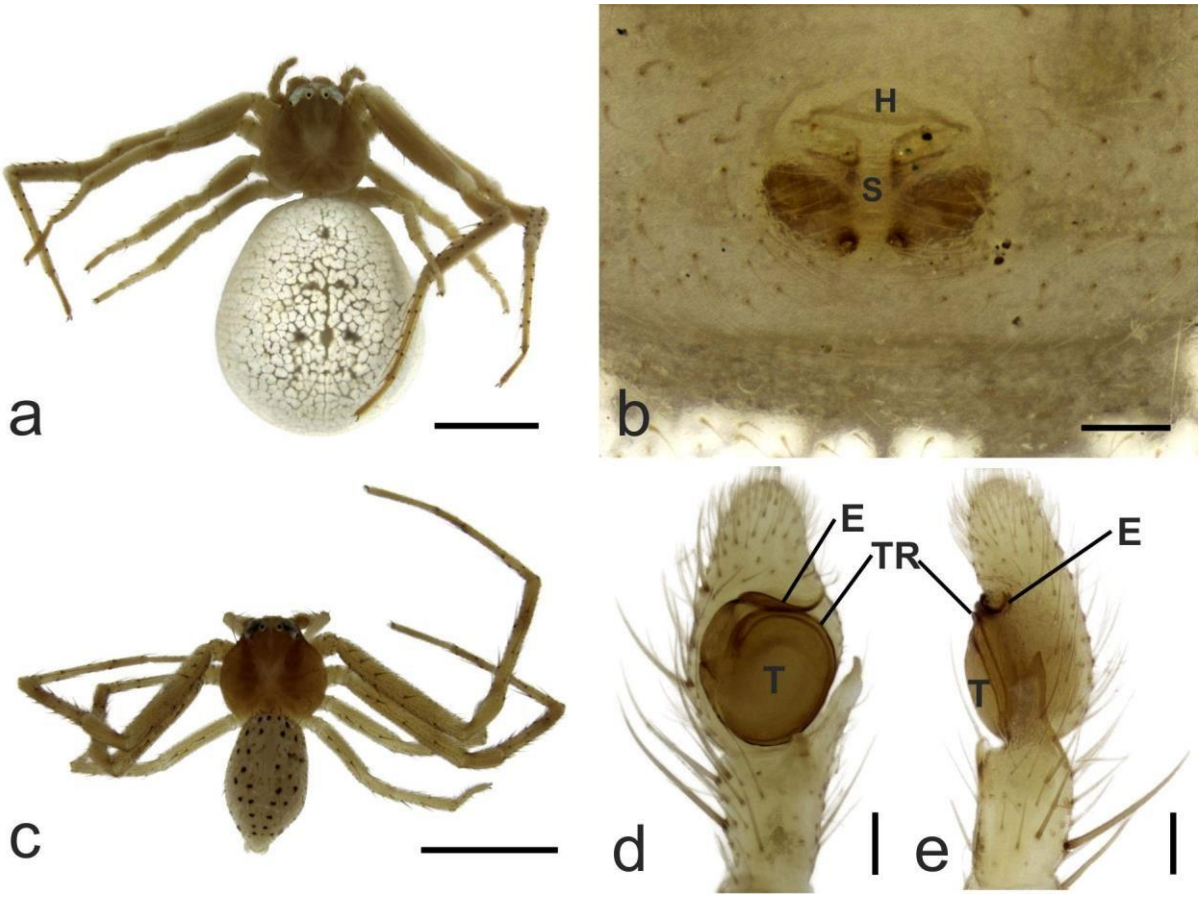

Figure 8. *Misumenops delmasi* Berland, 1927 (a–b female holotype, c–e male). **a** habitus, dorsal; **b** epigynum, ventral; **c** habitus, dorsal; **d–e** left palp (d ventral, e retrolateral). Abbreviations: E, embolus; H, hood; S, septum; T, tegulum; TR, tegulum ridge. Scale bars: a, c, 2 mm. b, d–e, 0.1 mm.

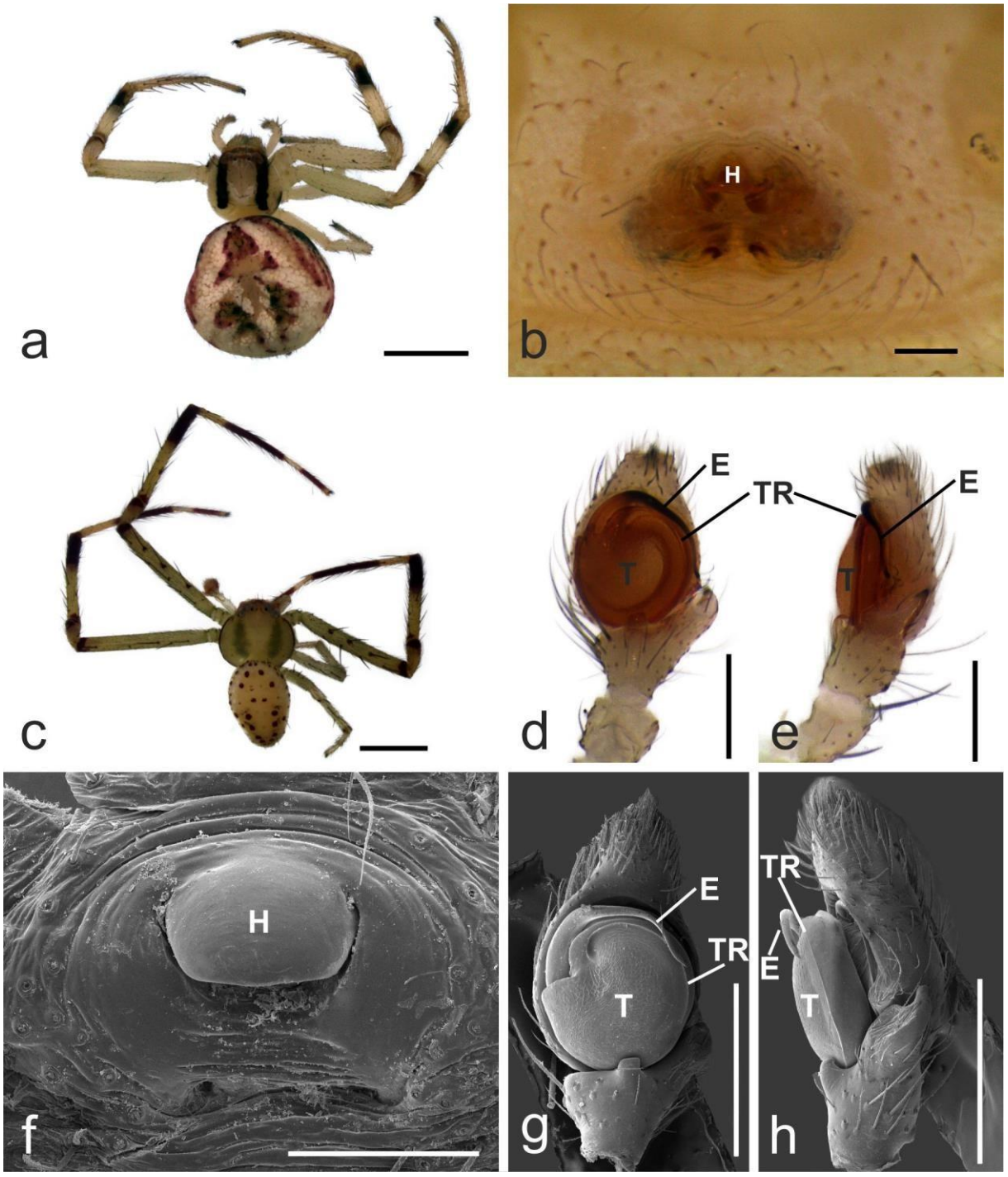

Figure 10. *Misumenops maculissparsus* (Keyserling, 1891) (a–b, f female, c–h male). **a** habitus, dorsal; **b** epigynum, ventral; **c** habitus, dorsal; **d–e** left palp (d ventral, e retrolateral); **f** SEM epigynum, ventral; **g–h** left palp, SEM (g ventral, h retrolateral). Abbreviations: E, embolus; H, hood; T, tegulum; TR, tegulum ridge. Scale bars: a, 2 mm. b, f 0.1 mm. d–e, 0.2 mm. f, g–h, 0.3 mm.

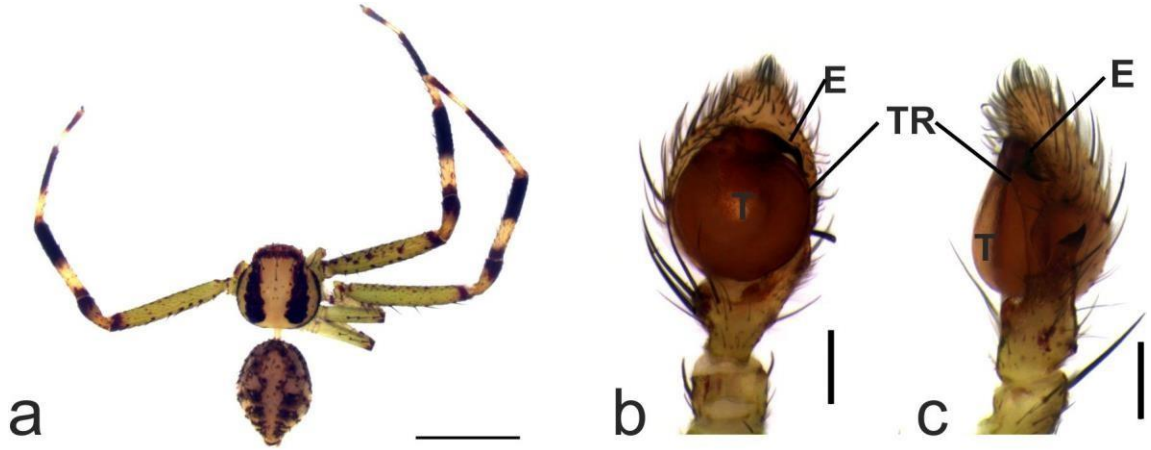

Figure 11. *Misumenops* sp.38 (a–c male). **a** habitus dorsal; **b–c** left palp (b ventral, c retrolateral). Abbreviations: E, embolus; T, tegulum; TR, tegulum ridge. Scale bars: a, 2 mm. b–c, 0.2 mm.

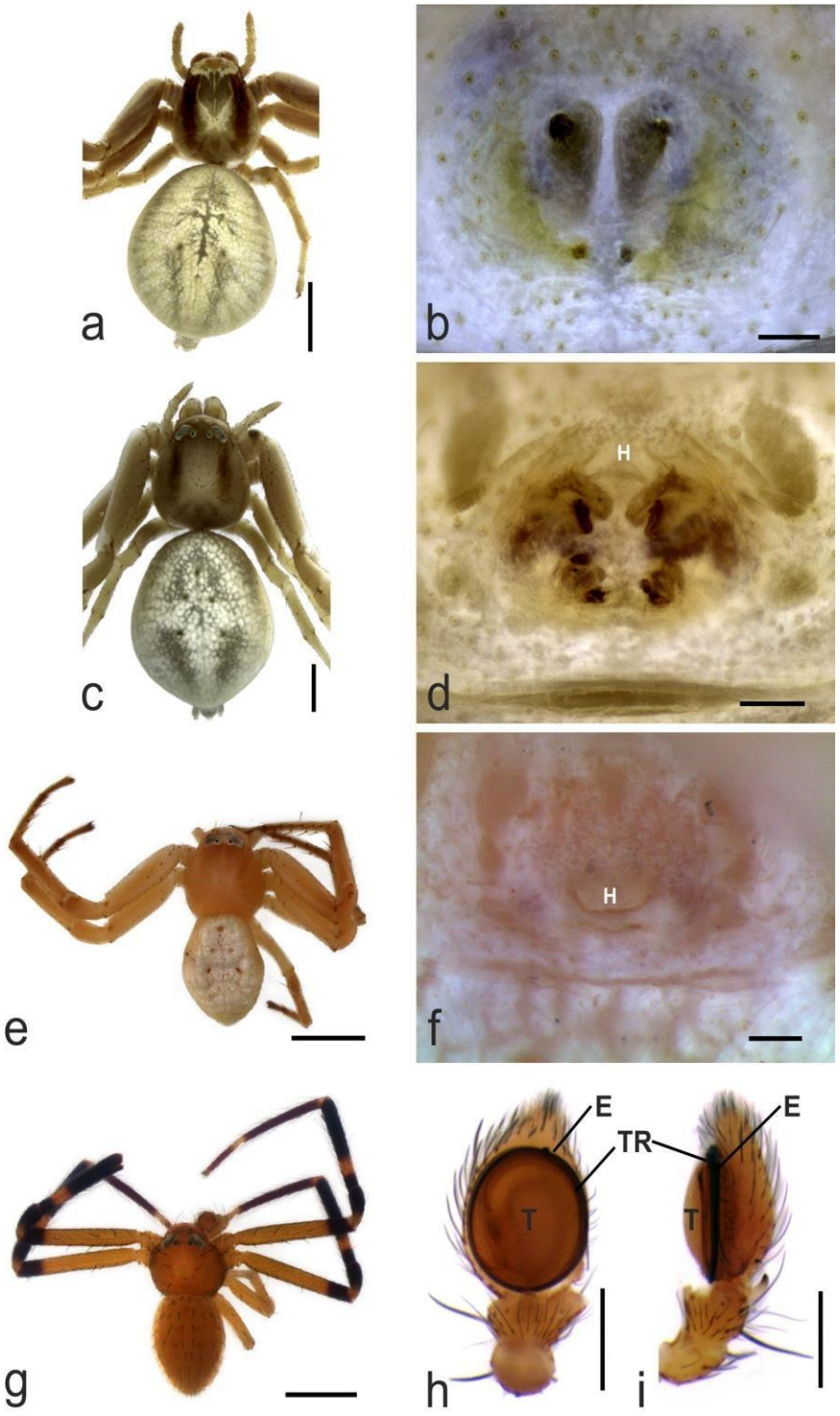

Figure 12. New World species of *Misumenops* (a–b *Misumenops bivittatus* (Keyserling, 1880), female holotype; c–d *Misumenops pallidus* (Keyserling, 1880), female holotype; e–i *Misumenops pallens* (Keyserling, 1880)). **a** habitus, dorsal; **b** epigynum, ventral; **c** habitus, dorsal; **d** epigynum, ventral; **e–f** female (e habitus, dorsal; f epigynum ventral); **g** male habitus, dorsal; **h–i** male left palp (d ventral, e retrolateral). Abbreviations: E, embolus; H, hood; T, tegulum; TR, tegulum ridge. Scale bars: a, e, 2 mm. b, d, f, 0.1 mm. g–c, 1 mm. h–i, 0.2 mm.

Supplementary Information

Table S1. Result of the saturation test. Values of Iss, Issc and p.

Locus	Codon position	Iss	Issc	p value
COI	1st	0,0392	0,6395	0,0000
	2nd	0,0392	0,6395	0,0000
	3rd	0,518	0,6399	0,0003
H3	1st	0,0831	0,46	0,0000
	2nd	0,0659	0,46	0,0000
	3rd	0,2842	0,46	0,0000

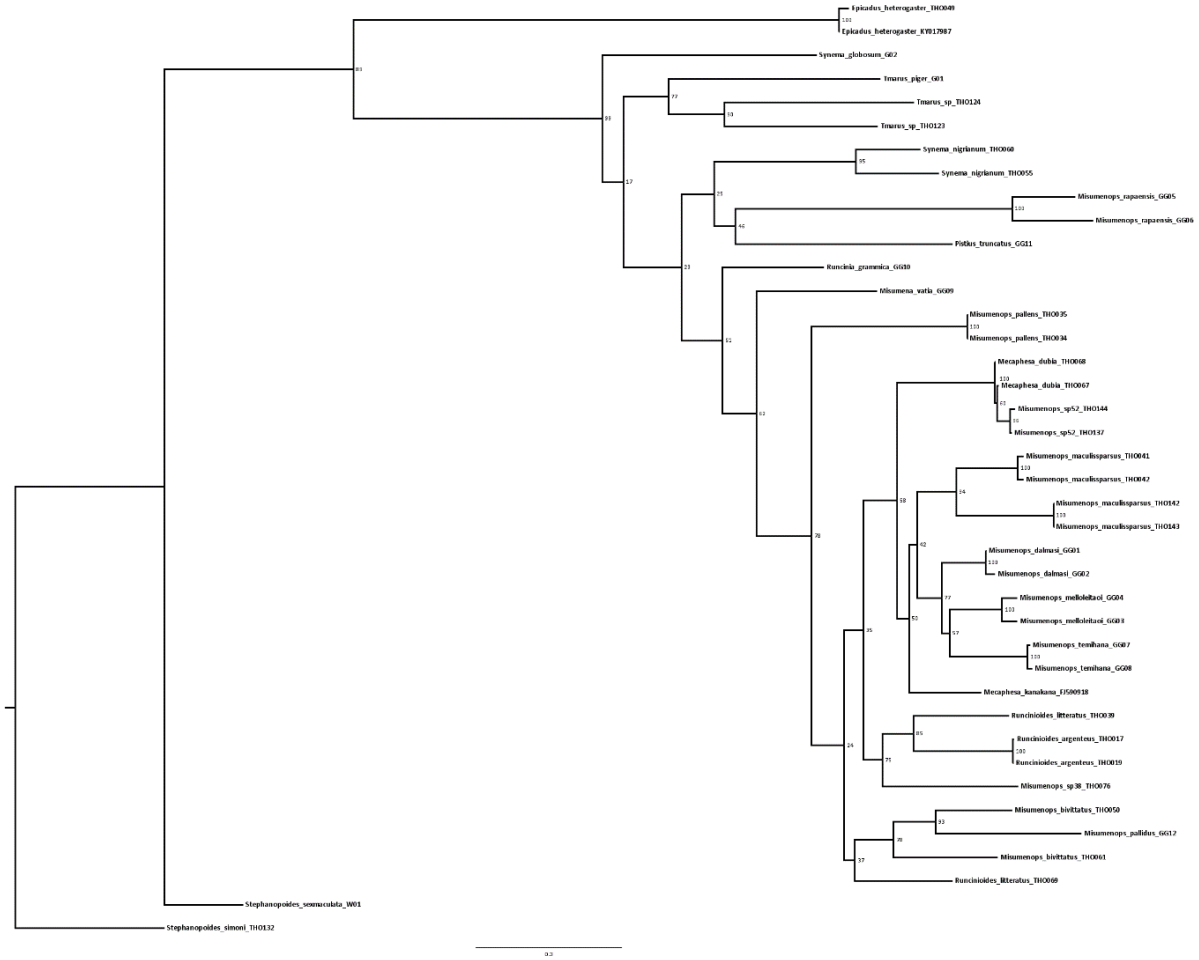

Figure S1. Resulting tree of the maximum likelihood analysis based on mitochondrial markers. Clade Bootstrap values are reported in front of the branches.

