CAMPUS DE SÃO JOSÉ DO RIO PRETO

"Revisão taxonômica e análise filogenética das espécies de *Daidalotarsonemus* De Leon e *Excelsotarsonemus* Ochoa & Naskrecki (Acari: Tarsonemidae)"

José Marcos Rezende

DOUTORADO

PÓS GRADUAÇÃO
EM BIOLOGIA ANIMAL

unesp UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"
Campus de São José do Rio Preto

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Orientador: Prof. Dr. Antonio Carlos Lofego

São José do Rio Preto
2016

Rezende, José Marcos.
Revisão taxonômica e análise filogenética das espécies de Daidalotarsonemus De Leon e Excelsotarsonemus Ochoa & Naskrecki (Acari: Tarsonemidae) / José Marcos Rezende. -- São José do Rio Preto, 2016
362 f. : il., tabs.

Orientador: Antonio Carlos Lofego
Tese (doutorado) – Universidade Estadual Paulista "Júlio de Mesquita Filho", Instituto de Biociências, Letras e Ciências Exatas

1. Biologia. 2. Ácaro - Classificação. 3. Ácaro – Filogenia. 4. Tarsonemidae. I. Lofego, Antonio Carlos. II. Universidade Estadual Paulista "Júlio de Mesquita Filho". Instituto de Biociências, Letras e Ciências Exatas. III. Título.

CDU – 595.42

Ficha catalográfica elaborada pela Biblioteca do IBILCE
UNESP - Câmpus de São José do Rio Preto

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São José do Rio Preto
21 de março de 2016

José Marcos Rezende

Taxonomic revision and phylogenetic analysis of the *Daidalotarsonemus* De Leon and *Excelsotarsonemus* Ochoa & Naskrecki species (Acari: Tarsonemidae)

Thesis presented as part of the requirements for obtaining the Animal Biology PhD at the Animal Biology Graduation Program of the Institute of Biosciences, Letters and Exact Sciences, São Paulo State University “Júlio de Mesquita Filho”, Campus São José do Rio Preto.

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São José do Rio Preto
March 21st, 2016

Dedicatória

“Aos meus pais Idelvan Tadeu Rezende e Zédina Conceição Silva Rezende, por todo o carinho ao longo desta árdua caminhada. Pelo apoio nos momentos difíceis, quando achei que não teria forças pra continuar. Agradeço por tê-los como pais. São meus maiores exemplos de perseverança. Amo vocês”.

“À minha noiva, namorada e melhor amiga Daiane Ferreira da Silva, pela compreensão em meus momentos de ausência e angústia durante todo meu curso de Doutorado. Por ter suportado comigo toda a distância e a saudade no tempo em que estive no exterior. Por ser sempre carinhosa e compreensiva. Por todo amor e apoio. Te amo”.

“Ao meu irmão Flávio Silva Rezende, pelos ensinamentos que me ajudaram a enfrentar as dificuldades desta jornada”.

“Aos meus avós Juvenal Carneiro Rezende (*in memorian*), Anésia Ferreira Rezende; José Carneiro da Silva e Iza Cândida da Silva; além de todos os meus tios e primos”.

Agradecimentos

"Ao meu orientador, Prof. Dr. Antonio Carlos Lofego (UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brasil), pelos ensinamentos pessoais e profissionais, indispensáveis para conclusão deste trabalho; pela paciência e disposição nas difíceis tarefas que tivemos ao longo destes anos; por suportar meu mau humor e minhas angústias, tendo sempre um bom conselho para dar nestas situações".

"Ao Dr. Ronald Ochoa (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, Estados Unidos), pelos ensinamentos; por ter me recebido tão calorosamente em seu laboratório nos Estados Unidos; por ser meu coorientador (não oficialmente, mas na prática) e, principalmente, meu amigo".

"Ao Prof. Dr. Reinaldo J. F. Feres (UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brasil), pelos ensinamentos, críticas e sugestões oferecidas para meu crescimento pessoal e profissional durante todos estes anos.

"Ao Dr. Gary Bauchan (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, Estados Unidos) pela ajuda e amizade nos meses em que estive no exterior, além de ceder espaço em seu laboratório para desenvolver meu trabalho".

"Ao amigo Elizeu Barbosa de Castro (PPG de Biologia Animal, UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brasil), companheiro de república no Brasil e Estados Unidos; pela amizade em todos estes anos e pela ajuda nos momentos difíceis que passamos durante o período no exterior".

“Ao Prof. Dr. Anibal Ramadan Oliveira (UESC – Universidade Estadual de Santa Cruz, Ilhéus, Brasil), por me receber e prover espaço em seu laboratório durante duas viagens de coleta feitas para a região de Ilhéus-BA; por todos os conselhos, sugestões, críticas e boas conversas”.

“Ao Dr. Gregory Evans (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, Estados Unidos), pela amizade no tempo que estive nos Estados Unidos; e pelas correções de meu inglês nos manuscritos”.

“A Chris Pooley (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, Estados Unidos) pela ajuda com os ajustes das fotografias e desenhos para publicações”.

“Ao Dr. Cal Welbourn (DPI-FSCA – Division of Plant Industry, Florida State Collection of Arthropods, Gainesville, Estados Unidos), pelos ensinamentos; por enviar material para estudo durante meu tempo no exterior; pelas correções de meu inglês nos manuscritos”.

“Ao Dr. Evert Lindquist (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canadá), por todos os ensinamentos passados de forma direta e indireta; pelos comentários feitos nos manuscritos, ajudando a enriquecer as respectivas publicações”.

“Aos Drs. Carl Childers (CREC-UF – Citrus Research and Education Center, University of Florida, Lake Alfred, Estados Unidos), Eddie Ueckermann (BD-ARC – Biosystematics Division, Agricultural Research Council, Pretoria, África do Sul), Frederic Beaulieu (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canadá), Jim Amrine (DPSS-WVU – Division of Plant and Soil Sciences, West Virginia University, Morgantown, Estados Unidos), Jurgen Otto (AIMS – Australian Institute of Marine Sciences, Townsville, Australia), Owen Seeman (QM – Queensland Museum, Brisbane, Australia), e Wayne Knee (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canadá), pelo empréstimo de material para estudos durante meu tempo nos Estados Unidos".

"Ao Dr. Jianzhen Lin (IPP-FAAS – Institute of Plant Protection, Fujian Academy of Agricultural Sciences, Fuzhou, China) e sua filha, Ms. Gongyu Lin (UM – Université de Montreal, Montreal, Canadá), pelo envio de micrografias das espécies chinesas. Mais um agradecimento a Gongyu pela tradução dos artigos de descrição de espécies chinesas, do mandarim para o inglês."

"Ao Dr. László Dányi (HNHM-SZC – Hungarian Natural History Museum, Soil Zoology Collection, Budapeste, Hungria), pelo empréstimo dos holótipos de *D. costulatus*, *D. ethiopicus*, *D. hewitti* e *D. ostracodes*".

"Ao Dr. Tomasz Huflejt (MIZ-PAS – Museum and Institute of Zoology, Polish Academy of Sciences, Varsóvia, Polônia), pelo empréstimo dos exemplares de *D. vandevriei*, além de informações referentes à espécie *D. gutierrezi*".

"Ao Prof. Dr. Gilberto José de Moraes (ESALQ-USP – Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, Brasil), por ceder espécimes e equipamentos para estudo durante o tempo que passei em seu laboratório; por emprestar exemplares para estudos posteriores (o que levou a uma nova espécie descrita); além dos ensinamentos passados de forma direta ou indireta".

"Aos Drs. André Matioli, Jefferson Mineiro e Mário Sato (IB – Instituto Biológico, Campinas, Brasil), pelo empréstimo de espécimes de *Daidalotarsonemus* e por disponibilizarem infra-estrutura para estudos nos dias em que estive em seu laboratório".

"Aos atuais colegas de laboratório: Alexandre Mondin, Elizeu Barbosa de Castro, Felipe Micali Nuvoloni, Felipe Santa Rosa do Amaral, Gustavo Cauê Oliveira Piccoli, Mizael de Melo Ferreira, Marcel Santos de Araújo, Paulo Vittor Parecis Silva e Thafarel Pitton, pela amizade em todos estes anos".

"Ao amigo, Prof. Dr. Peterson Rodrigo Demite, (IF Goiano – Instituto Federal Goiano, Urutaí, Brasil), pelos ensinamentos, conversas e indicações de livros desde 2008, quando iniciei minha vida na Acarologia".

"Ao Prof. Dr. Ricardo Pinto da Rocha (DZ-USP – Departamento de Zoologia, Universidade de São Paulo, São Paulo, Brasil), ao Ms. Yuri Campanholo Grandinete (PPG Entomologia, Universidade de São Paulo, Ribeirão Preto, Brasil), ao Dr. Fernando Rogério Carvalho (IB-UFMT – Instituto de Biociências, Universidade Federal de Mato Grosso, Cuiabá, Brasil) e à Ms. Ana Cláudia dos Santos (UNESP – PPG Biologia Animal, Universidade Estadual Paulista, São José do Rio Preto, Brasil), pelo auxílio nos softwares e interpretações das análises filogenéticas".

"A Nit Malikul e Debra Creel (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, Estados Unidos) por toda a ajuda com material da coleção de Acari".

"Ao Lic. Danilo Brenes Madrigal (Estación Biológica La Selva, Heredia, Costa Rica), pelas informações fornecidas sobre as plantas hospedeiras das espécies de ácaros da Costa Rica".

"A Alan Bernardes e Cleide Arruda (ONF Brasil, Cuiabá, Brasil), por autorizar a coleta e pelo apoio logístico durante nossa estadia na Fazenda São Nicolau, Cotriguaçu-MT".

Muito Obrigado!

Acknowledgements

“To my advisor, Prof. Dr. Antonio Carlos Lofego (UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brazil) for his personal and professional teachings, which were indispensable for the conclusion of this work; for the patience and good mood he showed during all the hard tasks we had throughout the years; for supporting me during difficult times and for always providing good and wise advice in these situations”.

“To Dr. Ronald Ochoa (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, USA) for receiving me so well during my period in his laboratory in USA; for being my co-advisor (unofficially, but in practice) and, above all, my friend”.

“To Prof. Dr. Reinaldo J. F. Feres (UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brazil) for his teachings, criticisms and suggestions offered for my personal and professional growth over the years”.

“To Dr. Gary Bauchan (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, USA) for all his help and friendship during the months when I was abroad; for providing necessary space on his laboratory to develop my work”.

“To my friend Elizeu Barbosa de Castro (PPG de Biologia Animal, UNESP – Universidade Estadual Paulista, São José do Rio Preto, Brazil), my roommate in Brazil and USA, for the friendship over the years and help during the difficult times we had while in the United States”.

“To Prof. Dr. Anibal Ramadan Oliveira (UESC – Universidade Estadual de Santa Cruz, Ilhéus, Brazil), for receiving me and providing enough space in his laboratory during two sampling trips in the region of Ilhéus, Bahia State; for all his advice, suggestions, criticisms and good conversations".

"To Dr. Gregory Evans (USDA-ARS – United States Department of Agriculture, Animal and Plant Inspection Service, Beltsville, USA), for the friendship during the time I was in the USA and for reviewing and correcting the English in various manuscripts produced during the study".

"To Chris Pooley (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, USA) for making the adjustments in the micrographs and drawings for the publications".

"To Dr. Cal Welbourn (DPI-FSCA – Division of Plant Industry, Florida State Collection of Arthropods, Gainesville, USA) for sending material for study during my time abroad; for the English corrections on the manuscripts".

"To Dr. Evert Lindquist (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada), for all teachings provided directly or indirectly; for the comments made on the manuscripts, which helped to improve the final publications".

"To Drs. Carl Childers (CREC-UF – Citrus Research and Education Center, University of Florida, Lake Alfred, USA), Eddie Ueckermann (BD-ARC – Biosystematics Division, Agricultural Research Council, Pretoria, South Africa), Frederic Beaulieu (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada), Jim Amrine (DPSS-WVU – Division of Plant and Soil Sciences, West Virginia University, Morgantown, USA), Jurgen Otto (AIMS – Australian Institute of Marine Sciences, Townsville, Australia), Owen Seeman (QM – Queensland Museum, Brisbane, Australia), and Wayne Knee (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada), for the loan of slides for study during my time in the USA".

“To Dr. Jianzhen Lin (IPP-FAAS – Institute of Plant Protection, Fujian Academy of Agricultural Sciences Fuzhou, China) and his daughter, Msc. Gongyu Lin (UM – Université de Montreal, Montreal, Canada), for sending micrographs of Chinese species. Additional thanks to Gongyu for the translation of description papers from Mandarin to English”.

“To Dr. László Dányi (HNHM-SZC – Hungarian Natural History Museum, Soil Zoology Collection, Budapest, Hungary), for the loaning of *Daidalotarsonemus costulatus*, *D. ethiopicus*, *D. hewitti* and *D. ostracodes* types”.

“To Dr. Tomasz Huflejt (MIZ-PAS – Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland), for the loaning of *D. vandevriei* types, and sending information about *D. gutierrezi*”.

“To Prof. Dr. Gilberto José de Moraes (ESALQ-USP – Escola Superior de Agricultura “Luiz de Queiroz”, Universidade de São Paulo, Piracicaba, Brazil), for providing specimens and equipment in his laboratory; for loaning individual specimens for subsequent studies (which led to the description of a new species); and for all his teachings”.

“To Drs. André Matioli, Jefferson Mineiro and Mário Sato (IB – Instituto Biológico, Campinas, Brazil), for providing specimens and equipment in their laboratory; and for loaning individuals for subsequent studies”.

“To my current laboratory colleagues: Alexandre Mondin, Elizeu Barbosa de Castro, Felipe Micali Nuvoloni, Felipe Santa Rosa do Amaral, Gustavo Cauê Oliveira Piccoli, Mizael de Melo Ferreira, Marcel Santos de Araújo, Paulo Vittor Parecis Silva and Thafarel Pitton, for their friendship over the years”.

"To my friend, Prof. Dr. Peterson Rodrigo Demite, (IF Goiano – Instituto Federal Goiano, Urutaí, Brazil), for his teachings, conversations and book references since 2008, when I started my acarological career".

"To Prof. Dr. Ricardo Pinto da Rocha (DZ-USP – Departamento de Zoologia, Universidade de São Paulo, São Paulo, Brazil), to Ms. Yuri Campanholo Grandinete (PPG Entomologia, Universidade de São Paulo, Ribeirão Preto, Brazil), to Dr. Fernando Rogério Carvalho (IB-UFMT – Instituto de Biociências, Universidade Federal de Mato Grosso, Cuiabá, Brazil) and to Ms. Ana Cláudia dos Santos (UNESP – PPG Biologia Animal, Universidade Estadual Paulista, São José do Rio Preto, Brazil) for the help with TNT software and interpretation of phylogenetic analyses".

"To Nit Malikul and Debra Creel (USDA-ARS – United States Department of Agriculture, Agricultural Research Service, Beltsville, USA) for helping with all Acari Collection matters".

"To Lic. Danilo Brenes Madrigal (Estación Biológica La Selva, Heredia, Costa Rica), for the information about host plants of the Costa Rica mite species".

"To Alan Bernardes and Cleide Arruda (ONF Brasil, Cuiabá, Brazil), for authorizing samplings and providing logistical support during my time in the Farm São Nicolau, Cotriguaçú, Mato Grosso State".

Thanks!

Auxílio Financeiro

Este trabalho recebeu o apoio financeiro da Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), através das concessões de bolsas de Doutorado regular (DR) (Proc. 2011/19890-0), e estágio e pesquisa no exterior (BEPE) (Proc. 2013/08402-0).

RESUMO

Daidalotarsonemus (Acari: Tarsonemidae) é um dos poucos gêneros de ácaros tarsonemídeos registrados em todo mundo. Até 2014, este era composto de 26 espécies conhecidas. *Excelsotarsonemus* também é um gênero de ácaros tarsonemídeos; contudo, sua distribuição geográfica estava restrita a América Central e apenas três espécies foram descritas até aquele ano. Neste trabalho, são apresentados avanços no conhecimento sobre a biologia, taxonomia e a filogenia destes dois gêneros. Os primeiros três capítulos apresentam a descrição de 15 novas espécies, 13 pertencendo à *Daidalotarsonemus* e duas à *Excelsotarsonemus*. O capítulo final compila informações sobre as espécies de ambos os gêneros em uma revisão taxonômica. Também é apresentada uma análise filogenética, além de uma breve discussão sobre a distribuição geográfica destas. Os resultados aqui obtidos incrementam o conhecimento, não apenas para estes dois gêneros, mas para toda família Tarsonemidae

Palavras-chave: *Biologia. Filogenia. Heterostigmata. Prostigmata*. *Taxonomia.*

ABSTRACT

Daidalotarsonemus (Acari: Tarsonemidae) is one of the few tarsonemid mite genera which have been recorded worlwide. Until 2014, it was composed of 26 known species. Excelsotarsonemus is also a tarsonemid mite genus; however, its geographical distribution was restricted to the Central America and just three species were described until that year. Here, it is presented some advances on knowledge about the biology, taxonomy and phylogeny of these two genera. The first three chapters show the description of 15 new species, 13 of those belonging to Daidalotarsonemus and two to Excelsotarsonemus. The last chapter gathers information about all species of both genera in a taxonomic revision. It is also provided a phylogenetic analysis, and a brief discussion about their geographical distribution. The results obtained increase the knowledge, not just for these two genera, but for all family Tarsonemidae.

Keywords: *Biology. Heterostigmata. Phylogeny. Prostigmata. Taxonomy.*

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INTRODUCTION

Tarsonemid mites are classified in the Order Trombidiformes and Cohort Heterostigmata (Walter *et al.* 2009). Among its species, there are some very economically important species such as *Polyphagotarsonemus latus* Banks and *Phytonemus pallidus* (Banks) (Gerson *et al.* 2003; Moraes and Flechtmann 2008). Its superfamily is defined by the absence of setae *v2* and femur and genu III and IV fused in females; and by the absence of setae *pl´´* on tarsus III in adults (Lindquist 1986).

De Leon (1956) described the genus *Daidalotarsonemus* based on *D. tessellatus* (type species) individuals found on lychee *Litchi chinensis* Sonn. (Sapindaceae) in Miami, Florida, USA. According to this paper, the morphological characters which define this genus are: dorsal plates ornamented and some dorsal setae distinctly larger (for females); dorsal setae longer than for other genera and tibiae IV significantly longer than large (for males). Lindquist (1986) detailed the diagnosis, citing that adults of both sexes are distinguished by having tergital setae *c2* smooth or slightly barbed, and by retaining two or three genual setae on leg III and usually both solenidia in the tibial sensory cluster of leg I. The feeding habits of *Daidalotarsonemus* are still unclear, but it is thought they may be algophagous, fungivorous (Lindquist 1986), lichenophagous (Gerson and Seaward 1977) or phytophagous (Lofego *et al.* 2005).

The genus *Excelsotarsonemus* was described by Ochoa *et al.* (1995) based on *E. kaliszewskii* representatives inhabiting *Theobroma cacao* L. (Malvaceae). According to them, females of *Excelsotarsonemus* can be distinguished by the characteristic form of setae *sc2*, *c1* and *d*; which are elliptical, heavily veined and inserted on tubercles. In this paper, a phylogenetic analysis is provided, and *Excelsotarsonemus* is hypothesized to be the sister group of *Daidalotarsonemus*. For *Excelsotarsonemus*, feeding habits are also unclear, but it is suspected they are similar to *Daidalotarsonemus* (Ochoa and OConnor 1998).

Over the last decades, the traditional taxonomy used in Acarology has been modified and integrated with new approaches. Phylogenetic concepts are being also used for making decisions about validity and position of species and higher taxa (Klompen *et al.* 2007; Dabert *et al.* 2010; Hernandes and Feres 2013). Also, significant advances in microscopy over the last years have expanded the knowledge about mite morphological characters (Fisher and Dowling 2010). One of most effective techniques that have been used recently is the Low Temperature Scanning Electron Microscopy (LT-SEM), in which the sample is instantly frozen with liquid nitrogen (Bolton et al. 2014; Castro *et al.* 2015; Rezende *et al.* 2015). All these new metodologies are helpful for taxonomist and gather new information that may be used on different areas, e.g. biology, ecology, behaviour, etc.

Taxonomic revisions are very useful for taxonomists and all those interested in the identification of certain taxa. For *Daidalotarsonemus*, there is one revision (Smiley 1972), in which information is presented on the seven species that were known at that time; no revisions exist for *Excelsotarsonemus*. Given the great number of *Daidalotarsonemus* species described after its last revision, clearly a paper which revises the taxonomic aspects of the genus *Daidalotarsonemus* is needed. It is also necessary to verify the hypothesis of *Daidalotarsonemus* and *Excelsotarsonemus* being a sister group; and the phylogenetic relations among species within both groups. Finally, it is important to update the information on the geographical distribution for these taxa, gathering all records made throughout the world. All these aspects are discussed in the chapters ahead.

The first three chapters show the description of 15 new species (13 *Daidalotarsonemus* and two *Excelsotarsonemus*). The first also presents a new interpretation for some characters based on the LT-SEM study. The second one is about the description of ten new *Daidalotarsonemus* species from Costa Rica. The third chapter presents descriptions of two new *Daidalotarsonemus* species from Brazil. The last chapter gathers information available about all species of both genera in a taxonomic revision, including description of six new species (five *Daidalotarsonemus* and one *Excelsotarsonemus*). A phylogenetic analysis is provided, as is a brief discussion on their geographical distribution.

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CHAPTER 1

NEW SPECIES OF *DAIDALOTARSONEMUS* AND *EXCELSOTARSONEMUS* (ACARI, TARSONEMIDAE) FROM THE BRAZILIAN RAINFOREST

Manuscript published in the periodic Zookeys on January 22, 2015

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Abstract

Three new species of Tarsonemidae, *Daidalotarsonemus oliveirai* Rezende, Lofego & Ochoa, sp. n., *Excelsotarsonemus caravelis* Rezende, Lofego & Ochoa, sp. n. and *Excelsotarsonemus tupi* Rezende, Lofego & Ochoa, sp. n. are described and illustrated. Measurements for these species are provided, as well as drawings, phase contrast (PC), differential interference contrast (DIC) and low temperature scanning electron microscopy (LT-SEM) micrographs. Some characters, which have not been used or clearly understood, are described herein. Biological, ecological and agricultural aspects about the role of these species in the rainforest and its surrounding environment are briefly discussed.

Keywords

Atlantic Forest, canopy, faunistics, LT-SEM, systematics, Tarsonemoidea, Trombidiformes

Introduction

Currently, *Daidalotarsonemus* De Leon (Acari, Prostigmata, Tarsonemidae) consists of 26 described species (Lin and Zhang 2002, Lofego et al. 2005, Sousa et al. 2014). It is one of the few genera of Tarsonemidae which have been documented on all continents, except Antarctica (Lindquist 1986, Lin and Zhang 2002). The known geographical distribution of *Excelsotarsonemus* Ochoa & Naskręcki is much more restricted, previously recorded only from Costa Rica. The two genera are closely related and considered to be sister genera (Ochoa et al. 1995, Ochoa and OConnor 1998). Both are considered to be plant inhabiting taxa, apparently with a preference for plants located in humid places, where there is an abundance of fungi, bacteria and lichens. In Brazil, the Amazon and Atlantic Rainforests are biomes which fit these requirements, because of their high temperature and rainfall index.

In recent years, significant advances in microscopy have expanded our knowledge of the morphological characters of organisms, which has led to a better understanding of the taxonomy and ecology of species (Fisher and Dowling 2010). One of most effective techniques that has been integrated to study mite morphology and biology is Low Temperature Scanning Electron Microscopy (LT-SEM), in which a sample is instantly frozen with liquid nitrogen, making a frozen snap-shot of the specimen as it occurs in nature available for microscopic study (Bolton et al. 2014). This procedure is critical for understanding not only external morphology, but also ecological and behavior characteristics, not accessible using light microscopy.

The objective here is to describe new species of *Daidalotarsonemus* and *Excelsotarsonemus* found in a rainforest in Brazil using phase contrast (PC), differential interference contrast (DIC) light microscopy and LT-SEM microscopy techniques. The LT-SEM study led to a better understanding of the morphology of these species and their respective genera and is discussed herein.

Material and Methods

Several leaves of *Annona muricata* L. (Annonaceae), *Theobroma cacao* L. (Malvaceae) and *Spondias purpurea* L. (Anacardiaceae) were collected in and the area surrounding a section of the rainforest near Santa Cruz State University campus (UESC), 14° 47' 45" S; 39° 10' 18" W, Ilhéus, Bahia State, Brazil. The region is characterized by having high relative humidity (75-90%) and high precipitation (100-330 mm/month) indexes throughout the year. Mites collected in the study were prepared and analysed using three different microscopy techniques: phase contrast (PC), differential interference contrast (DIC) and low temperature scanning electron microscopy (LT-SEM). The terminology used herein follows that of Lindquist (1986), except for the gnathosomal setae *dgs* and *vgs* (Magowski and Di Palma 2000). For each structure, all the measurements are provided in micrometers (μm), followed by the range of all specimens measured in parentheses, including the holotype. The following abbreviations are used for institutions where the types were deposited: Acari Collection of the Departamento de Zoologia e Botânica (DZSJRP), São Paulo State University, São José do Rio Preto, São Paulo, Brazil; United States National Museum of Natural History (USNM), Smithsonian Institution, housed in Beltsville, Maryland 20705, USA.

Specimens were prepared and observed with an LT-SEM using the same techniques as described in Bolton et al. (2014). Briefly, live specimens were secured to 15 cm x 30 cm copper plates using ultra smooth, round (12mm diameter), carbon adhesive tabs (Electron Microscopy Sciences, Inc., Hatfield, PA). The specimens were frozen in a Styrofoam box, by placing the plates on the surface of a pre-cooled (-196°C) brass bar whose lower half was submerged in liquid nitrogen (LN_2). After 20-30 seconds, the holders containing the frozen samples were transferred the Quorum PP2000 cryo-prep chamber (Quorum Technologies, East Sussex, UK) attached to an S-4700 field emission scanning electron microscope (Hitachi High Technologies America, Inc., Dallas, TX). The specimens were etched inside the cryotransfer system to remove any surface contamination (condensed water vapour) by raising the temperature of the stage to -90°C for 10-15 minutes. Following etching, the temperature inside the chamber was lowered below -130°C, and the specimens were coated with a 10nm layer of platinum using a magnetron sputter head equipped with a platinum target. The specimens were transferred to a pre-cooled (-130°C) cryostage in the SEM for observation. An accelerating voltage of 5kV was used to view the specimens. Images were captured using a 4pi Analysis System (Durham, NC). For the PC and DIC micrographs, it was used a Zeiss Axioscope™ microscope with differential interference contrast (DIC) 100x Plan Apochromatic objective with a NA 1.4. For the drawings, it was used a Leica® DM 2500 microscope with a drawing tube attached. Images were sized and placed together to produce a single illustrative plate using the software ADOBE® PHOTOSHOP CS 5.0 AND ADOBE® ILLUSTRATOR CS 5.0.

Results

Daidalotarsonemus oliveirai **Rezende, Lofego & Ochoa, sp. n.**
(Figs. 1–14)

Diagnosis: Females of the new species are most similar to those of *Daidalotarsonemus jamesbakeri* Smiley (1969) and *D. folisetae* Lofego & Ochoa (Lofego et al. 2005), because of the irregular ornamentation pattern on the prodorsum and the similar shape of the setae *e*. However, *Daidalotarsonemus oliveirai* sp. n. has the tergite C with a W-shaped reticulate pattern in the central area and longitudinal, wavy interrupted ridges laterally, whereas in *D. jamesbakeri* and *D. folisetae* the reticulation is uniform on all tergites, with longitudinal continuous ridges. The shape of setae *e* is also different among the three species, being cordate in *D. oliveirai*, acicular in *D. jamesbakeri*, and phylliform in *D. folisetae*. Males are similar to *Daidalotarsonemus deleoni* Smiley (1967), by the shape and length of almost all dorsal setae, except the setae *sc1*. In *D. oliveirai*, the relative length of the setae *sc1*/*sc2* is 1:0.6, whereas in *D. deleoni* is 1:0.3.
Adult female (6 specimens measured).

Gnathosoma (Figs. 3 and 6): partially covered by prodorsum. Subtriangular in ventral view, length 24 (23–26), maximum width 21 (19–23); dorsal apodeme distinct. Setae *dgs* 9 (8–10) and *vgs* 6 (6) smooth; palps moderately long 9 (8–11), with two small subterminal setae and terminal projections. Pharynx fusiform, 19 (18–23) long and 6 (5–7) wide at maximum width. Gnathosoma, idiosoma and legs covered with tiny dimples, each around 0.3 (0.2–0.5) in diameter.

Idiosoma – dorsum (Figs. 1-2): length 179 (170–188), width at level of *c1* 82 (75–90); prodorsal shield with irregular ornamentation covers gnathosoma. Entire dorsum covered with cerotegument (Fig. 2C). Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with a W-shaped reticulate pattern in central area and longitudinal, wavy uninterupted ridges laterally; tergite D ornamented with regular sculpturing. Lengths of setae: *v1* 23 (22–25), *sc1* 11 (10–12) (Fig. 7C), *sc2* 28, *c1* 11 (10–12), *c2* 11 (10–12), *d* 33 (31–35), *e* 15 (15–16), *f* 24 (23–25) and *h* 24 (24–25). Maximum width of expanded setae: *d* 6 (5–7), *e* 15 (14–16) and *f* 7 (7–8). All dorsal setae serrate, except for *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *sc2*, *c1*, *c2* and *h* setiform; setae *d*, *e* and *f* inserted on tubercles (Fig. 7D-E). Setae *d* linear and *e* cordate, both with a central serrate vein; *f* lanceolate, with two serrate veins. Distances between dorsal setae: *v1–v1* 25 (24–27), *sc2–sc2* 46 (44–48), *v1–sc2* 23 (23–24), *c1–c1* 50 (49–53), *c2–c2* 82 (76–88), *c1–c2* 27, *d–d* 44 (40–48), *f–f* 10, *e–f* 12 (11–13) and *h–h* 16 (14–17). Seta *sc2* inserted anteriorly to *sc1*. Dorsal cupules not easily seen.

Idiosoma – venter (Figs. 3-4): setae *1a* 6 (6–7), posteriad of apodemes 1; *2a* 9 (9), posterolaterad of apodemes 2; *3a* 14 (13–15) near anteriomedial margins of apodemes 3; *3b* 11 (11–12) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long and fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme. Sejugal apodeme uninterrupted, with a single median indentation. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 12 (11–13) and very short, 4 (4–5) (Fig. 7F); posterior margin slightly arched. Seta *ps* 12 (11–13) serrate. Ventral surface covered with tiny dimples (Fig. 7F).

Legs (Fig. 5): lengths (measured from femur to tarsus): leg I 40 (39–42), leg II 37 (35–40), leg III 79 (78–80). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Claws medium-sized (not reduced) and hooked. Empodia of legs I, II and III about same size or slightly smaller compared to respective basal stalks. Tarsal solenidion *ω* of tibiotarsus I 6 (5–7), stout, wider medially. Sensory cluster of tibia I complete (Fig. 7A), solenidion *φ1* 3 (3–4), slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 18 (18–19), serrate. Solenidion *ω* of tarsus II proximally inserted, 4 long, stout, wider medially (Fig. 7B). Seta *d* of tibia II 13 (13–14), serrate. Femorogenu IV 11 (14–15); tibiotarsus IV 8. Length of leg IV setae: *v′* F 9, *v′* G 11, *v´* Ti 19 and *tc″* 24 (23–27); setae *v′* Ti and *tc″* serrate; *v′* Ti falcate.

Adult male (3 specimens measured).

Gnathosoma (Figs. 10, 13 and 14A): subtriangular in ventral view, length 22 (21–23), maximum width 20 (19–20); dorsal apodeme distinct. Setae *dgs* 11 (10–12) and *vgs* 7 (7) smooth; Palps moderately long 9 (8–10), with 2 small subterminal setae and terminal projections. Pharynx fusiform, 15 (14–17) long and 7 (6–8) wide at widest region. Gnathosoma, idiosoma and legs covered with tiny dimples, each 0.3 (0.2–0.5) in diameter.

Idiosoma – dorsum (Figs. 8-9): length 174 (170–178), maximum width 82 (80–84). Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 30 (29–31), *v2* 24 (22–25), *sc1* 38 (37–40), *sc2* 24 (22–25), *c1* 21 (20–22), *c2* 26 (24–29), *d* 32 (30–34), *f* 14 (13–16). All setae setiform and serrate. Distances between dorsal setae: *v1–v1* 13 (12–14), *sc1–sc1* 34 (32–35), *sc2–sc2* 44 (43–46), *v1–sc2* 26 (25–27), *c1–c1* 75 (74–77), *c2–c2* 78 (76–80), *c1–c2* 44 (43–47), *d–d* 45 (44–47), *f–f* 22 (20–23). Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Figs. 10-11): setae *1a* 6 (5–6) posteriad of apodemes 1; setae *2a* 7 (7–8) located in center of coxisternal plate 2; seta *3a* 12 (11–13) located near anterior end of apodeme 3; and seta *3b* 12 (10–14) located near middle of apodeme 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 not fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but thin between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous (apodemes 3 and 4, poststernal apodeme and connecting apodeme between apodemes 3 and 4); connecting apodemes between apodemes 4 and poststernal diffuse.

Legs (Fig. 12): lengths (measured from femur to tarsus): leg I 63 (62–65), leg II 59 (57–61), leg III 81 (79–83), leg IV 83 (81–84). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 4-4-6(2)-9(1), leg II: 3-3-4-4(1), leg III: 1-3-4-3. Claws medium-sized (not reduced) and hooked. Empodia of legs I, II and III about same size or slightly smaller compared to respective basal stalks. Solenidion *ω* of tarsus I 4 (3–5), stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3 (3), *φ2* 4 (4–5) and famulus *k* 4 (4), all inserted at approximately same level (Fig. 14B). Seta *d* of tibia I 27 (26–30), serrate. Solenidion *ω* of tarsus II proximally inserted 4 (4–5) long, stout, wider medially (Fig. 14C). Seta *d* of tibia II 23 (21–24), serrate. Trochanter IV slightly wider than long, seta *v′* 13 (12–14), smooth. Femorogenu IV 41 (40–43) long and 17 (16–19) wide at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third, with a serrate-like projection between these margins. Seta *v′* F 9 (8–10), serrate. Setae *v′* G 17 (16–18) and *l″* G 12 (11–13), smooth. Tibia IV 24 (22–26) long; solenidion *φ* 7 (6–8); seta *v′* Ti 28 (27–31), serrate. Tarsus IV short, bearing 3 smooth setae of following length: *tc″* 4 (4–5), *pv″* 6 (5–7) and *u′* 5 (4–6). Claw well developed (Fig. 14D).

Type material: Holotype female, allotype male, 6 paratype females and 2 paratype males from *Theobroma cacao* L., 1 paratype female from *Annona muricata* L. and 2 paratype females from *Spondias purpurea* L., 14° 47' 45" S; 39° 10' 18" W, Ilhéus, State of Bahia, Brazil, 10/IX/2012, A.C. Lofego and J.M. Rezende. Holotype, allotype, 7 paratype females and 2 paratype males are deposited at DZSJRP and 2 paratype females are deposited at USNM.

Etymology: The species name *oliveirai* is in honor of Dr. Anibal Ramadan Oliveira (UESC - Universidade Estadual Santa Cruz from Ilhéus-BA) for his contribution to study of mites and for all his support during the samplings in the region.