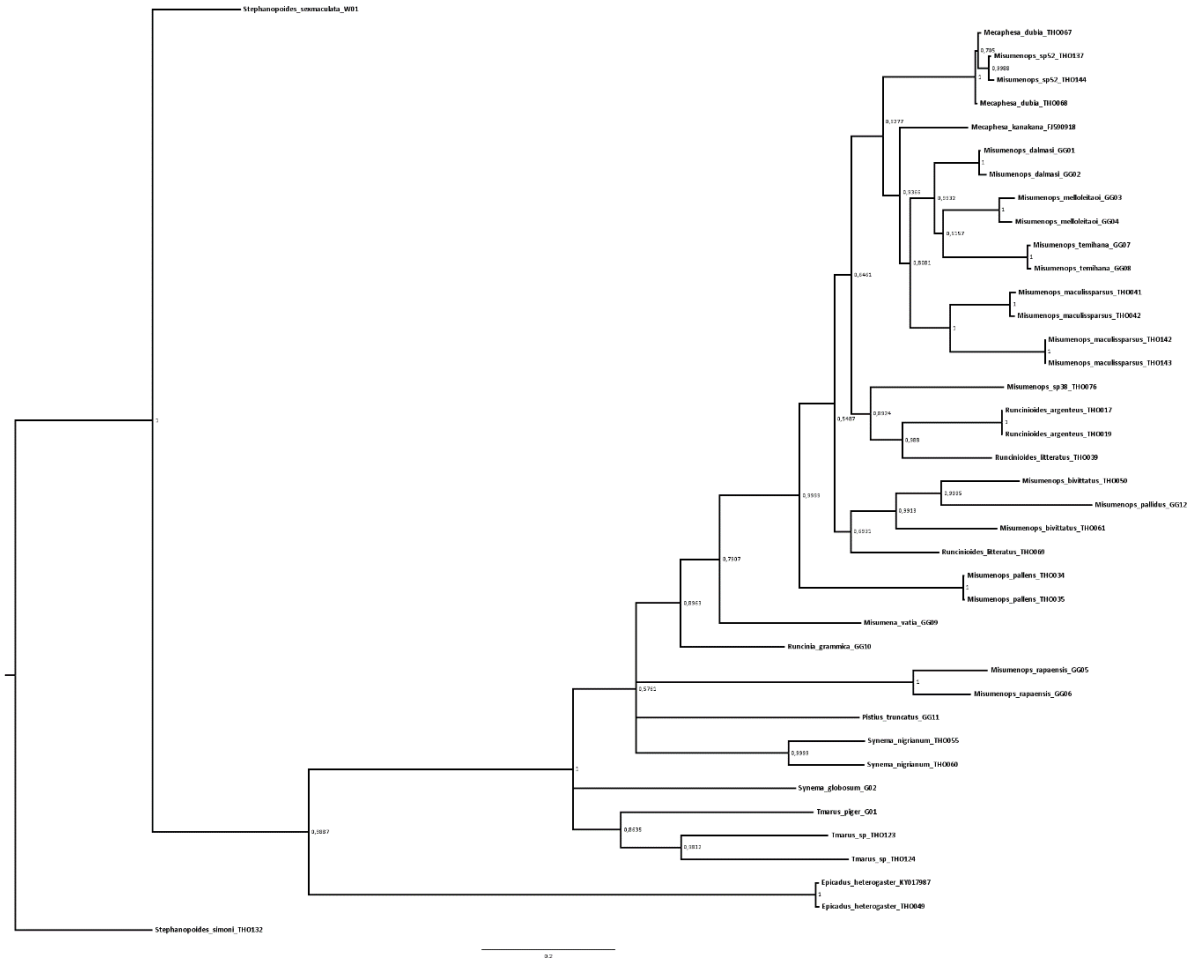

Figure S2. Resulting tree of the Bayesian inference analysis based on mitochondrial markers. Clade posterior probabilities are reported in front of the branches.

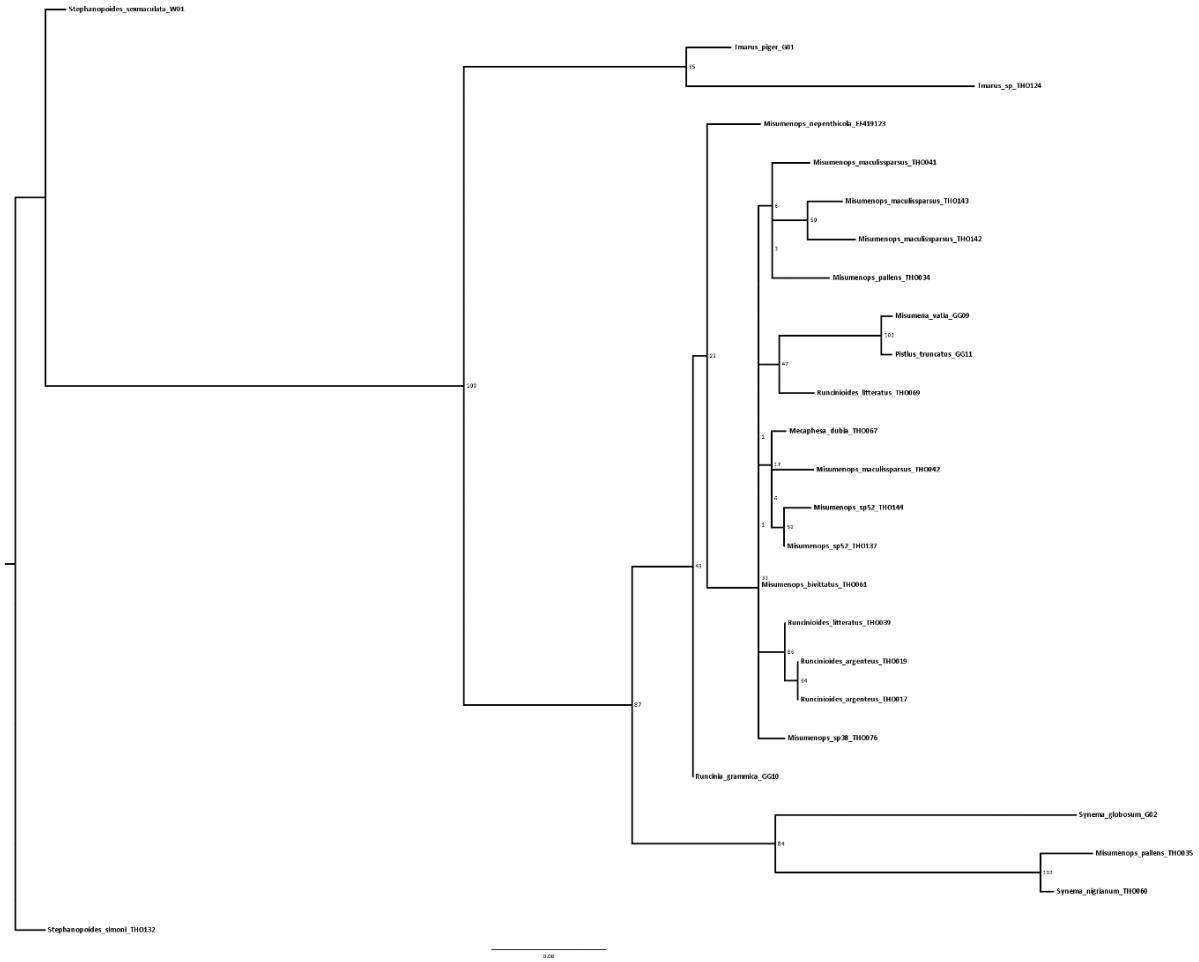

Figure S3. Resulting tree of the maximum likelihood analysis based on H3. Clade Bootstrap values are reported in front of the branches.

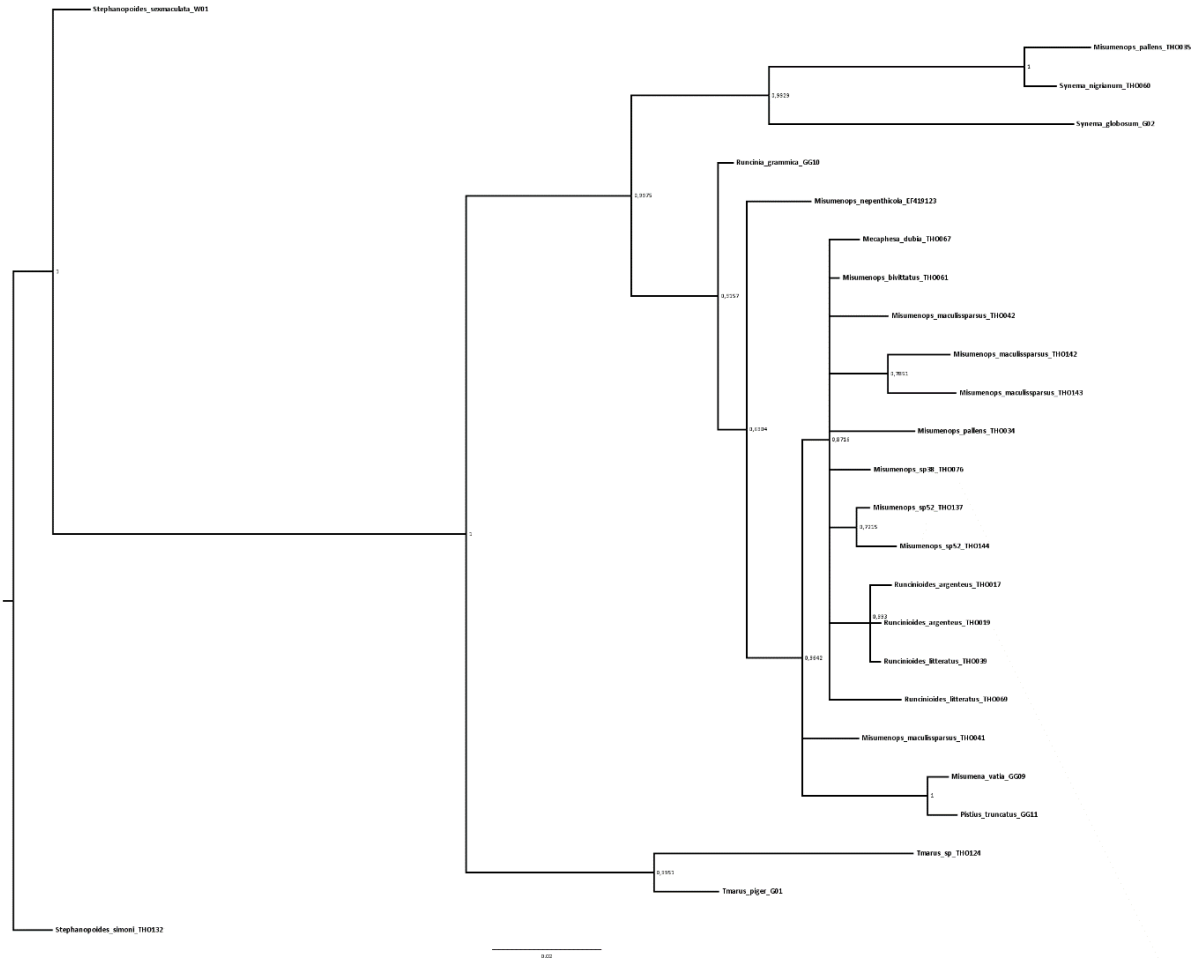

Figure S4. Resulting tree of the Bayesian inference analysis based on H3. Clade posterior probabilities are reported in front of the branches.

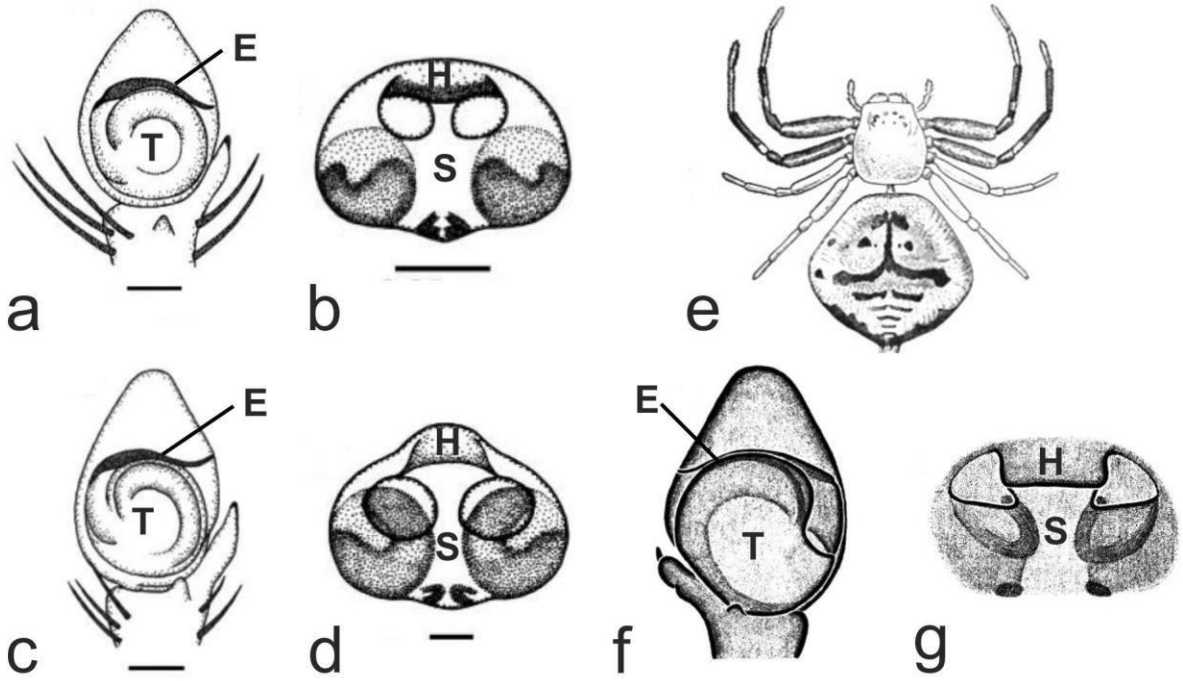

Figure S5. Misumenini species, figures modified from the literature (a–b *Misumenops temihana* Garb, 2007, c–d *Misumenops melloleitaoi*, e *Synema nigrianum* Mello-Leitão, 1929, f–g *Mecaphesa kanakana* (Karsch, 1880)). **a–b** figures 5 and 9 from Garb (2007) (a male left palp, ventral; b female epigynum, ventral); **c–d** figures 13 and 17 from Garb (2007) (c male left palp, ventral; d female epigynum, ventral); **e** figure 1 from Soares (1943), female habitus, dorsal; **f–g** figures 93 and 95 from Suman (1971) (f male left palp, ventral; g female epigynum, ventral). Abbreviations: E, embolus; H, hood; S, septum; T, tegulum. Scale bars: a, c, 0.1 mm. b, d, 0.05 mm.

Chapter 2

Revision of the crab-spiders of the genus *Runcinioides* Mello-Leitão, 1929 (Araneae, Thomisidae)

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Abstract

The genus *Runcinioides* is revised, including the redescription of *R. argenteus* Mello-Leitão, 1929 and *R. litteratus* (Piza, 1933). The male of *R. litteratus* is described and illustrated for the first time and *Misumenops paranensis* (Mello-Leitão, 1932) is here considered a junior synonym of *R. argenteus*. The known geographic distribution of both species is expanded with the inclusion of new occurrence data. *Runcinioides pustulatus* Mello-Leitão, 1929 and *Runcinioides souzai* Soares, 1942 are not related to the other species of the genus, and provisionally considered as *incertae sedis*.

Key words: Misumenini, Neotropical region, spiders, taxonomy, Arachnida.

1. Introduction

Runcinioides Mello-Leitão, 1929 is a small crab-spider genus with only four

species, and is known only from Brazil except by two isolated records in French Guiana (World Spider Catalog 2018). Specimens of *Runcionioides* are ambush predators associated with flowers, where they hunt floral-visiting insects (Romero & Vasconcellos-Neto 2003, 2004, Rocha-Filho & Rinaldi 2011, personal observation, Fig. 1). *Runcinioides* was first described by Mello-Leitão (1929) to contain three species: *R. argenteus* Mello-Leitão, 1929; *R. nigromaculatus* Mello-Leitão, 1929 and *R. pustulatus* Mello- Leitão, 1929. Later, Soares (1942) added one more species to the genus, *R. souzai* Soares, 1942. The first revision of the genus was published by Rinaldi (1988), who considered *Runcinioides* a junior synonym of *Misumenops* Sundevall, 1833, and synonymized *M. nigromaculatus* with
M. argenteus. Part of her conclusions was challenged by Lehtinen & Marusik (2008), who revalidated *Runcinioides* and included *Metadiaea litterata* Piza, 1933.

Despite all the previous studies cited above, the taxonomic boundaries of *Runcionioides* species remain obscure, mostly due to the scarcity of detailed descriptions and accurate illustrations. Here we present a new diagnosis for *Runcinioides* and revise the included species. We redescribe the females of *R. argenteus* and *R. literatus*, describe the male of *R. litteratus* for the first time and synonymize *Metadiaea paranensis* Mello-Leitão, 1932 with *R. argenteus*. Finally, we expand the known geographic distribution of the genus based on a thorough survey of the material available in scientific collections.

2. Material and methods

Specimens included in this study are deposited in the following institutions (abbreviations and curators in parentheses): Instituto Butantan, São Paulo, Brazil (IBSP, A.D. Brescovit); Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil (MCN, R. Ott); Museu Nacional, Rio de Janeiro, Brazil (MNRJ, A.B. Kury); Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZSP, R. Pinto-da- Rocha); Centro de Coleções Taxonômicas, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (CCT-UFMG, A.J. Santos); Muséum National d'Histoire Naturelle, Paris, France (MNHN, C. Rollard).