Excelsotarsonemus caravelis **Rezende, Lofego & Ochoa, sp. n. (Figs. 15–21)**

Diagnosis: Females of this species resemble those of *Excelsotarsonemus kimhansenae* Ochoa & OConnor because of the shape of dorsal setae *v1*, *sc2*, *c1* and *c2*, and the ornamentation pattern on the prodorsum; but they are distinguished by the asymmetric shape of setae *e* and the U-shaped cerotegument accumulation between prodorsum and tergite C in *Excelsotarsonemus caravelis* sp. n., whereas setae *e* are orbicular and smooth and tergite C surface is smoother in *E. kimhansenae*. The accumulation of the cerotegument between the tergites was easily noticed in all microscopy techniques used (Fig. 16), and it is being considered a taxonomic feature, useful for distinguishing these species.

Adult female (5 specimens measured).

Gnathosoma (Figs. 17, 20, 21A-B): completely covered by prodorsum. Subtriangular in ventral view, length 22 (21–24), maximum width 17 (16–19); dorsal apodeme distinct. Setae *dgs* 7 (7–8) and *vgs* 5 (5–6) smooth; palps moderately short 6–8 (7), with 2 small subterminal setae and terminal projections. Pharynx fusiform, 15 (15–16) long and 6

(6) wide at maximum width. Gnathosoma, idiosoma and legs covered with tiny dimples, each 0.3 (0.2–0.5) in diameter.

Idiosoma – dorsum (Figs. 15-16): length 167 (166–168), width at level of *c1* 86 (84–90); prodorsal shield normally covering entire gnathosoma, with three external humps, broader proximally, central area with an inverted Y-shaped pattern. Stigma near lateral notch of prodorsal shield, equidistant to *v1* and *sc2* setal bases. Entire dorsum covered with cerotegument with a U-shaped cerotegument accumulating between prodorsum and tergite C (Fig. 16). Tergite D with irregular bumps near setae *d*. Lengths of setae: *v1* 29 (27–31), *sc1* 16 (14–18) (Fig. 21C), *sc2* 47 (45–49), *c1* 40 (40–41) (Fig. 21E), *c2* 9 (8–10), *d* 30 (28–32) (Fig. 21F), *e* 16 (16–17), *f* 36 (35–38) and *h* 13 (11–16). Maximum width of expanded setae: *sc2* 3 (3–4), *c1* 11 (11–12), *d* 22 (21–23), *e* 32 (31–33) and *f* 12 (11–13). All setae serrate, except for *c2* which is smooth. Bothridial setae *sc1* capitate with tiny spines; *sc2* linear with a strong central furrow; setae *c1* lanceolate, *d* ovate and *f* oblanceolate with serrate central veins; *e* each totally asymmetric (Figs. 21G-H). Distances between dorsal setae: *v1–v1* 26 (24–29), *sc2–sc2* 46 (45–48), *v1–sc2* 15 (14–16), *c1–c1* 43 (41–45), *c2–c2* 89 (85–96), *c1–c2* 36 (34–38), *d–d* 27 (27–28), *f–f* 11 (9–13), *e–f* 12 and *h–h* 5 (4–7). Seta *sc2* located anteriorly to *sc1*. Dorsal cupules not easily seen.

Idiosoma – venter (Figs. 17-18): seta *1a* 6 (6–7), posteriad of apodemes 1; *2a* 9 (9–10), posterolaterad of apodemes 2; *3a* 11 near anteriomedial margins of apodemes 3; *3b* 8 (8–9) on posterior margins of apodemes 4. Apodeme 1 conspicuous and fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 near middle of sejugal apodeme portion. Sejugal apodeme uninterrupted with several small indentations. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 16 (15–17) and very short, 4 (4–5) (Fig. 21I), posterior margin slightly arched. Setae *ps* 17 (16–19) smooth.

Legs (Fig. 19): lengths (measured from femur to tarsus): leg I 42 (42–43), leg II 40 (39–41), leg III 92 (89–95), leg IV 32 (31–35). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: leg I: 3-4-5(2)-7(1), leg II: 3-3-4-4(1), leg III: 2+2-4-4. Claws medium-sized (not reduced) and hooked. Empodia of legs I, II and III about same size or slightly smaller compared to respective basal stalks. Tarsal solenidion *ω* of tibiotarsus I 4 (4–5), stout, wider medially. Sensory cluster of tibia I complete (Fig. 21D), solenidion *φ1* 4 (4–5), slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6; all those inserted at approximately in same level. Seta *d* of tibia I 23 (22–24), serrate. Solenidion *ω* of tarsus II proximally inserted, 4 long, stout, wider medially. Seta *d* of tibia II 17 (17–18), serrate. Femorogenu IV 18 (16–20); tibiotarsus IV 9 (9–10). Length of leg IV setae: *v′* F 8 (8–9), *v′*G 10 (10–11), *v′* Ti 23 (22–24) and *tc″* 31 (29–33); setae *v′* Ti and *tc″* smooth; *v′* Ti falcate.

Adult male: Unknown.

Type material: Holotype female and 4 paratype females on *Theobroma cacao* L., 14° 47' 45" S; 39° 10' 18" W, Ilhéus, State of Bahia, Brazil, 10/IX/2012, A.C. Lofego and J.M. Rezende. Holotype and 3 paratypes are deposited in the DZSJRP and 1 paratype is deposited in the USNM.

Etymology: The region where this mite was found is the same place as the first Portuguese explorers arrived in Brazil, at the end of 15th century. On their trip, they used caravels, which had big sails. The name *caravelis* is used because several dorsal setae of this mite species are held in the upright position resembling those sails.

Note: Setae *f* has a unique modification as it is oblanceolate dorsal view, with four faces attached by the main vein, giving a deep concavity at either site, with a central furrow dorsally shoe-like; all margins serrate (Fig. 21H). Similar setal complex modification has been observed in *E. mariposa* (setae *d*, *f* and *e*) and other *Excelsotarsonemus* and *Daidalotarsonemus* species under DIC. However, it is under the LT-SEM that we can understand their complexity.

Excelsotarsonemus tupi **Rezende, Lofego & Ochoa, sp. n.**
(Figs. 22–28)

Diagnosis: Females of this species resemble those of *Excelsotarsonemus kaliszewskii* Ochoa & Naskręcki (Ochoa et al. 1995) because of the similar shape of setae *sc2*, *c1* and *d*. However, setae *c2* and *e* of *Excelsotarsonemus tupi* sp. n. are setiform-like, while in *E. kaliszewskii* these setae are falcate and elongate. In addition, the humps on the prodorsum and the muscle attachments of tergite D are very different in shape between these two species, being more ornate and prominent in *E. kaliszewskii*.

Adult female (3 specimens measured).

Gnathosoma (Figs. 24 and 27): completely covered by prodorsum. Subtriangular in ventral view, length 21 (21–22), maximum width 17 (16–19); dorsal apodeme distinct. Setae *dgs* 8 (7–9) and *vgs* 4 (4–5) smooth; Palps moderately short 6–8 (7), with 2 small subterminal setae and terminal projections. Pharynx fusiform, 15 (14–16) long and 8 (7–9) wide at maximum width region. Gnathosoma, idiosoma and legs covered with tiny dimples, each around 0.3 (0.2–0.5) in diameter.

Idiosoma – dorsum (Figs. 22-23): length 175 (171–179), width at level of *c1* 94 (93–95); prodorsal shield covering gnathosoma. Entire dorsum covered with cerotegument. Stigma inserted proximally at lateral notch of prodorsal shield, near base of setae *v1*. Prodorsum, tergites C and D with distinct muscle attachments, visible with DIC and PC optic microscopes. Lengths of setae: *v1* 23 (22–25) (Fig. 28C), *sc1* 15 (15–16) (Fig. 28B), *sc2* 44 (43–47) (Fig. 28D), *c1* 46 (44–49) (Fig. 28E), *c2* 14 (11–

17), *d* 32 (31–34), *e* 26 (25–29), *f* 36 (35–37) and *h* 19 (19–20). Maximum width of expanded setae: *sc2* 12 (11–13), *c1* 8 (8–9), *d* 22 (21–23), *e* 3 (3–4) and *f* 22 (21–23). All dorsal setae serrated. Bothridia *sc1* capitate with tiny spines. Setae *v1* linear; *c2* setiform; *c1* oblong very elongated; *sc2* lanceolate with three heavy dorsal veins; *d* ovate and *f* asymmetrical, both with internal cells; *e* linear, heavily serrate (Figs. 28F-H); *h* elliptical, serrate with one dorsal vein. Distances between dorsal setae: *v1–v1* 37 (37–38), *sc2–sc2* 48 (47–49), *v1–sc2* 16 (15–18), *c1–c1* 45 (44–46), *c2–c2* 76 (74–80), *c1–c2* 17 (16–19), *d–d* 25 (23–28), *f–f* 11 (9–15), *e–f* 13 (11–16) and *h–h* 10 (9–14). Seta *sc2* located lateral to *sc1*. Dorsal cupules not easily seen.

Idiosoma – venter (Figs. 24-25): setae *1a* 5 (4–7), inserted on tubercles posteriad of apodemes 1; *2a* 7 (6–10), posterolaterad of apodemes 2; *3a* 8 (7–11) near anteriomedial margins of apodemes 3; *3b* 6 (5–9) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme not clearly united with sejugal apodeme, continuous along length to level of apodemes 2, ending in a diffuse area that reaches to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Externally, apodemes 3 and 4 surrounded by a distinct punctation. Tegula wide 16 (15–17) and very short 4 (4–5) with posterior margin slightly arched. Seta *ps* 6 (15–6) smooth.

Legs (Fig. 26): lengths (measured from femur to tarsus): leg I 44 (43–48), leg II 40 (39–41), leg III 90 (88–93), leg IV 33 (31–35). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-4(2)-7(1), leg II: 3-3-4-4(1), leg III: 0+3-4-4. Claws medium-sized (not reduced) and hooked. Empodia of legs I, II and III about same size or slightly smaller compared to respective basal stalks. Tarsal solenidion *ω* of tibiotarsus I 4 (4–5), stout, wider medially. Sensory cluster of tibia I incomplete, solenidion *φ1* 4, slender, capitate; famulus *k* 6 (6–7); both inserted at approximately same level (Fig. 28A). Seta *d* of tibia I 21 (20–22), serrate. Solenidion *ω* of tarsus II proximally inserted, 4 long, stout, wider medially. Seta *d* of tibia II 18 (17–21), serrate. Femorogenu IV 19 (19–20); tibiotarsus IV 8 (7–9). Length of leg IV setae: *v′* F 7 (7–8), *v′* G 10 (9–11), *v´* Ti 18 (19–23) and *tc″* 25 (23–28); setae *v′* Ti and *tc″* smooth; *v′* Ti falcate.

Adult male: Unknown.

Type material: Holotype female and 2 paratype females on *Theobroma cacao* L., 14° 47' 45" S; 39° 10' 18" W, Ilhéus, State of Bahia, Brazil, 10/IX/2012, A. C. Lofego and J.M. Rezende. Holotype and 2 paratype females are deposited in the DZSJRP.

Etymology: The species name *tupi* is in honor of a Tupi people, one of the most important native indigenous tribes in Brazil which used to live in all coastal region where this mite species was found.

Discussion

Some characters of *Daidalotarsonemus*, *Excelsotarsonemus* and other tarsonemids in general have been misunderstood or have not been clearly interpreted, certainly because of the reliance on only light microscopy technology. This becomes clear by comparing LT-SEM micrographs with the drawings of species described previously. The use of LT-SEM and other SEM techniques by acarologists is useful to truly understanding morphological details of the mites, and contributing to more accurate and reliable taxonomic and systematic studies.

The extension of the prodorsum over the gnathosoma in the genera *Daidalotarsonemus* and *Excelsotarsonemus* is a feature mentioned by Lindquist (1986) and Ochoa et al. (1995), respectively. Using the LT-SEM, it was observed the gnathosoma has the ability to protract and retract, being covered by the prodorsum and the coxisternal plates I (Figs. 4, 18 and 25).This is a difficult character to discern using light microscopy, mainly because slide mounting distorts it by the flattening of the specimen between the slide and the coverslip, often pushing the gnathosoma forward. In the *Daidalotarsonemus* species studied, it was observed these mites are able to partially retract the gnathosoma under the propodosoma, leaving the distal part, including the palps exposed. The two species of *Excelsotarsonemus* are able to retract the entire gnathosoma, similar to turtles, under the propodosoma and over the apodemes 1.

Both genera studied, especially *Excelsotarsonemus*, have some dorsal setae (especially *sc2, c1*, *d*, *e* and *f*) with very broad and intricate folding patterns. It is not clear the function of these setae yet. Each one has strong veins that probably help it raise up and maintain itself perpendicular to the body. These sail-like setae might allow them to become airborne, gliding within the canopies and colonizing new trees (Ochoa and OConnor 1998). Setae *e* and *f,* because of their position and the way they lay above tergite H, seem to have different functions, perhaps related to protection, entrapping fungal spores and/or improving the aerodynamic characteristics of the mites. Some setae have even more complicated patterns, e.g. the setae *e* of *Excelsotarsonemus caravelis* (clearly asymmetric) and setae *f* of *Excelsotarsonemus tupi* (asymmetrical and with internal cells). Furthermore, setae *d* in both species apparently sits on the modified setae *e* or *f* like a lid (Fig. 21G, 21H, 28F, 28H). Tergite EF and its setae are supported by plate H, which is concave; both plates are partially covered by the posterior projection of tergite D (Fig. 28I).

It was noticed the production of cerotegument (Krantz 2009) over the body of both genera. Using LT-SEM, the cerotegument was captured extending over the body with fungi, lichens and bacteria accumulating on it. The cerotegument along with its attached material are shed at the edge of the tergites, especially on the propodosoma and tergites C and D (Figs. 2C, 4C, 9C, 16C, 18C, 23C and 25C), indicating a way these mites might disseminate microorganisms and even plant pathogens. Although these mites were preserved in 70% alcohol for about eight months, the cerotegument still contained fungi and bacteria. The primary purpose of this substance appears to be water retention, but it also may allow the mite to cover itself in another layer of particles if the substance is sticky (Walter and Proctor 2013). This fact has important biological and agricultural implications. First, this substance allows them to carry debris over their body when they disperse between the canopies. Also, the cerotegument could protect the mite against harmful fungi, being a barrier between them and the soft cuticle. Lastly, by carrying fungi and bacteria, they may act as reservoirs of microorganisms (including plant pathogens) to their host plants, and spreading them throughout the forests and surrounding crops. More studies on the biology and feeding parameters of these genera are necessary to better understand their role and impact.

The discovery of three new mite species in such a small sampling area is remarkable. Although South America has five of the biodiversity hotspots biomes of the world (Myers et al. 2000), just 10 tarsonemid species have been described based on specimens found in this region (Lofego et al. 2005, Lofego and Gondim Jr. 2006, Lofego and Feres 2006, Lofego et al. 2007, Moraes et al. 2002). In addition, two species of *Daidalotarsonemus* and three of *Excelsotarsonemus* were found in very similar rainforest areas in Costa Rica (Ochoa et al. 1991; Ochoa et al. 1995, Ochoa and OConnor 1998). Most of these mite species in Costa Rica and Brazil were collected on cocoa trees. This tropical crop has broad leaves which are often covered with fungi and lichens, making it a perfect collecting trap of falling insects and mites from the surrounding tree canopy. Undoubtedly, there is much more to be learned of the species composition, biology and ecology of tarsonemid species present in this rainforest. It is also alarming to think about how much biological information is probably being lost even before it becomes known to the scientific community due to deforestation. For this reason, it is imperative to conduct more surveys to increase the knowledge of the fauna of Tarsonemidae and other mite families in forest canopies around the world.

Acknowledgements

To FAPESP (Fundação de Amparo a Pesquisa do Estado de São Paulo) (Procs. 2011/19890-0 and 2013/08402-0) for its financial support. To Prof. Dr. Anibal R. Oliveira (UESC) for his support during samplings in Bahia State. To Nit Malikul, Debra Creel (SEL-USDA) for their technical support and to Chris Pooley (ECMU-USDA) for his help with the LT-SEM images. To Dr. Gregory Evans (APHIS-USDA), for helpful suggestions and careful review of the manuscript. To the Smithsonian Natural History Museum and National Agricultural Library (NAL-USDA), SEL-USDA for support and assistance with references for this study. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA; USDA is an equal opportunity provider and employer.

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Figures

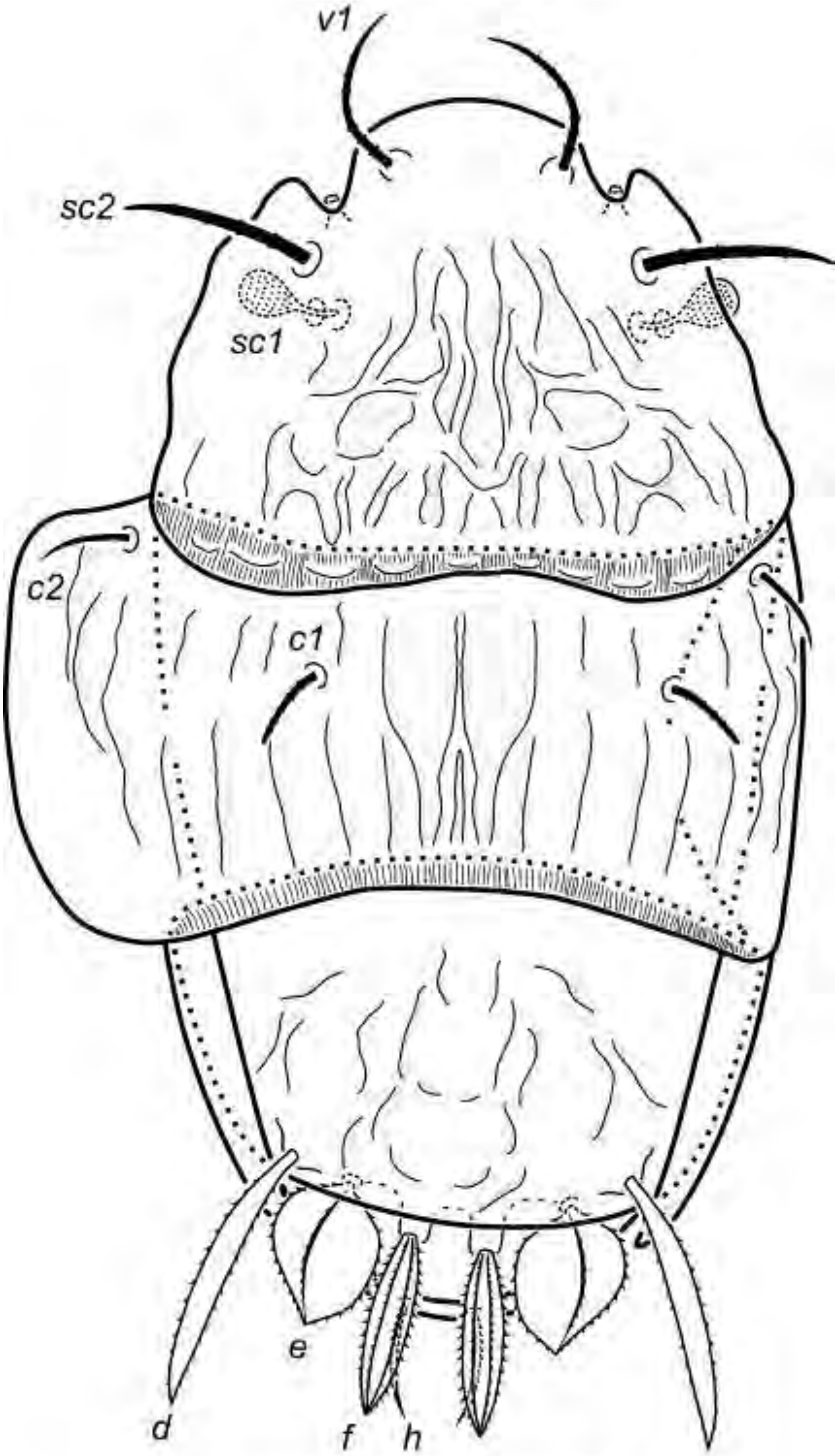

Figure 1. *Daidalotarsonemus oliveirai* sp. n. (female). Dorsal surface.

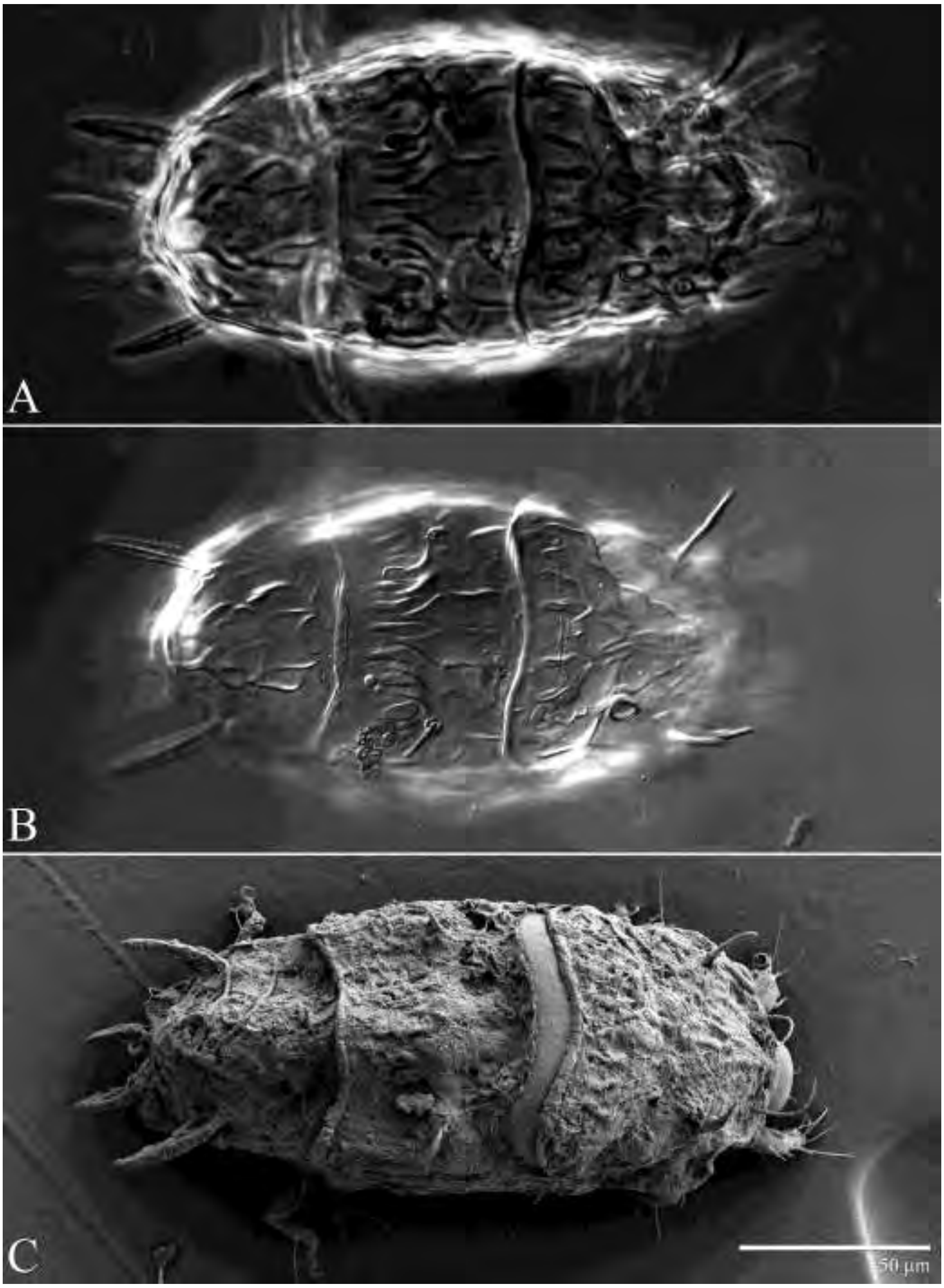

Figure 2. *Daidalotarsonemus oliveirai* sp. n. (female). Dorsal micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

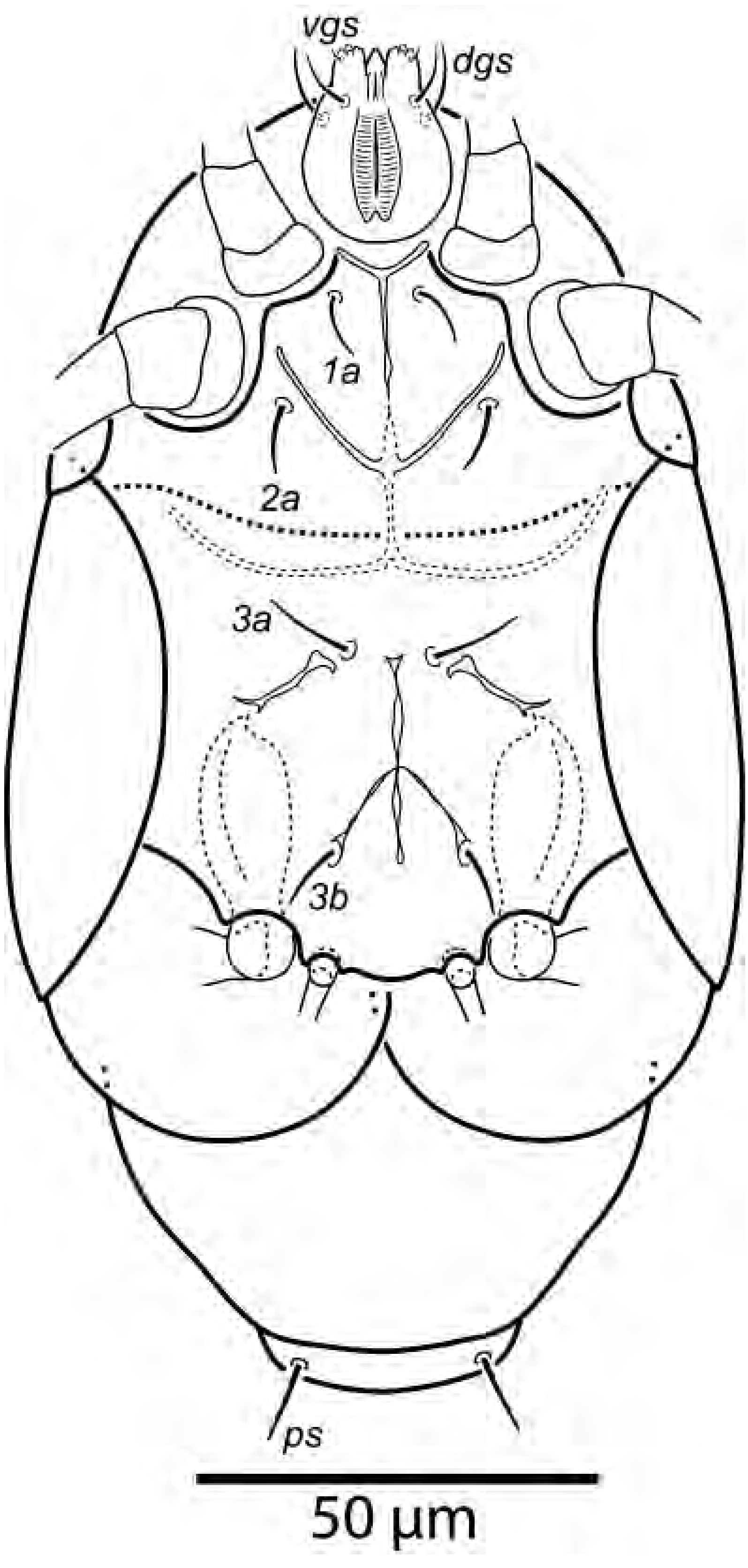

Figure 3. *Daidalotarsonemus oliveirai* sp. n. (female). Ventral surface.

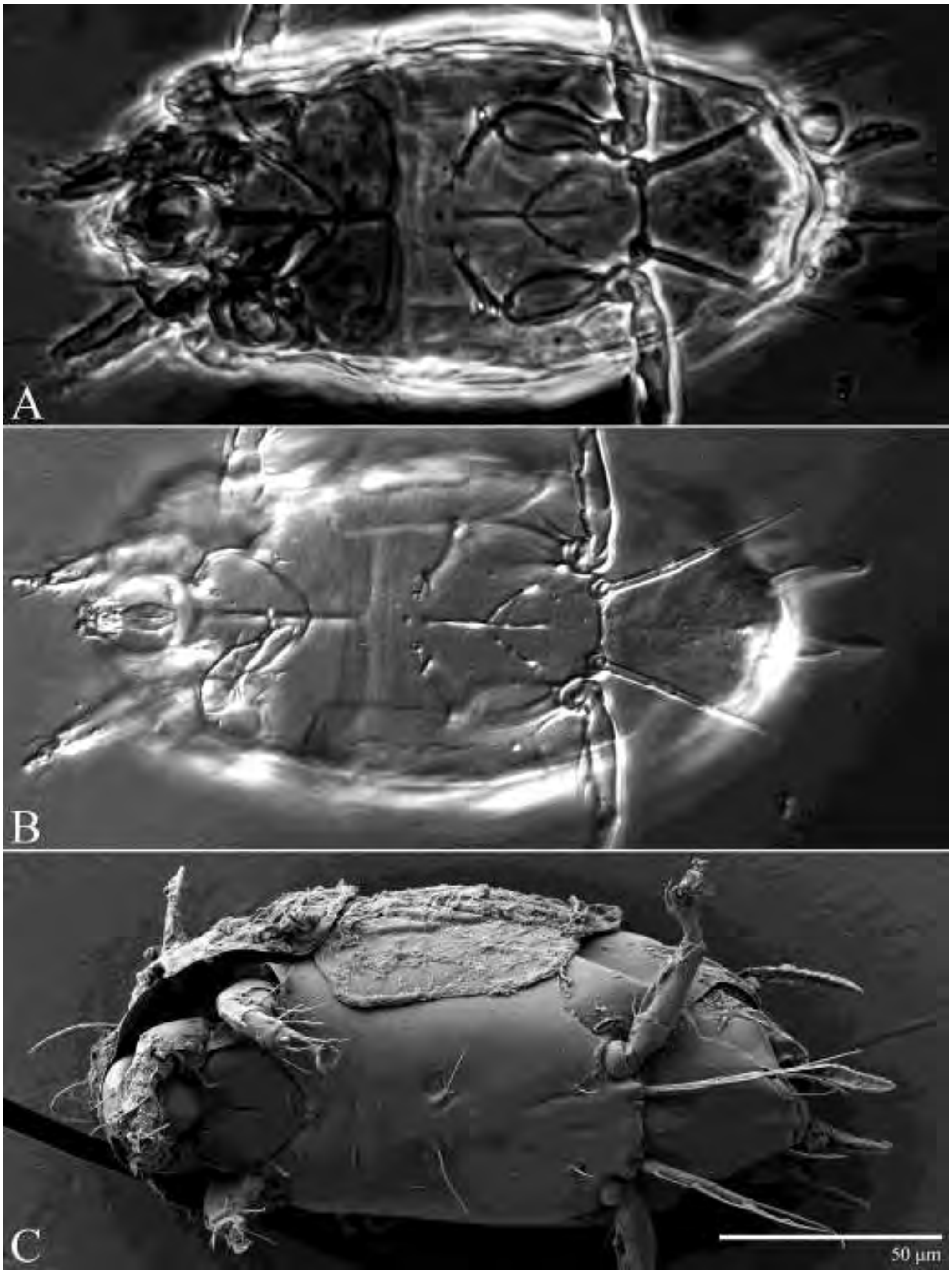

Figure 4. *Daidalotarsonemus oliveirai* sp. n. (female). Ventral micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

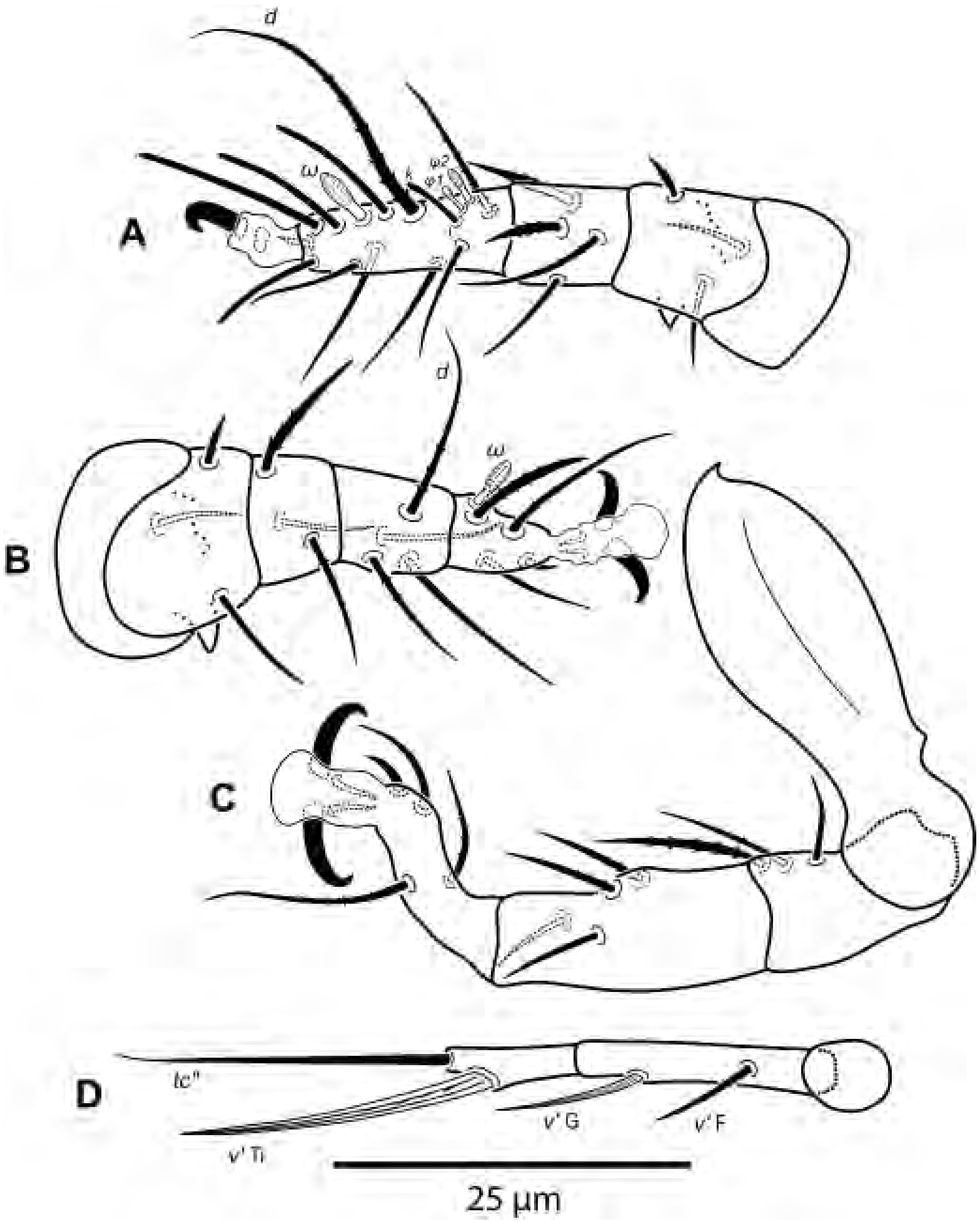

Figure 5. *Daidalotarsonemus oliveirai* sp. n. (female). A, leg I; B, leg II; C, leg III; D, leg IV.

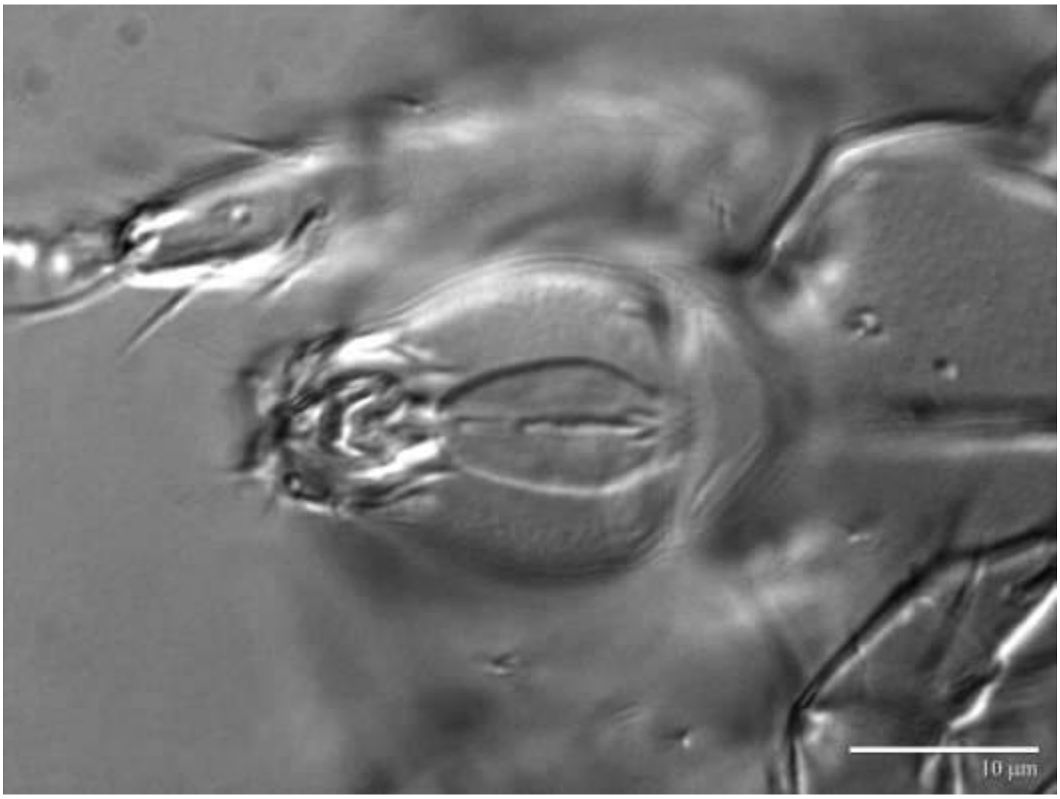

Figure 6. *Daidalotarsonemus oliveirai* sp. n. (female). Detail of the gnathosoma.

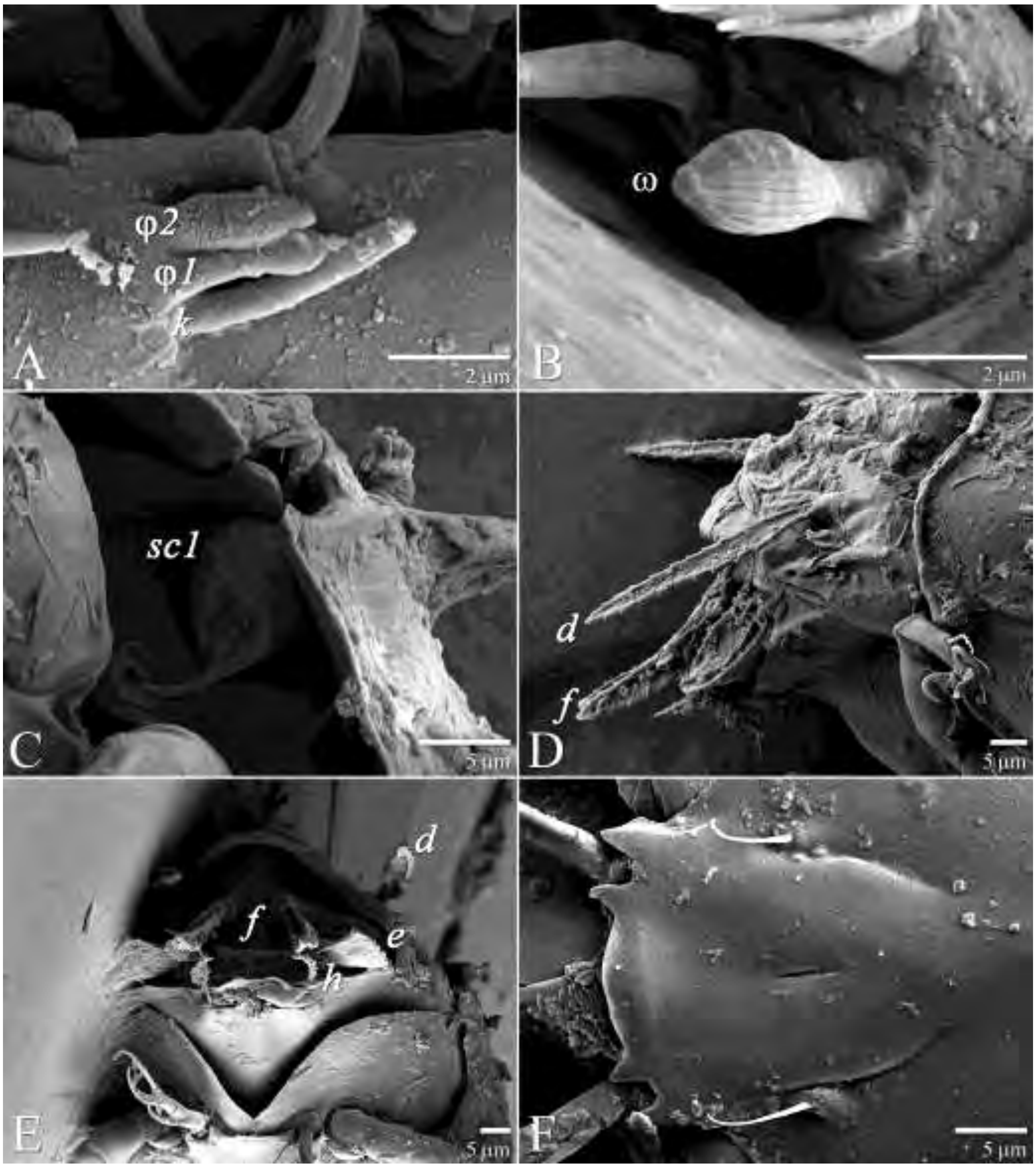

Figure 7. *Daidalotarsonemus oliveirai* sp. n. (female). A, sensorial cluster of tibia I; B, Solenidion *ω* of tarsus II; C, Bothridial seta *sc1*; D, lateral view of the setae *d*, *e* and *f*; E, posterior view of the setae *d*, *e* and *f*; F, detail of the tegula.

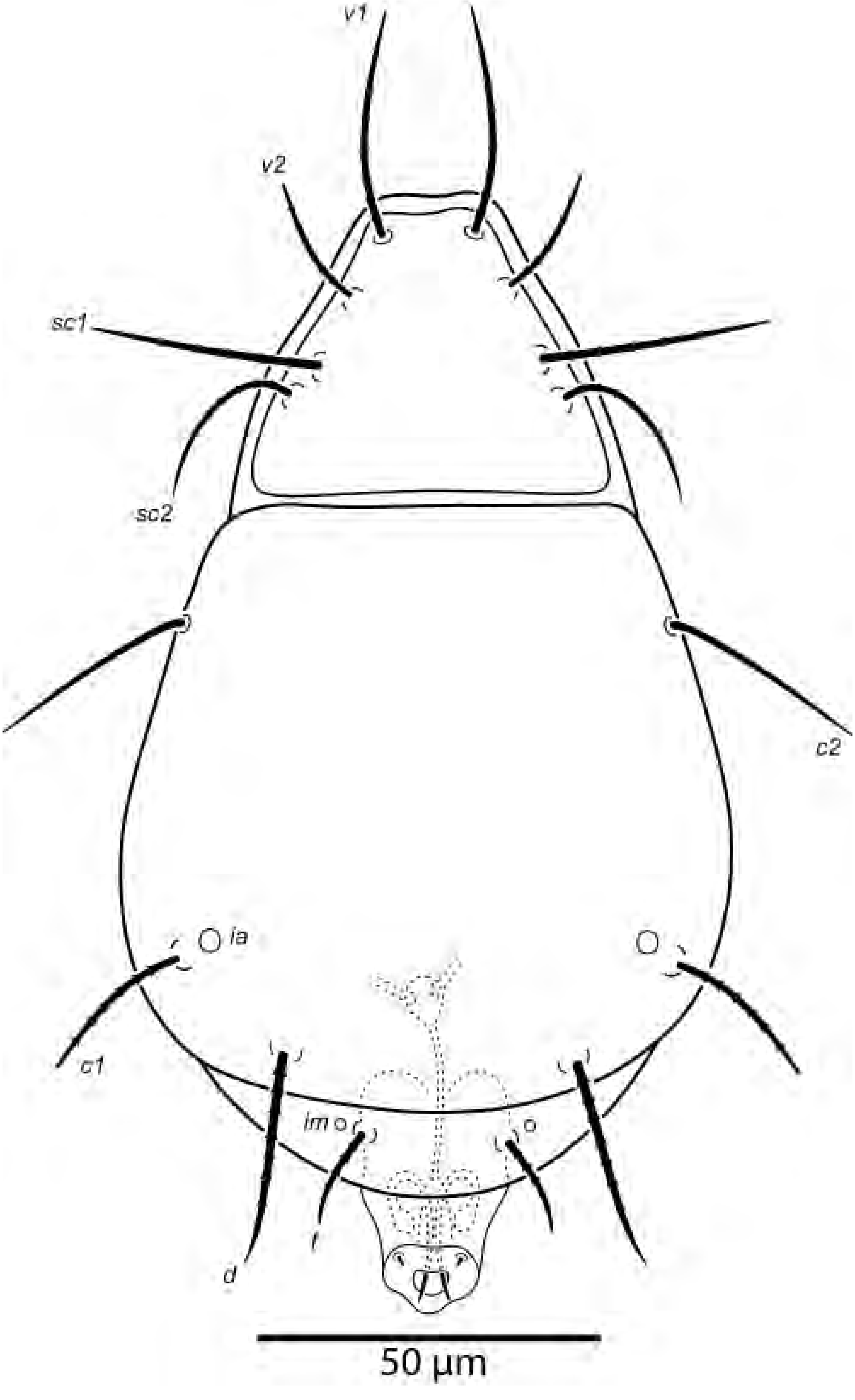

Figure 8. *Daidalotarsonemus oliveirai* sp. n. (male). Dorsal surface.

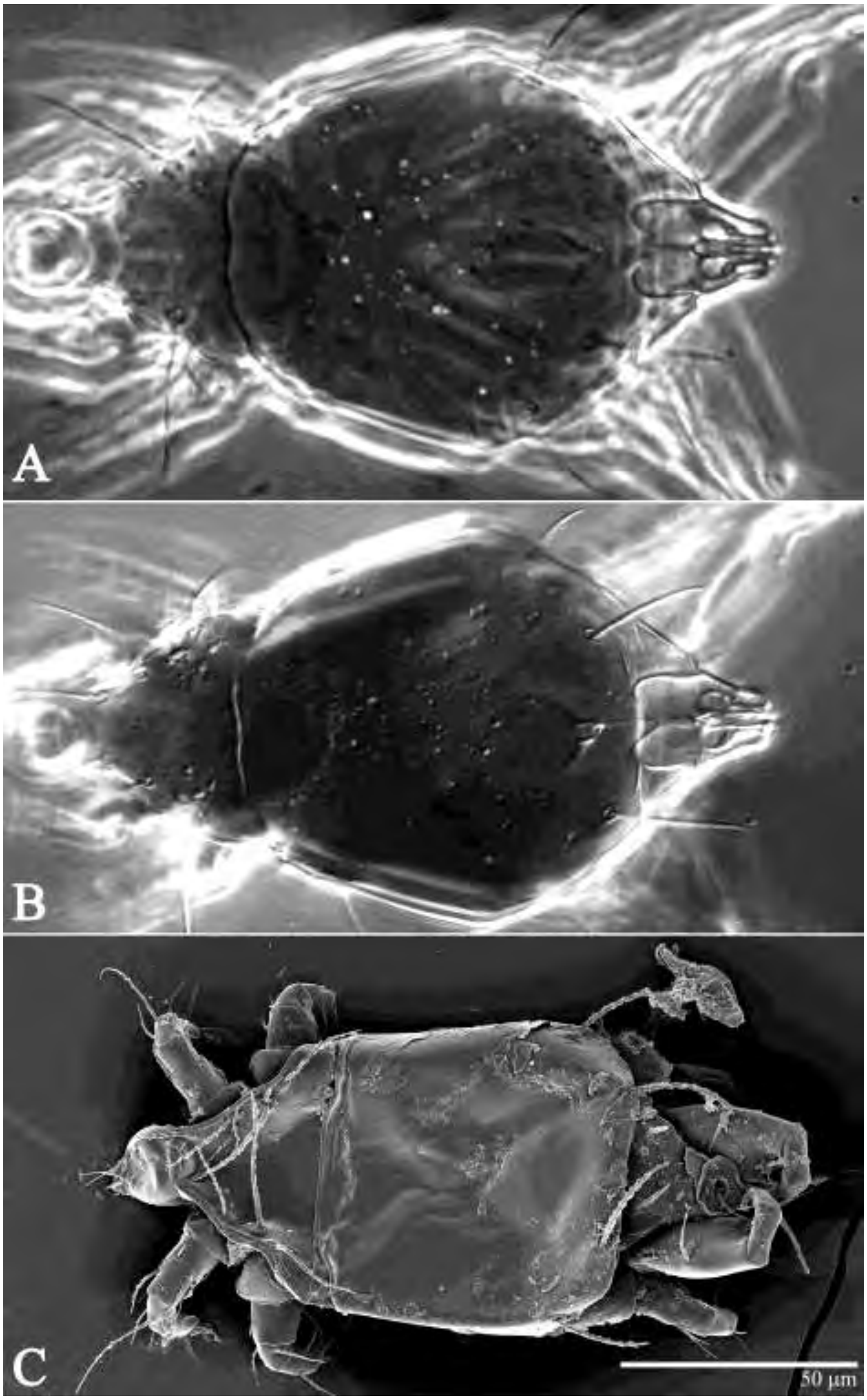

Figure 9. *Daidalotarsonemus oliveirai* sp. n. (male). Dorsal micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

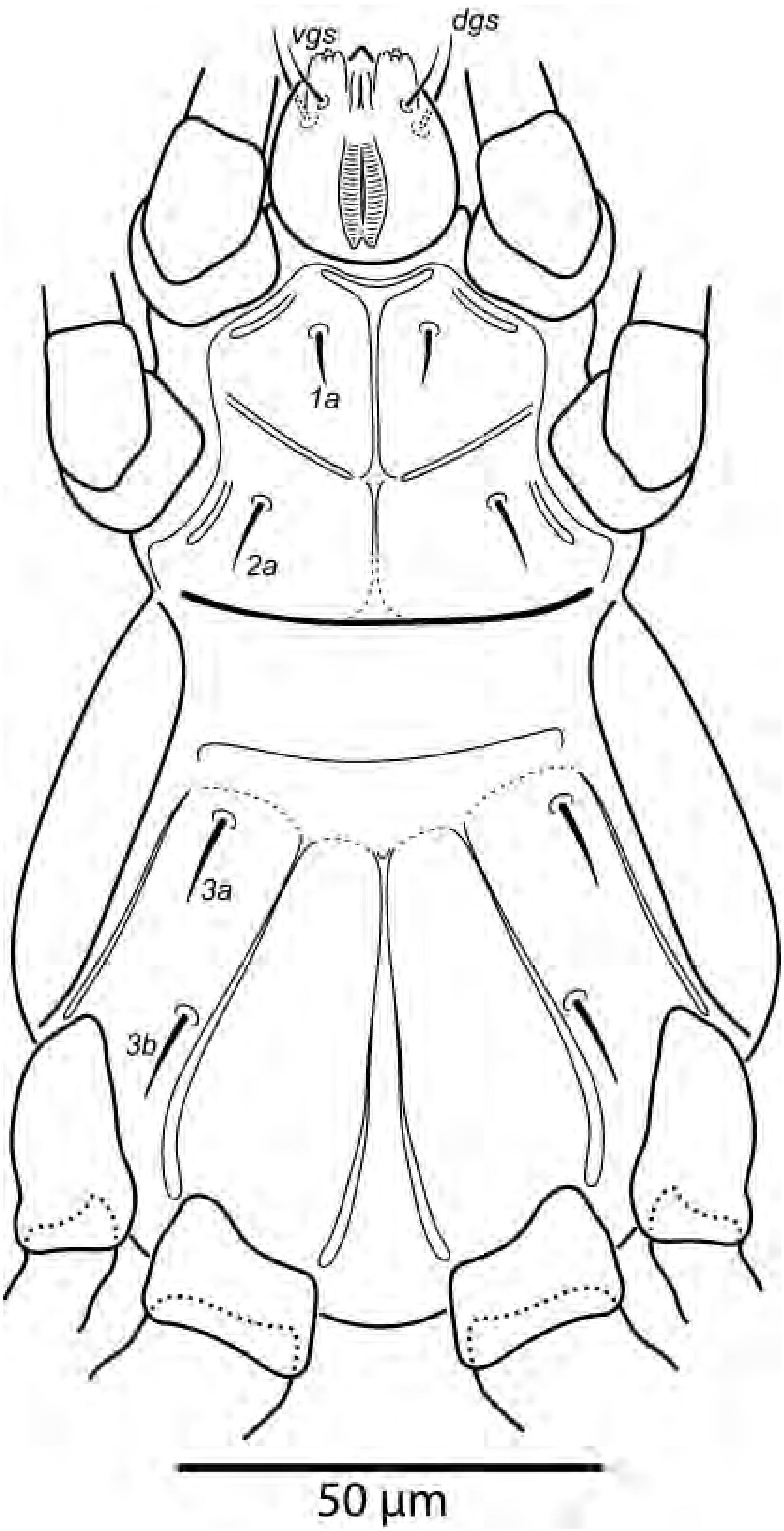

Figure 10. *Daidalotarsonemus oliveirai* sp. n. (male). Ventral surface.

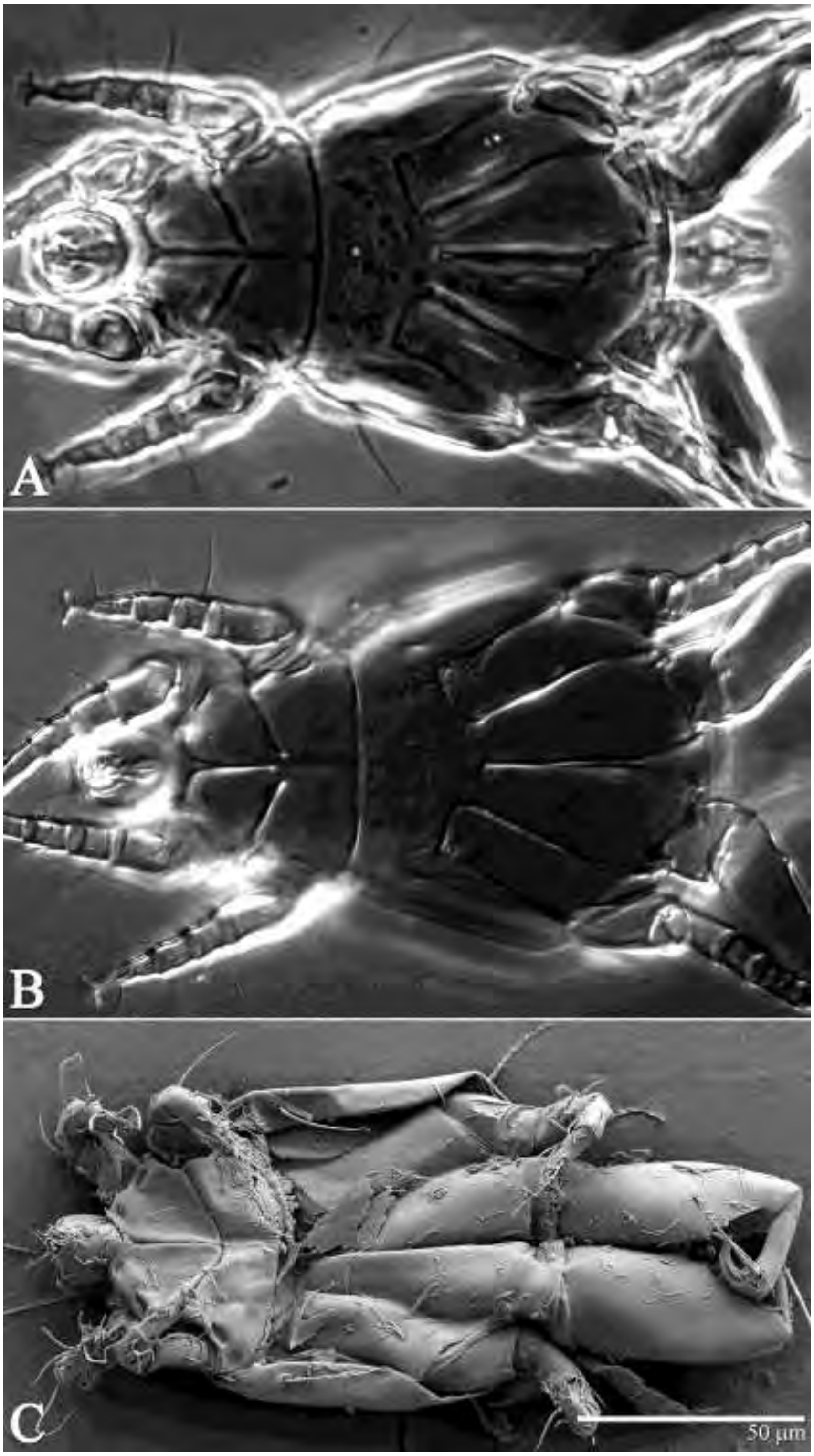

Figure 11. *Daidalotarsonemus oliveirai* sp. n. (female). Ventral micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

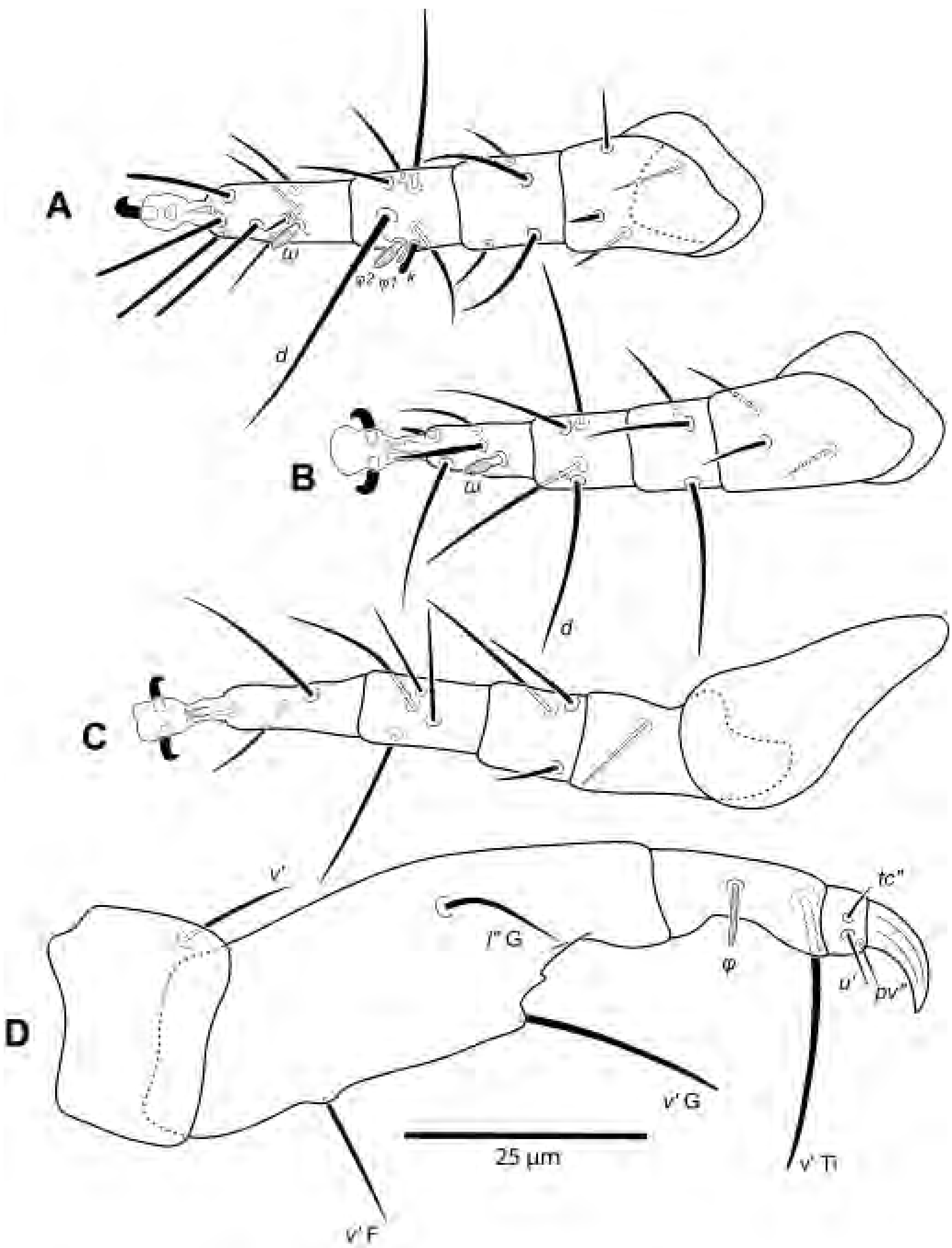

Figure 12. *Daidalotarsonemus oliveirai* sp. n. (male). A, leg I; B, leg II; C, leg III; D, leg IV.

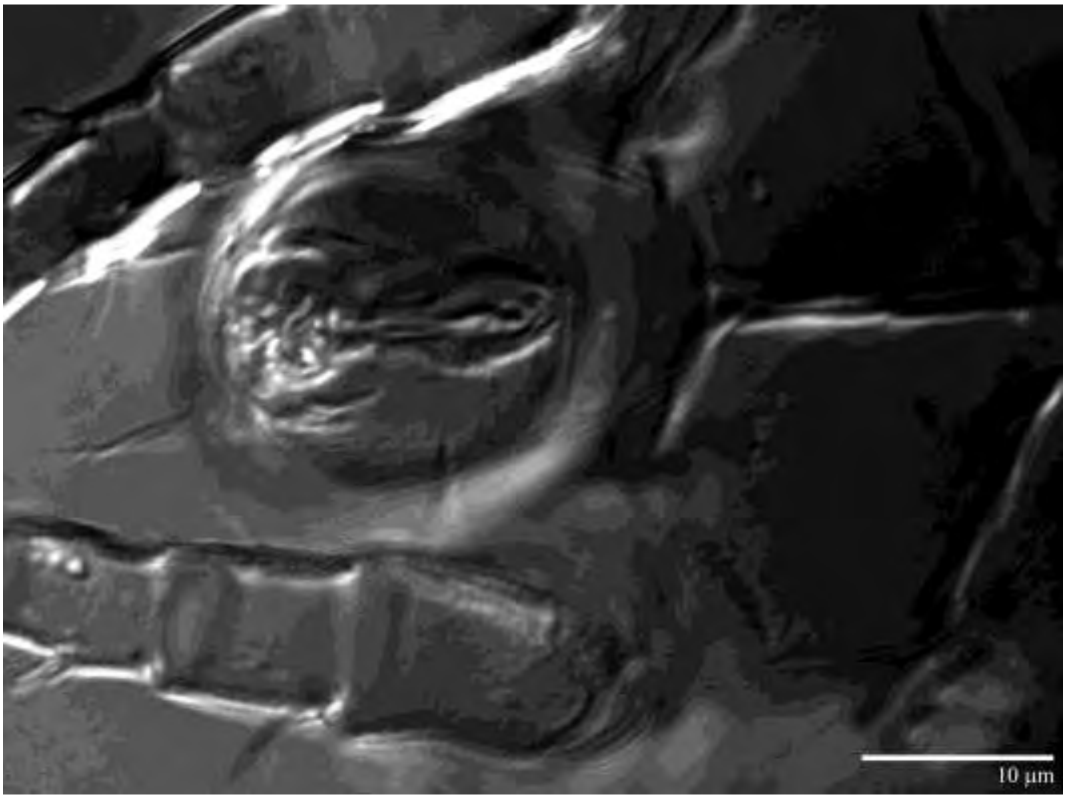

Figure 13. *Daidalotarsonemus oliveirai* sp. n. (male). Detail of the gnathosoma.

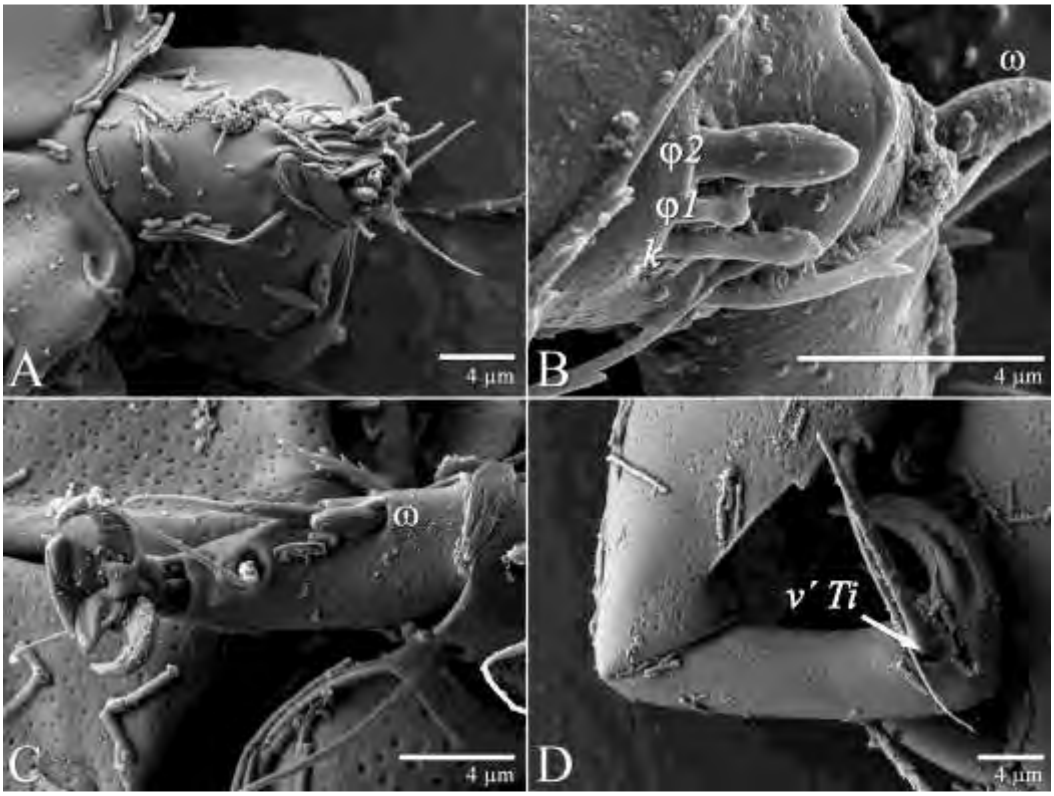

Figure 14. *Daidalotarsonemus oliveirai* sp. n. (male). A, gnatosoma; B, sensorial cluster of tibia I; C, tarsus II; D, part of tibia and tarsus IV.

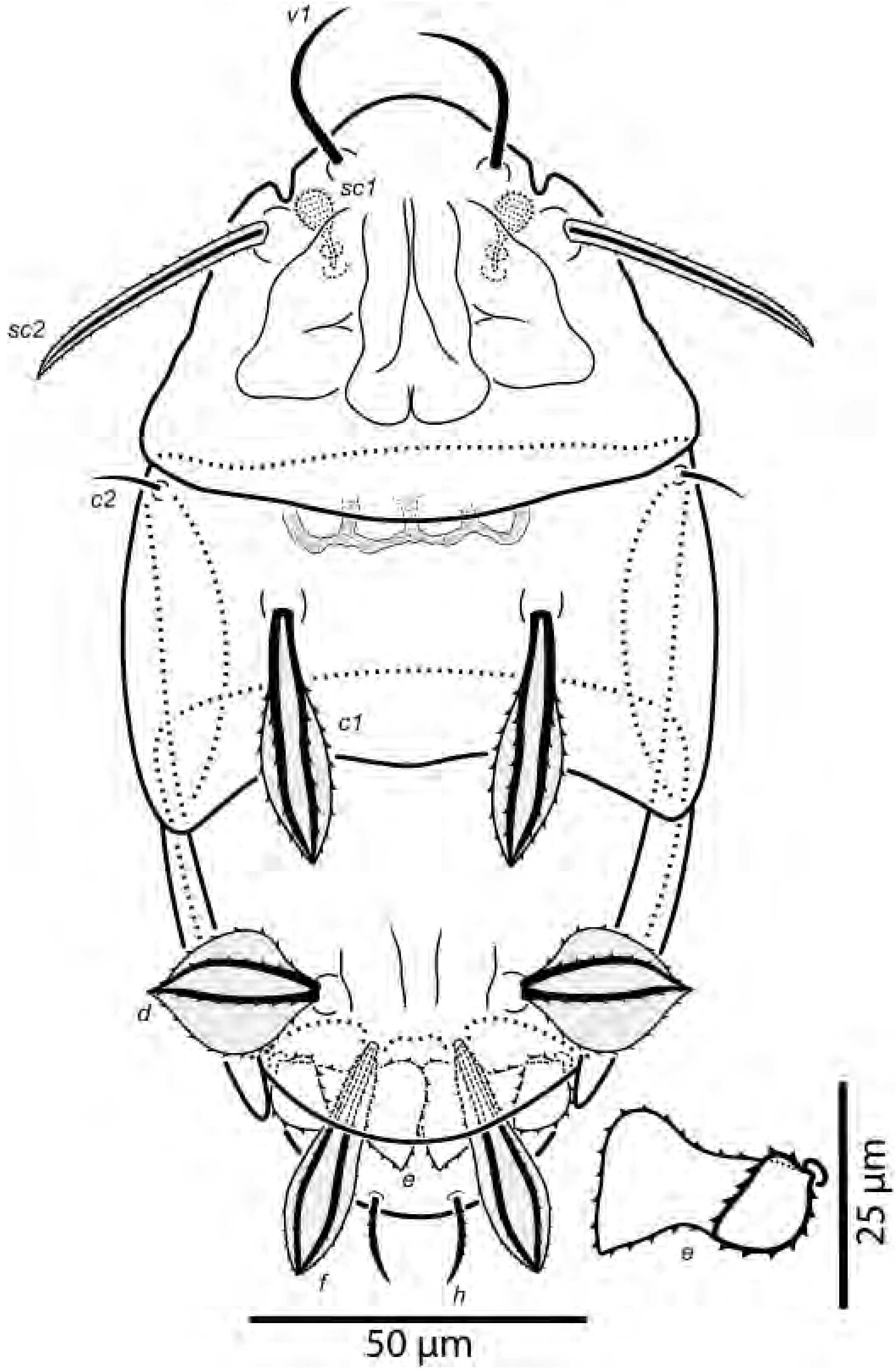

Figure 15. *Excelsotarsonemus caravelis* sp. n. (female). Dorsal surface.