The specimens were examined and measured immersed in 80% ethanol using

an Olympus SZ40 stereoscopic microscope with a micrometer eyepiece. All the measurements are in millimeters. Digital images were taken with a Leica DFC500 digital camera attached to a Leica M205C stereoscopic microscope. Pictures taken in several focal planes were assembled as multifocus images with the software Leica Applications Suite Version 3.8.0 (Leica Inc.) or the software Zerene Stacker Version 1.04 (Zerene Systems). Pencil drawings of female and male genitalia were made based on the obtained images. Specimens for SEM were dehydrated in a Leica Bal-tec CPD 030 critical-point dryer, mounted on stubs with adhesive copper tape and sputter-coated with 10 nm of gold-palladium alloy in a Leica Bal-tec MD20 sputter. SEM images were taken under high vacuum in a FEG-Quanta 200 FEI Scanning Electron Microscope at the Centro de Microscopia da UFMG. All figures were edited using Adobe Photoshop CS3 Version 10.0 (Adobe Systems Inc.). For the examination of internal female genitalia, it was removed from the specimen using an entomological pin, immersed for two hours in a pancreatin solution (prepared according to Álvarez-Padilla & Hormiga 2008), washed in distilled water and preserved immersed in 80% ethanol. The terminology used to describe the female genitalia follows Sierwald (1989), Benjamin (2011) and Edwards (2017), for male palp Benjamin (2011) and for spinnerets, Ramirez (2014). Geographic coordinates were taken from specimen labels or, when not previously provided, obtained from Google Earth Pro Version 7.3.2.5491 (Google LLC) or from GeoHack system. Maps were made using ArcGIS Version 10.3 by Esri®.

3. Taxonomy

Family Thomisidae Sundevall,
1833 Genus *Runcinioides* Mello-
Leitão, 1929

Runcinioides Mello-Leitão, 1929: 211. Mello-Leitão 1944: 319; Mello-Leitão 1947: 276;

Caporiacco 1954: 140; Lehtinen 2004: 151; Lehtinen & Marusik 2008: 190.

Misumenops ad part. Rinaldi 1988: 20.

Type species: *Runcinioides argenteus* Mello-Leitão, 1929, by subsequent designation (Roewer 1955).

Diagnosis. *Runcinioides* is included in the Misumenini tribe *sensu* Lehtinen (2004) and shares some characteristics of the group, like the presence of a coupling pocket in the epigyne and male legs I and II with brownish annulations. Males of *Runcinioides* can be distinguished from all other Misumenini by the presence of a long embolus originating in 4-6 o'clock position in ventral view of the left palp, that runs widely separated from the tegulum in the distal half of the bulb (Figs 2c, 4e, 6a, 8c, 9c, 11e, 14a). The female can be distinguished by the presence of a large, non-sclerotized and flexible coupling pocket (= hood *sensu* Benjamin 2011) (Figs 2a, 3e, 5a–c, 9a, 10e, 13a–c), and by the long and coiled stalk of the spermathecae and copulatory ducts (Figs 2b, 3f, 5d–e, 9b, 10f, 13d–e).

Description. Small to medium sized spiders (total length: males 2.62–5.04; females 2.92–9.74). Males usually smaller than females, the size dimorphism more accentuated in *R. litteratus*. Carapace and opisthosoma covered with spiniform setae, especially in *R. argenteus* (Figs 3a– c, 4a–c, 10a–c, 11a–c). Male and female with a line of marginal setae on the carapace, more conspicuous in the males (Figs 4c, 11c). Leg formula I-II-IV-III. Two tarsal claws, retroclaw with four (*R. litteratus*) to five (*R. argenteus*) large teeth and one small basal tooth (Figs 6f, 14f), proclaw with four (*R. litteratus*) to five (*R. argenteus*) larger teeth and numerous small basal teeth (Fig. 14f). Distal tarsus with few pseudotenent setae and some twisted setae (Figs 6f, 14f). Macrosetae on the lateroventral side of tibia and metatarsus I and II more conspicuous in the female (Figs 3a–b, 10a–b,) than in the male (Figs 4a–b, 11a–b). Carapace with two longitudinal dark bands (Figs 1, 3a–c, 4a,c, 8b, 10a,c, 11a,c, 12), male legs I–II with dark rings (Figs 1c; 4a–b; 11a–b) and opisthosoma usually with dorsal dark spots (Figs 1b–d, 4a, 8b, 10a, 11a, 12c–f). Male palp larger compared to other genera of Misumenini; without ITA; promargin of the RTA with apical, transverse ridges (Figs 6e, 14e); retrolateral margin of the cymbium with a large tutaculum, which ends in a transverse groove (Figs 2c–d, 4d–e, 6a–b, d, 9d, 11f, 14d); tegulum round, very sclerotized, with a marginal deep slit delimited by a ridge, which is more pronounced prolaterally (Figs 2c–d, 4e–f, 6a–b, d, 9c–d, 11e–f, 14a,d); embolus long, originating at 4 o'clock, with clockwise direction in the left palp (Figs 2c, 4e, 6a, 8c, 9c, 11e, 14a). Epigyne with two small cavities caudal to the posterior margin of the coupling pocket, henceforth

called “anchor openings” (Figs 2a, 3e, 5a, 9a, 10e, 13a–b); copulatory openings aside the coupling pocket (Figs 5a–c, 13c). spermathecae with large spermathecal glands (= “head of spermathecae”) (Figs 2b, 3f, 5d–f, 9b, 10f, 13d–f); copulatory ducts hyaline, with several loops before attachment to the long and tubular stalk of the spermathecae (Figs 2b, 3f, 5d–e, 9b, 10f, 13d–e); fertilization ducts adhered to the posterior plate and attached to the base of the spermathecae (Figs 2b, 3f, 5d, 9b, 10f, 13d–e). Male spinnerets (Fig. 7a): ALS with one major ampullate gland spigot and a nubbin on prolateral margin and numerous piriform gland spigots on retrolateral margin (Fig. 7b); PMS with three anterior aciniform gland spigots and one nubbin, one central tartipore and one posterior minor ampullate gland spigot and a nubbin (Fig. 7c); PLS with numerous aciniform gland spigots (Fig. 7d).

Remarks. We have examined the female type specimens of *Runcinioides pustulatus* (MNHN 9401) and *R. souzai* (MZSP 73), and found their genitalia significantly different from the remaining species of the genus. For instance, both are devoid of the characteristic non-sclerotized and flexible coupling pocket mentioned above. In addition, the recently discovered males of both species do not match the genus diagnosis presented above, and their palp morphology is consistent with characters of other thomisid genera (R.A. Teixeira, *pers. comm.*). Thus, we decided not to include those species in this revision, and provisionally they should be treated as *incertae sedis*.

Distribution. Eastern Brazil, from the state of Rio Grande do Norte to Rio Grande do Sul (Figs 15a–b). There are two literature records outside Brazil, from French Guiana (Caporiacco 1954), but since we could not find the specimens, these records remain doubtful.

Composition. Two species, *R. argenteus* and *R. litteratus*.

Runcinioides argenteus Mello-Leitão, 1929 (Figs 1c–d, 2–8, 15a)

Runcinioides argenteus Mello-Leitão, 1929: 211, figs 22, 22a, b. Mello-Leitão 1941: 242;

Lehtinen & Marusik 2008: 190, figs 50–53, 66, 67.

Runcinioides nigromaculatus Mello-Leitão, 1929: 211, figs 23, 23a, b. Mello-Leitão 1944: 319; Mello-Leitão 1947: 276; Caporiacco 1954: 140, figs 42, 42a.

Metadiaea paranensis Mello-Leitão, 1932: 74. Soares 1944: 153. **New synonymy.**

Misumenops argenteus (Mello-Leitão). Rinaldi 1988: 20, figs 1–3, 4a, b; Romero & Vasconcellos-Neto 2003, 2004.

Misumenops paranensis (Mello-Leitão). Word Spider Catalog 2018.

Type material: ***Runcinioides argenteus***, female holotype (MNRJ 898) from Brazil, Rio de Janeiro, Petrópolis city, examined. ***Runcinioides nigromaculatus***, subadult female holotype (MNRJ 899) from Brazil, Rio de Janeiro, Petrópolis city, examined. ***Metadiaea paranensis***, male holotype (MNRJ 14162) from Brazil, Paraná, Rio Negro city, examined.

Diagnosis. Males of *R. argenteus* resemble those of *R. litteratus* in the color pattern (Figs 1c, 4a–d) and palp conformation, but differ in the embolus without a prominent bulging process at the base (Figs 2c–d, 4e–f, 6a–b, d). Females differ from *R. litteratus* in the coupling pocket wider than long and diamond-shaped (Figs 2a, 3e, 5a–c).

Description. Female (holotype of *R. argenteus*):

Carapace pale-yellow with two lateral, longitudinal brown bands, and covered with strong, sparse setae (Figs 3a, c). Chelicerae, endites, labium and sternum pale-yellow (Figs 3b, d). Legs pale-yellow. Leg I with six pairs of lateroventral macrosetae in the tibia and five pairs in the metatarsus (Figs 3a–b). Leg II with two lateroventral pairs in the tibia and three pairs in the metatarsus (Figs 3a–b). Opisthosoma homogeneously pale gray (Figs 3a–b), covered by strong, sparse setae. *Measurements.* Total length 3.73, prosoma length 1.7, width 1.78, clypeus height 0.15, sternum length 0.89, width 0.76, opisthosoma length 2.03, width 1.91. Measurements of palp and legs: Palp: 1.45 (0.41, 0.2, 0.33, -, 0.51), I: 5.75 (1.78, 0.69, 1.27, 1.27, 0.74), II: 4.84 (1.4, 0.51, 1.12, 1.07, 0.74), III: 3.35 (1.12, 0.41, 0.81, 0.58, 0.43), IV: 3.03 (1.14, 0.41, 0.74, 0.74, 0.51). *Variation.* Female (N=21), total length 2.92–5.95, prosoma length 1.27–2.42, width 1.35–2.8, opisthosoma length 1.65–3.81, width 1.14–4.07.

Male (from Brazil, São Paulo, Campos do Jordão; UFMG 22097):

Carapace pale-yellow with a irregular, brown band at each side, a few scattered brown spots, and a thin marginal, dark brown band; covered with strong, sparse setae as in the female (Figs. 4a, c). Ocular area orange (Fig. 4c). Chelicerae pale-yellow with a dark spot at the proximal margin of the basal segment (Fig. 4c). Endites, labium and sternum pale-yellow (Fig. 4d). Legs I and II pale-green with distal dark rings on femur and patella; tibia with proximal dark ring and a broad distal, dark band; metatarsus and tarsus slightly darker in the distal half (Figs 4a– b). Legs III and IV pale-yellow with distal, slightly darker rings on tibia and metatarsus (Figs 4a–b). Legs with many dorsal and lateroventral spines (Figs 4a–b). Dorsum of opisthosoma homogeneously pale-yellow, with dark spots on the posterior half, covered by strong, sparse setae (Fig. 4a). Venter pale-yellow, with the epigastric plate slightly darker and with a posterior dark spot (Fig. 4b). Anal tubercle and spinnerets brown.

Measurements. Total length 4.4, prosoma length 1.86, width 2.08, clypeus height 0.25, sternum length 0.89, width 0.89, opisthosoma length 2.54, width 2.14. Measurements of palp and legs: Palp: 2.19 (0.69, 0.2, 0.23, -, 1.07), I: 9.23 (2.49, 0.84, 2.49, 2.29, 1.12), II: 9.01 (2.54, 0.81, 2.36, 2.16, 1.14), III: 4.51 (1.35, 0.51, 1.02, 0.94, 0.69), IV: 4.74 (1.53, 0.51, 1.02, 1.02, 0.66). *Variation.* Male (N=10), total length 3.41–5.04, prosoma length 1.58–2.16, width 1.86–2.29, opisthosoma length 1.78–2.88, width 1.53–2.29.

Natural history. *R. argenteus* live in flowers, like most Misumenini species, without an apparent strict preference for plant species. They are commonly found in Asteraceae (Fig. 1d): *Trichogoniopsis adenantha* (DC) (Romero & Vasconcellos-Neto 2003), *Eupatorium hirsutum* Baker, *Vernonia polyanthes* Less., *Viguiera robusta* Gardn., *Piptocarpha rotundifolia* (Less.) Baker, *Agerantum fastigiatum* (Gardn.) King & H. Rob. (Rocha-Filho & Rinaldi 2011). However, they were recorded from other plant families: *Banisteriopsis malifolia* (Ness & Mart.) B. Gates and *B. campestris* (A. Juss.) Little (Malpighiaceae), *Lippia lupulina* Cham. (Verbenaceae), *Hyptis lippioides* Pohl ex Benth. (Lamiaceae), *Senna rugosa* (G. Don.) Irwin & Barneby (Fabaceae), *Matayba guianensis* Aubl. (Sapindaceae), *Styrax ferrugineus* Ness & Mart. (Styracaceae) (Rocha-Filho & Rinaldi 2011); *Ruellia* sp. (Acanthaceae) (Fig. 1c).

Remarks. The holotype of *Metadiaea paranensis* (Fig. 8) has the palp morphology

indistinguishable from that of other male specimens of *R. argenteus*. We examined the holotype of *R. nigromaculatus* and, since it is a sudadult female we do not have any evidence to confirm the synonymy proposed by Rinaldi (1988). However, based on the specimen's general appearance, we think the synonymy is most probably correct.

Distribution. Eastern Brazil, from the state of Rio Grande do Norte to Rio Grande do Sul (Fig. 15a).

Material examined. BRAZIL. ***Alagoas:*** 1 #f, Campo Alegre, Foz do Rio Jequiá, [9°49'14"S, 36°15'7"W], C.A. Camargo & E. Dante *leg.*, 30 October 1952 (MZSP 9780); 1 #f, Maceió, [9°39'57"S, 35°44'6"W], F. Lane *leg.*, 2–6 November 1976 (MZSP 74365). ***Bahia:*** 1 #f, Brumado, Magnesita, [14°10'52.15"S, 41°42'0.7"W, 716 m], P.H. Martins *et al. leg.*, 24 February 2017 (UFMG 22217). ***Minas Gerais:*** 1 #f, Belo Horizonte, Parque Municipal das Mangabeiras, [19°56'50.34"S, 43°54'18.9"W, 1080 m], H.H. Santos *et al. leg.*, 21–23 July 2009 (UFMG 6508); 1 #f, [19°57'14.86"S, 43°54'19.15"W], 20–22 January 2009 (UFMG 7997); 1 #f, Brumadinho, Serra da Calçada, [20°5'42.2"S, 43°59'6.8"W,], B.T. Faleiro *leg.*, 15 March 2016 (UFMG 22098); 2 #f, Catas Altas, Serra do Caraça, [20°5'51"S, 43°29'18"W,], Martins *et al. leg.*, 24 February–3 March 1972 (MZSP 74366); 1 #f, Leme do Prado, Estação Ecológica de Acauã, Poção, [17°7'56.22"S, 42°46'7.98"W, 795m], P.H. Martins *leg.*, 18–28 February 2013 (UFMG 19983); 1 #f, Ouro Preto, Parque Estadual do Itacolomi, [20°26'5.3"S, 43°30'32.6"W, 1326m], K.P. Santos *et al. leg.*, 11–13 April 2008 (UFMG 2344); 1 #f, Estalagem Sesc Ouro Preto, [20°22'39.42"S, 43°33'30.72"W, 1285m], A.J. Santos *leg.*, 5 November 2016 (UFMG 22216); 1 #f, São Gonçalo do Rio Abaixo, Estação de Preservação e Desenvolvimento Ambiental de Peti, [19°53'0"S, 43°22'0"W,], G.H.F. Azevedo *et al. leg.*, 9 December 2012 (UFMG 12964). ***Paraíba:*** 2 #m, Campina Grande, São José da Mata, Sítio São Miguel, [7°10'55"S, 35°59'5"W], A.D. Brescovit *leg.*, 10 April 1997 (IBSP 8900). ***Paraná:*** 1 #m, 1 #f, Bituruna, [26°9'39"S, 51°33'10"W], V. Staviarsky *leg.*, February 1948 (MNRJ 6898); 1 #m, Candói, [25°34'15"S, 52°3'10"W], M.C. de Paula *leg.*, 24 November 2003 (IBSP 57942); 1 #m, Coronel Domingos Soares, UHE Governador Ney Aminthas de Barros Braga, Foz do Rio Iratim, [26°1'32"S, 51°53'37"W], R. Pinto-da-Rocha & A.P. Barreto *leg.*, 23 November 1991 (MZSP 14646); 2 #m 1 #f, Curitiba, [25°36'56"S, 53°7'40"W], A.D. Brescovit *leg.*, 2 November 1987 (IBSP 14180); 1 #f, [25°25'47"S, 49°16'19"W], Z. Rohr *leg.*, (MNRJ 18385); Guarapuava,

Estância Santa Clara, [25°22'23"S, 51°29'6"W], A.D. Brescovit *leg.*, 22 November 1987 (IBSP 2391); 1 #f, Imbituva, Rodovia BR373, km 80, Estrada Ponta Grossa-Guarapuceno, [25°10'28"S, 50°37'24"W], P. Biasi *leg.*, 28 April 1967 (MZSP 7014); 1 #m, Paranaguá, Parque Nacional de Saint-Hilaire-Lange, Fazenda Niteroi, [25°39'38.1"S, 48°35'45.1"W, 80 m], L.S. Carvalho *leg.*, 11 October 2014 (UFMG 22099); 1 #m, Pinhão, [25°41'45"S, 51°39'36"W], R. Pinto-da-Rocha *leg.*, 22 November 1991 (MCN 22221); 1 #m, Reserva do Iguaçu, UHE Governador Ney Aminthas de Barros Braga, [25°59'53"S, 51°59'14"W], R. Pinto-da-Rocha & M.R.S. Lopes *leg.*, 25 October 1991 (MZSP 14639); 2 #m, R. Pinto-da-Rocha & A.P. Barreto *leg.*, 22 November 1991 (MZSP 14647); 1 #f (MZSP 14664); 1 #m, Tijucas do Sul, Lagoa, [25°57'6"S, 49°13'15"W], J. Ricetti *leg.*, 28 October 2001 (IBSP 39045); 1 #m, Toledo, [24°42'50"S, 53°44'34"W], S.M. Hefler *et al. leg.*, October–December 2003 (IBSP 57902); [24°42'50"S, 53°44'43"W], 1 #f, October–December 2003 (IBSP 57900); 2 #m (IBSP 57908). ***Pernambuco:*** 1 #f, Santa Cruz do Capibaribe, Serra do Pará, [7°52'29.2"S, 36°24'10.06"W], F.M.G. Las-Casas *leg.*, 27 October 2012 (UFMG 13603). ***Rio Grande do Norte:*** 1 #f, Parnamirim, [5°54'57"S, 35°15'46"W], M. Alvarenga *leg.*, 11 February 1952 (MZSP 3088). ***Rio Grande do Sul:*** 1 #f, Arroio do Meio, [29°24'3"S, 51°56'42"W], A.A. Lise *leg.*, 9 January 1985 (MCN 13070); 2 #m, Barra do Ribeiro, [30°17'27"S, 51°18'3"W], M.L. Tavares *leg.*, 1 November 1976 (MCN 4742); 4 #f, Camaquã, [30°52'26"S, 51°35'43"W], Ferrari & Freitas *leg.*, 16 November 2016 (UFMG 22215); 1 #m 1 #f, Cambará do Sul, [29°2'52"S, 50°8'42"W], L.A. Moura *leg.*, 2 November 1993 (MCN 24375); 3 #m 1 #f, A.B. Bonaldo *leg.*, 26 November 1993, (MCN 24416); 1 #m 1 #f, M.A.L. Marques *leg.*, 24 November 1993 (MCN 24437); 1 #m, N. Silveira *leg.*, 20 October 1994 (MCN 25818); 1 #m, Candelária, Cerro do Botucaraí, [29°42'26"S, 52°50'17"W], A.F. Franceschini *leg.*, 8–9 October 2001 (MCN 34076); 1 #m, Canela, Floresta Nacional de Canela, [29°19'12.7"S, 50°49'2.6"W, 812 m], L.S. Carvalho *leg.*, 24 October 2014, (UFMG 22100); 1 #f, [29°21'57"S, 50°48'57"W], A.A. Lise *leg.*, 2 February 1965 (MCN 332); 6 #f, 3 February 1967 (MCN 549); 2 #m, 7 October 1967 (MCN 648); 1 #m (MCN 650); 3 #m 1 #f, 31 December 1973 (MCN 2073); 2 #m 2 #f 1 imm., 2 December 1973 (MCN 2191); 1 #f, 15 February 1972 (MCN 2469); 1 #m 1 #f, 7 October 1967 (MCN 2594); 1 #f, 10 February 1969 (MCN 7538); 1 #f, 5 February 1973 (MCN 8833); 6 #m, 3 February 1967 (MCN 9311); 1 #m 1 imm., Usina Hidrelétrica Canastra, [29°23'36"S, 50°44'44"W], E.H. Buckup *leg.*, 20 November 1997 (MCN