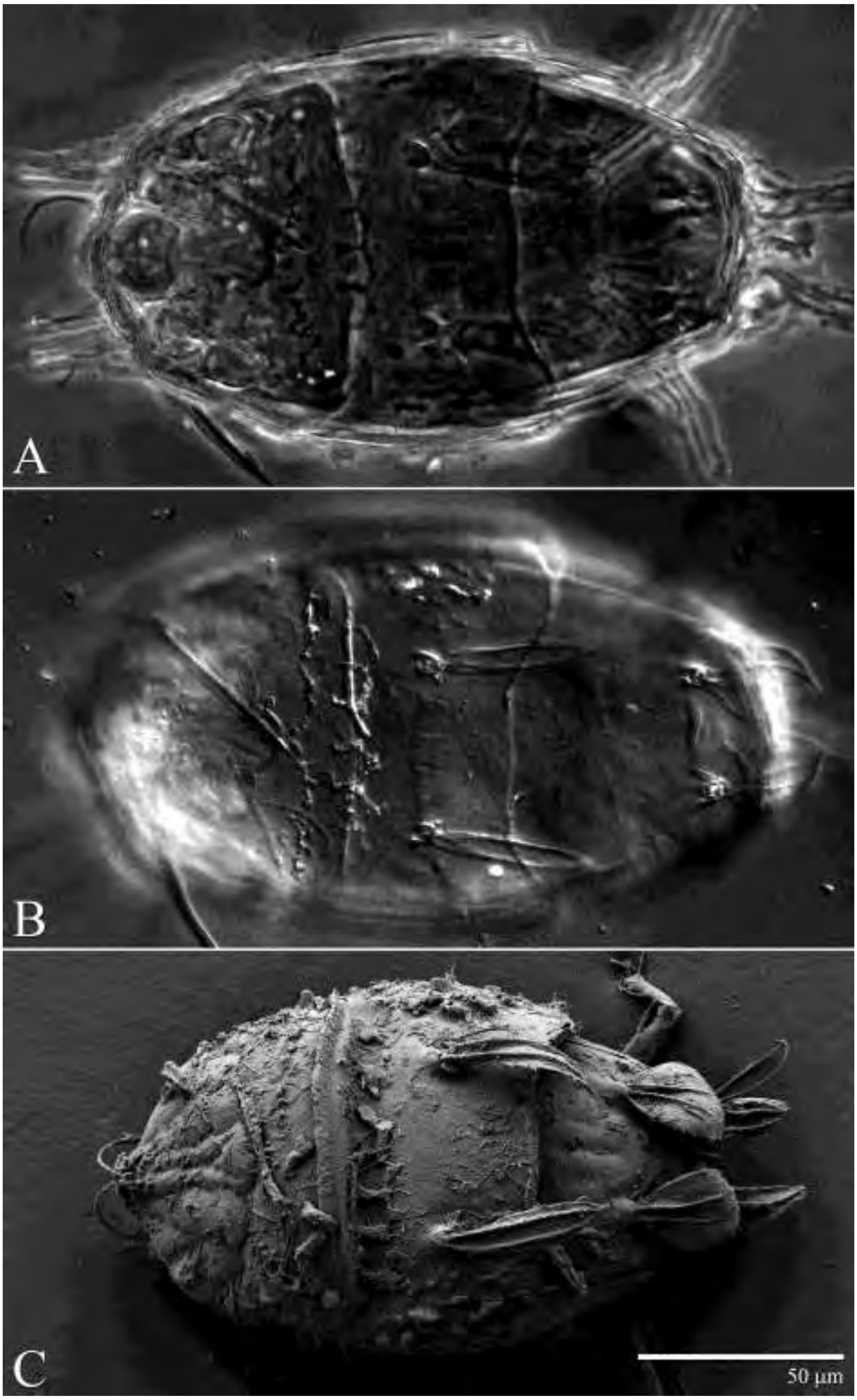

Figure 16. *Excelsotarsonemus caravelis* sp. n. (female). Dorsal micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

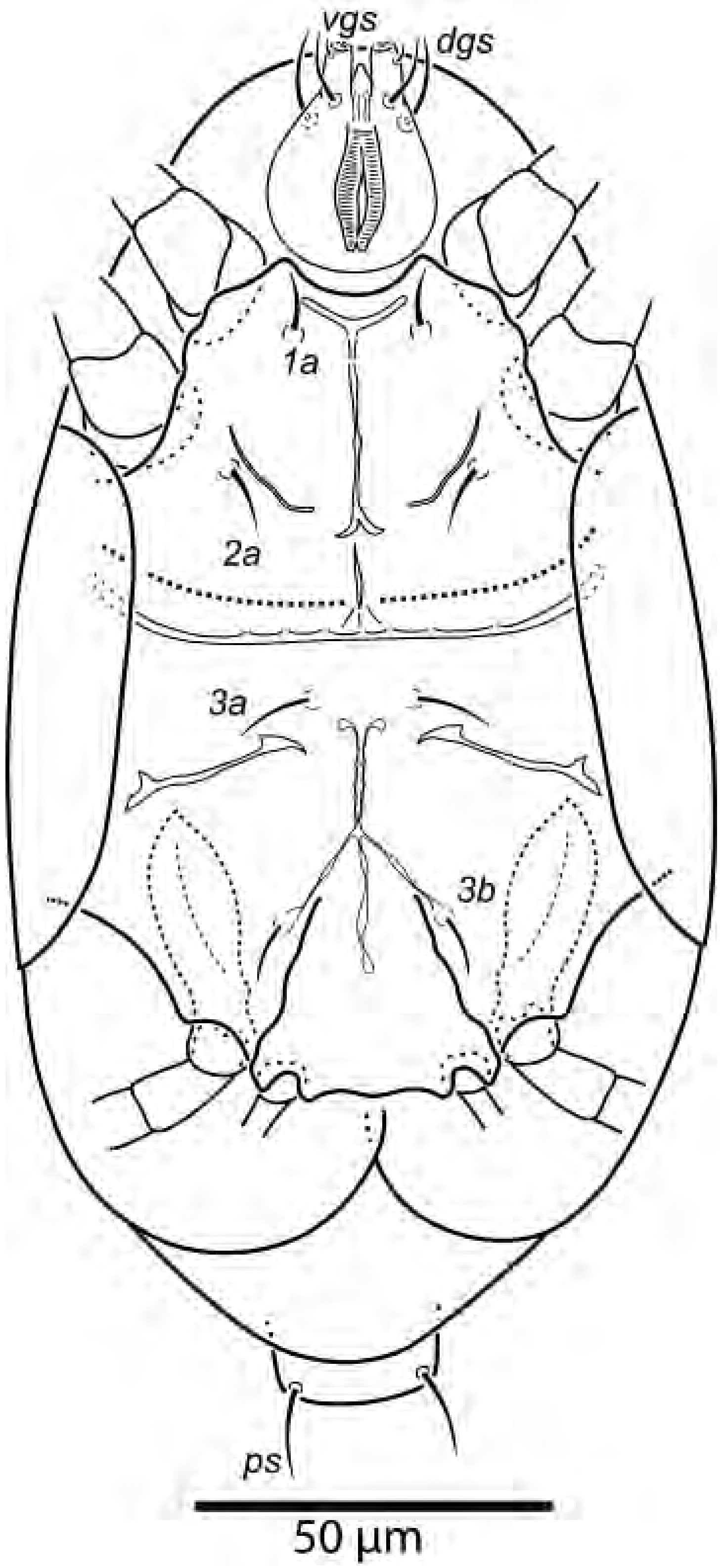

Figure 17. *Excelsotarsonemus caravelis* sp. n. (female). Ventral surface.

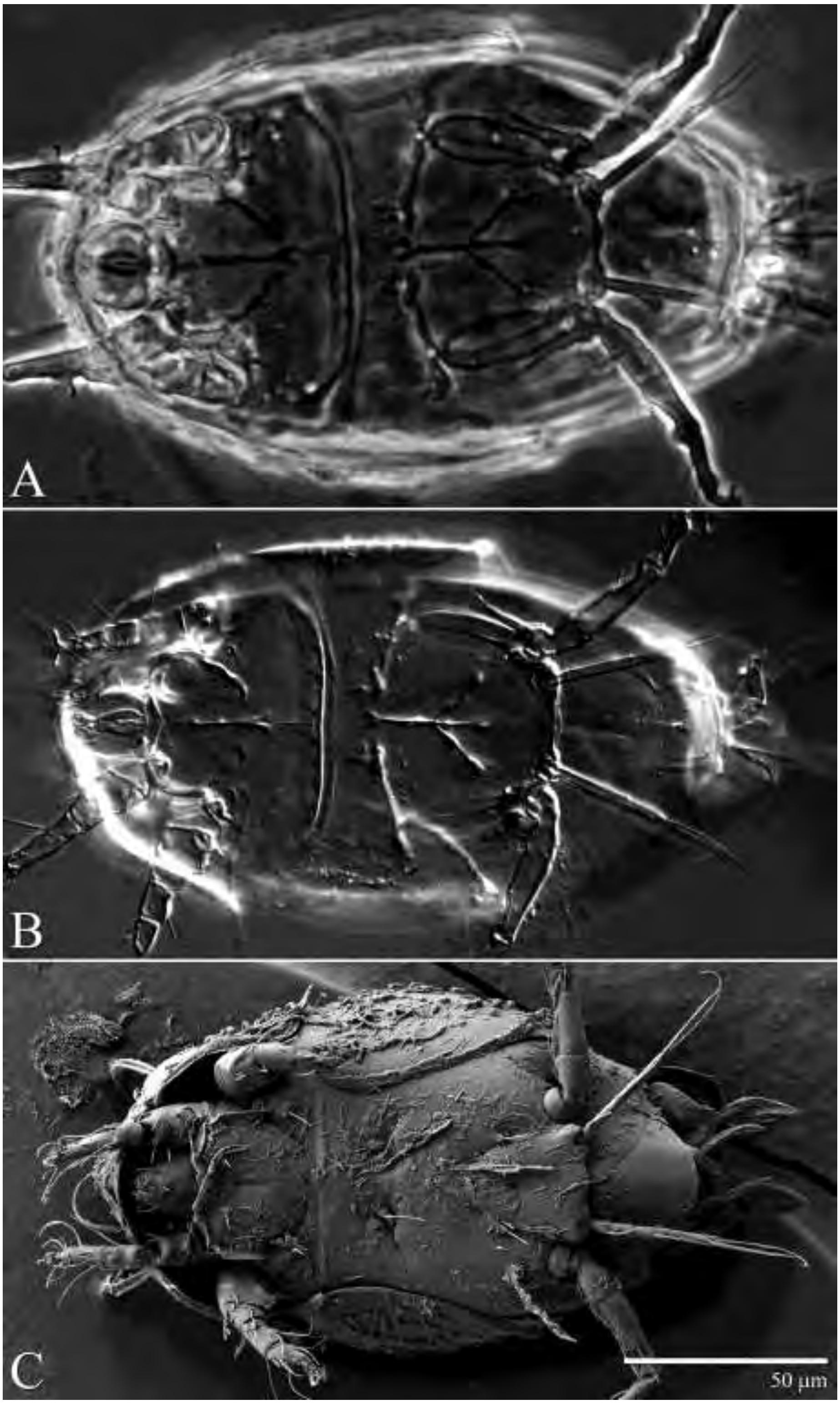

Figure 18. *Excelsotarsonemus caravelis* sp. n. (female). Ventral micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

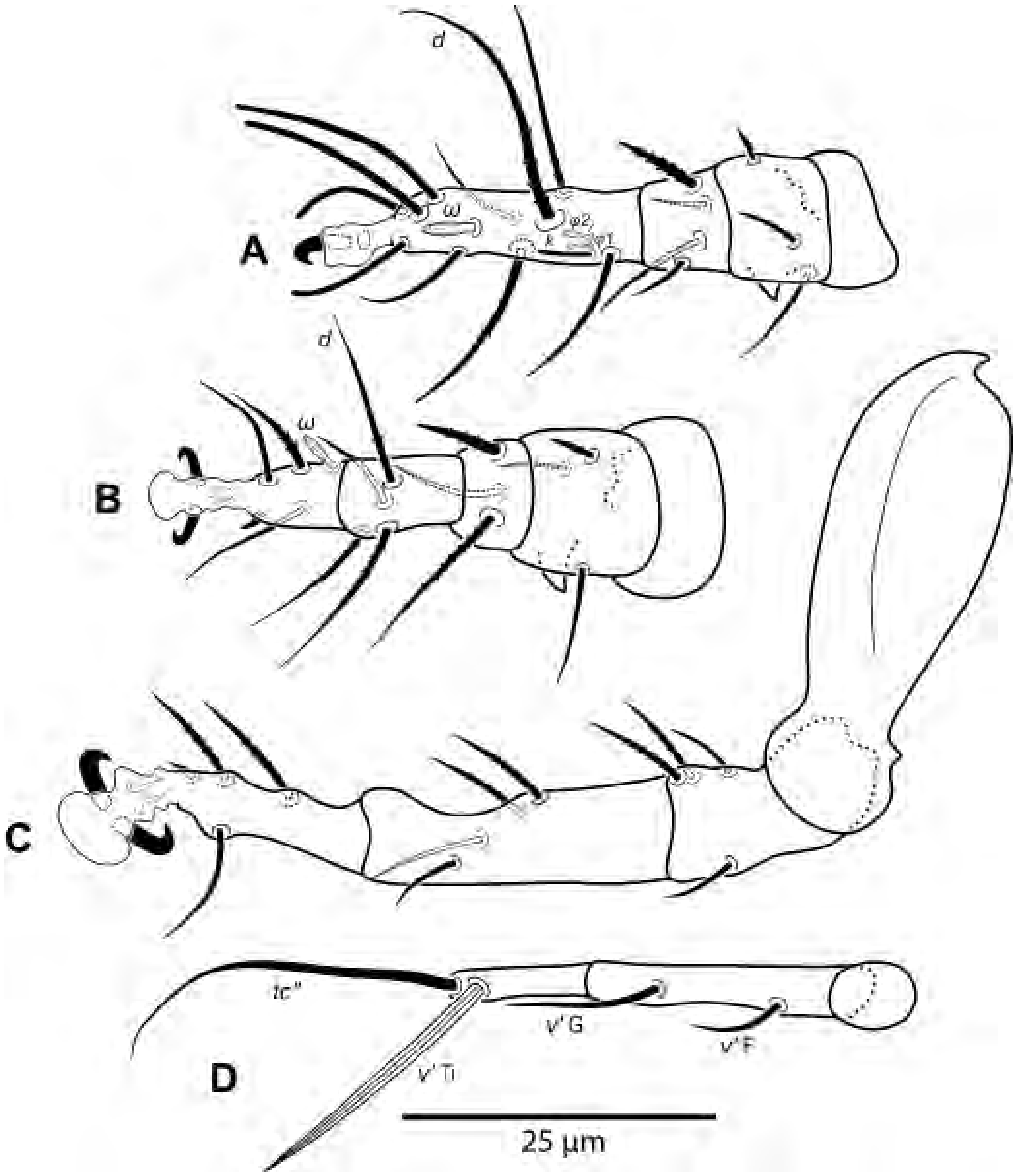

Figure 19. *Excelsotarsonemus caravelis* sp. n. (female). A, leg I; B, leg II; C, leg III; D, leg IV.

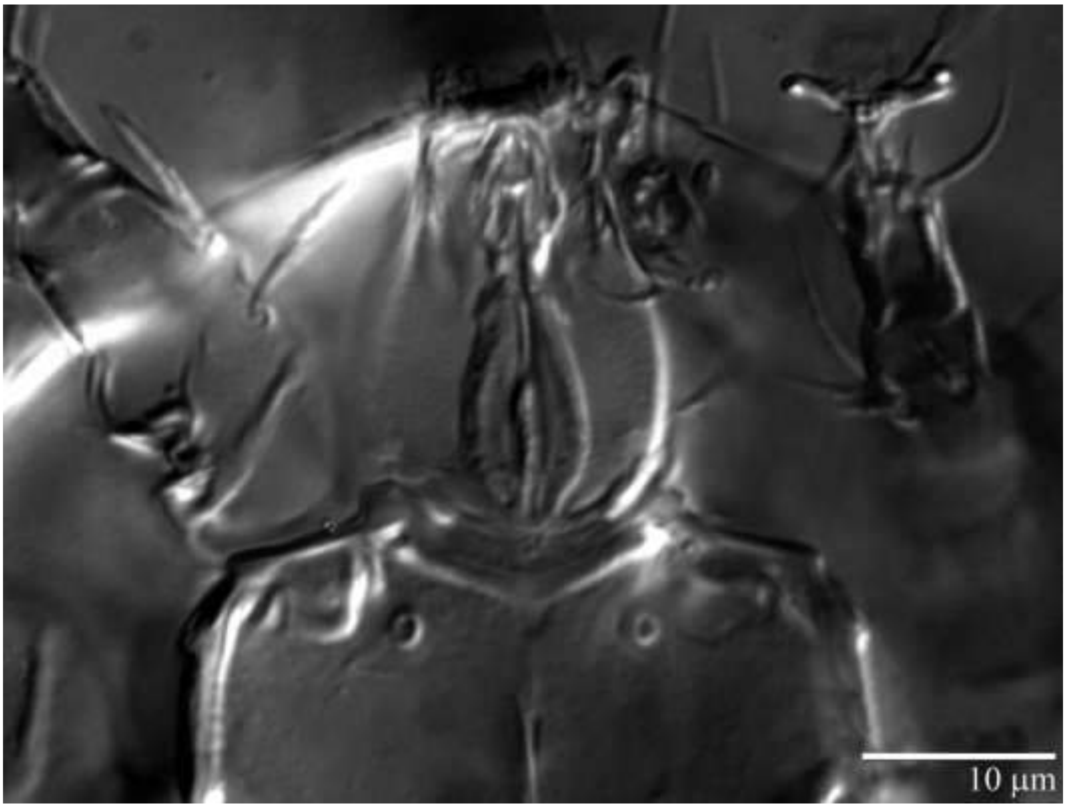

Figure 20. *Excelsotarsonemus caravelis* sp. n. (female). Detail of the gnathosoma.

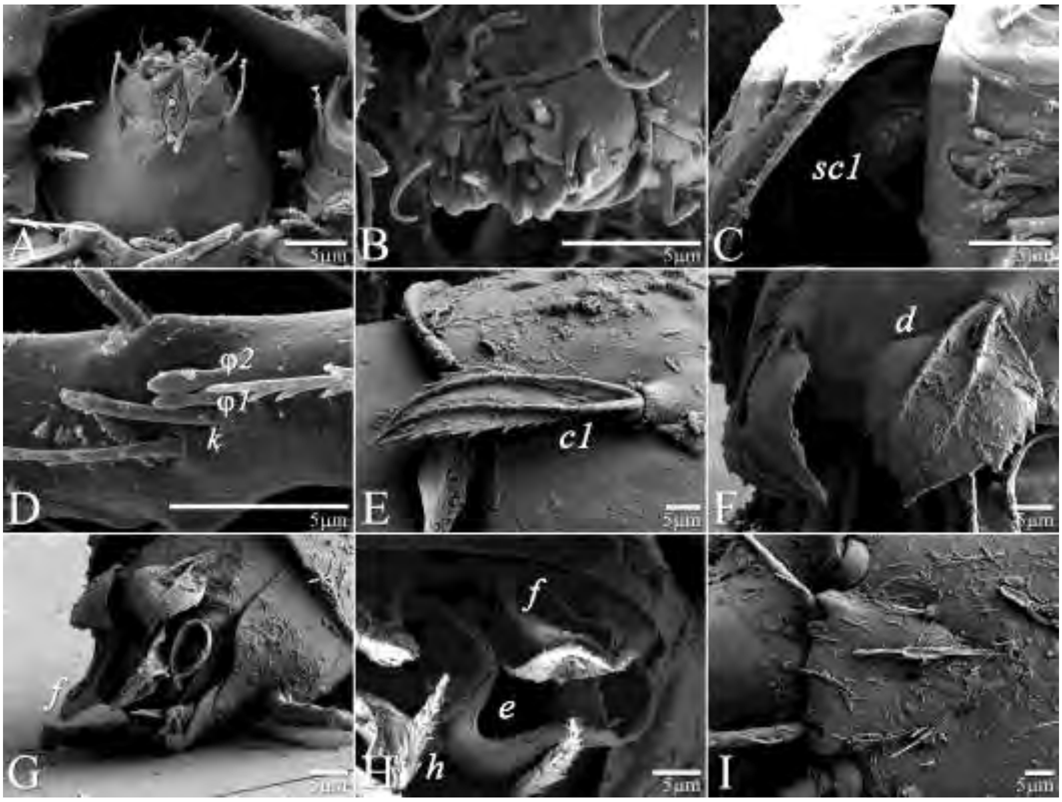

Figure 21. *Excelsotarsonemus caravelis* sp. n. (female). A, gnatosoma; B, detail of the palps; C, Bothridial seta *sc1*; D, sensorial cluster of tibia I; E, seta *c1*; F, seta *d*; G, tergites D, EF, H and posterior setae; H, setae *e*, *f* and *h*; I, tegula.

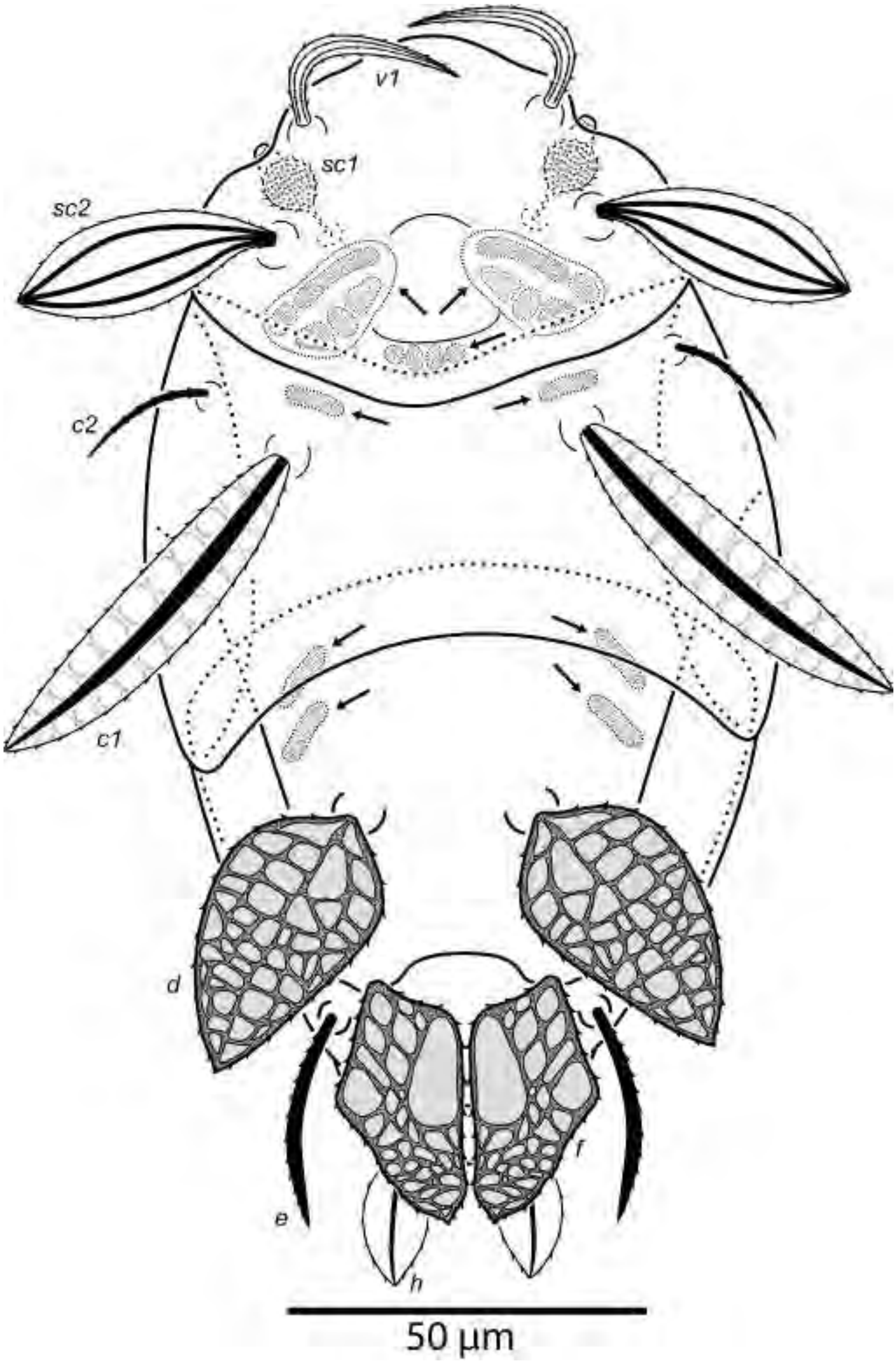

Figure 22. *Excelsotarsonemus tupi* sp. n. (female). Dorsal surface (arrows indicate muscle attachments present over the body).

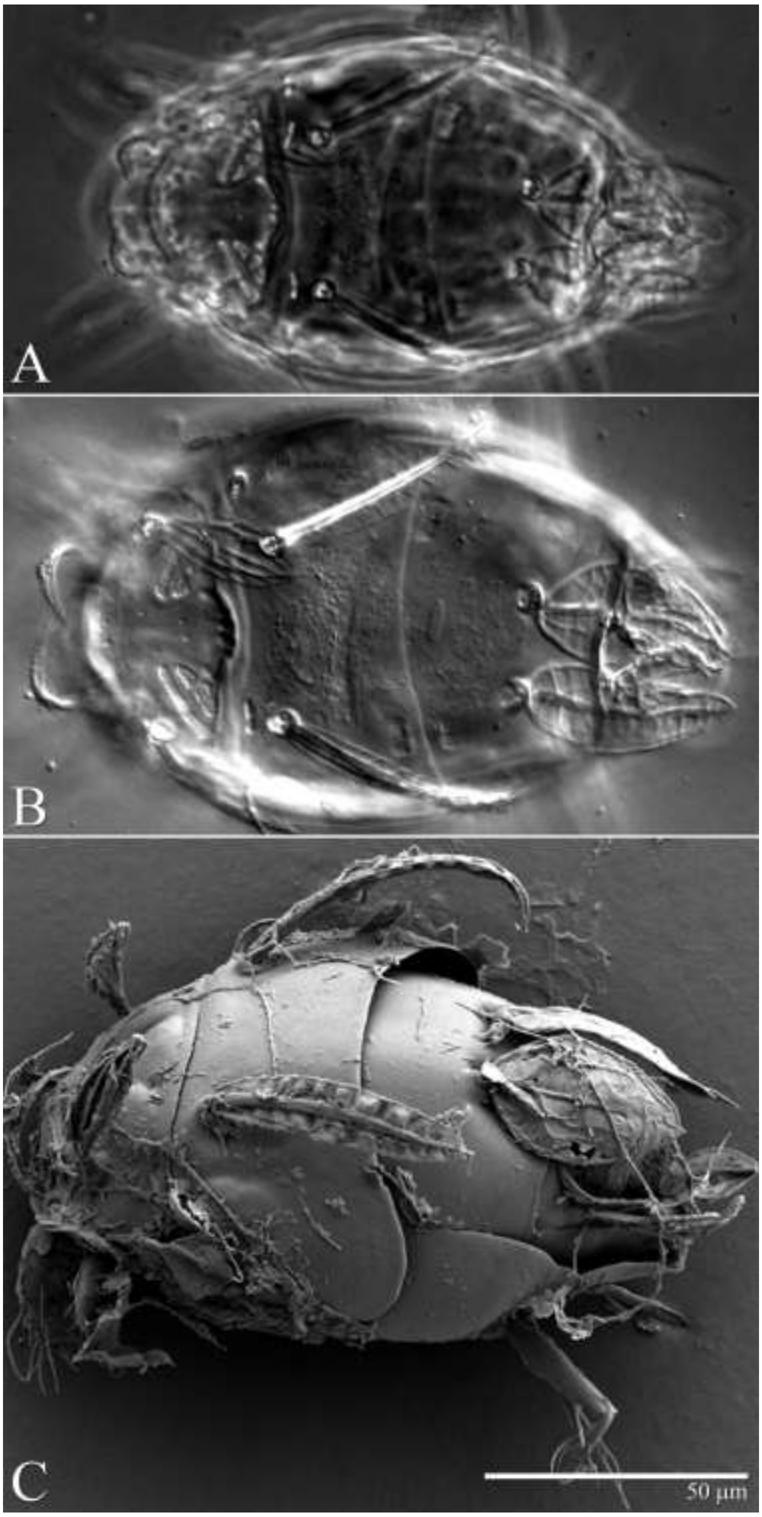

Figure 23. *Excelsotarsonemus tupi* sp. n. (female). Dorsal micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

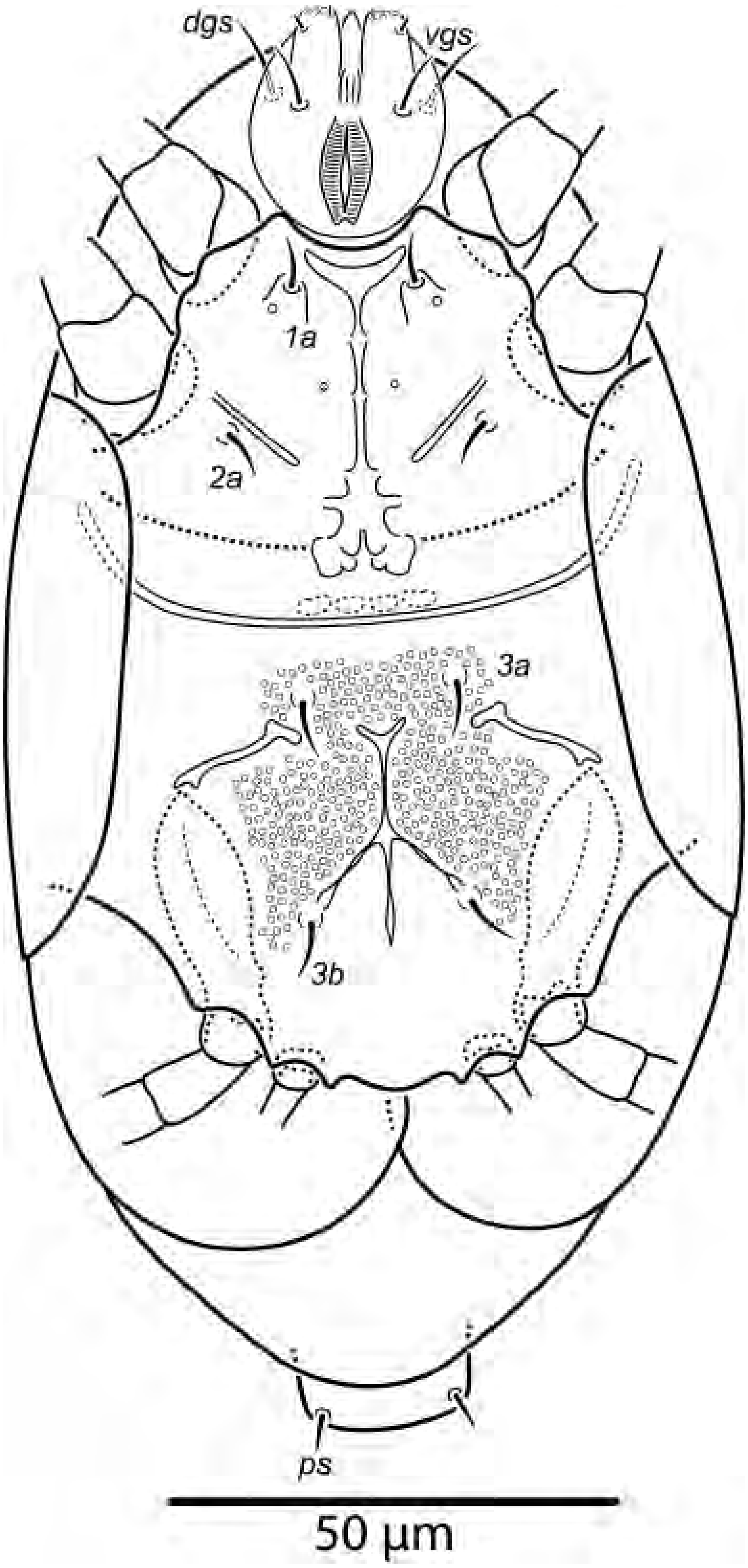

Figure 24. *Excelsotarsonemus tupi* sp. n. (female). Ventral surface.

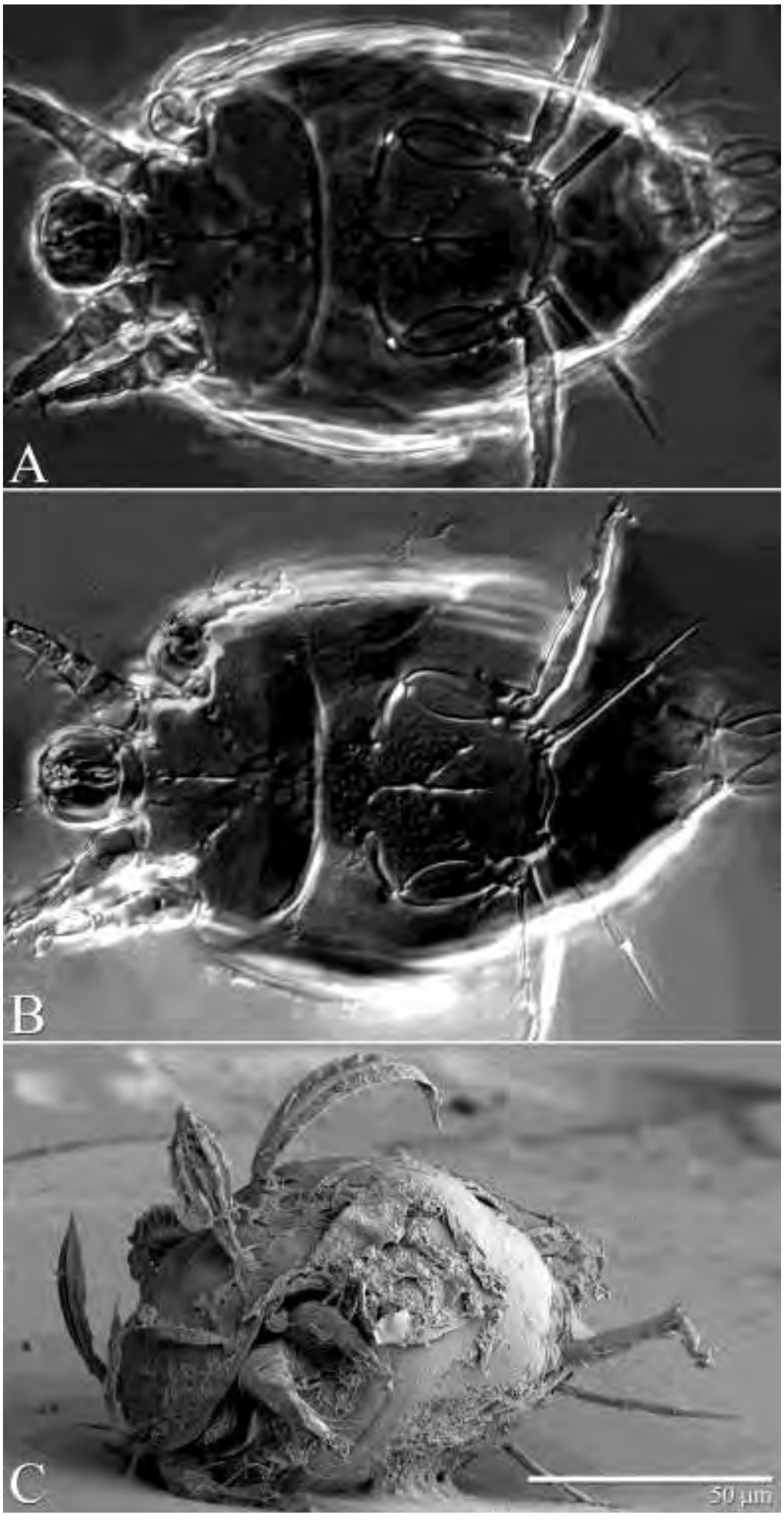

Figure 25. *Excelsotarsonemus tupi* sp. n. (female). Ventral micrographs. A, phase contrast; B, differential interference contrast; C, low temperature scanning electron microscopy.