28843); 1 #m 1 #f, A.F. Franceschini *leg.*, 15 December 1999 (MCN 32017); 4 #m, Canoas, [29°55'12"S, 51°10'48"W], E.H. Buckup *leg.*, 13 December 1990 (MCN 20198); 1 #f, Caxias do Sul, Distrito de Vila Oliva, [29°13'39"S, 50°53'29"W], A.A. Lise *leg.*, 5 April 1975 (MCN 2539); 1 #m, [29°10'4"S, 51°10'44"W], L.A. Moura *leg.*, 19–20 November 1993 (MCN 24613); 3 #f, Derrubadas, Parque Estadual do Turvo, Salto do Yucumã, [27°8'45"S, 53°53'14"W], A.A. Lise *leg.*, 16 January 1985 (MCN 13059); 29 #m 19 #f 1 imm., Parque Estadual do Turvo, [27°8'44"S, 53°53'10"W], R. Ott *et al. leg.*, 27–31 October 2003 (MCN 37828); 8 #m 7 #f (MCN 38861); 1 #m 1 #f, 19–22 October 2004 (MCN 38869); 7 #m 7 #f (MCN 38871); 38 #m 36 #f (MCN 38880); 1 #m, Dom Pedro de Alcântra, [29°22'8"S, 49°51'0"W], A.A. Lise *leg.*, 21 November 1976 (MCN 4835); 2 #m, Estrela Velha, Usina Hidrelétrica Itaúba, [29°15'23"S, 53°13'39"W], A. Silva *leg.*, 20 October 1998 (MCN 30773); 1 #f (MCN 30774); 1 #f, 2 October 1998 (MCN 30787); 3 #m 2 #f, A.F. Franceschini *leg.*, 28 October 1999 (MCN 31954); 1 #m, A.B. Bonaldo *leg.*, 27 October 1999 (MCN 31998); 1 #f (MCN 31999); 1 #m 2 #f, A.F. Franceschini *leg.*, 17–21 January 2000 (MCN 32133); 1 #f, General Câmara, [29°54'18"S, 51°45'36"W], J. Pinto *leg.*, 14 October 1982 (MCN 10820); 1 #f, E.H. Buckup, 19 October 1982 (MCN 10901); 1 #f, M. Rosenau *leg.*, 14 October 1982 (MCN 11094); 1 #f, Gravataí, Distrito de Morungava, [29°50'54"S, 50°54'1"W], A.D. Brescovit *leg.*, 2 February 1992 (MCN 21988); 1 #f, Guabijú, Fundação Ecológica, Cultural e Social Guabijuense, [28°32'30"S, 51°41'11"W], A.F. Franceschini *leg.*, 9–11 October 2000 (MCN 33399); 1 #m 1 #f, Igrejinha, [29°34'26"S, 50°47'24"W], P. Biasi *leg.*, 19 October 1967 (MZSP 7161); 2 #m, Iraí, [27°11'38"S, 53°15'3"W], A.A. Lise *leg.*, 19 November 1975 (MCN 3046); 1 #f, Itaara, Reserva Biológica Ibicuí-Mirim, [29°33'5"S, 53°48'27"W], N. Silveira *leg.*, 10 December 1992 (MCN 22637); 1 #m, Júlio de Castilhos, Barragem de Itaúba, [29°15'28"S, 53°13'50"W], A.B. Bonaldo *leg.*, 22 October 1998 (MCN 30598); 4 #f 1 imm., Lajeado, [29°28'1"S, 51°57'39"W], A.A. Lise *leg.*, 20 April 1974 (MCN 1995); 2 #m, Maquiné, Rio Maquiné, [29°36'29"S, 50°15'55"W], E.N.L. Rodrigues *leg.*, 20 November 2007 (MCN 48430); 1 #m, Montenegro, [29°41'20"S, 51°27'39"W], H. Bischoff *leg.*, 29 September 1977 (MCN 6620); 1 #f, A.A. Lise *leg.*, (MCN 6624); 2 #m, Morro Reuter, BR 116, Km 80, [29°32'30"S, 51°4'45"W], 7 October 1967 (MCN 1341); 3 #f 8 imm. (MCN 2276); 3 #m 1 #f, Novo Hamburgo, Bairro Lomba Grande, Morro dos Bois, [29°45'58"S, 51°2'27"W], 27 November 1980 (MCN 9430); 1 #f, Porto Alegre, [30°1'58"S, 51°13'48"W],

C.A. Hartlieb *leg.*, 8 December 1962 (MCN 1252); 1 #m, L. Jantsch *leg.*, March 1980 (MCN 8993); 1 #m, A. Tavares *leg.*, 27 September 1985 (MCN 13479); 1 #m, Bairro Morro Santana, [30°2'20"S, 51°7'43"W], R.A. Ramos *leg.*, 28 October 1989 (MCN 18979); 1 #m 1 imm., [30°1'58"S, 51°13'48"W], P. Buck (MNRJ 41913); 1 #m 1 #f 45 imm., Rio Grande, Estação Ecológica do Taim, [32°44'33"S, 52°34'28"W], M. Rosenau *leg.*, 17 October 1985 (MCN 13801); 2 #m 2 #f, M.A.L. Marques *leg.*, 28 November 1985 (MCN 13941); 1 #m 2 #f 2 imm., H.A. Gastal *leg.* (MCN 13949); 2 #f 1 imm., M. Rosenau *leg.* (MCN 13953); 1 #m 1 #f, A.A. Lise *leg.*, 14 December 1985 (MCN 14151); 1 #m 1 #f, 17 December 1985 (MCN 14169); 2 #m 5 #f 1 imm, M. Rosenau *leg.*, 4 December 1986 (MCN 16121); 2 #m 7 #f 2 imm., M.A.L. Marques *leg.* (MCN 16127); 1 #f, A.D. Brescovit *leg.* (MCN 16141); 3 #m 3 #f, E.H. Buckup *leg.* (MCN 16144); 1 #m 1 #f, M.C. Moraes (MCN 16306); 1 #f, 1 December 1986 (MCN 16314); 1 #m 2 imm., M.A.L. Marques *leg.*, 2 December 1986 (MCN 16315); 6 #m 5 #f, M. Rosenau *leg.*, 4 December 1986 (MCN 16318); 10 #m 3 #f 3 imm. (MCN 16345); 1 #m 2 #f, A.A. Lise *leg.*, 7 January 1987 (MCN 16626); 5 #f, Santa Maria, [29°41'2"S, 53°48'25"W], A.D. Brescovit *leg.*, 2 November 1985 (MCN 14561); 3 #m (MCN 14562); 1 #m, São Francisco de Paula, Barragem dos Bugres, [29°20'48"S, 50°42'7"W], M.A.L. Marques *leg.*, 18 Noveber 1997 (MCN 28811); 4 #m, 4–6 November 1998 (MCN 30798); 8 #m, 23–25 November 1998 (MCN 30810); 5 #m 7 #f 3 imm., Usina Hidrelétrica Passo do Inferno, [29°16'12"S, 50°45'17"W], E.H. Buckup *leg.*, 19 November 1997 (MCN 28812); 7 #m 3 #f, M.A.L. Marques *leg.* (MCN 28817); 1 #m 1 #f, L.A. Moura *leg.*, 3 November 1998 (MCN 29736); 1 #m 1 #f, A. Silva *leg.*, 16 December 1999 (MCN 32032); 5 #m, Fazenda Três Cachoeiras, [29°15'29"S, 50°45'30"W], A.B. Bonaldo *leg.*, 5 November 1998 (MCN 30868); 1 #f, Taquara, Morro da Pedra, [29°42'0"S, 50°53'36"W], 17 February 1995 (IBSP 6719); 1 #f, Triunfo, [29°56'34"S, 51°43'4"W], E.H. Buckup *leg.*, 15 September 1977 (MCN 6491); 2 #m, 20 October 1977 (MCN 6874); 1 #f, A.A. Lise *leg.* (MCN 6878); 3 #m, Parque Copesul de Proteção Ambiental, [29°51'45"S, 51°22'13"W], M.A.L. Marques *leg.*, 30 November 1987 (MCN 17048); 4 #m, 24 October 1988 (MCN 17879); 1 #m 1 #f, E.H. Buckup *leg.*, 21 September 1989 (MCN 18640); 8 #m 6 #f, A.D. Brescovit *leg.*, 24 October 1989 (MCN 18879); 4 #m 4 #f, E.H. Buckup *leg.*, 28 November 1989 (MCN 19000); 1 #f, A.B. Bonaldo *leg.*, 17 September 1993 (MCN 24006); 1 #m, P. Preiss *leg.*, 28 November 2000 (MCN 33508); 1 #m 1 #f, A. Barcellos & L. Schmidt *leg.*, 22 October 2003 (MCN 36468); 1 #f, 21

October 2003 (MCN 36516); 1 #m 2 #f, R. Ott *leg.* (MCN 36636); 2 #m 2 #f, R. Ott *et al. leg.*, 24 August 2004 (MCN 38299); 1 #m, 6 January 2005 (MCN 38349); 1 #m, E.N.L. Rodrigues *leg.*, 29 April 2005 (MCN 40080); 2 #f, M.A.L. Marques *leg.*, 12 November 2007 (MCN 43696); 2 #m 5 #f, A. Barcellos & L. Schmidt *leg.* (MCN 43722); 1 #f, A. Barcellos *et al. leg.*, 9 July 2008 (MCN 44168); 5 #m 2 #f, A. Barcellos *leg.*, 11 November 2008 (MCN 44987); 1 #m, M.A.L. Marques *leg.*, 12 December 2008 (MCN 45540); 2 #m, M.R.M. Poeta *leg.*, (MCN 45549); 1 #f, Parque Braskem de Proteção Ambiental, [29°51'57"S, 51°21'55"W], M. Pairet Jr *leg.*, 15 September 2009 (MCN 46524); 2 #m 1 #f, M.A.L. Marques *leg.*, 4 December 2009 (MCN 46913); 1 #f, M.R.M. Poeta *leg.* (MCN 46920); 1 #m, P.E.S. Rodrigues *leg.* (MCN 46935); 2 #f, Viamão, Estação Experimental Fitotécnica Águas Belas, [30°5'18"S, 51°1'26"W], A.A. Lise *leg.*, 29 December 1976 (MCN 4946); 1 #f, A.D. Brescovit *leg.*, 18 October 1985 (MCN 14452); 2 #m 2 #f, Sede Campestre do Colégio Farroupilha, [30°6'34"S, 50°58'46"W], M.A.L. Marques *leg.*, 8 October 1997 (MCN 28590). ***Santa Catarina:*** 1 #m, Chapecó, IBAMA, [27°6'2"S, 52°36'38"W], T. Kunst *leg.*, (IBSP 58132); 3 #f, Concórdia, Parque Estadual Fritz Plaumann, [27°17'27"S, 52°6'53"W], J. Griss *leg.*, October 2005–July 2006 (MCN 42194); 1 #m, Maracajá, [28°50'49"S, 49°27'10"W], R.A. Teixeira *leg.*, 23 August 2006 (IBSP 79741); 2 #m 1 #f, Porto Belo, [27°9'28"S, 48°33'10"W], F.Z. da Cruz *leg.*, 27 October 1984 (MCN 12574); 1 #f, Rancho Queimado, [27°40'22"S, 49°1'19"W], L.A. Moura *leg.*, 8–11 October 1994 (MCN 25885); 2 #f, 13–15 January 1995 (MCN 26474); 1 #f, 15–18 November 1995 (MCN 26940); 1 #f, Santo Amaro da Imperatriz, [27°41'16"S, 48°46'44"W], E.H. Buckup *leg.*, 3 October 1986 (MCN 16031); 1 #f, São Bento do Sul, Centro de Estudos e Pesquisas Ambientais Rugendas, [26°19'29.9"S, 49°18'26.4"W, 617 m], I.L.F. Magalhães *et al. leg.*, 16–20 December 2011 (UFMG 11240); 1 #m, São Cristóvão do Sul, Monte Alegre, [27°18'0"S, 50°25'59"W], J.M.M. *leg.*, 2001–2002 (IBSP 141412). ***São Paulo:*** 1 #m, Atibaia, Parque Florestal do Itapetinga, [23°12'18"S, 46°29'59"W], G. Machado, 27 October 2002 (IBSP 36662); 1 #f, Campos do Jordão, Parque Estadual Campos do Jordão, estrada para Bosque Vermelho, [22°41'23.3"S, 45°28'58.6"W, 1519 m], V.S.R. Diniz & B.T. Faleiro *leg.*, 2 October 2015 (UFMG 22093); 1 #f (UFMG 22094); 1 #m (UFMG 22095); 3 #m (UFMG 22096); 1 #m (UFMG 22097); 1 #m, Capão Bonito, Parque Estadual Intervales, [24°16'6"S, 48°24'50"W], A.D. Brescovit *et al. leg.*, 8–10 October 2011 (IBSP 168639); 1 #f, Cunha, Parque Estadual da Serra do Mar, Núcleo Cunha,

[23°14'4.6"S, 45°1'23.9"W, 1018 m], V.S.R. Diniz & B.T. Faleiro *leg.*, 25 September 2015 (UFMG 22091); 1 #f (UFMG 22092); 2 #f, Guarulhos, [23°27'46"S, 46°31'58"W], F.S. Pereira *leg.*, 14–15 June 1942 (MZSP 357); 1 #m, Itapevi, [23°32'56"S, 46°56'2"W], C. Bertim & V. Onófrio *leg.*, January–December 1999 (IBSP 122118); 1 #f, Itú, Fazenda Pau d'Alho, [23°15'50"S, 47°17'56"W], P. Biasi *leg.*, 27–29 October 1965 (MZSP 5295); 1 #m 2 #f, Jundiaí, [23°11'11"S, 46°53'3"W], C.A. Rheims *leg.*, 30 October–2 November 1998 (IBSP 20167); 2 #f, 9–12 October 1999 (IBSP 26255); 1 #m, Reserva Biológica Municipal da Serra do Japi, [23°12'31"S, 46°57'58"W], A.J. Santos *leg.*, 12–17 November 1997 (IBSP 38814); 1 #f, C. Vieira *leg.*, 2008–2009 (IBSP 140799); 1 #m, [23°13'1"S, 46°56'0"W] (IBSP 140804); 1 #m, Juquitiba, [23°55'54"S, 47°4'6"W], R.S. Mattos *leg.*, 11 October 1983 (IBSP 14245); 1 #f, Mogi das Cruzes, Distrito de Biritiba-Ussu, [23°38'8"S, 44°7'25"W], E. Kashimata & R. Martins *leg.*, May 2001 (IBSP 56324); 1 #f (IBSP 56332); 1 #f (IBSP 56591); 1 #f, Monte Alegre do Sul, Fazenda Santa Maria, [22°40'55"S, 46°40'51"W], B.A.M. Soares *leg.*, 18–19 December 1942 (MZSP 335); 2 #m, Salesópolis, Estação Biológica de Boracéia, [23°37'59"S, 45°31'59"W], K. Lenko *leg.*, 10 November 1960 (MZSP 1200); 1 #m, 17 October 1960 (MZSP 1208); 1 #f, 18 October 1960 (MZSP 1217); 1 #m, 19 October 1960 (MZSP 1219); 1 #m, 10 November 1960 (MZSP 1220); 2 #f, 1–2 June 1961 (MZSP 1741); 1 #f, B.A.M. Soares *leg.*, 8–10 February 1942 (MZSP 3446); 3 #f, P. Biasi *leg.*, 12 January 1961 (MZSP 9807); 1 #f, 23 October 1965 (MZSP 74370); 2 #m 2 #f, Santo André, Reserva Biológica do Alto da Serra de Paranapiacaba, [23°46'47"S, 46°18'39"W], C.A. Rheims & R.P. Indicatti *leg.*, 14–16 December 2003 (IBSP 52035); 1 #f, São Bernardo do Campo, Represa Billings, [23°47'11"S, 46°33'12"W], P. Biasi *leg.*, 7 February 1968 (MZSP 74369); 1 #f, São Paulo, [23°32'51"S, 46°38'10"W], May 1962 (IBSP 1782); 1 #f, [23°33'1"S, 46°38'2"W], 1960 (IBSP 1879); 1 #f, Bairro Butantãn, Parque da Previdência, [23°34'51"S, 46°43'34"W], J. Império *leg.*, 27 November 2000 (IBSP 29010); 1 #f (IBSP 29011); 1 #m (IBSP 29113); 1 #m, Reservatório Guarapiranga, Ilha dos Eucaliptos, [23°44'2"S, 46°44'1"W], I. Cizauskas & C.R.M Garcia *leg.*, 7–13 October 2003 (IBSP 66915); 1 #m, Campus do Instituto Butantan, [23°34'3"S, 46°43'6"W], R.H. Moraes *leg.*, 5–7 October 2014 (IBSP 167745); 1 #f, Parque Residencial Cocaia, Represa Billings, [23°45'55"S, 46°40'59"W], H. Urban *leg.*, 7 November 1948, (MZSP 873); 1 #f 3 December 1951 (MZSP 2300); 1 #f, Bairro Vila Ema, [23°35'17"S, 46°32'37"W], J. Damico *leg.*, December 1941 (MZSP 3433); 1 #m 1 #f, Ubatuba, Parque Estadual da

Serra do Mar, núcleo Picinguaba, [23°21'29"S, 44°51'2"W], L.S. Rocha *leg.*, November 1996 (IBSP 7684). ***Tocantins:*** 1 #f, Porto Nacional, [10°42'28"S, 48°25'1"W], I. Knysak e R. Martins *leg.*, 28 October–4 November 2001 (IBSP 159729).