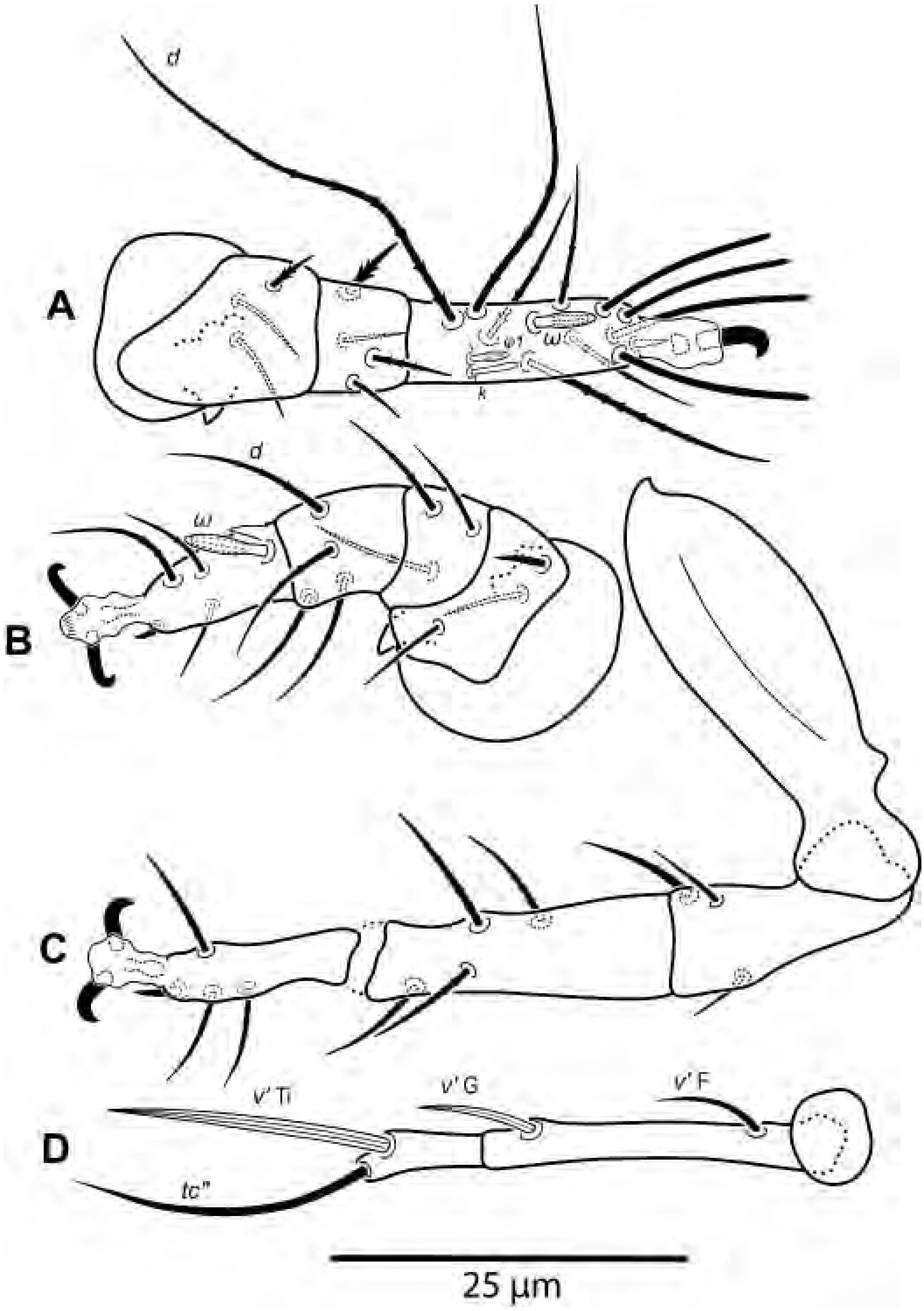

Figure 26. *Excelsotarsonemus tupi* sp. n. (female). A, leg I; B, leg II; C, leg III; D, leg IV.

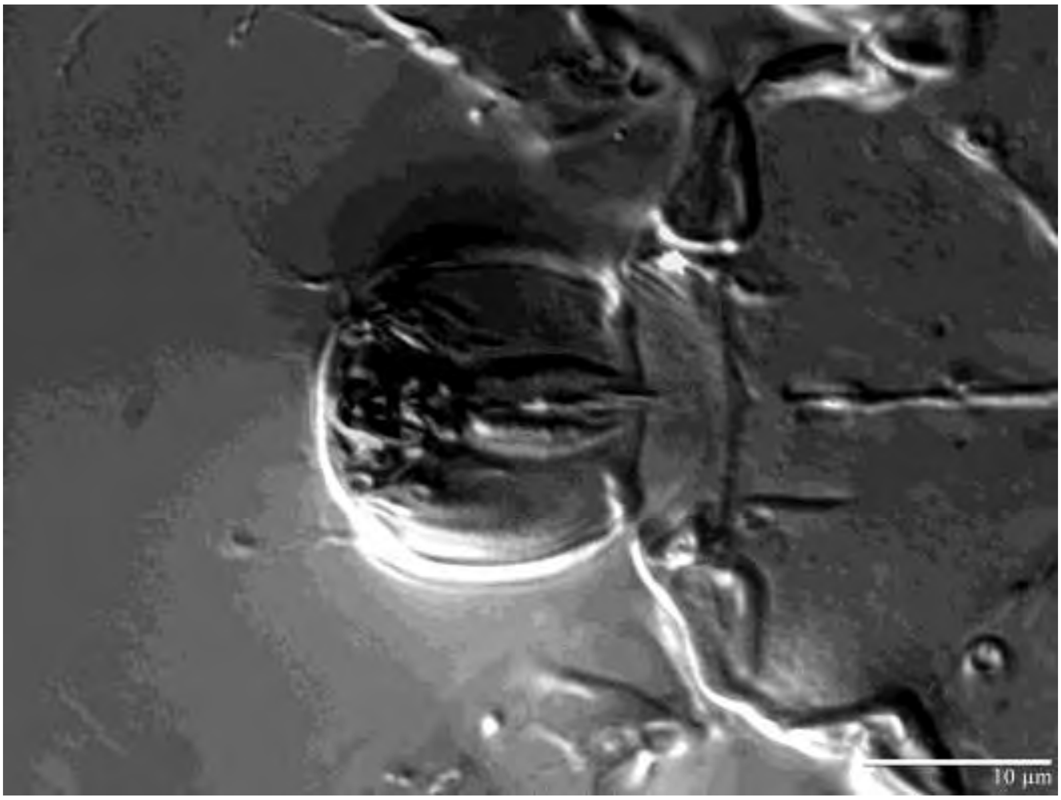

Figure 27. *Excelsotarsonemus tupi* sp. n. (female). Detail of the gnathosoma.

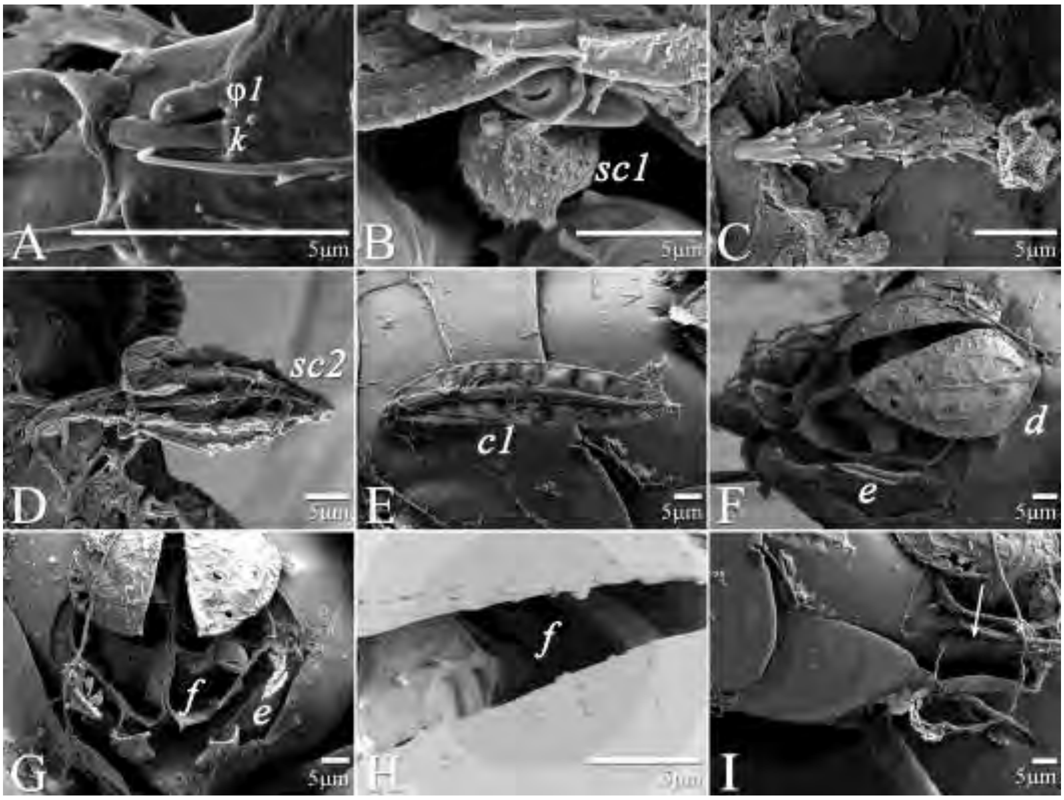

Figure 28. *Excelsotarsonemus tupi* sp. n. (female). A, sensorial cluster of tibia I; B, Bothridial seta *sc1* and stigma opening; C, seta *v1*; D, seta *sc2*; E, seta *c1*; F, lateral view of the setae *d*, *e*, *f* and *h*; G, posterior view of the setae *d*, *e*, *f* and *h*; H, insertion of seta *f*; I, posterior view of tergites EF and H (which is indicated by an arrow).

CHAPTER 2

TEN NEW SPECIES OF *DAIDALOTARSONEMUS* (PROSTIGMATA: TARSONEMIDAE) FROM COSTA RICA

Manuscript published in the periodic International Journal of Acarology on August 19, 2015

Authors: José M. Rezende, Ronald Ochoa and Antonio C. Lofego

Abstract

Ten new tarsonemid species of the genus *Daidalotarsonemus* found on native plants in Costa Rica are described herein: *Daidalotarsonemus alas* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus azofeifai* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus bauchani* sp. n. Rezende, Ochoa & Lofego; *Daidalotarsonemus cuadradus* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus ginae* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus lini* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus marini* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus maryae* sp. n. Ochoa, Rezende & Lofego; *Daidalotarsonemus puntarenensis* sp. n. Rezende, Ochoa & Lofego; and *Daidalotarsonemus serratus* sp. n. Rezende, Ochoa & Lofego. Measurements, a diagnosis for all the new species and a key to the species known to occur in Costa Rica are provided. The findings related in this article emphasize the importance of conducting mite surveys in rainforests around the world, to better understand the mite diversity which inhabits these biomes.

Keywords

Acari, Heterostigmata, La Selva Biological Station, rainforest, taxonomy

Introduction

Currently, the genus *Daidalotarsonemus* De Leon (1956) consists of 27 described species (Lin and Zhang 2002; Lofego et al. 2005; Sousa et al. 2014; Rezende et al. 2015). It is considered to be a plant-inhabiting taxon, apparently with a preference for hosts located in humid places with an abundance of algae, lichen and fungi on them, e.g. rain forests (Lindquist 1986). Three species of this genus, *Daidalotarsonemus deleoni* (Smiley), *D. limonensis* Ochoa and *D. ternifoliae* Ochoa, have been described from Central America, all from Costa Rica (Ochoa et al. 1991, 1994).

The Arthropods of La Selva (ALAS) Project began as an effort to discover and better understand the arthropod fauna from the La Selva Biological Station, a protected area encompassing a lowland tropical rain forest in north- eastern Costa Rica. The project began in 1991 and continues to attract taxonomic collaborators, who have visited the Station to train ALAS staff to recognize, prepare and identify specimens collected in the survey. Through this project, a considerable number of new arthropod taxa have been identified, including new mite species. This article describes ten new *Daidalotarsonemus* species collected in Costa Rica by the ALAS Project and compares them with all other species of *Daidalotarsonemus*.

Material and Methods

Individuals collected throughout the La Selva Biological Station and few specimens from other provinces of Costa Rica were studied and described. The Station is located in the Caribbean lowland at the northern base of the Braulio Carrillo National Park, 10°26′N 84°1′W, Heredia Province, Costa Rica. It comprises about 1600 ha of tropical wet forests and undisturbed lands. ALAS staff used canopy fogging technique for collecting plant- inhabiting mites. They prepared the specimens on slides and entered the specimen data in a relational database designed for the project.

Daidalotarsonemus individuals were analysed by two techniques: phase-contrast (PC) microscopy and differential interference contrast (DIC) microscopy. The terminology used herein mainly follows Lindquist (1986), except for gnathosomal setae *dgs* and *vgs* (Suski 1967a; Magowski et al. 1998). For each structure, the mean measurements are provided in micrometres (μm), followed in parentheses by the range of the specimens measured (when available), including the holotype. The specimens were examined, drawn and photographed using a Zeiss Axioplan microscope (DIC). For the diagnoses, comparisons with previously described species were based on the study of the holotypes, except for the following species: *Daidalotarsonemus cornutus* Lin, Chen & Zhang (1998), *D. duolamella* Lin, Chen & Zhang (1998), *D. euonymus* Yang, Ding & Zhou (1987)and *D. serissae* Yang, Ding & Zhou (1987), for which the comparisons were based on literature descriptions and illustrations.

The following abbreviations are used for institutions where the types were deposited: Canadian National Collection of Insects, Arachnids and Nematodes (CNC), Ottawa, Ontario, Canada; Department of Zoology and Botany (DZSJRP), São Paulo State University, São José do Rio Preto, São Paulo, Brazil; Department of Life Sciences, The Natural History Museum (TNHM), London, United Kingdom; Faculty of Agronomy (CIPROC), Costa Rica University, San Jose, Costa Rica; Florida State Collection of Arthropods (FSCA), Gainesville, Florida, USA; Institute of Plant Protection, Fujian Academy of Agricultural Sciences (FAAS), Pudan, Fuzhou, Fujian, China; National Museum of Costa Rica (NMCR), Department of Natural History, San Jose, Costa Rica; Queensland Museum (QM), South Brisbane, Queensland, Australia and United States National Museum of Natural History (USNM), Smithsonian Institution, National Insect and Mite Collection located at the USDA, SEL, Beltsville, Maryland, USA. The holotypes are deposited at NMCR, Departamento de Historia Natural, San José, Costa Rica; due to the recent reorganization of the INBio collections (Wade 2014).

Results

Key to the species of *Daidalotarsonemus* from Costa Rica (based only on females)

1a. Insertion of the setae *c1* near border of tergite D (Figs. 36 and 40); tegula rounded apically (Figs. 37 and 41); one pair of fissures overlapping apodemes IV (Figs. 37 and 41)......………………………………….…....**2**

1b. Insertion of the setae *c1* not as above (e.g. Figs. 1, 5, and 12); tegula truncated (e.g. Figs. 2, 6 and 13); no pairs of fissures overlapping apodemes IV………………..……………..…………….…..…………….**3**

2a. Setae *f* elongated (± 34 µm) with no visible central vein; four rows of reticula covering tergite C (Fig. 36)……………………………...………...… …………………………………..***Daidalotarsonemus puntarenensis*** **sp. n.**

2b. Setae *f* shorter (± 18 µm), leaf-shaped and with visible central vein; just one row of reticula completely formed on the tergite C (Fig. 40)……………………………….....…***Daidalotarsonemus serratus*** **sp. n.**

3a. No rows of reticula on the tergite C (e.g. Figs. 1 and 28)…..…………..**4**

3b. At least one row of reticula on the tergite C (e.g. Figs. 5, 20, 24 and 32)……………………………………………………………………………**6**

4a. Setae *c1* setiform (Fig. 1); prosternal apodeme conspicuous to the junction to sejugal apodeme (Fig. 2)…………..…………….…………………..***Daidalotarsonemus alas*** **sp. n.**

4b. Setae *c1* oblanceolate (Fig. 28); prosternal apodeme inconspicuous to the junction to sejugal apodeme (Fig. 29)……………………………………**5**

5a. Setae *sc2* setiform; setae *e* wider (± 12 µm) (Fig. 28)…………………… ……………………………………..…..***Daidalotarsonemus marini*** **sp. n.**

5b. Setae *sc2* oblanceolate; setae *e* narrow (± 4 µm)……………………….. …...…***Daidalotarsonemus limonensis*** **Ochoa**

6a. Setae *e* narrow (at most 3 µm) (Figs. 12 and 24)…………......……….**7**

6b. Setae *e* wider (at least 8 µm) (e. g. Figs. 5, 20 and 32)………………..**8**

7a. Setae *c1* short (± 15 µm); setae *tc"* on tarsus II lanceolate (Figs. 12 and 14)…………………………........***Daidalotarsonemus bauchani*** **sp. n.**

7b. Setae *c1* long (± 30 µm); setae *tc"* on tarsus II setiform (Figs. 24 and 26)..……………....……………...………...***Daidalotarsonemus lini*** **sp. n.**

8a. Setae *e* asymetric and wider (± 25 µm) (Fig. 16)………………………… ..……………………………………..***Daidalotarsonemus cuadradus*** **sp. n.**

8b. Setae *e* symmetric and narrow (± 13 µm) (e.g. Figs. 5, 20 and 32)......**9**

9a. Setae *c1* long (± 45 µm); setae *sc2* long (± 55 µm) (Fig. 20)……………
………………………………………..……***Daidalotarsonemus ginae* sp. n.**
9b. Setae *c1* short (± 15 µm); setae *sc2* short (± 35 µm) (Figs. 5 and 32)…
……………………………………………………………………………...**10**
10a. Setae *d* narrow (± 3 µm); setae *c1* short (± 8 µm) (Fig. 5)……
……………….………………………….***Daidalotarsonemus azofeifai* sp. n.**
10b. Setae *d* wider (± 10 µm); setae *c1* long (± 18 µm) (Fig. 32)……………
…………………………………………...***Daidalotarsonemus maryae* sp. n.**

***Daidalotarsonemus alas* sp. n. Ochoa, Rezende & Lofego**
(Figs. 1–4)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus seitus* Attiah (1970) for the shape of the ornamentation on the prodorsal shield and tergite C; the distinct prominent tubercle-shaped insertion of the setae *f*; and the length of the setae *sc2*. They differ by the shape of ornamentation of prodorsal shield and tergite D; the tubercle-shaped insertion of setae *c1* and *c2* present in the new species; the presence of one central serrate vein on the setae *e* (not two as in *D. seitus*); and by the length of *d* and *f* dorsal setae, which are around 20-30% longer in *D. seitus*.

Adult female (seven specimens measured).

Gnathosoma: subtriangular in ventral view; length 30 (29–32), maximum width 26 (25–28). Setae *dgs* 12 (11–13) and *vgs* 9 smooth; palps moderately long 9 (9–10). Pharynx fusiform, 18 (18–19) long and 7 wide at maximum width.

Idiosoma – dorsum (Figs. 1 and 4): length 209 (206–213), width at level of *c1* 123 (118–127); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with waved and continuous ridges. Tergite D with irregular reticulation. Lengths of setae: *v1* 25 (24–27), *sc1* 15 (14–17), *sc2* 29 (27–31), *c1* 13 (12–16), *c2* 12 (11–14), *d* 37 (35–38), *e* 18 (17–

20), *f* 33 (31–35) and *h* 14 (12–16). Maximum width of expanded setae: *d* 5, *e* 14 (13–5) and *f* 4. All dorsal setae serrate; except *sc2* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* setiform; *sc2* falcate; *d* and *f* linear elongated with two veins; *e* elliptical with one central serrate vein. All inserted on tubercles; except for *sc1*, *e* and *h*. Distances between dorsal setae: *v1–v1* 30 (28–32), *sc2–sc2* 52 (51–53), *v1–sc2* 26 (25–28), *c1–c1* 56 (55–58), *c2–c2* 108 (105–114), *c1–c2* 39 (37–41), *d–d* 46 (45–48), *f–f* 11 (10–13), *e–f* 11 (10–13) and *h–h* 20 (20–21). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 2): setae *1a* 7 (7–8); *2a* 11 (11–12); *3a* 15 (14–17) near anteriomedial margins of apodemes 3; *3b* 7 (7–8) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long and fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where is fused with it. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b.* Poststernal apodeme not bifurcated anteriorly. Tegula 17 (16–18) wide and very short 4 (4–6); posterior margin slightly arched. Setae *ps* 14 (13–15) smooth.

Legs (Fig. 3): lengths (measured from femur to tarsus): leg I 52 (51–54), leg II 51 (50–52), leg III 85 (84–87). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete: solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (5–6); all inserted at approximately same level. Seta *d* of tibia I 29 (28–30), serrate. Solenidion *ω* of tarsus II proximally inserted 5 long, stout, wider medially. Seta *d* of tibia II 18 (17–19), serrate. Femorogenu IV 18 (17–21); tibiotarsus IV 9 (8–10). Length of leg IV setae: *v′* F 9 (8–11), *v′*

G 16 (14–17), *v´* Ti 20 (19–22) and *tc″* 31 (28–32); all setae smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and twenty-seven paratype females. Holotype and two paratypes from Moraceae sp., 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 16/V/1994, ALAS; three paratypes from a Moraceae species, 17/V/1994, other collection data as holotype; one paratype from *Bolbitis portoricensis* (Spreng.) Hennipman (Dryopteridaceae), 22/V/1994, other collection data as holotype; two paratypes from *Cyathea* sp. (Cyatheaceae), 22/V/1994, other collection data as holotype; two paratypes from *Guarea guidonia* (L.) Sleumer (Meliaceae), 05/VI/1995, other collection data as holotype; three paratypes from a Melastomataceae species, 16/V/1994, other collection data as holotype; one paratype from a Myristicaceae species, 29/V/1994, other collection data as holotype; one paratype from *Nephrolepis* sp. (Nephrolepidaceae), 22/V/1994, other collection data as holotype; one paratype from a Ochnaceae species, 17/V/1994, other collection data as holotype; one paratype from a palm (Arecaceae), 16/V/1994, other collection data as holotype; one paratype from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 12/VI/1994, other collection data as holotype; one paratype from a Phytolaccaceae species, 17/V/1994, other collection data as holotype; one paratype from a Piperaceae species, 16/V/1994, other collection data as holotype; one paratype from a Rhamnaceae species, 16/V/1994, other collection data as holotype; one paratype from a Rubiaceae species, 16/V/1994, other collection data as holotype; one paratype from a Sapindaceae species, 16/V/1994, other collection data as holotype; one paratype from a Simaroubaceae species, 16/V/1994, other collection data as holotype; two paratypes from a Violaceae species, 16/V/1994, other collection data as holotype; one paratype from *Theobroma cacao* L. (Malvaceae), 9°54´N 83°40´W, Turrialba, Cartago, Costa Rica, 15/III/1994, C. Vargas. Holotype deposited at NMCR; 19

paratypes are deposited at USNM; three paratypes deposited at CIPROC; two paratypes deposited at CNC; one paratype deposited at DZSJRP; two paratypes deposited at TNHM.

Etymology: The species is named in honor of the ALAS team, for supporting the research and results presented herein.

***Daidalotarsonemus azofeifai* sp. n. Ochoa, Rezende & Lofego**
(Figs. 5–11)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus cornutus* Lin, Chen & Zhang (1998) for the shape of ornamentation on the tergite D, limited to the center of the tergite and the similar shape of the setae *d*, sejugal apodeme and pharynx. They differ by the ornamentation of tergite C, composed by small reticules which cover the entire plate in *D. cornutus* as opposed to having two reticulated rows between setae *c1* in the new species; and by the elliptical shape of setae *e* which is lanceolate in *D. cornutus*.

Adult female (seven specimens measured).

Gnathosoma: subtriangular in ventral view; length 28 (26–31), maximum width 19 (18–21). Setae *dgs* 12 (11–14) and *vgs* 8 smooth; palps moderately long 10 (8–11). Pharynx fusiform, 20 (19–22) long and 12 (11–14) wide at maximum width.

Idiosoma – dorsum (Figs. 5 and 8): length 198 (194–205), width at level of *c1* 139 (137–142); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with two central rows of reticulation, and irregular ornamentation laterally; tergite D reticulated between pits *ia*. Lengths of the setae: *v1* 29 (27–31), *sc1* 18 (17–20), *sc2* 39 (38–41), *c1* 8 (8–9), *c2* 17 (15–18), *d* 37 (35–38), *e* 20 (19–22), *f* 36 (34–37) and *h* 18 (17–19). Maximum width of expanded setae: *d* 3, *e* 13 (12–15) and *f* 7 (6–8). All dorsal setae serrate; except *sc2* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c2* and *h* setiform; *sc2* falcate; *c1* linear with a central serrate vein, *d* linear elongated with two veins, *e* elliptical with two serrate veins, *f* lanceolate with two veins. All setae inserted on tubercles, except for *sc1*, *e* and *h*. Distances between dorsal setae: *v1–v1* 32 (30–33), *sc2–sc2* 52 (51–53), *v1–sc2* 32 (31–34), *c1–c1* 53 (52–54), *c2–c2* 119 (118–122), *c1–c2* 44 (43–46), *d–d* 43 (42–45), *f–f* 10 (9–11), *e–f* 12 (11–14) and *h–h* 20 (20). Seta *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Figs. 6): setae *1a* 7 (7–8); *2a* 12 (11–13); *3a* 18 (17–20) near anteriomedial margins of apodemes 3; *3b* 12 (11–13) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long and fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and inconspicuous from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 24 (23–26) and very short 4 (4–6); posterior margin slightly arched. Setae *ps* 14 (13–15) smooth.

Legs (Fig. 7): lengths (measured from femur to tarsus): leg I 59 (58–62), leg II 51 (50–52), leg III 86 (84–87). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete: solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (5–6); all inserted at approximately same level. Seta *d* of tibia I 29 (28–30), serrate. Solenidion *ω* of tarsus II proximally inserted, 6 long, stout, wider medially. Seta *d* of tibia II 19 (18–20), serrate. Femorogenu IV 16 (15–18); tibiotarsus IV 9 (8–11). Length of leg IV setae: *v′* F 13 (12–14), *v′* G 22 (21–25), *v´* Ti 28 (28–29) and *tc″* 58 (57–60); all setae smooth; *v′* Ti falcate.

Adult male (four specimens measured).

Gnathosoma: subtriangular in ventral view; length 28 (26–29), maximum width 27 (26–28). Setae *dgs* 11 (10–12) and *vgs* 8 smooth; Palps moderately long 8 (8–9). Pharynx fusiform, 16 (15–17) long and 8 wide at widest region.

Idiosoma – dorsum (Fig. 9): length 168 (166–170), maximum width 104 (103–105). Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 25 (24–27), *v2* 20 (19–21), *sc1* 50 (49–52), *sc2* 25 (24–27), *c1* 28, *c2* 27 (25–28), *d* 36 (34–37), *f* 24 (23–26). All setae setiform and serrate. Distances between dorsal setae: *v1–v1* 13 (12–14), *sc1–sc1* 34 (32–35), *sc2–sc2* 44 (43–46), *v1–sc2* 28 (25–30), *c1–c1* 92 (89–93), *c2–c2* 91 (89–92), *c1–c2* 46 (45–47), *d–d* 52 (50–55), *f–f* 18 (17–20). Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Fig. 10): setae *1a* 4 posteriad of apodemes 1; setae *2a* 9 (8–11) located in center of coxisternal plates II; setae *3a* 15 (14–17) located near anterior end of apodemes 3; and setae *3b* 12 (10–13) located posteromedial margins of apodemes 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 not fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but inconspicuous between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous; connecting between 3, 4 and poststernal apodemes diffuse.

Legs (Fig. 11): lengths (measured from femur to tarsus): leg I 63 (62–65), leg II 59 (57–62), leg III 82 (79–83), leg IV 93 (91–95). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-3-5(1), leg III: 1-3-4-3. Solenidion *ω* of tarsus I 5, stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3, *φ2* 4 (4–5) and famulus *k* 4, both inserted at approximately same level.

Seta *d* of tibia I 27 (26–29), serrate. Solenidion ω of tarsus II proximally inserted 5 long, stout, wider medially. Seta *d* of tibia II 20 (19–22), serrate. Trochanter IV slightly wider than long, seta *v′* 4, smooth. Femorogenu IV 50 (47–52) long and 21 (18–23) wide at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third. Seta *v′* F 4 (4–5), smooth. Setae *v′* G 17 (16–18) and *l″* G 13 (12–15), smooth. Tibia IV 24 (22–26) long; solenidion φ 8 (7–9); seta *v′* Ti 55 (53–58), serrate. Tarsus IV short, bearing 3 smooth setae of following length: *tc″* 6, *pv″* 6 (6–7) and *u′* 5 (5–6). Claw well developed.

Type material: Holotype female, twenty-eight paratype females and seven paratype males. Holotype female, 17 paratype females and seven paratype males from a palm (Arecaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 16/V/1994, ALAS; one paratype female from a Burseraceae species, 17/V/1994, other collection data as holotype; three paratype females from a Caesalpinaceae species , 17/V/1994, other collection data as holotype; two paratype females from a Ochnaceae species, 17/V/1994, other collection data as holotype; one paratype female from *Cyathea* sp. (Cyatheaceae), 22/V/1994, other collection data as holotype; one paratype female from *Guarea guidonia* (L.) Sleumer (Meliaceae), 05/VI/1995, other collection data as holotype; one paratype female from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 05/VI/1995, other collection data as holotype; one paratype female from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 12/VI/1995, other collection data as holotype. Holotype deposited at NMCR; 17 paratype females and two paratype males deposited at USNM; two paratype females and one paratype male deposited at CIPROC; two paratype females and one paratype male deposited at CNC; two paratype females and one paratype male deposited at DZSJRP; one paratype female deposited at FAAS; one paratype female and one paratype male deposited at FSCA; one paratype female and one paratype male deposited at QM; two paratype females deposited at TNHM.

Etymology: The species is in honor of Mr. Justo Azofeifa, chief technician for almost 30 years of the Laboratory of Acarology and Nematology, Escuela de Agronomia, Universidad de Costa Rica, for his dedication, support and advice to the study of mites in Costa Rica.

Daidalotarsonemus bauchani **sp. n. Rezende, Ochoa & Lofego**
(Figs. 12–15)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus venustus* Attiah (1970) by the reticulated ornamentation on the prodorsal shield and tergite C; and by the similar length of the dorsal setae *v1* and *sc2*. However, they differ by the ornamentation of tergite D, which is absent in this new species and not fully ornamented as in *D. venustus*. They also differ by the shape of setae *e*, which is subulate in this new species and obovate as in *D. venustus*; and by the shape of the setae *pl´´* on tarsus II.

Adult female (three specimens measured).

Gnathosoma: subtriangular in ventral view; length 38 (36–39), maximum width 35 (33–36). Setae *dgs* 15 (14–16) and *vgs* 8 (7–9) smooth; palps moderately long 13 (12–13). Pharynx fusiform, 22 (21–23) long and 13 wide at maximum width.

Idiosoma – dorsum (Figs. 12 and 15): length 222 (220–225), width at level of *c1* 121 (118–126); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with a reticulate ornamentation pattern covering all tergite; tergite D with lateral ridges near setae *d*. Lengths of setae: *v1* 26 (25–27), *sc1* 22 (20–24), *sc2* 25 (23–26), *c1* 15 (13–17), *c2* 17 (16–18), *d* 29 (28–30), *e* 13 (11–14), *f* 31 (29–33) and *h* 8 (7–9). Maximum width of expanded setae: *d* 4, *e* 3 and *f* 5. All dorsal setae serrate; except for s*c2*, *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* setiform; setae *sc2* falcate. Setae *d*, *e* and *f* inserted on tubercles; setae *d* and *f* linear, both with a central serrate vein; setae *e* subulate, with a serrate vein. Distances between dorsal setae: *v1–v1* 29 (27–30), *sc2–sc2* 57 (55–58), *v1–sc2* 34 (33–35), *c1–c1* 57 (56–58), *c2–c2* 114 (112–115), *c1–c2* 34 (33–36), *d–d* 55 (53–56), *f–f* 22 (20–23), *e–f* 13 (11–14) and *h–h* 23 (21–24). Seta *sc2* inserted anteriorly to *sc1*. Dorsal cupules not easily seen.

Idiosoma – venter (Fig. 13): setae *1a* 6 (5–8); *2a* 13 (12–14); *3a* 14 (12–15) near anteriomedial margins of apodemes 3; *3b* 9 (8–10) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 25 (23–26) and very short 4 (4); posterior margin slightly arched. Setae *ps* 11 (9–12) serrate.

Legs (Fig. 14): lengths (femur to tarsus): leg I 63 (61–64), leg II 70 (68–72), leg III 84 (82–85). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 6 (5–7), stout, wider medially. Sensory cluster of tibia I: complete, solenidion *φ1* 3 (3–4), slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (5–6); all inserted at approximately same level. Seta *d* of tibia I 28 (27–30), serrate. Solenidion *ω* of tarsus II proximal, 5 long, stout, wider medially. Seta *d* of tibia II 19 (17–20), serrate. Femorogenu IV 15 (13–16); tibiotarsus IV 9 (8–11). Length of leg IV setae: *v′* F 9 (8–10), *v′* G 24 (23–25), *v´* Ti 30 (29–31) and *tc″* 57 (55–58); setae *v´*G serrate; setae *v*′Ti and *tc″* smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and two paratype females. Holotype female from *Goethalsia meiantha* (Donn. Sm.) Burret (Malvaceae), two paratypes from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 06/VI/1995, ALAS. Holotype deposited at NMCR; two paratypes deposited at USNM.

Etymology: The species is in honor of Dr. Gary Bauchan (Electron and Confocal Microscopy Unit, United States Department of Agriculture, Agricultural Research Service, USA) for his contributions to the study of mites.

Daidalotarsonemus cuadradus **sp. n. Ochoa, Rezende & Lofego**

(Figs. 16–19)

Diagnosis: Females are most similar to *D. euonymus* Yang, Ding & Zhou (1987) and *D. somalatus* Attiah (1970) for shape of the dorsal posterior setae *d*, *e* and *f*. *Daidalotarsonemus cuadradus* sp. n. is also similar with *D. somalatus* by the presence of the setae *l″* G on femorogenu III. However, the new species is distinct from those species by the combination of the following characters: setae *sc2* with a serrate central vein; linear shape of setae *c1*; shape of ornamentation on tergite D, composed by waved continuous ridges between setae *d*; and by the oblong asymmetric shape of setae *e*.

Adult female (four specimens measured).

Gnathosoma: subtriangular in ventral view; length 29 (28–30), maximum width 25 (24–26). Setae *dgs* 12 (11–13) and *vgs* 8 (7–9) smooth; palps moderately short 8. Pharynx fusiform, 15 (13–17) long and 7 (7–8) wide at maximum width.

Idiosoma – dorsum (Figs. 16 and 19): length 192 (190–196), width at level of *c1* 122 (120–125); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with a reticulate ornamentation pattern covering all tergite; tergite D with lateral ridges near setae *d*. Lengths of setae: *v1* 31 (30–32), *sc1* 14 (13–16), *sc2* 36 (35–37), *c1* 21 (20–23), *c2* 17 (16–18), *d* 51 (49–52), *e* 28 (27–29), *f* 44 (43–45) and *h* 13 (12–14). Maximum width of expanded setae: *d* 7 (7–8), *e* 26 (26–27) and *f* 6. All dorsal setae serrate; except for *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. All setae inserted on tubercles, except for *sc1* and *h.* Setae *v1*, *c2* and *h* setiform; setae *sc2* falcate; *c1* linear with a central serrate vein; setae *d* and *f* linear, with two serrate veins; *e* asymmetrically oblong, with two serrate veins. Distances between dorsal setae: *v1–v1* 30 (29–31), *sc2–sc2* 51 (50–52), *v1–sc2* 29 (28–30), *c1–c1* 57 (56–59), *c2–c2* 115 (114–116), *c1–c2* 37 (36–39), *d–d* 37 (36–38), *f–f* 12 (11–14), *e–f* 15 (14–17) and *h–h* 16 (15–17). Seta *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 17): setae *1a* 7 (7–8); *2a* 12 (11–14); *3a* 19 (18–21) near anteriomedial margins of apodeme 3; *3b* 9 (8–10) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a single median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 25 (23–26) and very short 4; posterior margin slightly arched. Setae *ps* 14 (13–15) smooth.