***Runcinioides litteratus* (Piza, 1933) (Figs 1a–b, 9–14, 15b)**

Metadiaea litterata Piza, 1933: 46, fig. 2. Piza 1937: 179; Soares 1944: 153.

Misumenops litteratus (Piza). Rinaldi 1988: 23, figs 5–8.

Runcinioides litteratus (Piza) Lehtinen & Marusik 2008: 191.

Type material. Female holotype (IBSP 138196) from Brazil, São Paulo, Piracicaba, W.C. Vasconcellos *leg.*, examined.

Diagnosis. Males of *R. litteratus* differ from those of *R. argenteus* in the distinct bulging base of embolus (Figs 9c, 11e, 14a–b, d). Females differ in the coupling pocket longer than wide and with a tubular shape (Figs 9a, 10e, 13a–c).

Description. Female (holotype): Carapace brown, with one median, pale-yellow band (Figs 10a, c). Ocular area pale-yellow (Fig. 10c). Chelicerae pale-yellow with a dark spot at the proximal margin of the basal segment (Fig. 10c), endites light brown at the base, gradually becoming lighter towards the apex (Fig. 10d). Labium and sternum light brown (Fig. 10d). Legs I and II brown, III and IV pale-yellow (Fig. 10a–b). Legs I and II with five pairs of lateroventral macrosetae on the tibia and eight pairs on the metatarsus (Fig. 10a–b). Anterior half of opisthosoma dark yellow, with a marginal brown band, one median, inverted V-shaped brown spot and two brown spots. Posterior half is pale-yellow (Fig. 10a). Venter of opisthosoma, spinnerets and anal tubercle pale-yellow (Fig. 10b).

Measurements: Total length 8.47, prosoma length 3.55, width 3.8, clypeus

height 0.33, sternum length 1.65, width 1.63, opisthosoma length 4.92, width 4.31. Measurements of palp and legs: Palp: 2.59 (0.76, 0.38, 0.56, -, 0.89), I: 13.25 (3.91, 1.53, 3.3, 3.09, 1.42), II: 12.55 (3.8, 1.4, 3.09, 2.84, 1.42), III: 6.55 (2.28, 0.84, 1.53, 1.14, 0.76), IV: 7.14 (2.54, 0.84, 1.6, 1.4, 0.76). *Variation.* Female (N=15), total length 6.75–9.74, prosoma length 2.84–4.06, width 3.2–3.96, opisthosoma length 3.5–5.83, width 3.3–6.34. The color pattern of females is very variable; prosoma and legs I and II can be brown to almost white; the dorsum of the opisthosoma can vary from dark brown with many spots to almost white, without spots (Figs 1a–b, 12).

Male (from Brazil, Minas Gerais, Belo Horizonte, UFMG 5963): Color pattern as in the male of *R. argenteus* (Figs 11a–d).

Measurements. Total length 3.44, prosoma length 1.53, width 1.73, clypeus height 0.23, sternum length 0.74, width 0.81, opisthosoma length 1.91, width 1.5. Measurements of palp and legs: Palp: 0.82 (0.51, 0.18, 0.13 -, 0.86), I: 7.89 (2.29, 0.76, 1.96, 1.81, 1.07), II: 7.65 (2.36, 0.71, 1.91, 1.86, 0.81), III: 3.48 (1.12, 0.25, 0.84, 0.76, 0.51), IV: 3,59 (1.12, 0.36, 0.84, 0.81, 0.46). *Variation.* Male (N=24), total length 2.62–3.71, prosoma length 1.27–1.63, width 1.45–2.68, opisthosoma length 1.35–2.08, width 0.89–1.86.

Natural history. Like the other species of the genus, *R. litteratus* live in flowers. It has been collected in *Gardenia jasminioides* J. Ellis (Rubiaceae) (UFMG 22088), *Bauhinia* sp. (Caesalpinioideae) (UFMG 4104) and in Melostomataceae (UFMG 22086).

Distribution. Eastern Brazil, from the state of Paraíba to Rio Grande do Sul (Fig. 15b).

Material examined. BRAZIL. ***Alagoas:*** 4 #m, Maceió, Bairro Mangabeiras, [9°38'50"S, 35°42'50"W], C.A. Camargo & E. Dante *leg.*, 30 October 1952 (MZSP 2380). ***Bahia:*** 1 #m, Iraquara, Pratinha, [12°21'9"S, 41°32'30"W], L.S. Rocha *leg.*, 22 December 1998 (IBSP 20758); 1 #f, Mata de São João, Reserva Particular de Camurujipe, [12°31'0"S, 38°2'14"W], P. Fonseca *leg.*, May 2006 (IBSP 68565); 1 #m, São José da Vitória, Serra do Areial, [15°5'41.5"S, 39°22'35.5"W, 223m], A. Anker *et al. leg.*, 30 December 2014 (UFMG 17862); 1 #m, Una, Reserva Biológica de Una, [15°10'23"S, 39°7'56"W], A.D. Brescovit *et al. leg.*, 15–28 November 2000 (IBSP 47140). ***Distrito Federal:*** 1 #f, Brasília, [15°46'47"S, 47°55'47"W], C.C. Nogueira *et al. leg.*, April 1997 (IBSP 11921). ***Minas Gerais****:* 1 #f, Belo Horizonte, [19°55'15"S,

43°56'16"W], A.J. Santos *leg.*, 15 April 1994 (IBSP 26664); 1 #f, Bairro Coração Eucarístico, Campus da PUC-MG, [19°55'0"S, 43°59'0"W], J.E.M. Dias *leg.*, 5 July 2010 (UFMG 4104); 1 #f, Bairro Jardim América, [19°56'41"S, 43°58'24"W, 937 m], J.G.L. Costa *leg.*, 24 March 2009 (UFMG 1505); 1 #f, Bairro Luxemburgo, [19°56'54.4"S, 43°57'24.44"W, 957 m], L.C. Montresor *leg.*, 20 April 2001 (UFMG 841); 1 #f, Bairro Ouro Preto, [19°52'38.5"S, 43°58'53"W], A.J. Santos *leg.*, 14 March 2016 (UFMG 22089); 1 #f, Bairro Santa Mônica, [19°49'30.53"S, 43°58'45.95"W, 825 m], C. Freitas *leg.*, 17 February 2001 (UFMG 920); 1 #f, Campus da UFMG, ICB, [19°52'6"S, 43°57'57"W, 835 m], P.H. Martins *leg.*, 25 April 2013 (UFMG 12660); 1 #f, Campus da UFMG, Jardim do CAD II, [19°51'53"S, 43°57'38"W], R.F. Magalhães *leg.*, 11 January 2018 (UFMG 22088); 1 #f, Estação Ecológica da UFMG, [19°52'38"S, 43°58'16"W, 845 m], E.S.S. Álvares & E.O. Machado *leg.*, January 2001 (UFMG 121); 1 #f, January 2001 (UFMG 3968); 1 #m, December 2000 (UFMG 3973); 1 #f, E.S.S. Álvares *leg.*, 11 May 2002 (UFMG 1676); 1 #m, October 2000 (UFMG 5963); 1 #m, B.T. Faleiro *leg.*, 9 September 2009 (UFMG 3220); 1 #m, 14 November 2015 (UFMG 22086); 1 #m, B.T. Faleiro *et al. leg.*, 19 November 2011 (UFMG 10072); 1 #f, P.L.S. Miranda *leg.*, 26 May 2010 (UFMG 4777); 1 #m, [19°52'50.6"S, 43°58'19.6"W, 840 m], A.F. Kumagai *et al. leg.*, 23–30 January 2017 (UFMG 22087); 1 #m, [19°52'38"S, 43°58'16"W, 845 m], E.S.S. Álvares *leg.*, 3 February 2000 (UFMG 22101); 1 #m, Parque Ecológico da Lagoa do Nado, [19°50'5.27"S, 43°57'34.7"W, 785 m], M. de Maria *et al. leg.*, 6 October 2004 (UFMG 1302); #m, Parque Municipal das Mangabeiras, [19°57'14.86"S, 43°54'19.15"W], H.H. Santos *et al. leg.*, 20–22 January 2009 (UFMG 8001); 10 #m (UFMG 22102); 1 #m, Catas Altas, Serra do Caraça, [20°5'51"S, 43°29'18"W], 17 November 1961 (MZSP 3329); 1 #f, Contagem, Bairro Nossa Senhora de Fátima, Rua Virgílio César, [19°54'38.5"S, 44°5'8.3"W, 904 m], P.H. Martins *leg.*, 13 January 2015 (UFMG 22090); 3 #m, Itaobim, [16°31'58.6"S, 41°30'37.5"W, 464 m], I.L.F. Magalhães *et al. leg.*, 25 November 2011 (UFMG 10103); 1 #f, Monte Santo de Minas, [21°11'24"S, 46°58'48"W], F.S. Pereira *leg.*, 1–5 April 1942 (MZSP 100); 1 #f, Santana do Riacho, [19°7'5.98"S, 43°40'47.48"W, 1122 m], P. Henrique *leg.*, 2 June 2011 (UFMG 7615); #m, São Gonçalo do Rio Abaixo, Estação de Preservação e Desenvolvimento Ambiental de Peti, [19°53'0"S, 43°22'0"W], C.S. Azevedo *leg.*, 12 November 1999 (UFMG 831). ***Pernambuco:*** 1 #m, Santa Cruz do Capibaribe, Serra do Pará, [7°52'29.2"S, 36°24'10.06"W], F.M.G. Las-Casas *leg.*, 26 March 2012

(UFMG 13592); 1 #m, 23 May 2013 (UFMG 13618). ***Rio Grande do Sul:*** 1 #f, Derrubadas, Parque Estadual do Turvo, [27°14'51"S, 53°57'28"W, 440 m], G.H.F. Azevedo & A.J. Santos *leg.*, 21 March 2011 (UFMG 10244). ***São Paulo:*** 1 #f, Águas da Prata, [21°56'12"S, 46°43'0"W], V.C. Onófrio *leg.*, 11 April 1998 (IBSP 17522); 4 #m, Baruerí, [23°30'38"S, 46°54'34"W], K. Lenko *leg.*, 7 January 1961 (MZSP 1263); 5 #m, 21–22 January 1960 (MZSP 1270); 3 #m, 13 January 1962 (MZSP 2182); 1 #f, 20 March 1965 (MZSP 5537); 1 #f, Botucatu, [22°53'9"S, 48°26'42"W], H. Rubião & C.A. Mantovan *leg.*, 5 May 1965 (MNRJ 11504); 1 #f, Campinas, Loteamento Três Pontes Souza, [22°49'39"S, 46°56'13"W], 30 March–1 April 2009 (IBSP 137428); 1 #f, Carapicuiba, [23°31'21"S, 46°50'8"W], R.M.N. Gervauskão *leg.*, 11 September 2000 (IBSP 27458); 1 #m, Diadema, [23°41'9"S, 46°37'22"W], P. Biasi *leg.*, 11 February 1961 (MZSP 1243); 1 #m, Iporanga, [24°35'9"S, 48°35'34"W], K. Lenko & H. Reichardt *leg.*, January–November 1901 (MZSP 6824); 1 #f, Itirapina, [22°15'10"S, 47°49'22"W], 21 May 1992 (IBSP 6108); 1 #f, Jundiaí, Reserva Biológica Municipal da Serra do Japi, [23°12'31"S, 46°57'58"W], A.D. Brescovit *leg.*, 27 April 1996 (IBSP 7038); 1 #m, A.J. Santos *leg.*, 19 December 1996 (IBSP 38788); 1 #f, Mairiporã, [23°19'8"S, 46°35'13"W], 5 June 2002 (IBSP 34897); 2 #m, Monte Alegre do Sul, Fazenda Santa Maria, [22°40'55"S, 46°40'51"W], B.A.M. Soares *leg.*, 27–31 December 1942 (MZSP 342); 1 #f, Osasco, [23°31'58"S, 46°47'31"W], 2005 (IBSP 57290); 1 #f, A.R. Miranda *leg.*, 18 July 2012 (IBSP 212148); 1 #f, Piracicaba, [22°43'30"S, 47°38'56"W], A. Corrêa *leg.*, 27 February 1942 (MZSP 113); 1 #m, Reserva do Iguaçu, UHE Governador Ney Aminthas de Barros Braga, [25°59'53"S, 51°59'14"W], R. Pinto-da-Rocha & A.P. Barreto *leg.*, 22 November 1991 (MZSP 74364); 1 #f, Santo André, Distrito Paranapiacaba, [23°46'39"S, 46°17'59"W] (IBSP 212275); 1 #f, São Bento do Sapucaí, [22°41'20"S, 45°43'51"W], C. Costa, 22 March 1998 (IBSP 16220); 1 #f, São Paulo, [23°32'51"S, 46°38'10"W], L.H. Pereira *leg.*, July 1991 (IBSP 5728); 1 #f, March 1996 (IBSP 6923); 1 #f, S.E. Soares *leg.*, 25 March 1997 (IBSP 11922); 1 #f, March 1997 (IBSP 13994); 1 #f, A. Eterovic *leg.*, June 1997 (IBSP 14018); 1 #f, P.E. Vilella *leg.*, 30 April 1997 (IBSP 14033); 1 #f, W. Adinolti *leg.*, 5 June 1996 (IBSP 14038); 1 #f, R.A. Pinto *leg.*, 11 January 1998 (IBSP 16256); 1 #f, C.R. Bertim *leg.*, 1 August 1998 (IBSP 20419); 1 #f, M. Procópio *leg.*, 13 March 2000 (IBSP 27414); 1 #f, S.C. Scoldafemi *leg.*, 20 May 2002 (IBSP 34907); 1 #f, [23°33'1"S, 46°38'2"W], V.W. Maier *leg.*, 9 July 2016 (IBSP 211560); 1 #f, I.R. Presoto *leg.*, 20 April 2015 (IBSP 211700); 1 #f, E.B. Crispino *leg.*, 23 March 2013

(IBSP 211810); 1 #f, Bairro Butantãn, Parque da Previdência, [23°34'51"S, 46°43'34"W], J. Império *leg.*, 15 February 2001 (IBSP 29111); 1 #m, 27 November 2000 (IBSP 29112); 1 #f, Bairro Cháacara Flora, [23°38'44"S, 46°41'1"W], O.M. Emaculada *leg.*, 17 April 2014 (IBSP 165095); 1 #f, Campus da USP, [23°33'33.51"S, 46°42'56.4"W, 723 m], E.S.S. Álvares *leg.*, 8 June 2002 (UFMG 1681); 1 #f, Campus da USP, Instituto de Biociências, [23°33'55"S, 46°43'51"W], L. Camargo *leg.*, 12 May 2003 (IBSP 39879); 1 #f, Campus da USP, Creche USP, [23°33'50"S, 46°42'55"W], 26 February 2016 (IBSP 211470); 1 #f, Campus do Instituto Butantan, [23°34'3"S, 46°43'6"W], L.T. Miglio *leg.*, 8 May 2004 (IBSP 43687); 1 #f, Morumbi, [23°35'48"S, 46°43'15"W], E.R. Kiritschenco *leg.*, 15 February 2000 (IBSP 26856); 1 #f, C.V. Janini *leg.*, 22 March 2007 (IBSP 73195); 1 #f, Parque Ibirapuera, [23°35'18"S, 46°39'32"W], M. Gervatawskos *leg.*, 15 April 2002 (IBSP 35016); 2 #m, Parque Residencial Cocaia, Represa Billings, [23°45'55"S, 46°40'59"W], H. Urban *leg.*, 4 December 1952 (MZSP 1701); 1 #m, 23 November 1952 (MZSP 1750); 1 #m, November 1949 (MZSP 1809); 1 #m, Sacomã, [23°36'53"S, 46°35'49"W], J.L. Lima *leg.*, 14 February 1942 (MZSP 74368); 1 #f, Tremembé, [22°57'30"S, 45°32'58"W], M. Kratzsch *leg.*, 2 May 1973 (IBSP 2644); 1 #f, São Roque, [23°31'44"S, 47°8'6"W], F. Lane *leg.*, 7 March 1976 (MZSP 74367); 1 #f, Vargem Grande Paulista, [23°36'10"S, 47°1'33"W], W.G. Cintra *leg.*, 20 April 2015 (IBSP 211539). ***Sergipe:*** 1 #m 1 imm., São Cristovão, Campus da UFSE, [10°55'34"S, 37°6'8"W] (IBSP 10347).

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5. Attachments

Figures chapter 2

FIGURE 1a–d. *Runcinioides* spp., live specimens (a–b *Runcinioides litteratus* (Piza, 1933), c– d *Runcinioides argenteus* Mello-Leitão, 1929). a female from Belo Horizonte, Brazil (UFMG 22089, photo by L.S. Carvalho); b female from Belo Horizonte, Brazil (UFMG 12660, photo by P.H. Martins); c male from Campos do Jordão, Brazil, in *Ruellia* sp. (Acanthaceae) (UFMG 22095, photo by V.S.R. Diniz); d female from Campos do Jordão, Brazil, in an unidentified Asteraceae, feeding on a Syrphinae fly (UFMG 22093, photo by V.S.R. Diniz).

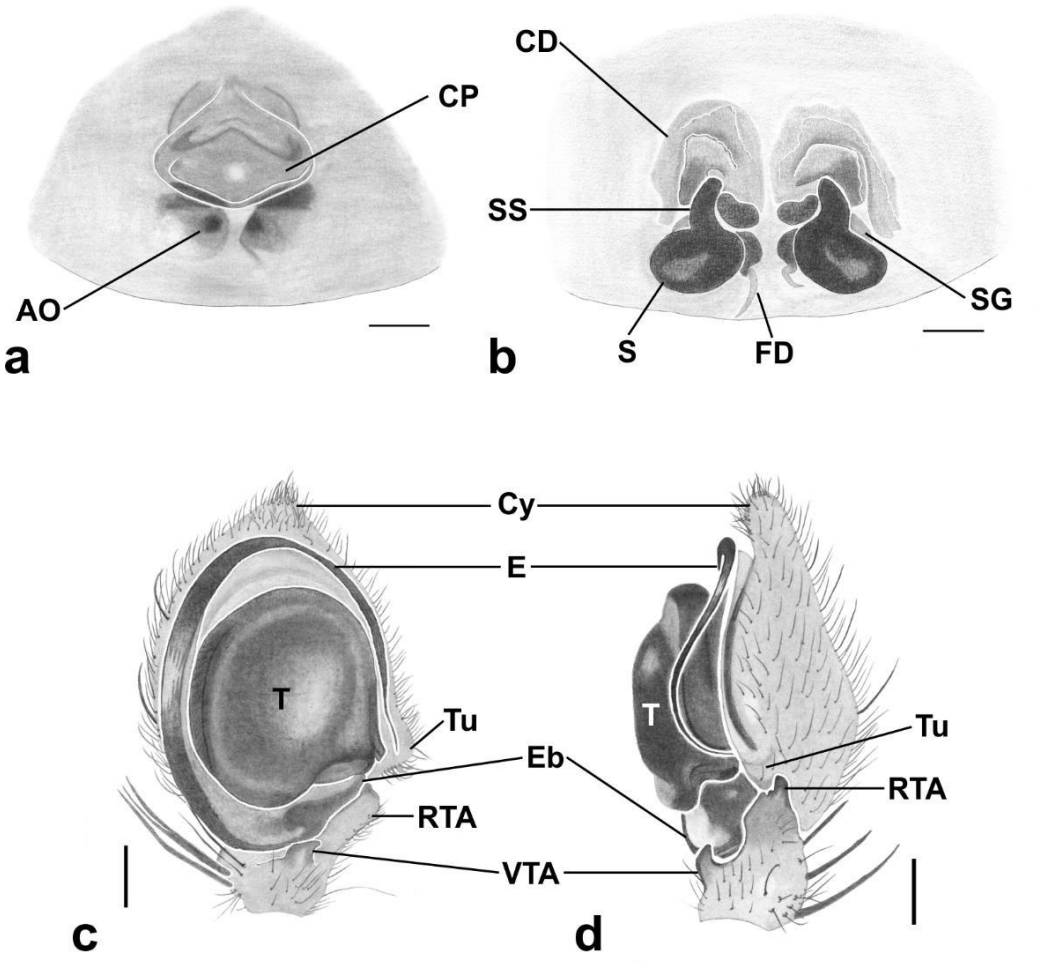

FIGURE 2a–d. *Runcinioides argenteus* Mello-Leitão, 1929. (a female holotype, b female (UFMG 6508), c–d male (UFMG 22097). a epigynum ventral.; b vulva dorsal; c–d left palp (c ventral, d retrolateral). Abbreviations: AO, anchor openings; CD, copulatory duct; CP, coupling pocket; Cy, cymbium; E, embolus; Eb, embolus base; FD, fertilization duct; RTA, retrolateral tibial apophysis; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk; T, tegulum; Tu, tutaculum; VTA, ventral tibial apophysis. Scale bars: a–b, 0.1 mm. c–d, 0.2 mm.

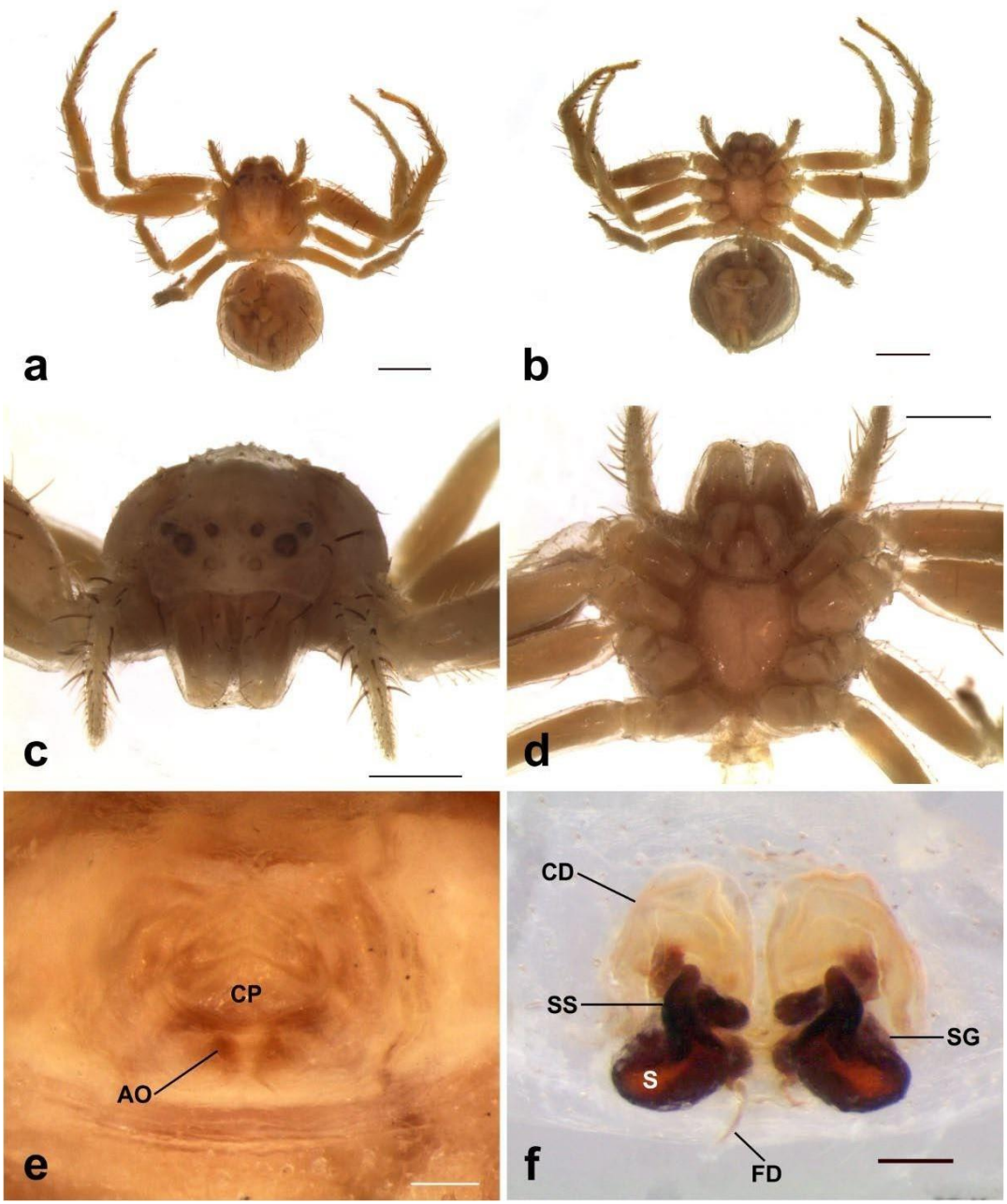

FIGURE 3a–f. *Runcinioides argenteus* Mello-Leitão, 1929 (a–e female holotype, f female (UFMG 6508). a–b habitus (a dorsal, b ventral); c–d prosoma (c frontal, d ventral); e epigynum ventral.; f vulva dorsal. Abbreviations: AO, anchor openings; CD, copulatory duct; CP, coupling pocket; FD, fertilization duct; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk. Scale bars: a–b, 1.0 mm. c–d, 0.6 mm. e–f, 0.1 mm.

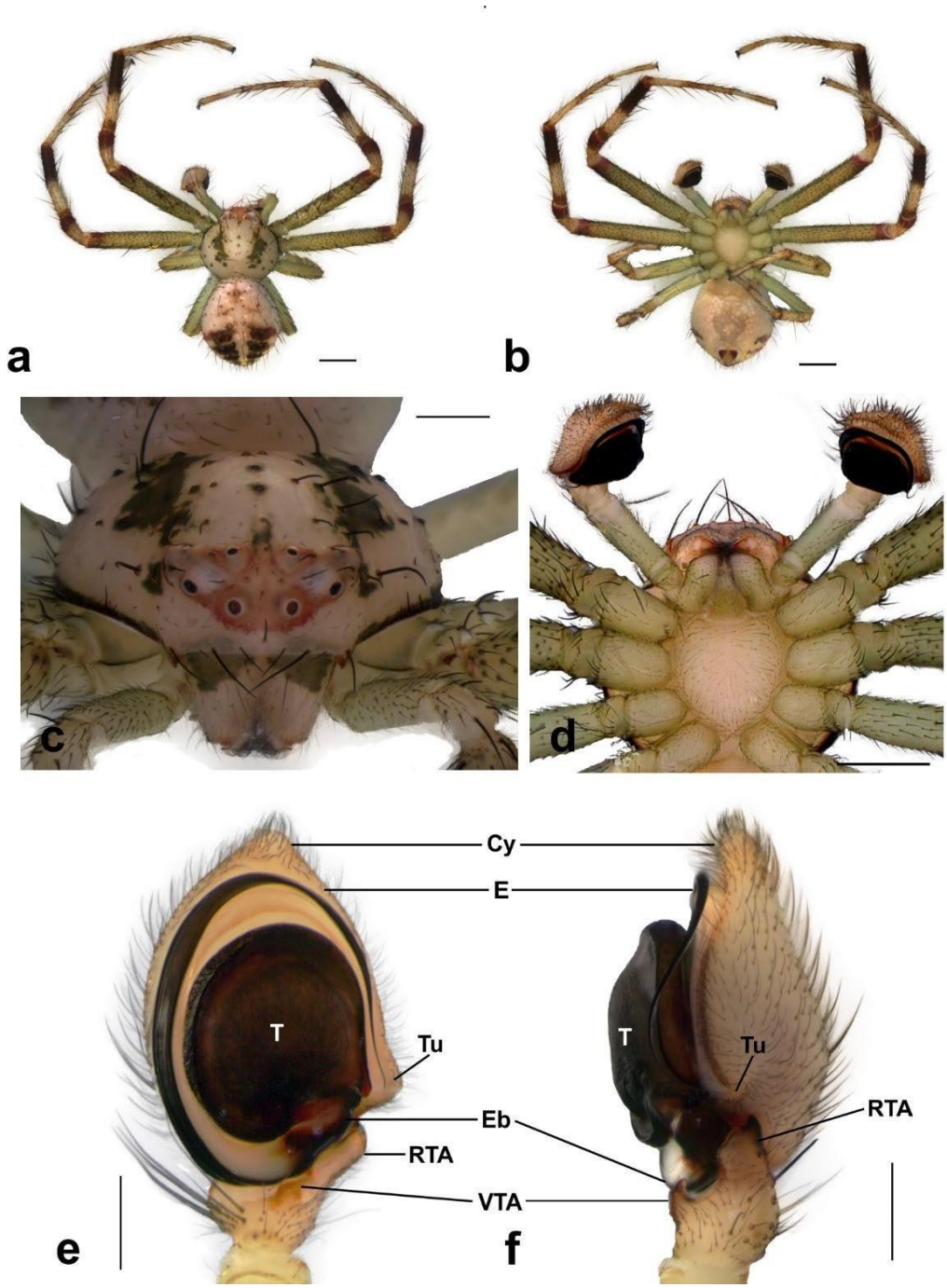

FIGURE 4a–f. *Runcinioides argenteus* Mello-Leitão, 1929 (male, UFMG 22097). a–b habitus (a dorsal, b ventral); c–d prosoma (c frontal, d ventral); e–f left palp (e ventral, f retrolateral). Abbreviations: Cy, cymbium; E, embolus; Eb, embolus base; RTA, retrolateral tibial apophysis; T, tegulum; Tu, tutaculum; VTA, ventral tibial apophysis. Scale bars: a–b, 1.0 mm. c, 0.4 mm. d, 0,5 mm. e–f, 0.3 mm.

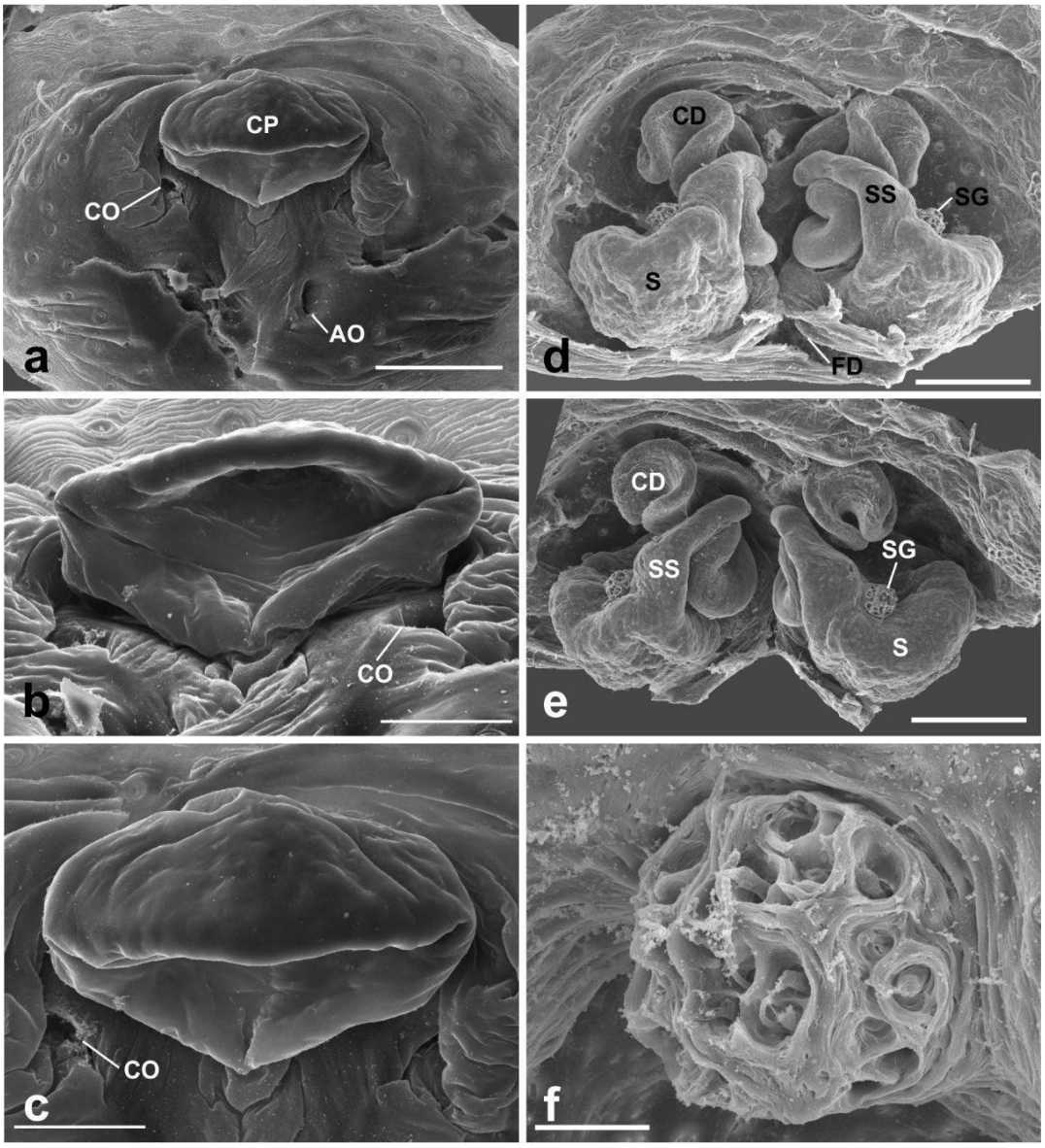

FIGURE 5a–f. *Runcinioides argenteus* Mello-Leitão, 1929 (female, UFMG 22215). a epigynum ventral; b–c coupling pocket (b posterior, c ventral); d–e vulva (d dorsal, e anterior); f right spermatheca gland. Abbreviations: AO, anchor openings; CD, copulatory duct; CO, copulatory opening; CP, coupling pocket; FD, fertilization duct; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk; Scale bars: a, d–e, 100 µm. b–c, 50 µm. f, 10 µm.

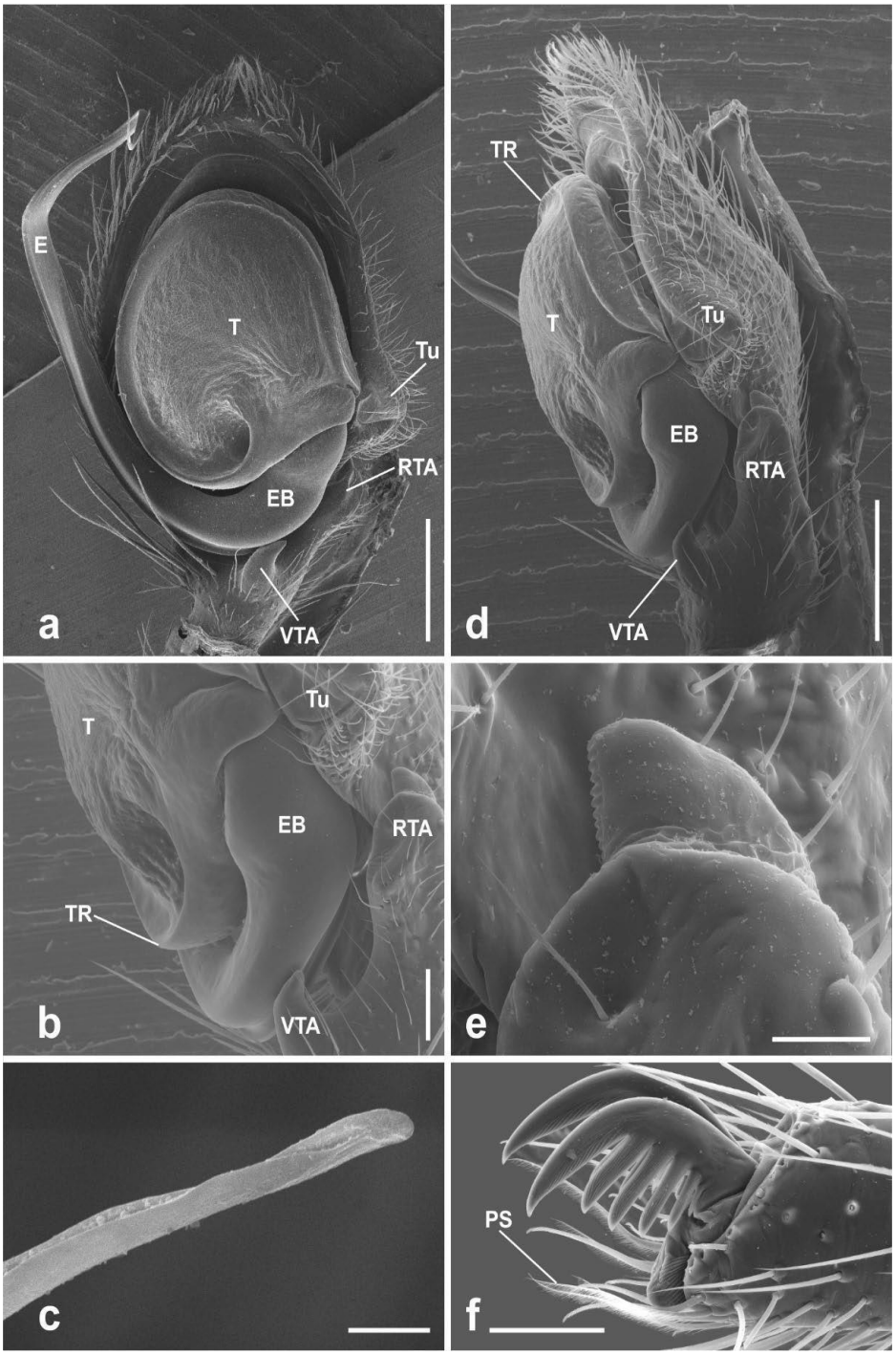

FIGURE 6a–f. *Runcinioides argenteus* Mello-Leitão, 1929 (male, UFMG 22096). a–e left palp (a ventral, b retrolateral base, c embolus tip detail, d retrolateral, e RTA tip detail retrolateral); f claws retrolateral of left leg I. Abbreviations: E, embolus; EB, embolus base; PS, pseudotenent setae; RTA, retrolateral tibial apophysis; T, tegulum; Tu, tutaculum; TR, tegulum ridge; VTA, ventral tibial apophysis; Scale bars: a, d, 300 µm. b, f, 100 µm. c, 5 µm. e, 30 µm.