Legs (Fig. 18): lengths (measured from femur to tarsus): leg I 58 (57–60), leg II 56 (55–57), leg III 86 (85–87). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-4(1), leg III: 1+3-4-4. Tarsal solenidion ω of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I: complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 41 (40–43), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 long, stout, wider medially. Seta *d* of tibia II 19 (18–20), serrate. Presence of setae *l″* G on femorogenu III. Femorogenu IV 13 (11–15); tibiotarsus IV 9 (9–10). Length of leg IV setae: *v′* F 6 (6–7), *v′* G 13 (12–15), *v´* Ti 29 (27–30) and *tc″* 37 (36–39); setae *v′* F, *v′* G and *v′* Ti smooth; seta *v′* Ti falcate; seta *tc″* serrate.

Adult male (Unknown).

Type material: Holotype female and three paratype females. Holotype female from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 08/VI/1995, ALAS. Two paratype females, 05/VI/1995, other collection data as holotype; one paratype female from a Melastomataceae species, 16/V/1994, other collection data as holotype. Holotype deposited at NMCR; three paratypes deposited at USNM.

Etymology: The species name *cuadradus* refers to the subquadrate reticulation between setae *c1* which is present in this species.

Daidalotarsonemus ginae **sp. n. Ochoa, Rezende & Lofego**

(Figs. 20–23)

Diagnosis: Females of this new species are unique among *Daidalotarsonemus* for the length (±46 µm) and linear aspect of the setae *c1*; by the length of the setae *sc2* (±55 µm); by the aspect of the ornamentation on the tergites C and D, which most of the reticulation is concentrated between the setae *c1* and *d*, respectively; by the tubercle-shaped insertion of the setae *1a* and *2a*; and by the irregular shape of the apodeme 2.

Adult female (eight specimens measured).

Gnathosoma: subtriangular in ventral view; length 25 (23–27), maximum width 24 (22–25). Setae *dgs* 7 (7–8) and *vgs* 11 (11–12) smooth; palps moderately long 8 (8–10). Pharynx fusiform, 14 (12–15) long and 6 (6–7) wide at maximum width.

Idiosoma – dorsum (Figs. 20 and 23): length 200 (194–208), width at level of *c1* 123 (118–127); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C ornamented with four rows of reticles between setae *c1* and irregular ornamentation laterally; tergite D with two large reticles between setae *d*. Lengths of setae: *v1* 31 (29–32), *sc1* 13 (12–15), *sc2* 55 (53–56), *c1* 46 (44–48), *c2* 22 (21–24), *d* 45 (43–46), *e* 13 (11–15), *f* 41 (38–43) and *h* 11 (10–13). Maximum width of expanded setae: *d* 5, *e* 8 and *f* 4. All dorsal setae serrate, except for *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c2* and *h* setiform. Setae *sc2* falcate, with two serrate veins. Setae *c1* linear, with a serrate vein. Setae *e* elliptical with two serrate veins. Setae *d* and *f* linear with two serrate veins. All setae inserted on tubercles, except for *sc1* and *h*. Distances between dorsal setae: *v1–v1* 27 (26–29), *sc2–sc2* 50 (48–52), *v1–sc2* 28 (27–30), *c1–c1* 47 (46–49), *c2–c2* 106 (103–108), *c1–c2* 41 (39–43), *d–d* 29 (28–31), *f–f* 8 (7–9), *e–f* 14 (13–16) and *h–h* 22 (20–25). Seta *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 21): setae *1a* 7 (7–8); *2a* 12 (11–13); *3a* 15 (13–16) near anteriomedial margins of apodemes 3; *3b* 9 (9–10) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 16 (15–17) and short 4 (4–5); posterior margin slightly arched. Setae *ps* 8 (7–10) smooth.

Legs (Fig. 22): lengths (measured from femur to tarsus): leg I 57 (55–59), leg II 58 (57–61), leg III 94 (92–97). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I: complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (6–7)); all inserted at approximately same level. Seta *d* of tibia I 27 (26–29), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 long, stout, wider medially. Seta *d* of tibia II 58 (56–60), serrate. Presence of setae *l″* G on femorogenu III. Femorogenu IV 11 (10–12); tibiotarsus IV 14 (13–16). Length of leg IV setae: *v′* F 7 (7–8), *v′* G 9 (9–10), *v´* Ti 30 (28–32) and *tc″* 38 (36–41); setae *v′* F and *tc″* smooth; seta *v′* G and *v′* Ti serrate; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and fifteen paratype females. Holotype female from a Moraceae species, 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 16/V/1994, ALAS; one paratype from *Goethalsia meiantha* (Donn.Sm.) Burret (Malvaceae), 08/VI/1995, other collection data as holotype; nine paratypes from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 05/VI/1995, other collection data as holotype; three paratypes from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 07/VI/1995, other collection data as holotype; two paratypes from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 08/VI/1995, other collection data as holotype. Holotype deposited at NMCR; eight paratypes deposited at USNM; three paratypes deposited at CIPROC; one paratype deposited at CNC; one paratype deposited at DZSJRP; one paratype deposited at FAAS; one paratype deposited at TNHM.

Etymology: The species is in honor of Alice Eugenia (Gina) Ochoa, daughter of Ronald Ochoa, for her interest in nature and these little arthropods.

Daidalotarsonemus lini **sp. n. Ochoa, Rezende & Lofego**
(Figs. 24–27)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus ethiopicus* Mahunka (1981) and *D. venustus* Attiah (1970) by the ornamentation on the prodorsum and between setae *c1* on the tergite C; by the tubercle-shaped insertion on the setae *c2*. This new species is easily distinguished by the acicular shape of setae *c1*; and by length, width and lanceolate shape of the setae *e*.

Adult female (six specimens measured).

Gnathosoma: subtriangular in ventral view; length 29 (28–32), maximum width 25 (23–28). Setae *dgs* 12 (12–13) and *vgs* 7 smooth; palps moderately long 11 (11–12). Pharynx fusiform, 17 (16–18) long and 8 (8–9) wide at maximum width.

Idiosoma – dorsum (Figs. 24 and 27): length 221 (218–226), width at level of *c1* 114 (112–116); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C ornamented with four rows of reticles between setae *c1* and irregular ornamentation laterally; tergite D with short longitudinal ridges around setae *d*. Lengths of setae: *v1* 29 (28–33), *sc1* 15 (15–16), *sc2* 31 (30–32), *c1* 27 (25–29), *c2* 23 (21–24), *d* 31 (30–32), *e* 12 (10–13), *f* 30 (29–31) and *h* 14 (13–15). Maximum width of expanded setae: *d* 7, *e* 3 and *f* 6. All dorsal setae serrate. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c2* and *h* setiform; setae *sc2* falcate; setae *c1* acicular with a serrate vein, *d* and *f* elliptical with two serrate veins, *e* lanceolate with two serrate veins. All setae inserted on tubercles, except for *sc1* and *h*. Distances between dorsal setae: *v1–v1* 29 (28–31), *sc2–sc2* 51 (49–53), *v1–sc2* 27 (26–28), *c1–c1* 47 (46–47), *c2–c2* 100 (99–101), *c1–c2* 40 (38–41), *d–d* 31 (30–31), *f–f* 15 (13–16), *e–f* 9 (9–10) and *h–h* 17 (17–18). Seta *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 25): setae *1a* 6 (6–7); *2a* 10 (9–11); *3a* 12 (11–14) near anteriomedial margins of apodemes 3; *3b* 11 (10–13) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to distal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a single median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 15 wide (14–17) and very short 5 (5–6); posterior margin slightly arched. Setae *ps* 14 (13–15) smooth.

Legs (Fig. 26): lengths (measured from femur to tarsus): leg I 58 (57–60), leg II 61 (59–62), leg III 96 (94–97). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 7, stout, wider medially. Sensory cluster of tibia I: complete, solenidion *φ1* 4, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 30 (29–32), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 long, stout, wider medially. Seta *d* of tibia II 19 (18–20), serrate. Femorogenu IV 11 (10–12); tibiotarsus IV 15 (14–17). Length of leg IV setae: *v′* F 6 (6–7), *v′* G 17 (16–19), *v´* Ti 26 (25–28) and *tc″* 41 (38–44); setae *v′* F, *v′* G and *tc″* smooth; seta *v′* Ti serrate and falcate.

Adult male (Unknown).

Type material: Holotype female and eight paratype females. Holotype female from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 05/VI/1995, ALAS; one paratype from a Ochnaceae species, 17/V/1994, other collection data as holotype; one paratype from *Nephrolepis* sp., 22/V/1994, other collection data as holotype; two paratypes from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 07/VI/1995, other collection data as holotype; three paratypes from *Goethalsia meiantha* (Donn.Sm.) Burret (Malvaceae), 08/VI/1995, other collection data as holotype; one paratype from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 12/VI/1995, other collection data as holotype. Holotype deposited at NMCR; four paratypes deposited at USNM; two paratypes deposited at CIPROC; one paratype deposited at CNC; one paratype deposited at DZSJRP.

Etymology: The species is in honor of Dr. Jianzhen Lin, from the Institute of Plant Protection, Fujian Academy of Agricultural Science, Fuzhou, Fujian, China, for his contributions to the study of the family Tarsonemidae.

***Daidalotarsonemus marini* sp. n. Ochoa, Rezende & Lofego**

(Figs. 28–31)

Diagnosis: Females of this new species are very similar to *D. duolamella* Lin, Chen & Zhang (1998), mainly by the shape of prodorsal shield and tergite C; and by the shape and the tubercle-shaped insertion of the setae *d*. However, they are distinguished by the shape of setae *c1*, which is setiform in *D. duolamella* and oblanceolate in the new species; and by the shape of setae *e* and *f*, which are obovate and lanceolate in *D. duolamella* and both elliptical in *D. marini* sp. n.

Adult female (six specimens measured).

Gnathosoma: subtriangular in ventral view; length 37 (36–39), maximum width 28 (27–30). Setae *dgs* 13 and *vgs* 7 (7–8) smooth; palps moderately long 11 (10–12). Pharynx fusiform, 28 (26–30) long and 16 (15–18) wide at maximum width.

Idiosoma – dorsum (Figs. 28 and 31): length 255 (252–258), width at level of *c1* 138 (137–139); prodorsal shield with irregular ornamentation and a central "H" form on it. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C ornamented with long longitudinal ridges, between setae *c1*; tergite D with short longitudinal ridges just between setae *d*. Lengths of setae: *v1* 32

(30–34), *sc1* 16 (15–17), *sc2* 42 (42), *c1* 35 (35), *c2* 26 (25–27), *d* 49 (47–51), *e* 26 (26–27), *f* 27 (25–28) and *h* 23 (20–26). Maximum width of expanded setae: *d* 4, *e* 12 (11–13) and *f* 11 (10–12). All dorsal setae serrate; except *h* smooth. Bothridial setae *sc1* capitate, with tiny spines; sSetae *v1*, *c2* and *h* setiform; setae *sc2* falcate; setae *c1* oblanceolate with two serrate veins, *d* linear elongated with two serrate veins, setae *e* and *f* elliptical with two serrate veins. All inserted on tubercles, except *sc1* and *h*. Distances between dorsal setae: *v1–v1* 30 (30–31), *sc2–sc2* 56 (55–57), *v1–sc2* 32 (31–34), *c1–c1* 48, *c2–c2* 122 (118–126), *c1–c2* 41 (40–42), *d–d* 46 (46–47), *f–f* 9, *e–f* 13 (12–14) and *h–h* 19. Seta *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 29): setae *1a* 7; *2a* 17 (16–18); *3a* 27 (26–30) near anteriomedial margins of apodemes 3; *3b* 18 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where it is fused with it. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 19 (19–20) and short 6; posterior margin slightly arched. Setae *ps* 10 (9–12) smooth.

Legs (Fig. 30): lengths (measured femur to tarsus): leg I 55 (54–56), leg II 51 (50–52), leg III 105 (104–106). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-6(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I: complete, solenidion *φ1* 4, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6 (5–6); all inserted at approximately same level. Seta *d* of tibia I 39 (38–40), serrate. Solenidion *ω* of tarsus II proximally inserted, 6 long, stout, wider medially. Seta *d* of tibia II 19 (18–20), serrate. Presence of setae *l″* G on femorogenu III. Femorogenu IV 16; tibiotarsus IV 9 (8–11). Length of leg IV setae: *v′* F 15 (15–16), *v′* G 22 (21–23), *v´* Ti 36 (35–37) and *tc″* 51 (50–52); all setae smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and twenty-three paratype females. Holotype female collected on a palm (Arecaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 29/V/1994, ALAS; eight paratypes from an unknown host, unknown calendar date, other collection data as holotype; one paratype from a Malvaceae species, 17/V/1994, other collection data as holotype; nine paratypes from a Moraceae species, 16/V/1994, other collection data as holotype. Five paratypes from *Theobroma cacao* L., 9°53´N 83°39´W, Tropical Agricultural Research and Higher Education Center, Costa Rica, 15/II/1994, CATIE. Holotype deposited at NMCR; 14 paratypes deposited at USNM; three paratypes deposited at CIPROC; two paratypes deposited at CNC; one paratype deposited at DZSJRP; one paratype deposited at FAAS; two paratypes deposited at TNHM.

Etymology: The species is in honor of Agr. Eng. Francisco Marín-Thiele, Pro-NAP, Ministerio de Agricultura y Ganaderia, Costa Rica, for his dedication to entomology in Costa Rica.

Daidalotarsonemus maryae **sp. n. Ochoa, Rezende & Lofego**
(Figs. 32–35)

Diagnosis: Females of this new species are similar to *D. folisetae* Lofego, Ochoa & Moraes (2005) by having irregular ornamentation on the prodorsum; longitudinal, waved continuous ridges as on tergites C and D; and the prosternal apodemes inconspicuous from the level of the apodemes 2 to the joint of the sejugal apodeme. They are distinguished by the following characters present on the new species: reticulation between setae *c1*; tubercle-shaped insertion of the setae *c1* and *c2*; presence of the setae *l″* G on femorogenu III; and shape of the dorsal posterior setae *d*, *e* and *f*.

Adult female (two specimens measured).

Gnathosoma: subtriangular in ventral view; length 28 (27–30), maximum width 24 (22–25). Setae *dgs* 12 (12–13) and *vgs* 7 (7–8) smooth; palps short 8. Pharynx fusiform, 15 (14–16) long and 6 (6–7) wide at maximum width.

Idiosoma – dorsum (Figs. 32 and 35): length 188 (186–190), width at level of *c1* 108 (107–109); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C and D ornamented with reticles between setae *c1* and irregular ornamentation laterally. Lengths of setae: *v1* 15 (14–16), *sc1* 15, *sc2* 29 (29–30), *c1* 18 (17–20), *c2* 17 (16–18), *d* 25 (24–27), *e* 15, *f* 24 (23–26) and *h* 12 (12–13). Maximum width of expanded setae: *d* 10, *e* 11 and *f* 7. All dorsal setae serrate, except for *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, c2 and *h* setiform; setae *sc2* falcate; setae *d*, *e* and *f* elliptical with two serrate veins; all setae inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 27 (27–28), *sc2–sc2* 51 (50–52), *v1–sc2* 27 (26–28), *c1–c1* 52, *c2–c2* 101 (100–103), *c1–c2* 36 (35–37), *d–d* 42, *f–f* 13 (13–14), *e–f* 12 (12–13) and *h–h* 15 (15–16). Seta *sc2* inserted posterior to *sc1*.

Idiosoma – venter (Fig. 33): setae *1a* 4 (4–5); *2a* 8 (8–9); *3a* 6 (6–7) near anteriomedial margins of apodemes 3; *3b* 6 (5–7) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III;

apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 14 (14–15) and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 9 (8–10) smooth.

Legs (Fig. 34): lengths (measured from femur to tarsus): leg I 53 (52–55), leg II 50 (48–51), leg III 85 (84–86). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete: solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 26 (25–27), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 (5–6) long, stout, wider medially. Seta *d* of tibia II 18 (17–19), serrate. Presence of the setae *l″* G on femorogenu III. Femorogenu IV 30 (28–32); tibiotarsus IV 9 (9–10). Length of leg IV setae: *v′* F 6 (6–7), *v′* G 9 (9–10), *v´* Ti 18 (17–20) and *tc″* 29 (27–31); all setae smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and one paratype female. Holotype female from *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae), 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 05/VI/1995, ALAS; one paratype, 12/VI/1995, other collection data as holotype. Holotype deposited at NMCR; paratype deposited at USNM.

Etymology: The species is in honor of Mary Abigail Ochoa, daughter of Ronald Ochoa, for her interest in bees, butterflies, ants and mites.

***Daidalotarsonemus puntarenensis* sp. n. Rezende, Ochoa & Lofego (Figs. 36–39)**

Diagnosis: Females of this new species are similar to *D. vandevriei* Suski (1967b) by the shape of posterior setae *e* and *f* and ornamentation of tergites C and D; but differ by shape and position of setae *c1*; shape of setae *d*; and length of palps which are around three times longer in *D.*

vandevriei (± 15 µm). This new species also resembles *D. fossae* De Leon (1956), *D. serissae* Yang, Ding & Zhou (1987) and *D. annonae* Sousa, Lofego & Gondim Jr. (2014) by heavily arched tegula and by position of setae *c1*, near to posterior margin of tergite C. *Daidalotarsonemus puntarenensis* sp. n. is distinguished from all these species by ornamentation on all tergites and shape of posterior setae *d*, *e* and *f*. Also, unlike all other ones, prodorsal shield of *D. puntarenensis* lacks deep emarginations where the stigmata are located.

Adult female (four specimens measured).

Gnathosoma: subtriangular in ventral view; length 28 (27–30), maximum width 31 (29–32). Setae *dgs* 12 (11–13) and *vgs* 8 (8–9) smooth; palps short 6 (6–7). Pharynx fusiform, 17 (16–19) long and 8 (8) wide at maximum width.

Idiosoma – dorsum (Figs. 36 and 39): length 254 (252–257), width at level of *c1* 121 (119–124); prodorsal shield with irregular ornamentation and lacking of deep emarginations where stigmata are located. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C ornamented with reticulation covering all the tergite; tergite D with reticles around setae *d* and irregular ornamentation laterally. Lengths of the setae: *v1* 31 (29–32), *sc1* 18 (17–20), *sc2* 30 (29–32), *c1* 15 (14–16), *c2* 15 (14–17), *d* 26 (24–27), *e* 26 (24–27), *f* 34 (32–36) and *h* 17 (16–18). Maximum width of expanded setae: *d* 4, *e* 3 and *f* 6. All dorsal setae serrate. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c2* and *h* setiform; *sc2* falcate; setae *c1*, *c2* and *d* lanceolate with one serrate vein; setae *e* and *f* linear; all setae inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 39 (38–41), *sc2–sc2* 61 (59–63), *v1–sc2* 23 (21–25), *c1–c1* 66 (64–67), *c2–c2* 82 (81–83), *c1–c2* 36 (35–38), *d–d* 44 (42–45), *f–f* 9 (9–10), *e–f* 18 (17–19) and *h–h* 24 (22–25). Seta *sc2* inserted posterior to *sc1*.

Idiosoma – venter (Fig. 37): setae *1a* 6 (6–7); *2a* 8 (8–9); *3a* 13 (13) near anteriomedial margins of apodemes 3; *3b* 7 (7–8) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, inconspicuous in middle. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle portion of poststernal apodeme to close femorogena III and IV. Fissures overlapping apodemes 4, reaching anterior level of femorogena III and IV. Poststernal apodeme bifurcated anteriorly. Tegula wide 15 (15–16) and long 8 (8–9); posterior margin heavily arched. Setae *ps* 5 (5–6) smooth.

Legs (Fig. 38): lengths (measured from femur to tarsus): leg I 54 (53–56), leg II 49 (48–51), leg III 91 (89–94). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-4-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 7, stout, wider medially. Sensory cluster of tibia I complete,: solenidion *φ1* 4, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 36 (35–38), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 (5–6) long, stout, wider medially. Seta *d* of tibia II 28 (27–30), serrate. Presence of setae *l″* G on femorogenu III. Femorogenu IV 24 (23–25); tibiotarsus IV 9 (9–10). Length of leg IV setae: *v′* F 7 (7–8), *v′* G 12 (12–13), *v´* Ti 20 (20–21) and *tc″* 30 (29–32); all setae smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and three paratype females. Holotype and three paratype females from *Elaeis guineensis* Jacq. (Arecaceae), 9°25´N 84°25´W, Quepos, Puntarenas, Costa Rica, 29/III/1990, Juan Rojos. Holotype deposited at NMCR; three paratypes deposited at USNM.

Etymology: The species name *puntarenensis* is in honor of the Province of Puntarenas, Costa Rica, region where this species was collected.

Daidalotarsonemus serratus **sp. n. Rezende, Ochoa & Lofego**

(Figs. 40–43)

Diagnosis: Females of this new species are most similar to *D. serissae* Yang, Ding & Zhou (1987), *D. annonae* Sousa, Lofego & Gondim Jr. (2014) and *D. puntarenensis* sp. n. by the heavily arched tegula and the position of the setae *c1*, near to the posterior margin of the tergite C. However, this new species is easily distinguished from these others by the following characters: shape of the ornamentation on all tergites; shape of the setae posterior setae *d*, *e* and *f*; and the length of the apodemes 2 and prosternal.

Adult female (three specimens measured).

Gnathosoma: subtriangular in ventral view; length 28 (27–30), maximum width 26 (25–29). Setae *dgs* 14 and *vgs* 7 (7–8) smooth; palps short 6 (6–7) Pharynx fusiform, 13 (12–14) long and 6 (6–7) wide at maximum width.

Idiosoma – dorsum (Figs. 40 and 43): length 201 (200–204), width at level of *c1* 118 (117–121); prodorsal shield with irregular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C ornamented with long longitudinal ridges between setae *c1* and irregular ornamentation laterally; tergite D with reticles around and irregular ornamentation setae *d*. Lengths of setae: *v1* 23 (21–25), *sc1* 19 (18–20), *sc2* 31 (30–32), *c1* 24 (23–25), *c2* 18 (17–19), *d* 22 (21–24), *e* 17 (17–18), *f* 18 (17–20) and *h* 16 (15–17). Maximum width of expanded setae: *d* 5, *e* 3 and *f* 7. All dorsal setae serrate; except *h* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1* and *c2* and *h* setiform; setae *sc2* falcate; *d* and *f* cuneate with one serrate vein; setae *e* linear elongated with one serrate vein. All setae inserted on tubercles, except for *sc1* and *h*. Distances between dorsal setae: *v1–v1* 35 (34–36), *sc2–sc2* 50 (48–52), *v1–sc2* 20 (19–22), *c1–c1* 62 (61–63), *c2–c2* 81 (80–82), *c1–c2* 37 (35–38), *d–d* 24 (23–25), *f–f* 11 (10–13), *e–f* 17 (15–18) and *h–h* 22 (21–23). Seta *sc2* inserted posterior to *sc1*.

Idiosoma – venter (Fig. 41): setae *1a* 6 (6–7); *2a* 9 (8–10); *3a* 12 (11–13) near anteriomedial margins of apodemes 3; *3b* 9 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to the sejugal apodeme. Sejugal apodeme uninterrupted, but inconspicuous in the middle. Apodeme 3 with a constriction near the anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from the middle portion of the poststernal apodeme to close the femorogena III and IV. Fissures overlapping apodemes 4, reaching the anterior level of the femorogena III and IV. Poststernal apodeme bifurcated anteriorly. Tegula wide 9 (9–10) and short 6 (6–7); posterior margin heavily arched. Setae *ps* 6 (5–7) smooth.

Legs (Fig. 42): lengths (measured from femur to tarsus): leg I 48 (47–50), leg II 46 (45–48), leg III 89 (87–90). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-4-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 7 (7–8), stout, wider medially. Sensory cluster of tibia I complete,: solenidion *φ1* 4, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 34 (33–35), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 (5–6) long, stout, wider medially. Seta *d* of tibia II 22 (21–24), serrate. Femorogenu IV 19 (18–21); tibiotarsus IV 7 (6–9). Length of leg IV setae: *v′* F 5 (5–6), *v′* G 9 (8–11), *v´* Ti 18 (17–21) and *tc″* 30 (28–32); all setae smooth; *v′* Ti falcate.

Adult male (Unknown).

Type material: Holotype female and two paratype females. Holotype and two paratype females from *Nephrolepis* sp., 10°26´N 84°1´W, La Selva Biological Station, Heredia, Costa Rica, 22/V/1994, ALAS. Holotype deposited at NMCR; two paratypes deposited at USNM.

Etymology: The species is named *serratus* by having all posterior setae heavily serrated.

Discussion

It is remarkable to find so many new species belonging to the same genus in such a relatively small area. The Costa Rica rain forest is considered a biodiversity hot spot (Myers et al. 2000) and the findings related on this paper strongly reinforce it. The number of species described from this area represents around 30% of the total of *Daidalotarsonemus* known species so far. In Brazil, just one sampling in three plant species located in a rain forest region in the Bahia State resulted in three new tarsonemid species found (Rezende et al. 2015). Many unexplored sites of rain forests still exist around the world, which undoubtedly contain many new species. Therefore, it is necessary to increase the sampling efforts and taxonomic studies related to the diversity of the Acari fauna in such places. In this context, the authors are currently working on a worldwide revision of the genus *Daidalotarsonemus*, which will include a key to species, geographical distribution and phylogenetic information.

Acknowledgements

We thank the USDA, ARS and the National Museum of Natural History, Smithsonian Institution, for the help with equipment and collection material. We thank Danilo Brenes, Ronald Vargas, Maylin Paniagua, Flor Cascante and Nelci Oconotrillo (ALAS parataxonomists) for thousands of hours of dedication to the study and collecting of the arthropod fauna of La Selva Biological Station. We thank Ronald Ochoa's former Prof. Dr Marek Kaliszewski, for sharing his love and knowledge for tarsonemid mites. Special thanks to Dr Evert E. Lindquist (CANACOLL-AC), Dr John T. (Jack) Longino (DB-UU), Dr Robert K. Colwell (EEB-UC), Dr Valerie Behan-Pelletier (CANACOLL-AC), Dr Roy A. Norton (CESF-SUNY) and Dr

Barry OConnor (MZ-UM) for their support and suggestions on the study of the Costa Rican mites. We thank Lic. Ana Cecilia Pineda and Lic. Armando Ruiz-Boyer, Museo Nacional de Costa Rica, for their suggestions and help with the deposition of types. We thank Dr Cal Welbourn (DPI-FDACS) and Dr Gregory Evans (APHIS-USDA) for the review and the comments on the manuscript and *Daidalotarsonemus* mite habitat. We thank Chris Pooley (ECMU- USDA) for his support with all the images. We thank the Smithsonian Natural History Museum and National Agricultural Library (NAL-USDA), SEL-USDA for support and assistance with references for this study. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA; USDA is an equal opportunity provider and employer.

Funding

We thank FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) (Procs. 2011/19890-0 and 2013/08402-0) and ALAS Project – Costa Rica, National Science Foundation, and Organization for Tropical Studies (OTS), for providing the financial support for this study. This work was supported by the Fundação de Amparo à Pesquisa do Estado de São Paulo [2011/19890-0, 2013/08402-0].

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Figures

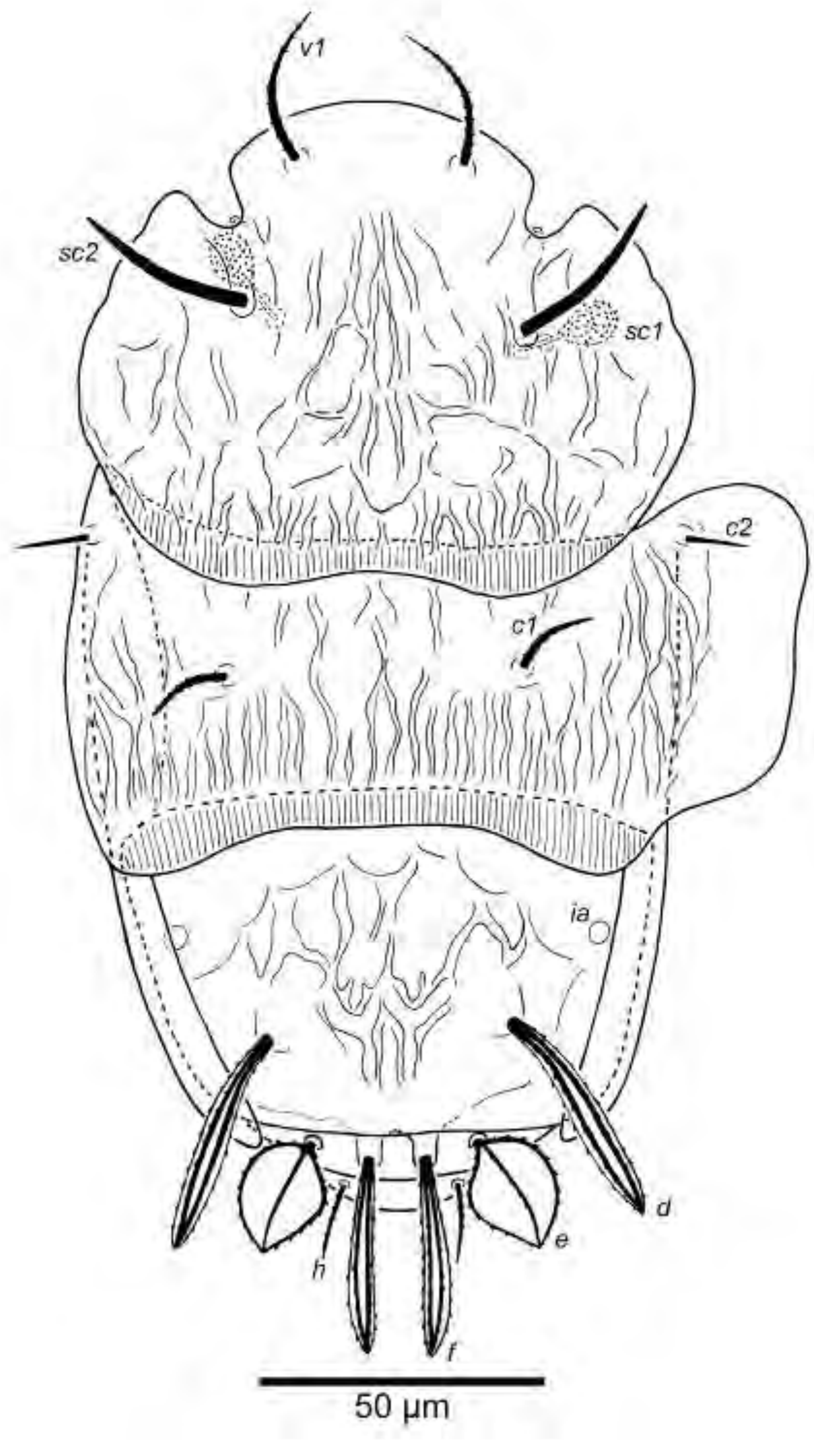

Fig. 1. *Daidalotarsonemus alas* sp. n. (female). Dorsal surface.

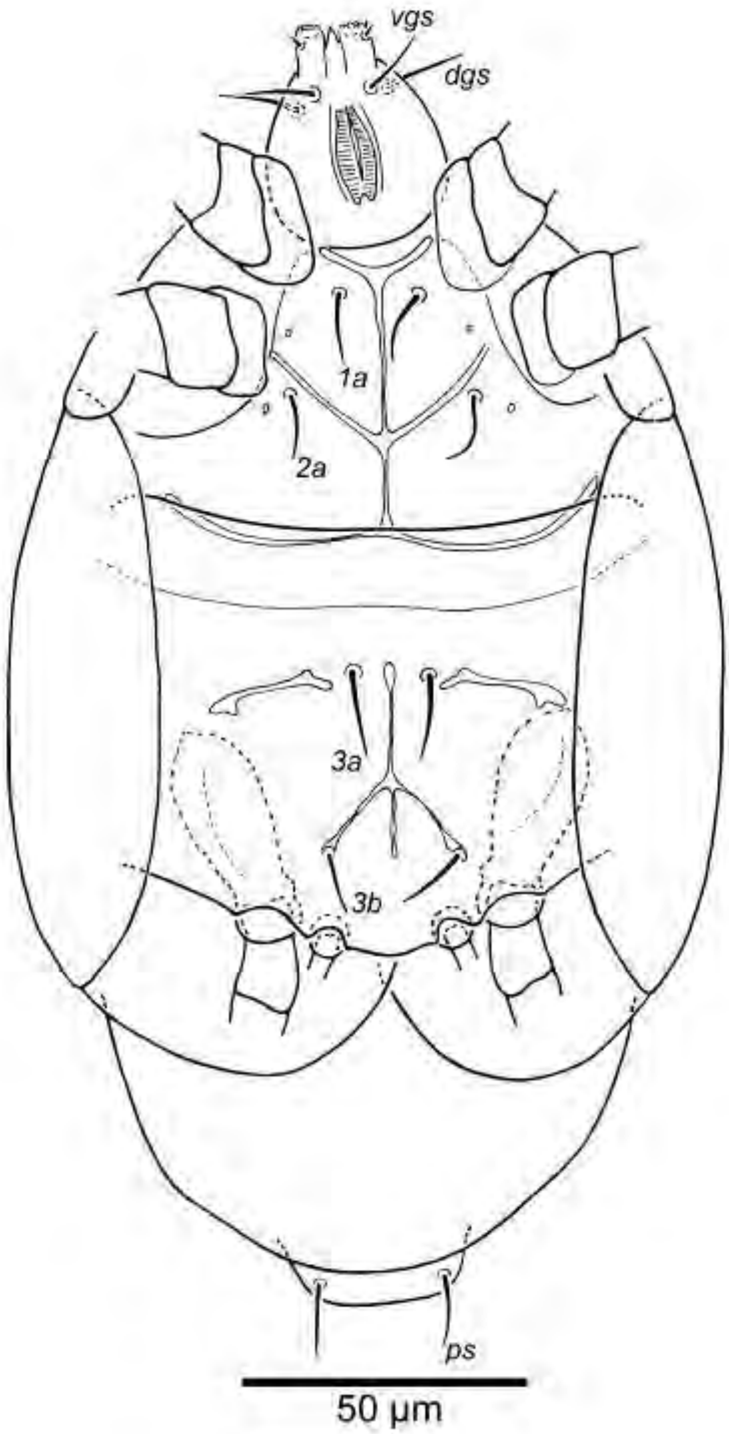

Fig. 2. *Daidalotarsonemus alas* sp. n. (female). Ventral surface.