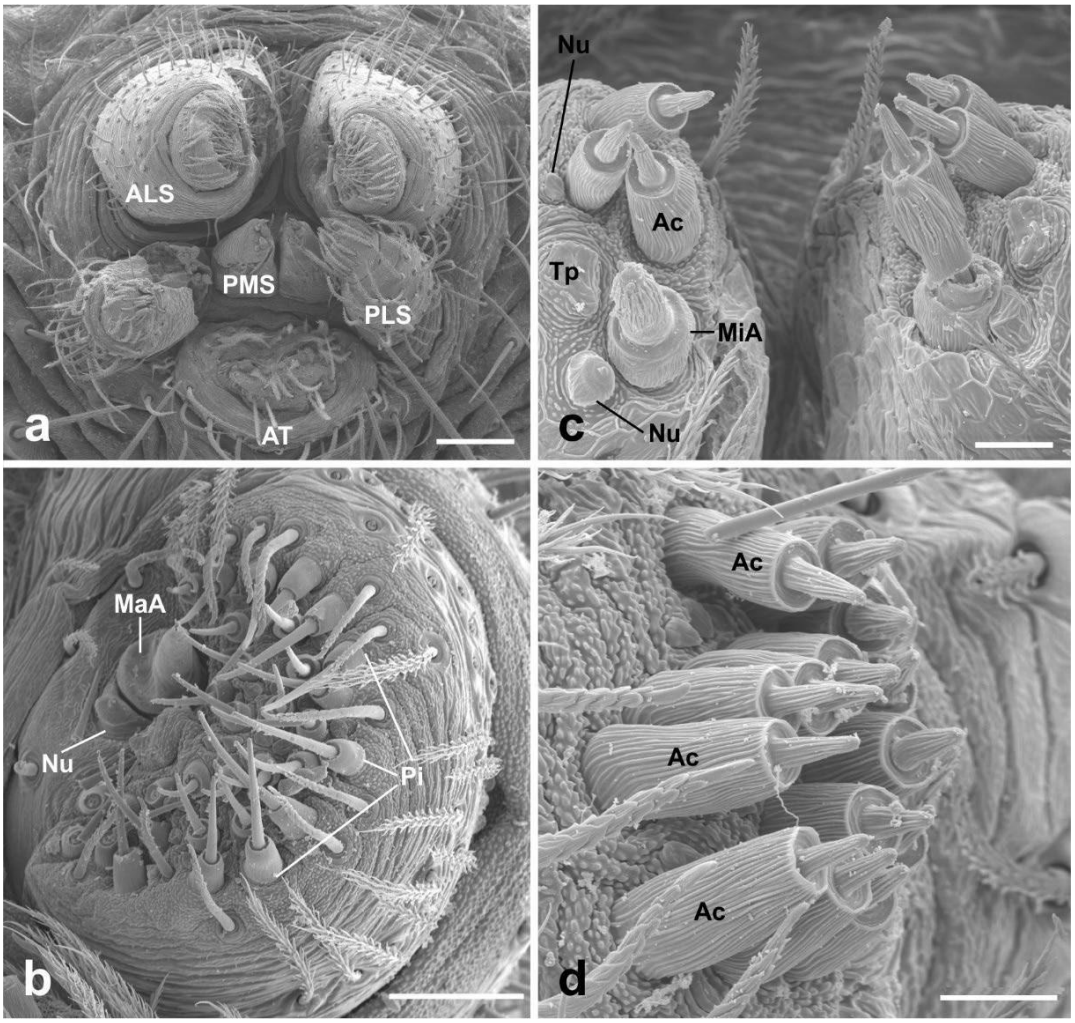

FIGURE 7a–d. *Runcinioides argenteus* Mello-Leitão, 1929 (male, UFMG 22096). a spinnerets; b left anterior lateral spinneret; c posterior median spinnerets; d right posterior lateral spinneret. Abbreviations: Ac, aciniform gland spigot; ALS, anterior lateral spinneret; AT, anal tubercle; MaA, major ampullate gland spigot; MiA, mirror ampullate gland spigot; Nu, nubbin; Pi, piriform gland spigot; PLS, posterior lateral spinneret; PMS, posterior median spinneret; Tp, tatipore; Scale bars: a, 100 µm. b, 30 µm. c–d, 10 µm.

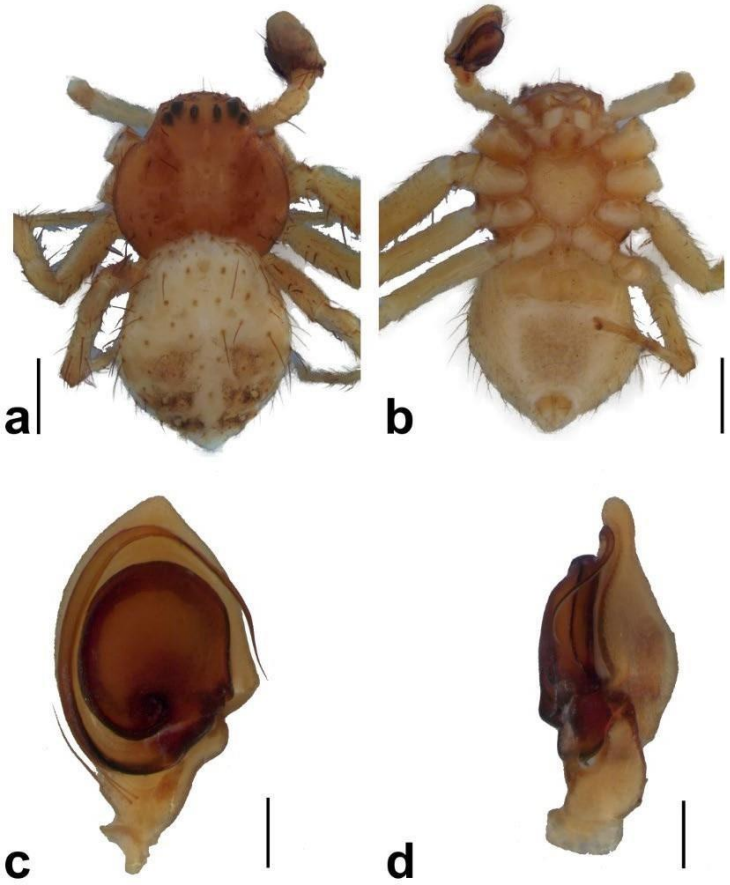

FIGURE 8a–d. *Metadiaea paranensis* Mello-Leitão, 1932 (male holotype). a–b habitus (a dorsal, b ventral); c–d left palp (c ventral, d retrolateral). Scale bars: a–b, 1,0 mm. c–d, 0,3 mm.

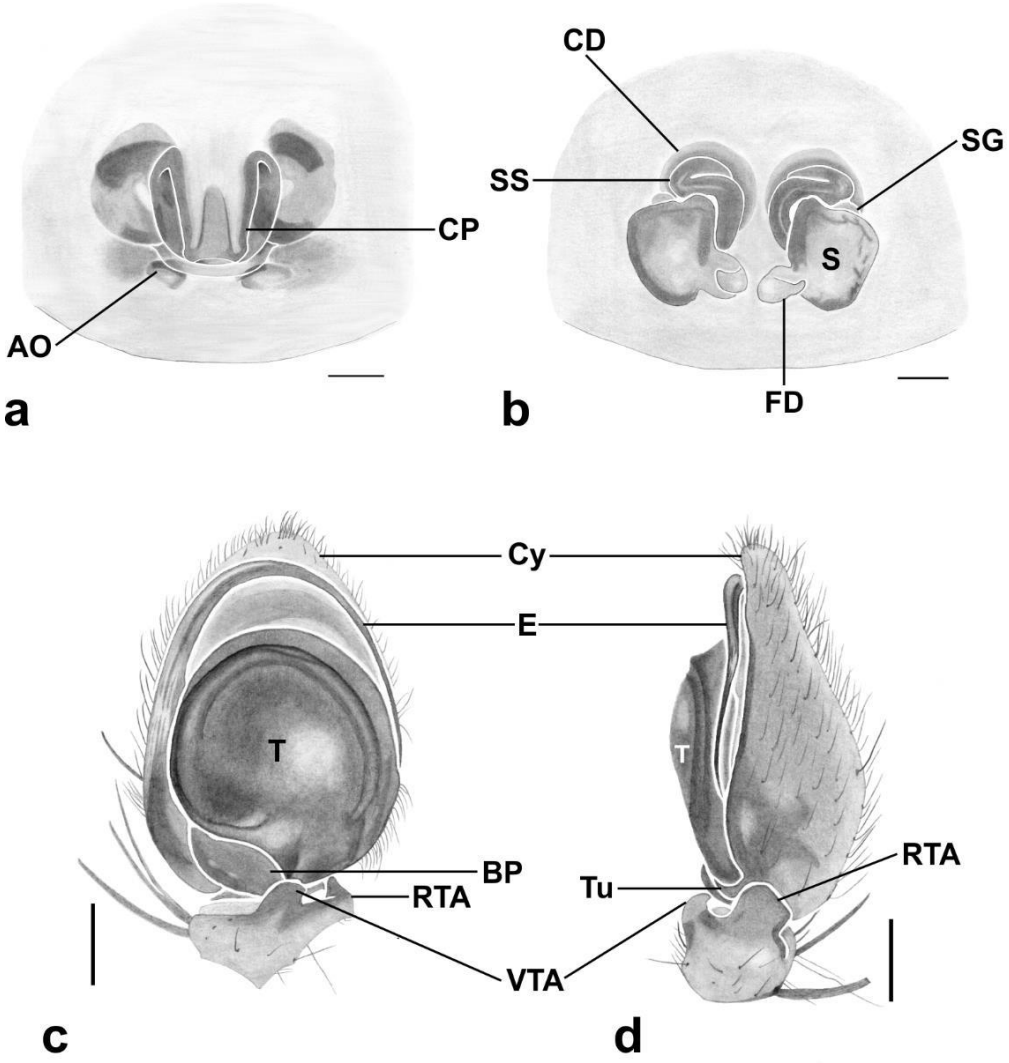

FIGURE 9a–d. *Runcinioides litteratus* (Piza, 1933) (a–b female holotype, c–d male, UFMG 5963). a epigynum ventral; b vulva dorsal; c–d left palp (c ventral, d retrolateral). Abbreviations: AO, anchor openings; BP, embolus bulging process; CD, copulatory duct; CP, coupling pocket; Cy, cymbium; E, embolus; FD, fertilization duct; RTA, retrolateral tibial apophysis; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk; T, tegulum; Tu, tutaculum; VTA, ventral tibial apophysis. Scale bars: a–b, 0,1 mm. b–c, 0,2 mm.

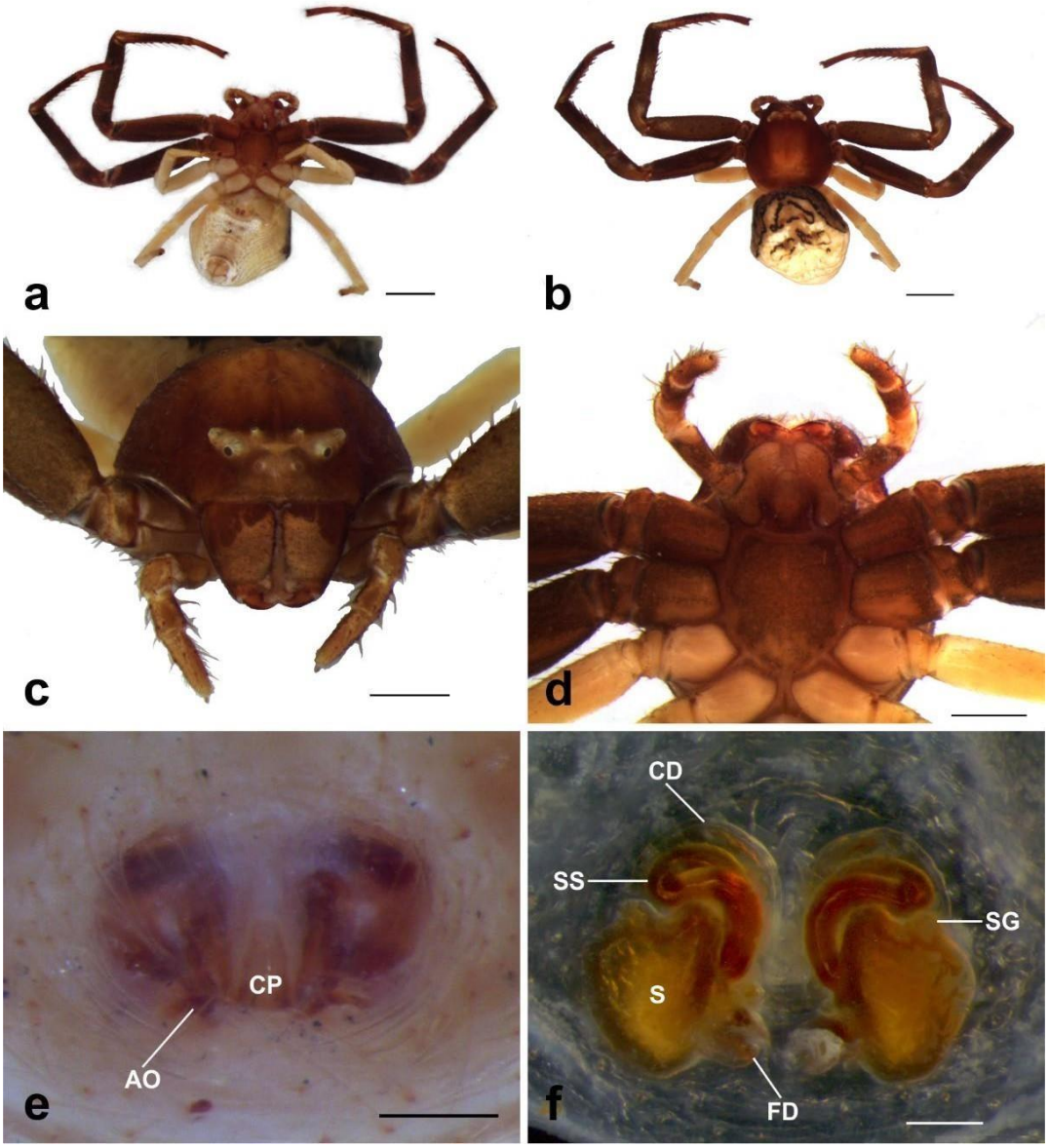

FIGURE 10a–f. *Runcinioides litteratus* (Piza, 1933) (female holotype). a–b habitus (a dorsal, b ventral); c–d prosoma (c frontal, d ventral); e epigunum ventral; f vulva dorsal. Abbreviations: AO, anchor openings; CD, copulatory duct; CP, coupling pocket; FD, fertilization duct; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk. Scale bars: a–d, 1,0 mm. e, 0,3
mm. f, 0,1 mm.