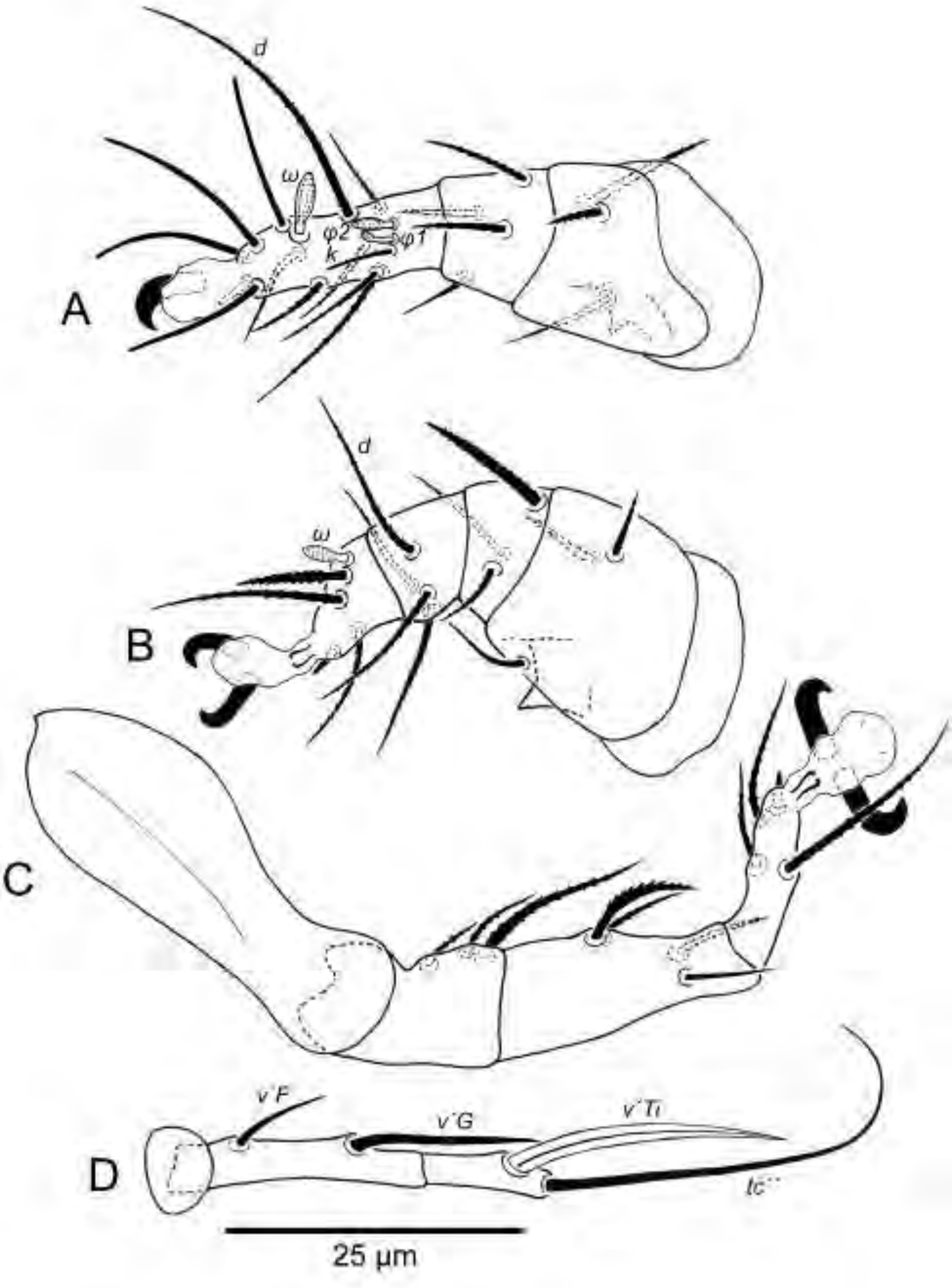

Fig. 3. *Daidalotarsonemus alas* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

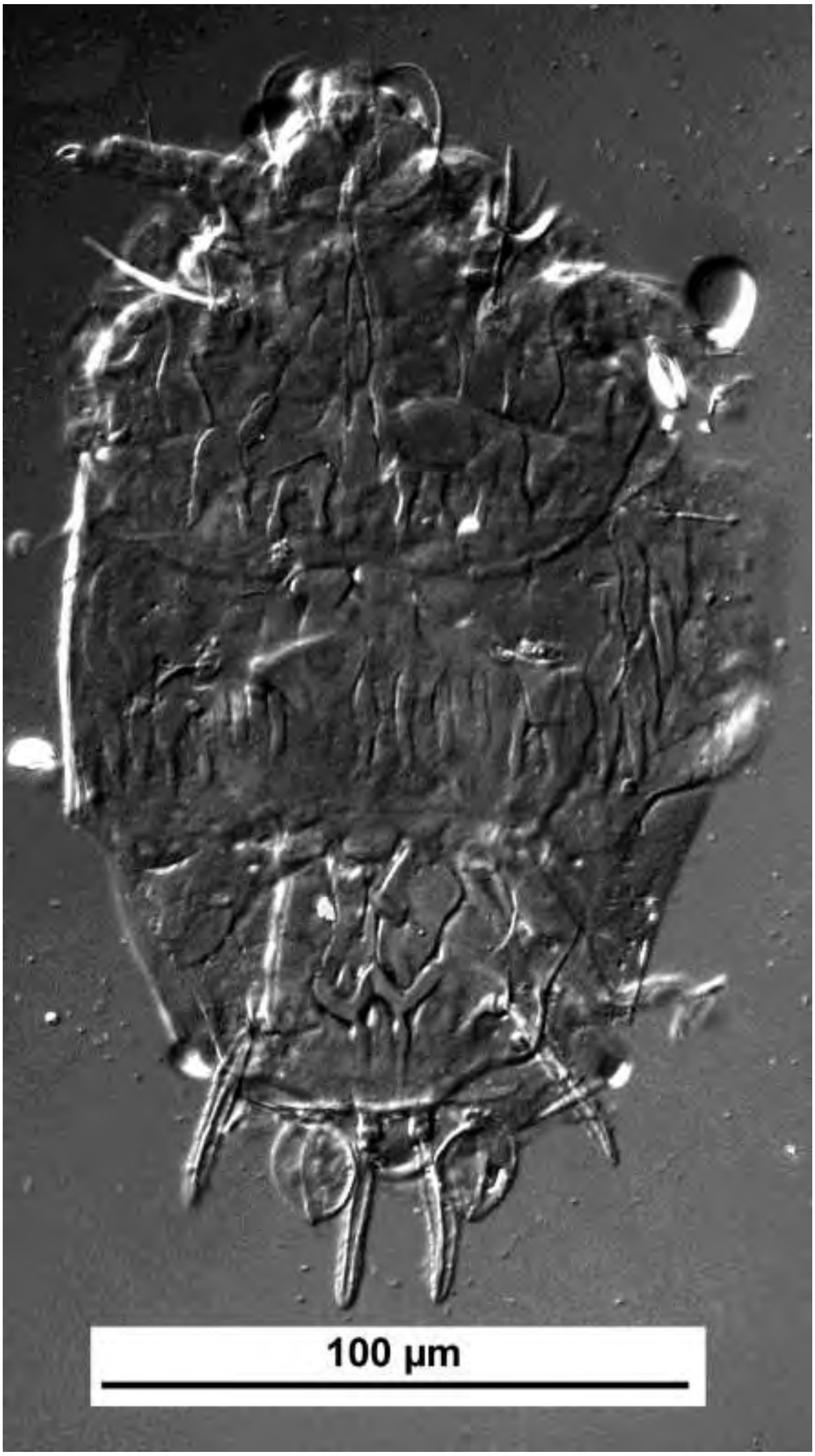

Fig. 4. *Daidalotarsonemus alas* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

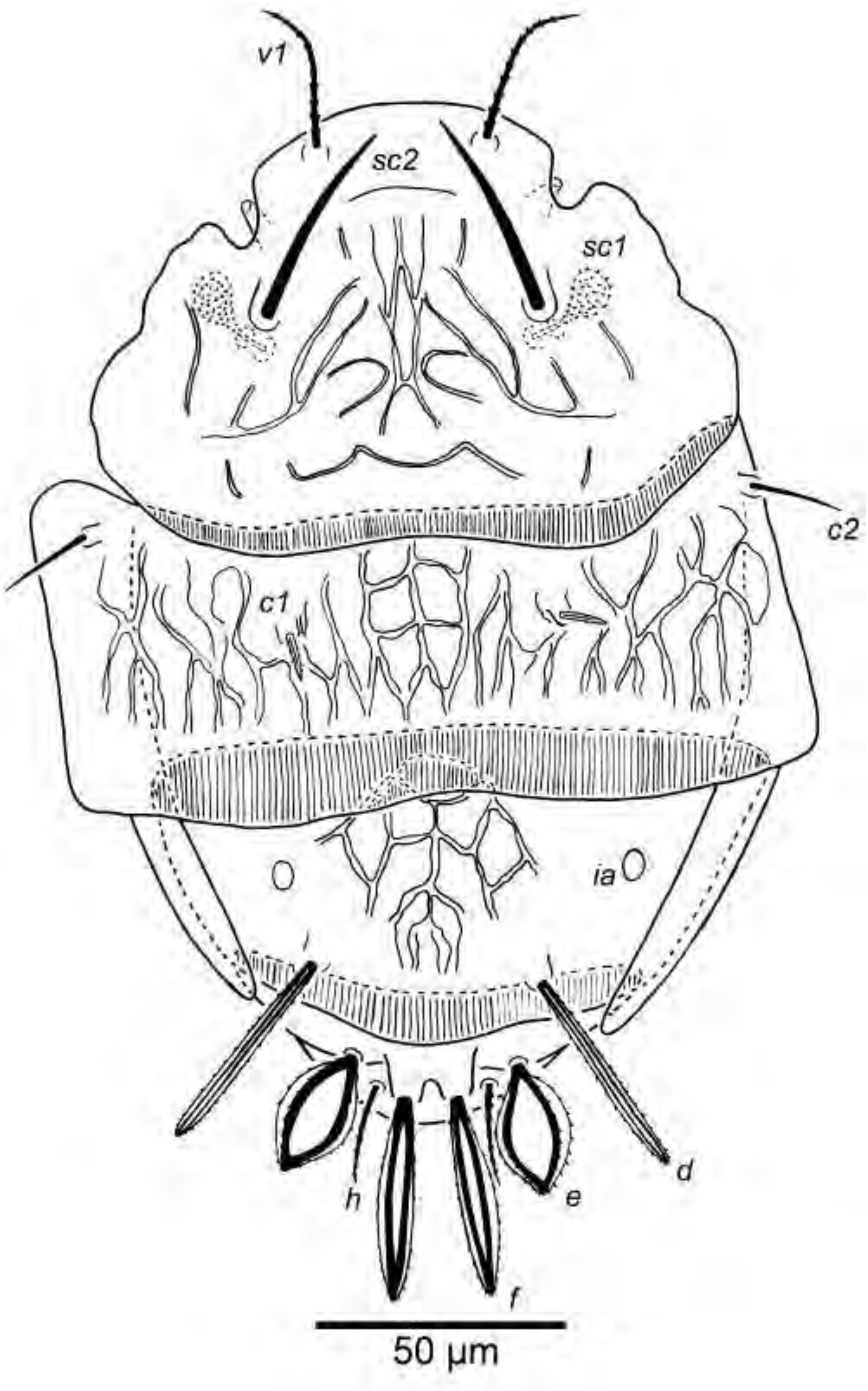

Fig. 5. *Daidalotarsonemus azofeifai* sp. n. (female). Dorsal surface.

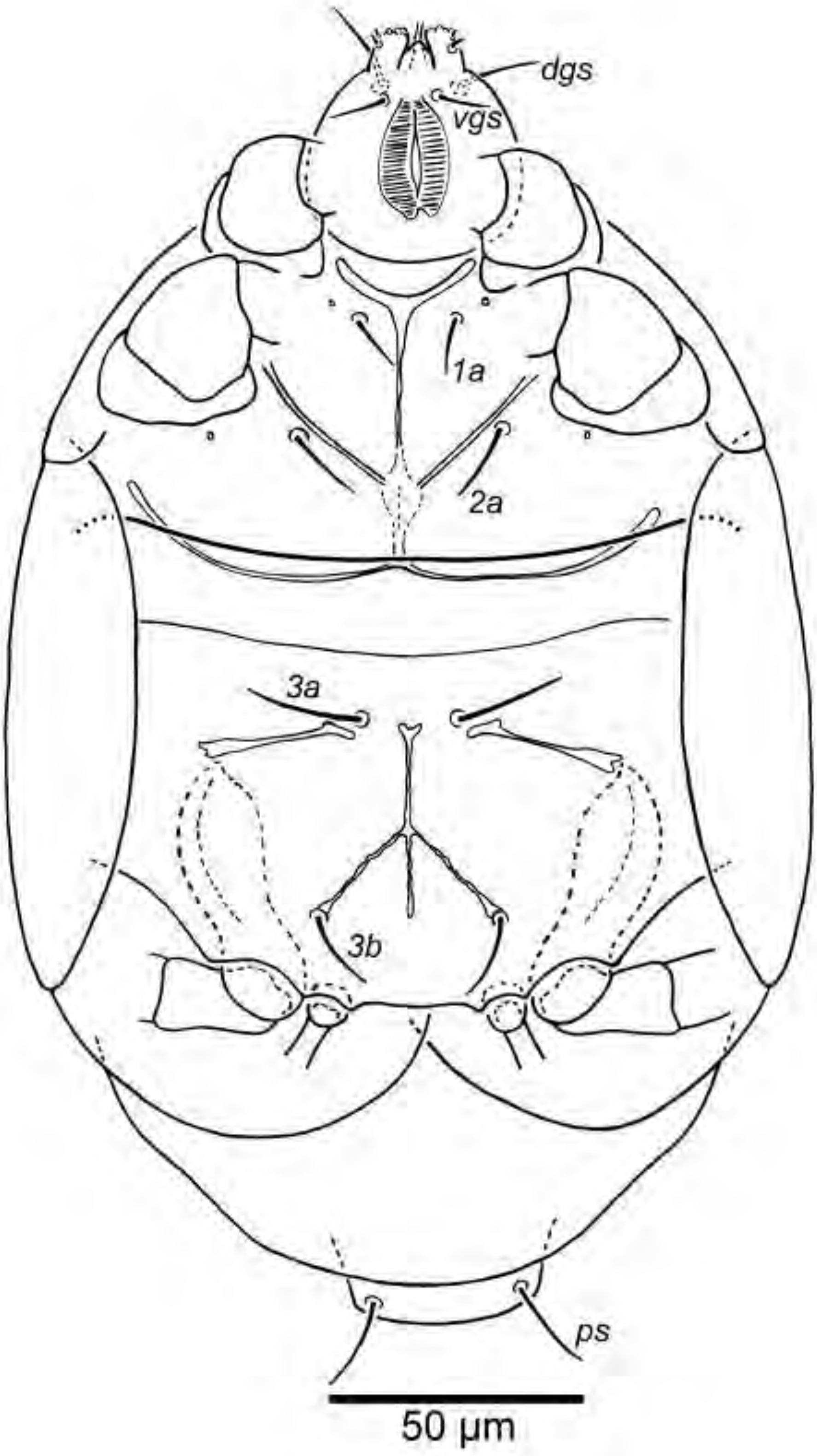

Fig. 6. *Daidalotarsonemus azofeifai* sp. n. (female). Ventral surface.

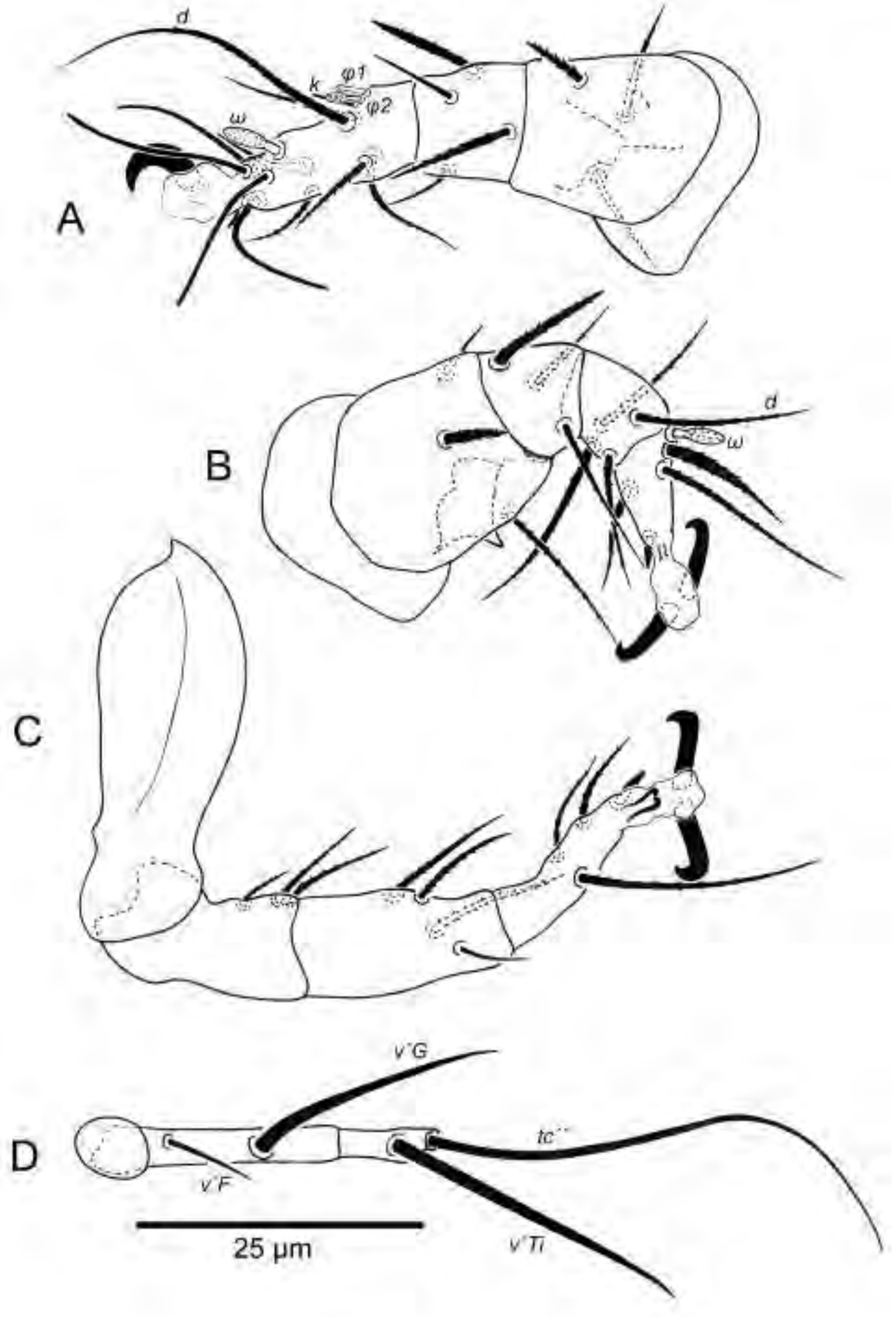

Fig. 7. *Daidalotarsonemus azofeifai* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

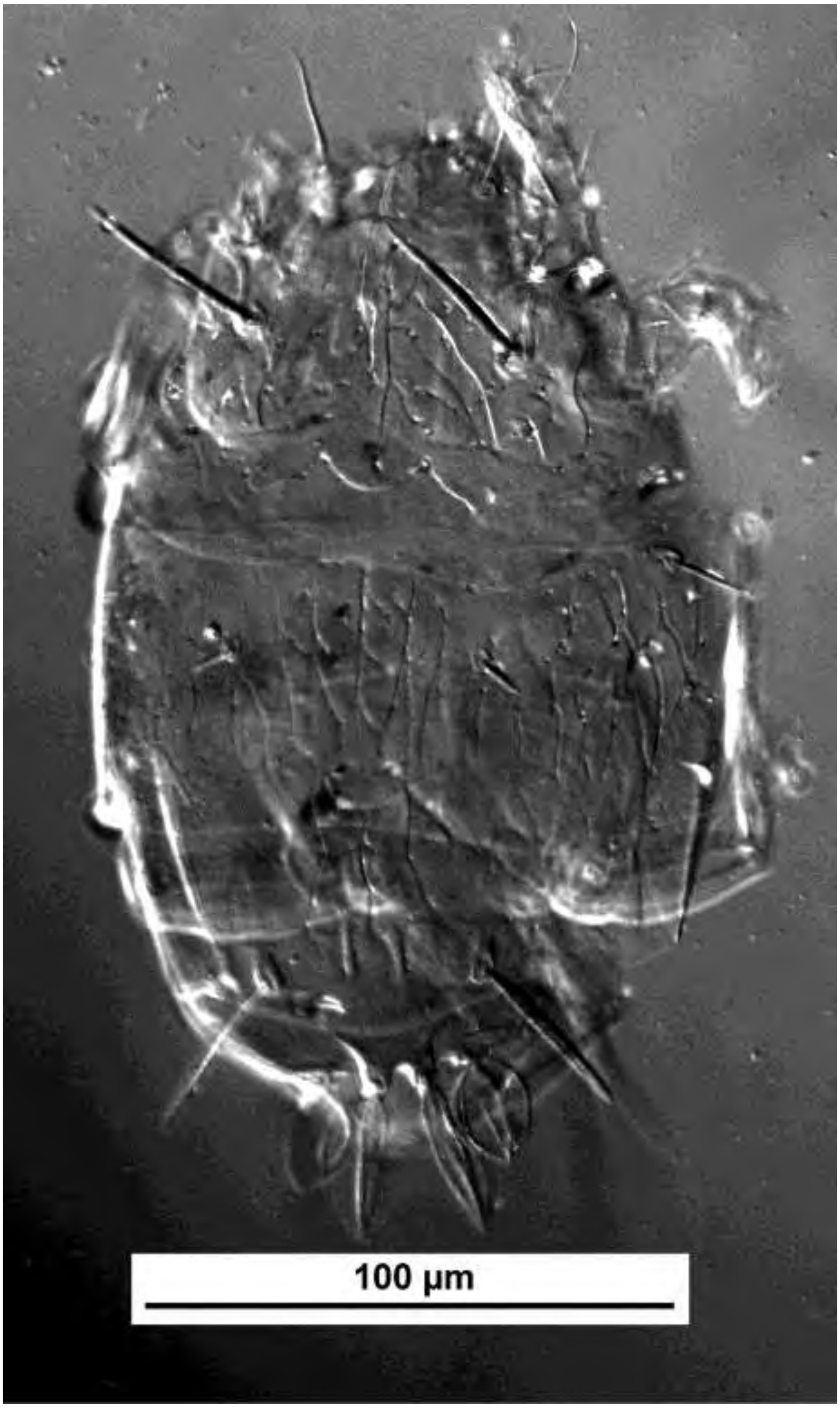

Fig. 8. *Daidalotarsonemus azofeifai* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

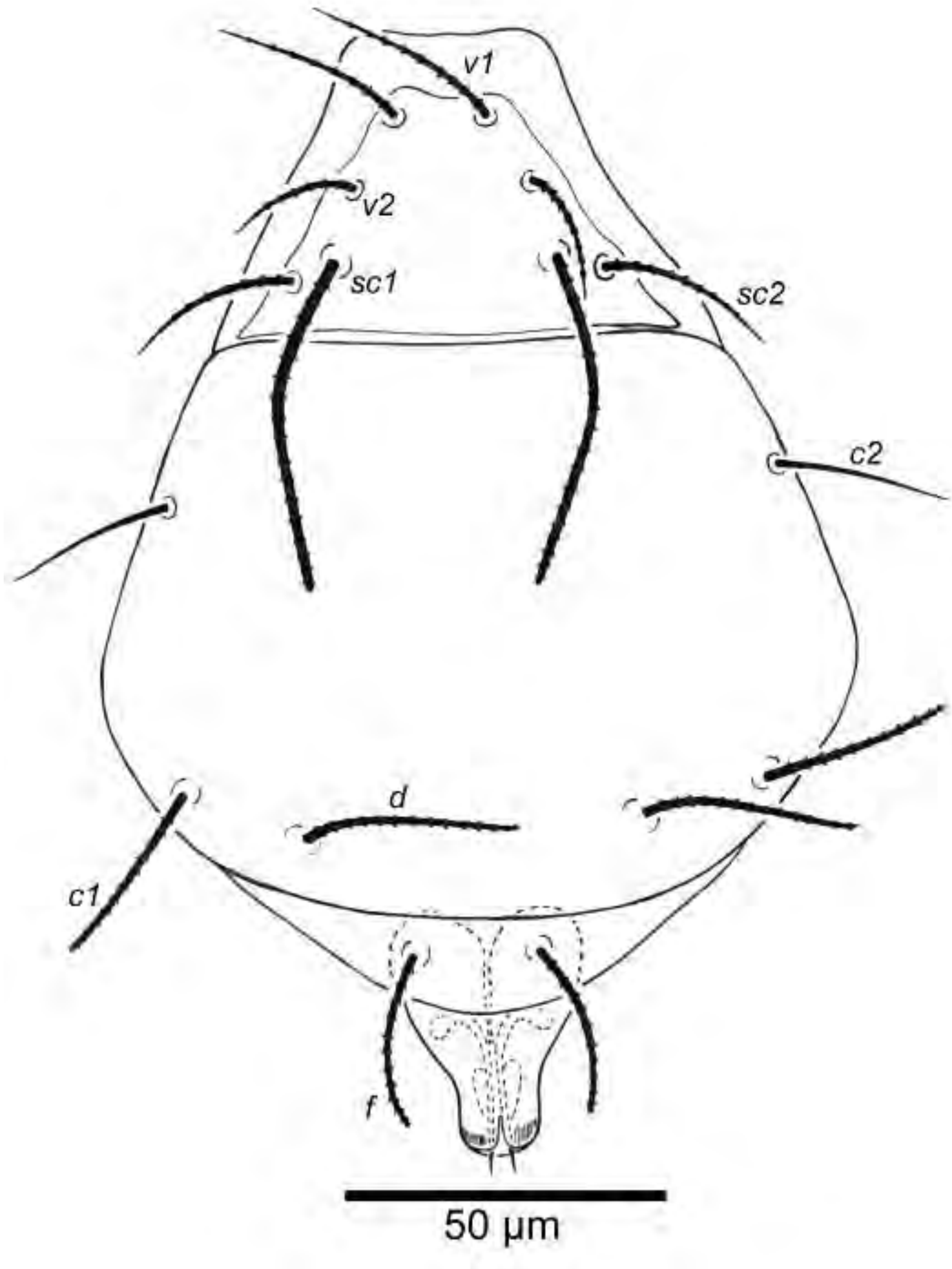

Fig. 9. *Daidalotarsonemus azofeifai* sp. n. (male). Dorsal surface.

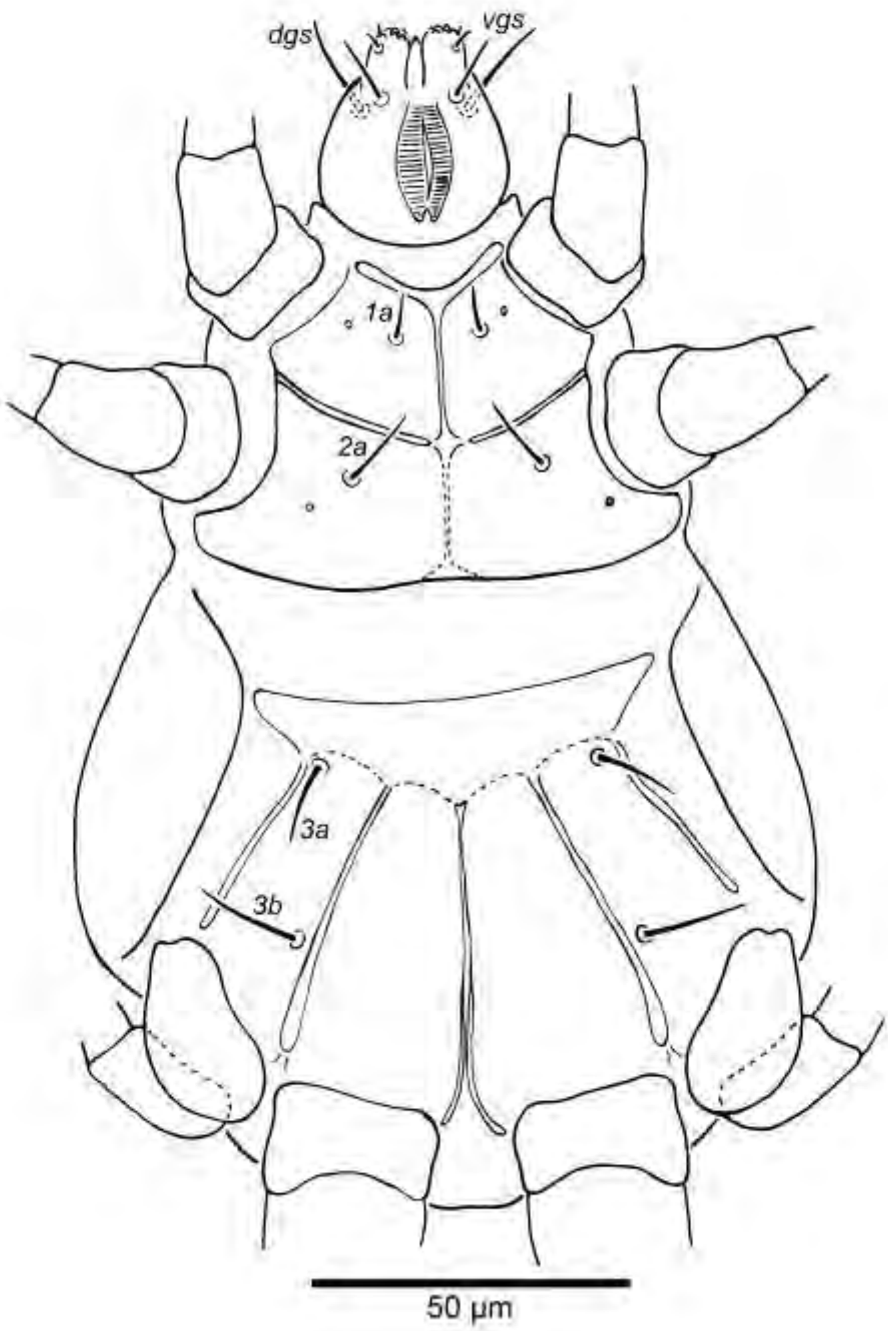

Fig. 10. *Daidalotarsonemus azofeifai* sp. n. (male). Ventral surface.

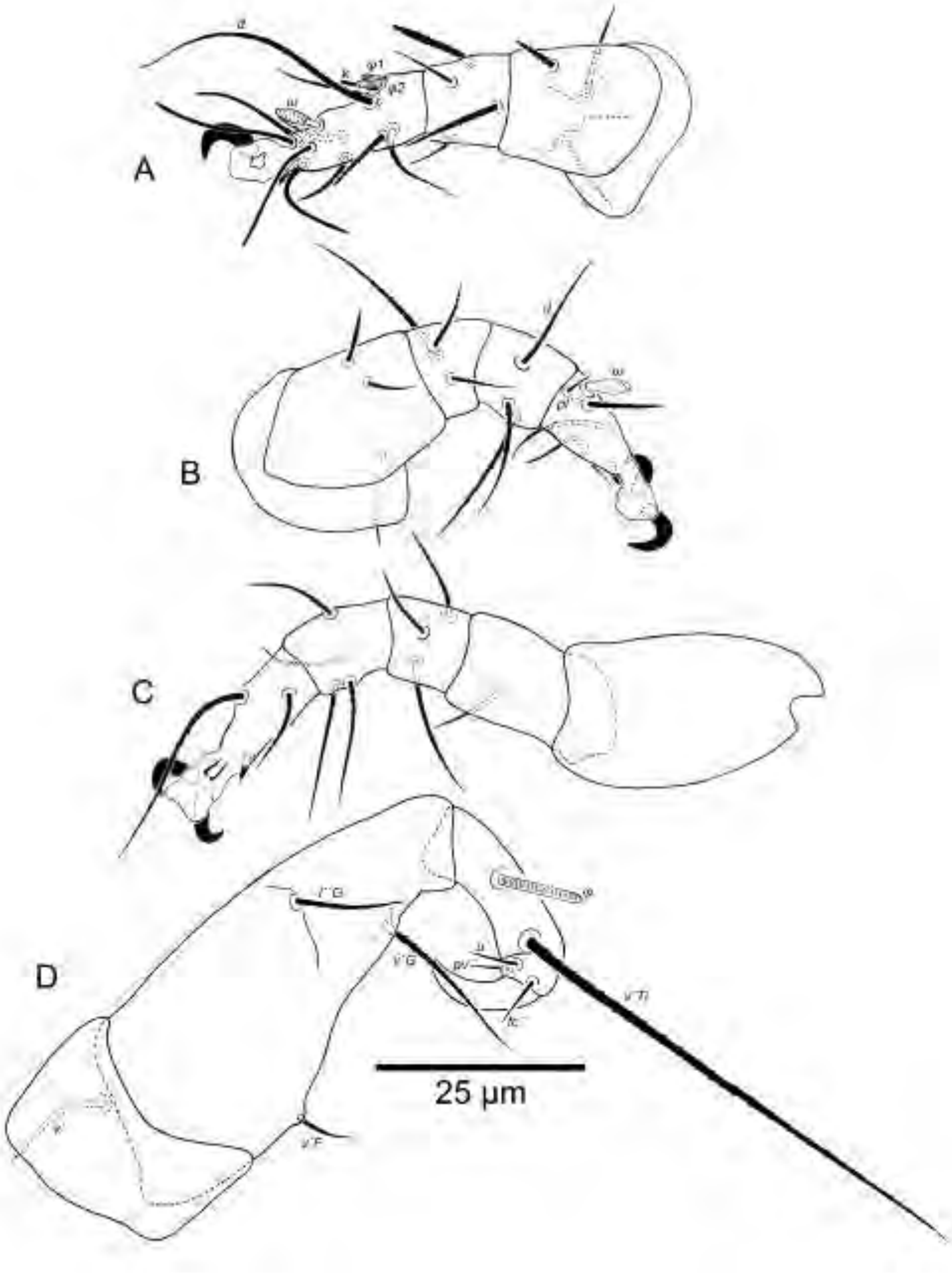

Fig. 11. *Daidalotarsonemus azofeifai* sp. n. (male). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

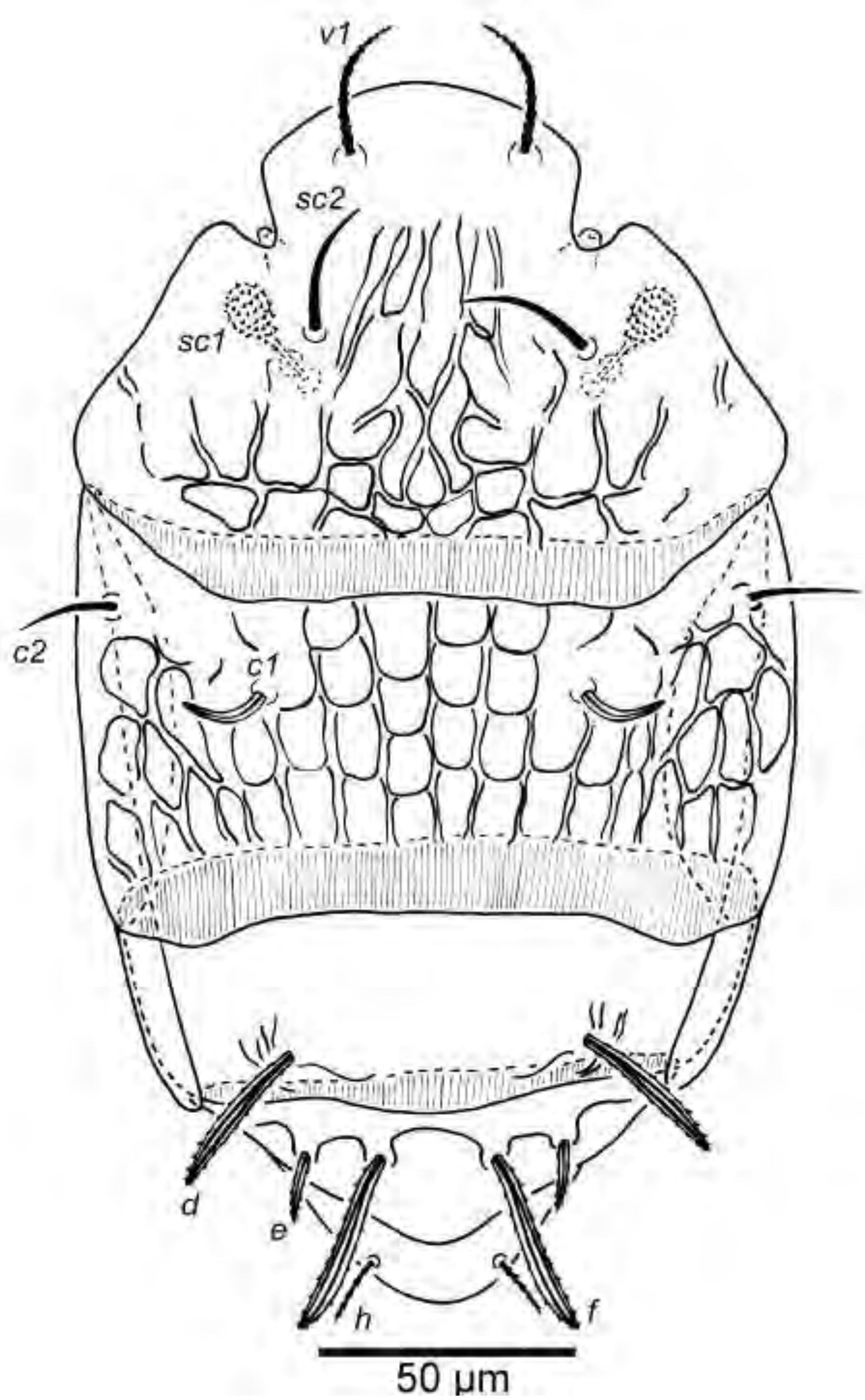

Fig. 12. *Daidalotarsonemus bauchani* sp. n. (female). Dorsal surface.