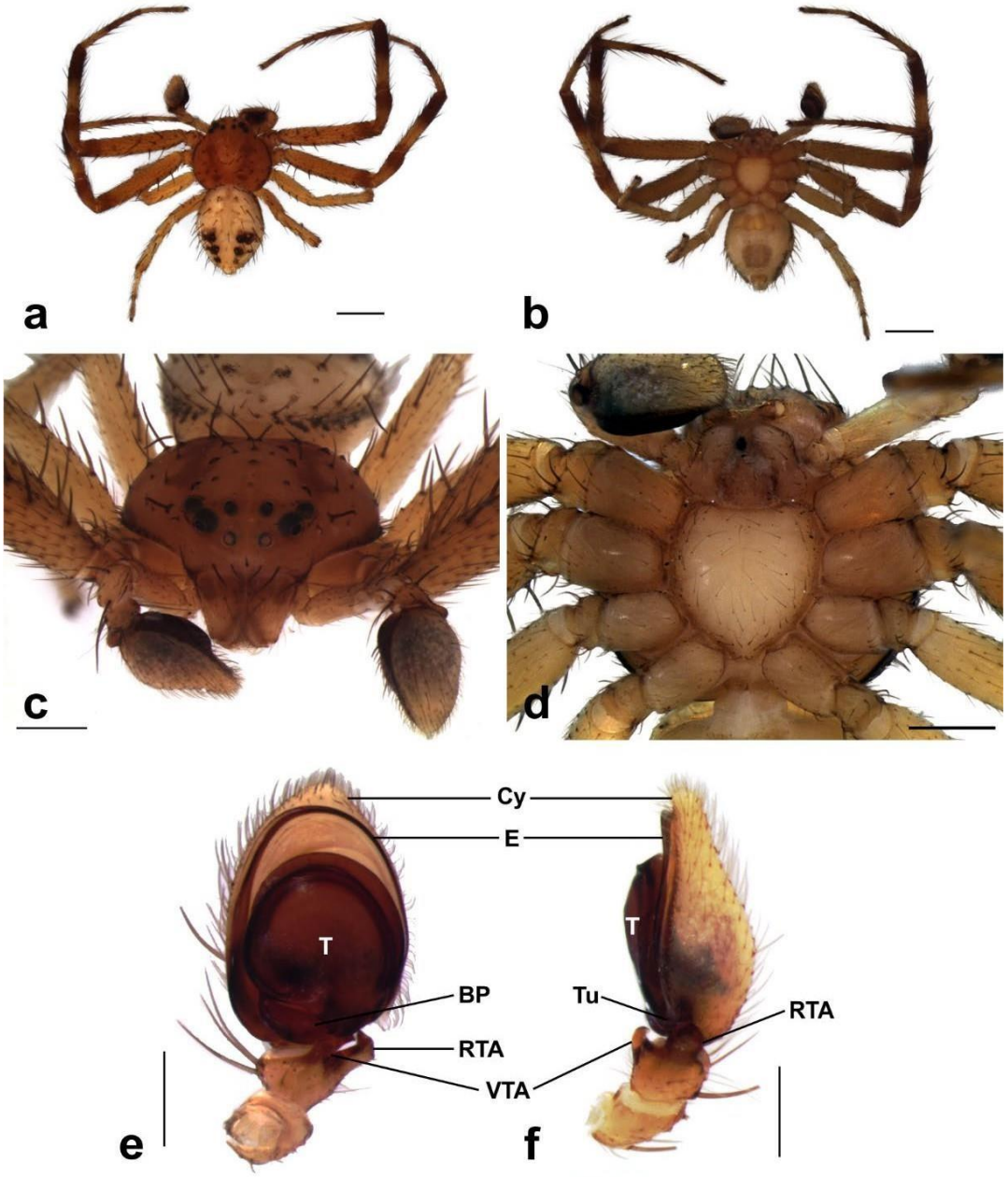

FIGURE 11a–f. *Runcinioides litteratus* (Piza, 1933) (male, UFMG 5963). a–b habitus (a dorsal, b ventral); c–d prosoma (c frontal, d ventral); e–f left palp (e ventral, f retrolateral). Abbreviations: BP, embolus bulging process; Cy, cymbium; E, embolus; RTA, retrolateral tibial apophysis; T, tegulum; Tu, tutaculum; VTA, ventral tibial apophysis. Scale bars: a–b, 1,0
mm. c, 0,5 mm. d–f, 0,3 mm.

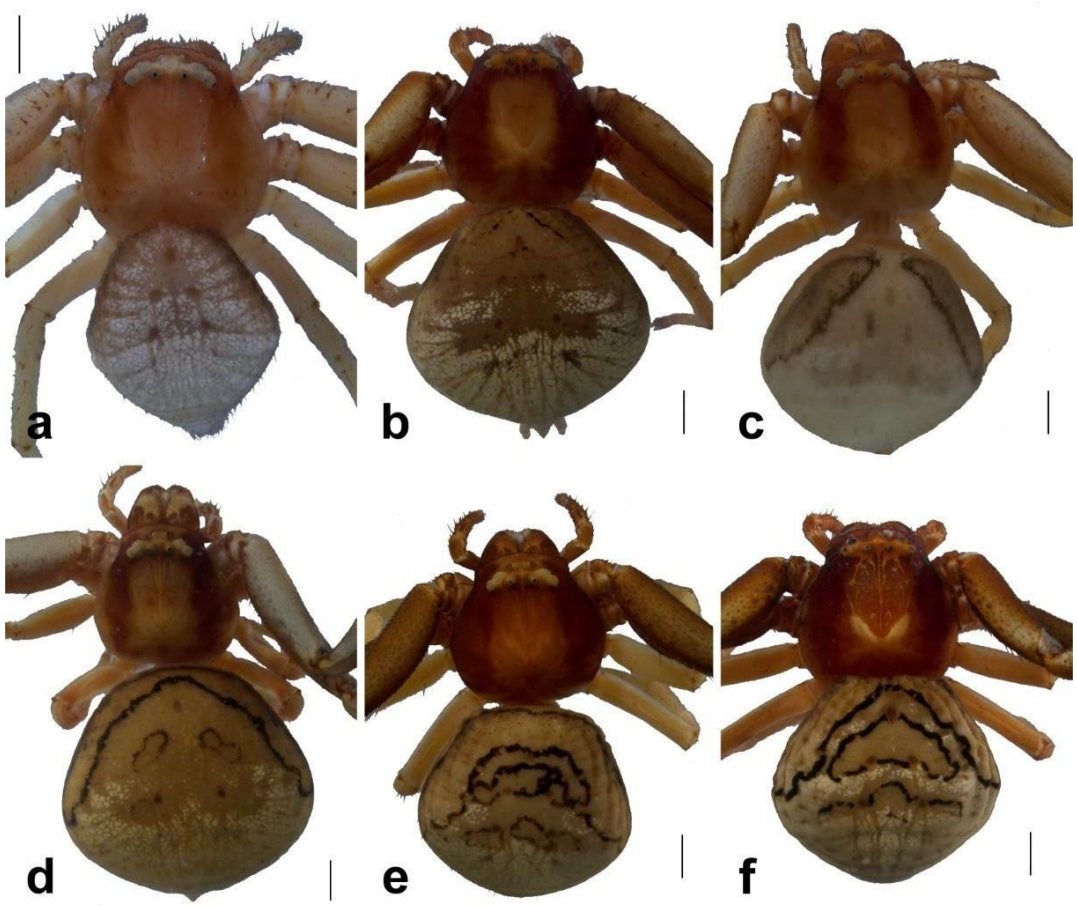

FIGURE 12a–f. *Runcinioides litteratus* (Piza, 1933) (female, habitus dorsal). a UFMG 121; b UFMG 1505; c UFMG 3968; d UFMG 10244; e UFMG 12660; f UFMG 4104. Scale bars: a–f, 1,0 mm.

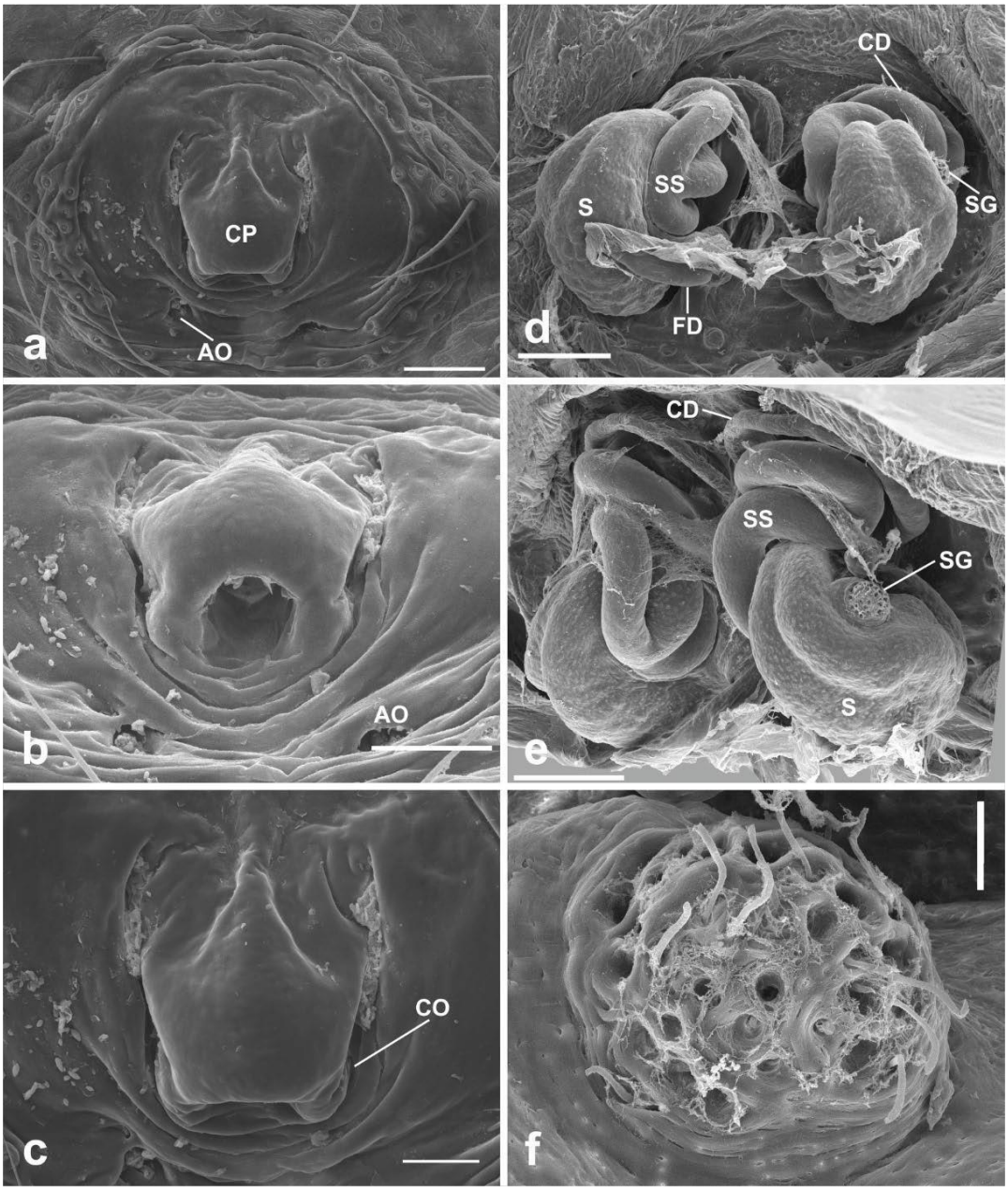

FIGURE 13a–f. *Runcinioides litteratus* (Piza, 1933) (female, UFMG 4777). a epigynum ventral; b–c coupling pocket (b posterior, c ventral); d–e vulva (d dorsal, e anterior retrolateral); f right spermatheca gland. Abbreviations: AO, anchor openings; CD, copulatory duct; CO, copulatory opening; CP, coupling pocket; FD, fertilization duct; S, spermatheca; SG, spermatheca gland; SS, spermatheca stalk. Scale bars: a–b, d–e, 100 µm. c, 50 µm. f, 10 µm.

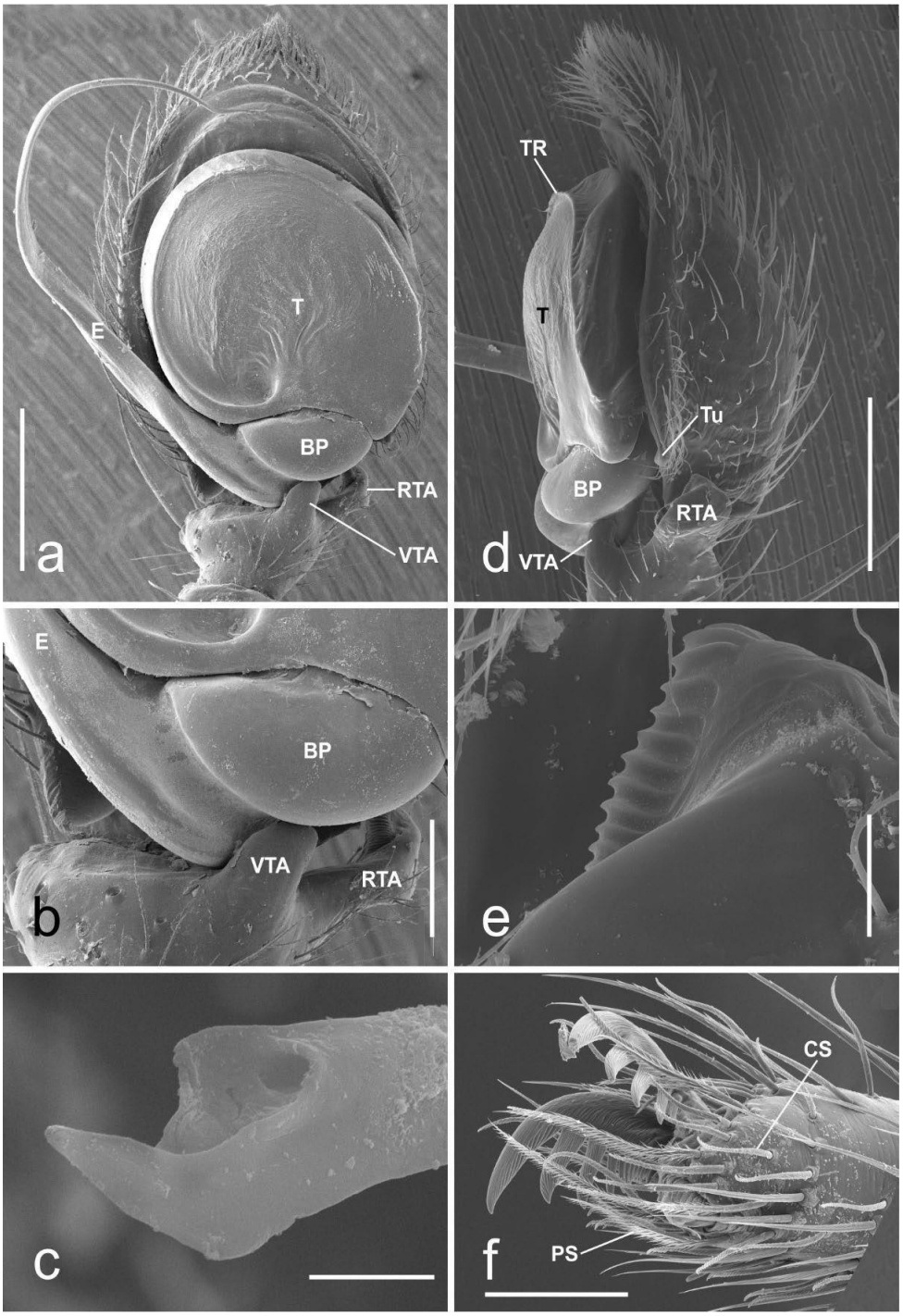

FIGURE 14a–f. *Runcinioides litteratus* (Piza, 1933) (male. UFMG 22102). a–e left palp (a ventral, b ventral base, c embolus tip detail, d retrolateral, e RTA tip detail retrolateral); f claws retrolateral ventral of left leg I. Abbreviations: BP, embolus bulging process; E, embolus; PS, pseudotenent setae; RTA, retrolateral tibial apophysis; T, tegulum; Tu, tutaculum; TR, tegulum ridge; VTA, ventral tibial apophysis. Scale bars: a, d, 300 µm. b, f, 100 µm. c, 5 µm. e, 20 µm.

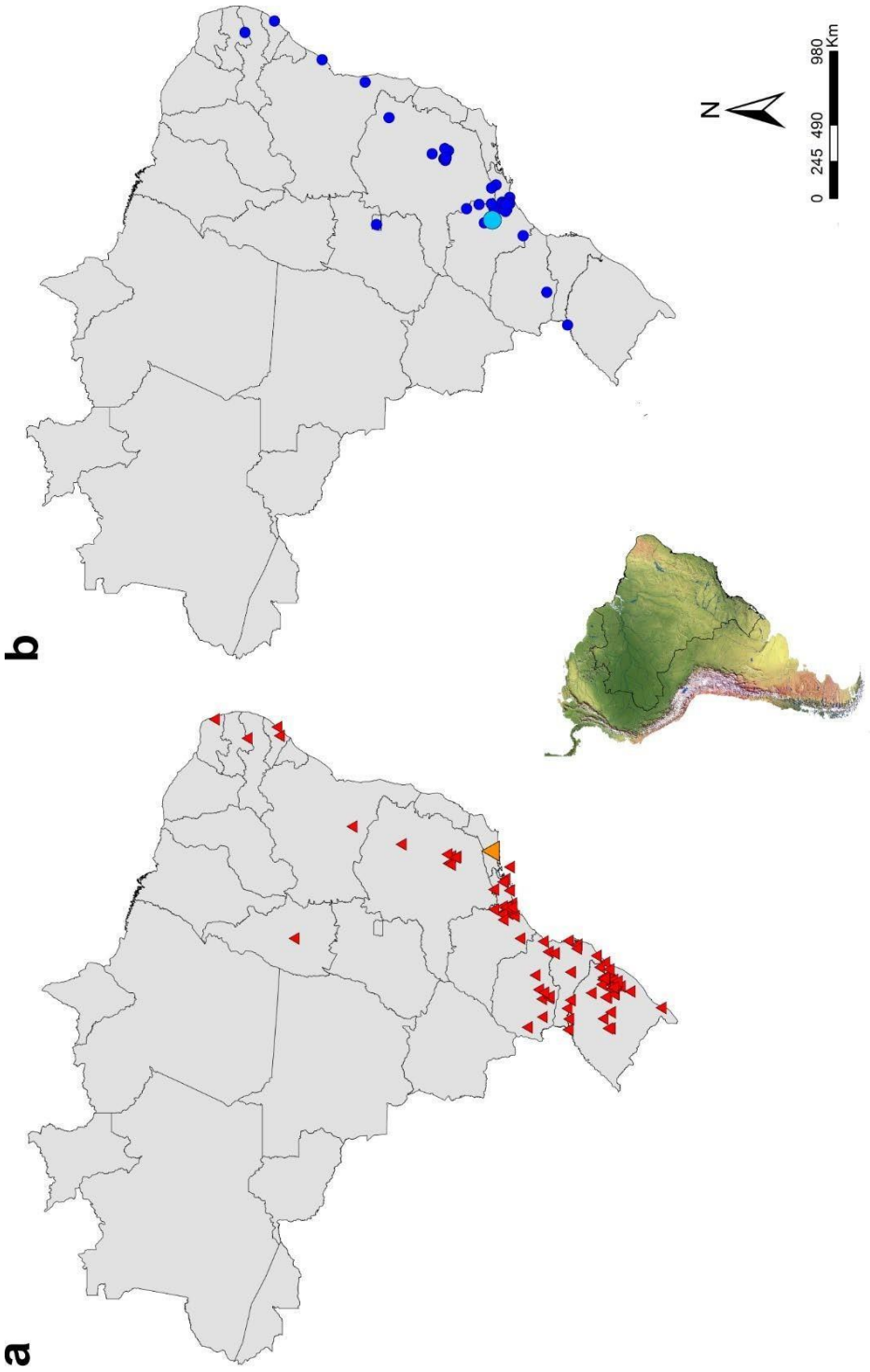

FIGURE 15a–b. Geographic distribution records of *Runcinioides* species. a *R. argenteus* Mello-Leitão, 1929 (large orange triangle indicates the type locality); b *R. litteratus* (Piza, 1933) (large, light blue circle indicates the type locality).