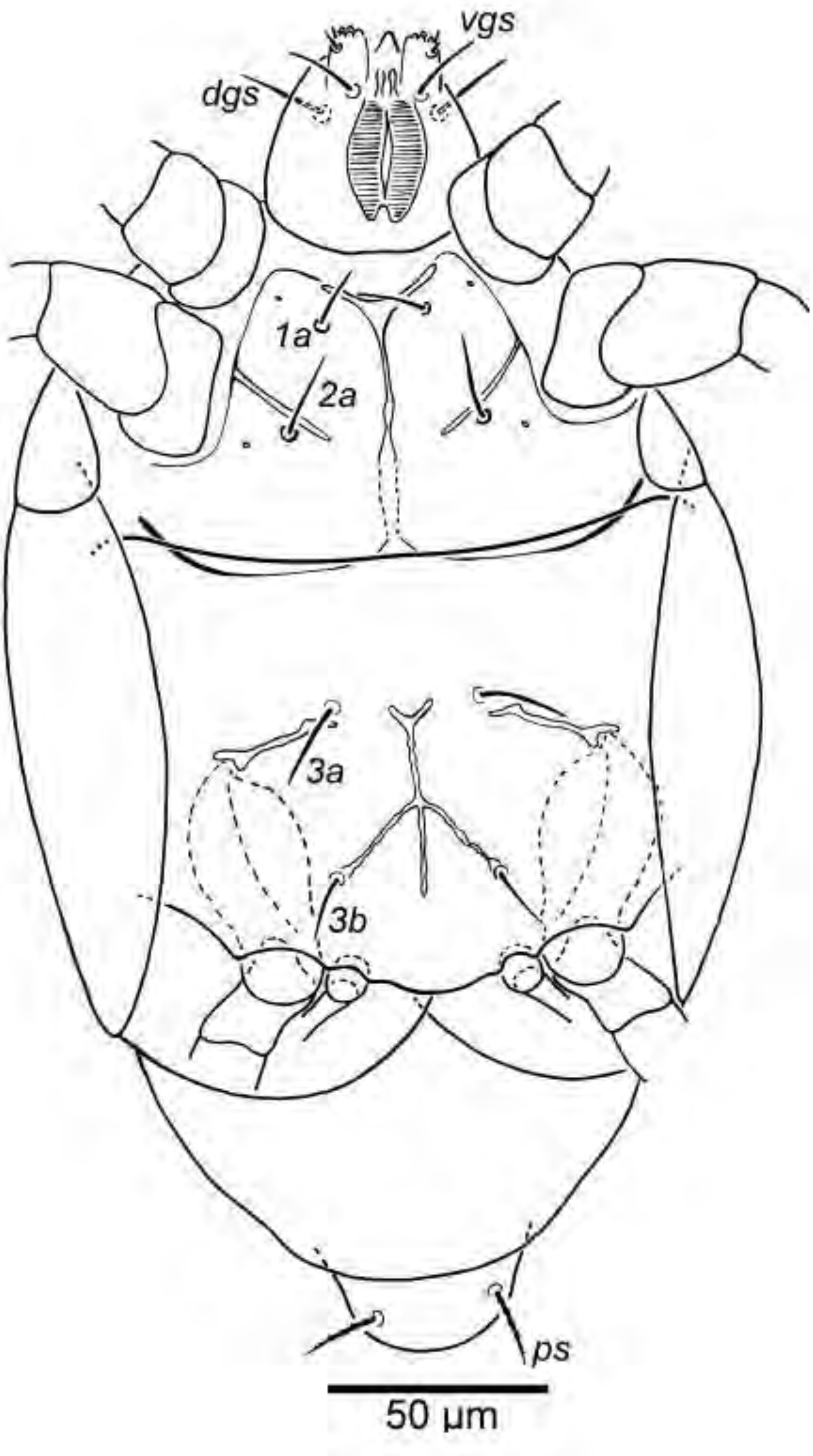

Fig. 13. *Daidalotarsonemus bauchani* sp. n. (female). Ventral surface.

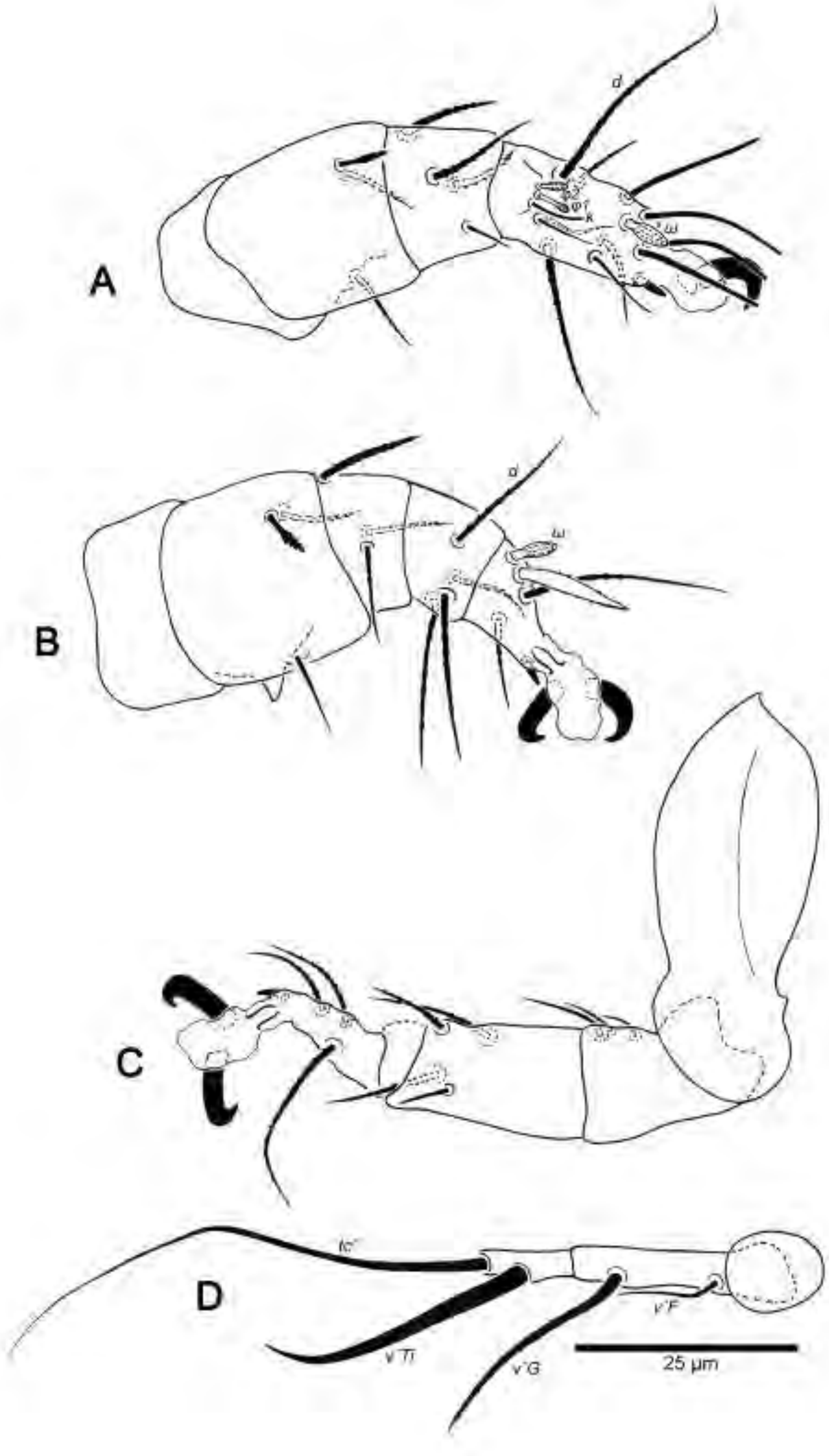

Fig. 14. *Daidalotarsonemus bauchani* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Fig. 15. *Daidalotarsonemus bauchani* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

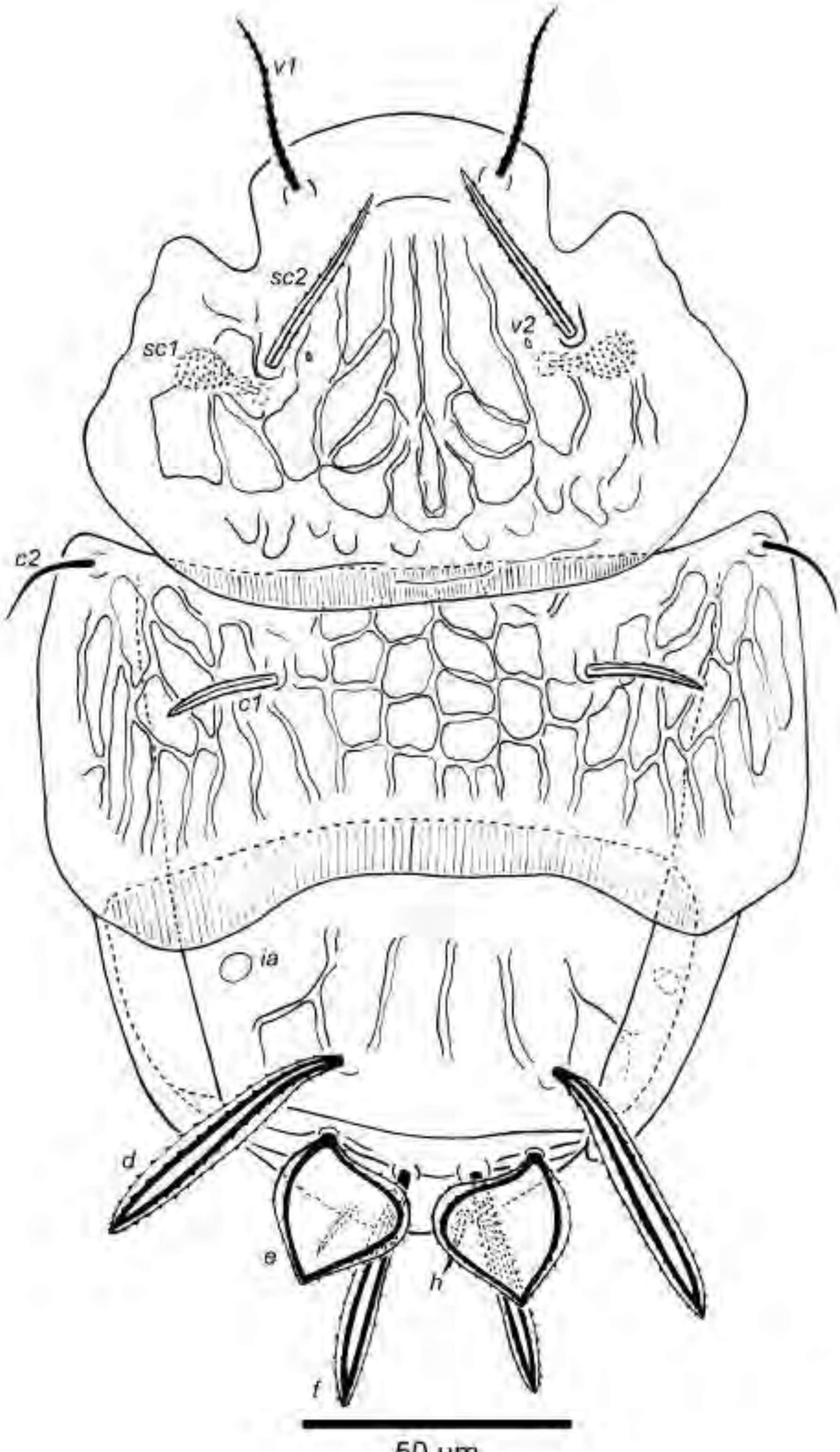

Fig. 16. *Daidalotarsonemus cuadradus* sp. n. (female). Dorsal surface.

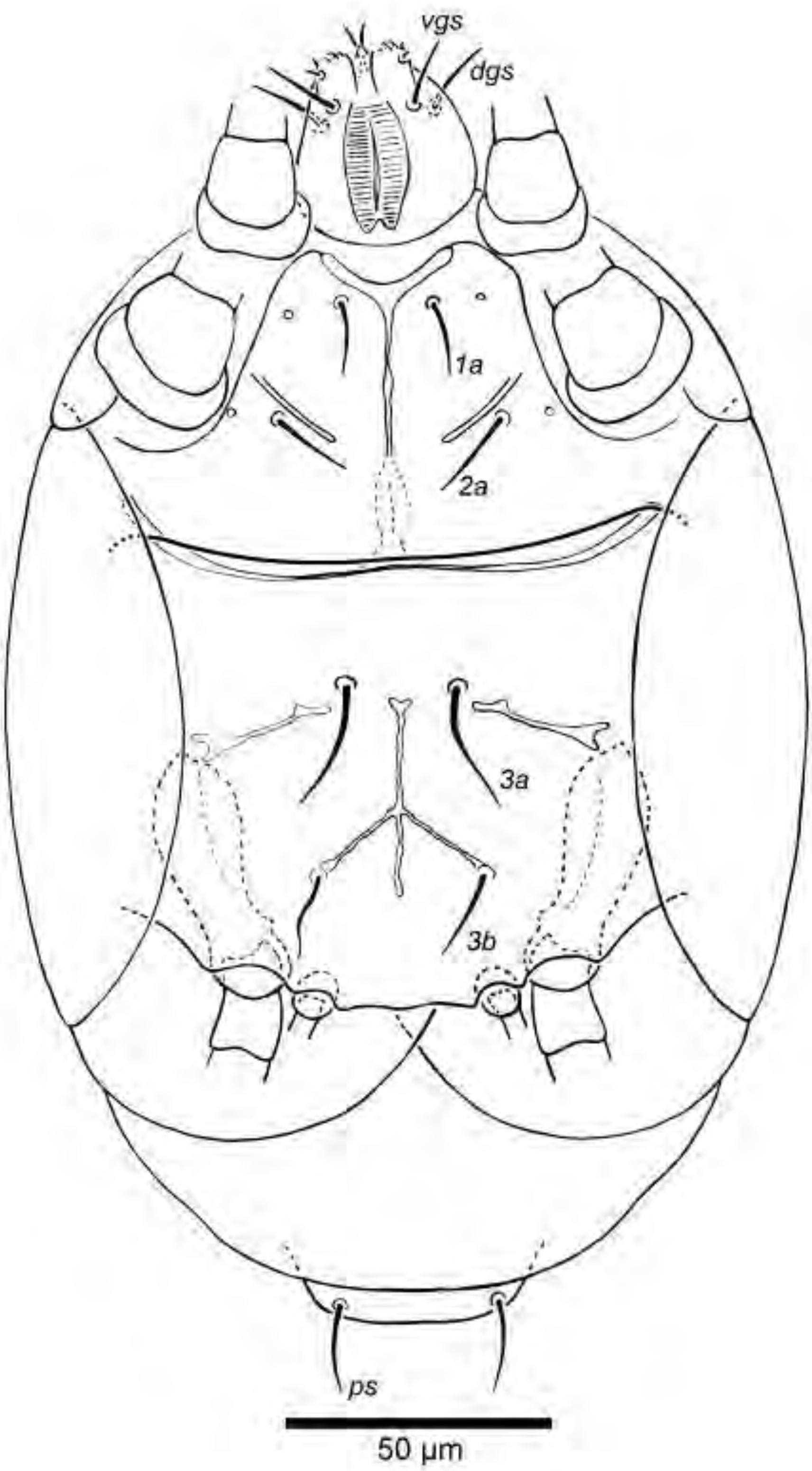

Fig. 17. *Daidalotarsonemus cuadradus* sp. n. (female). Ventral surface.

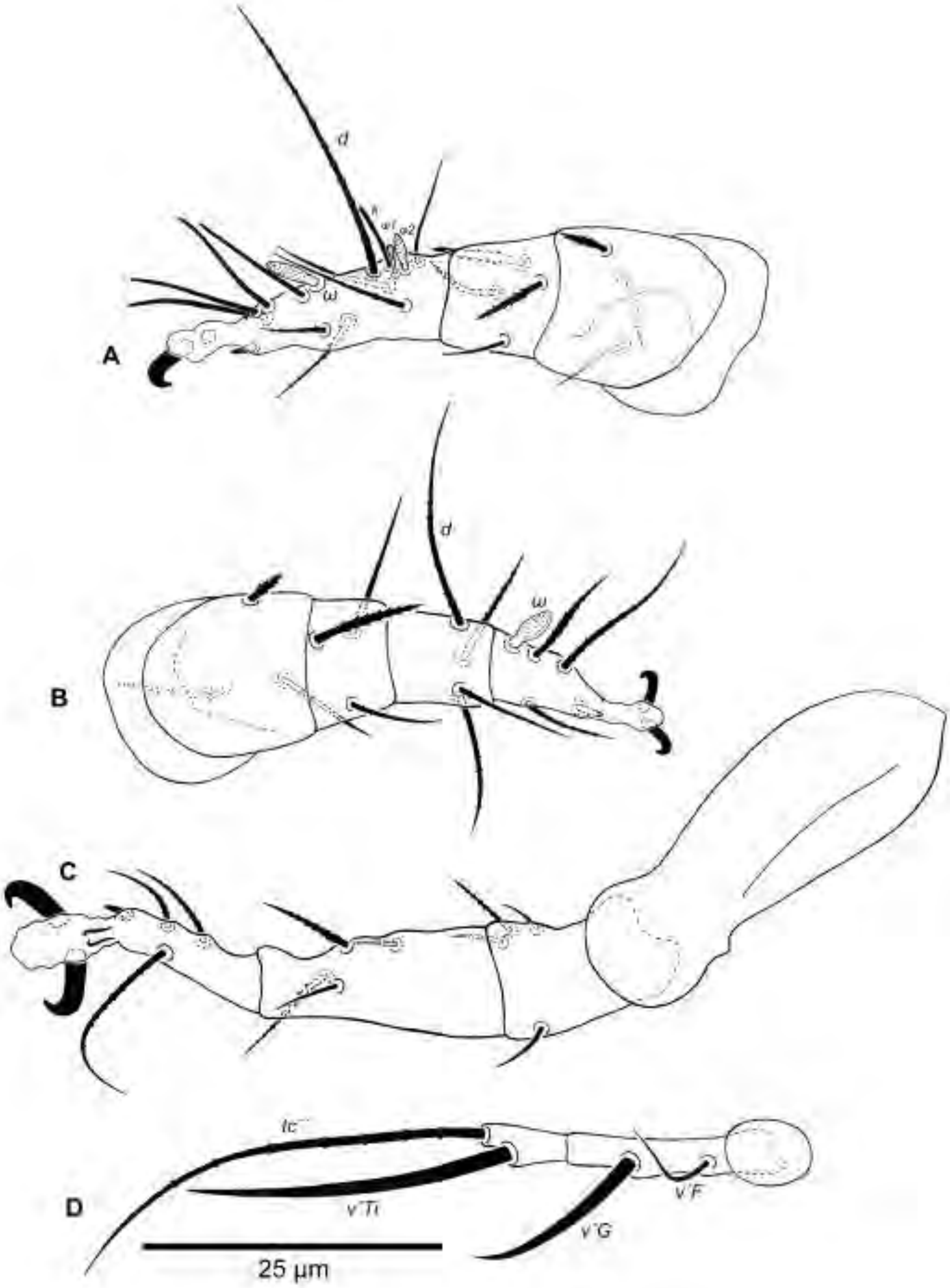

Fig. 18. *Daidalotarsonemus cuadradus* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

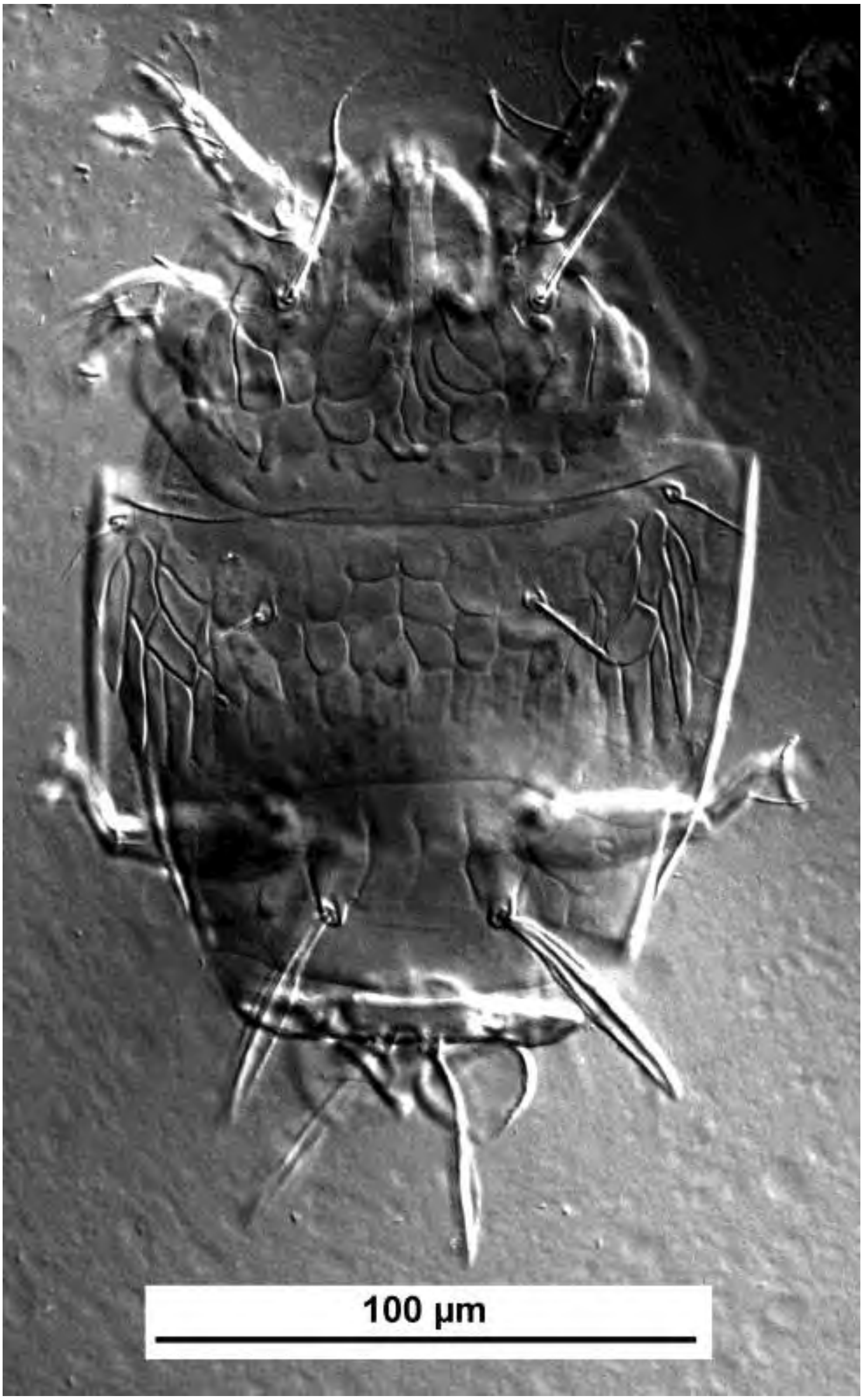

Fig. 19. *Daidalotarsonemus cuadradus* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

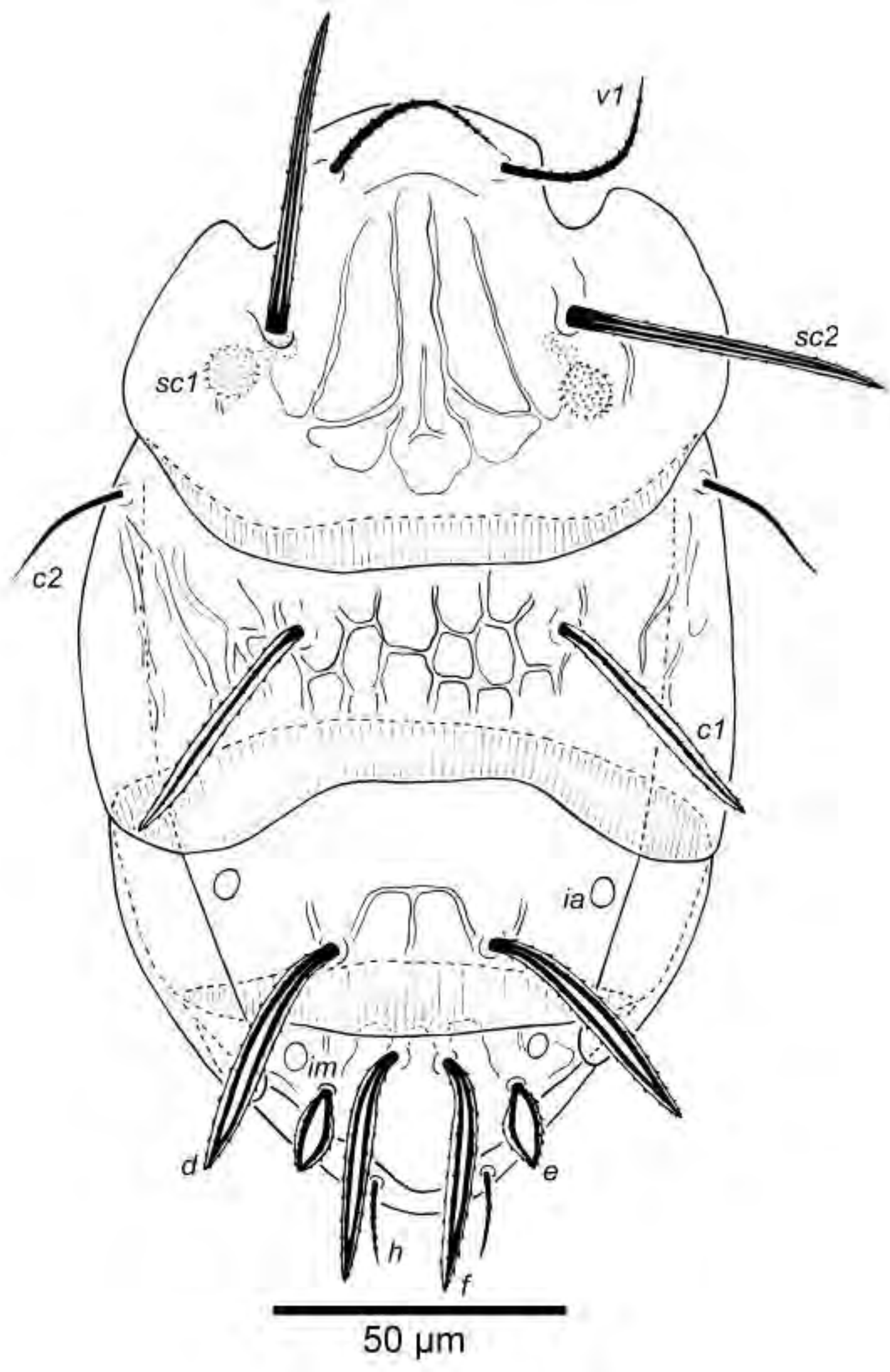

Fig. 20. *Daidalotarsonemus ginae* sp. n. (female). Dorsal surface.

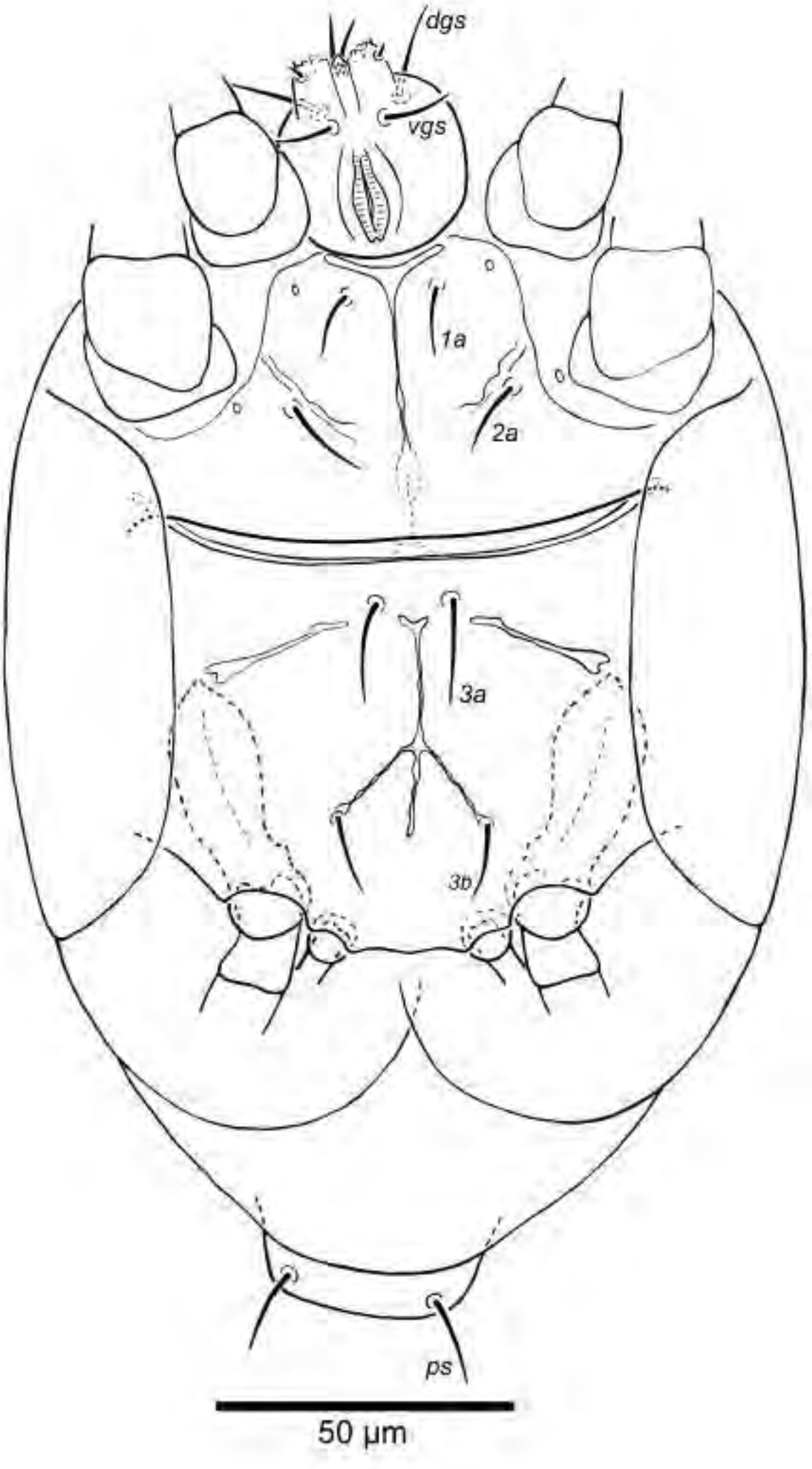

Fig. 21. *Daidalotarsonemus ginae* sp. n. (female). Ventral surface.

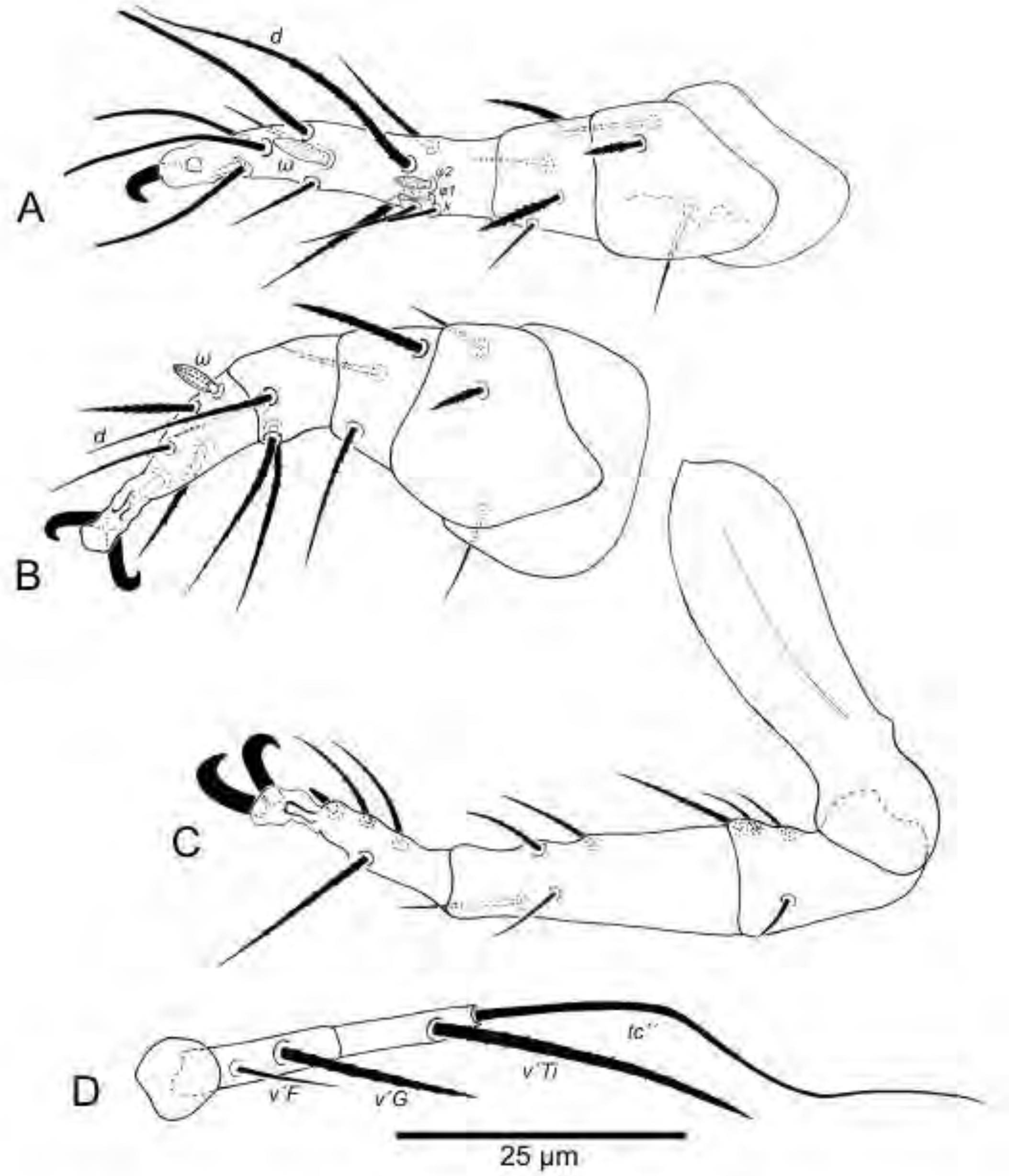

Fig. 22. *Daidalotarsonemus ginae* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

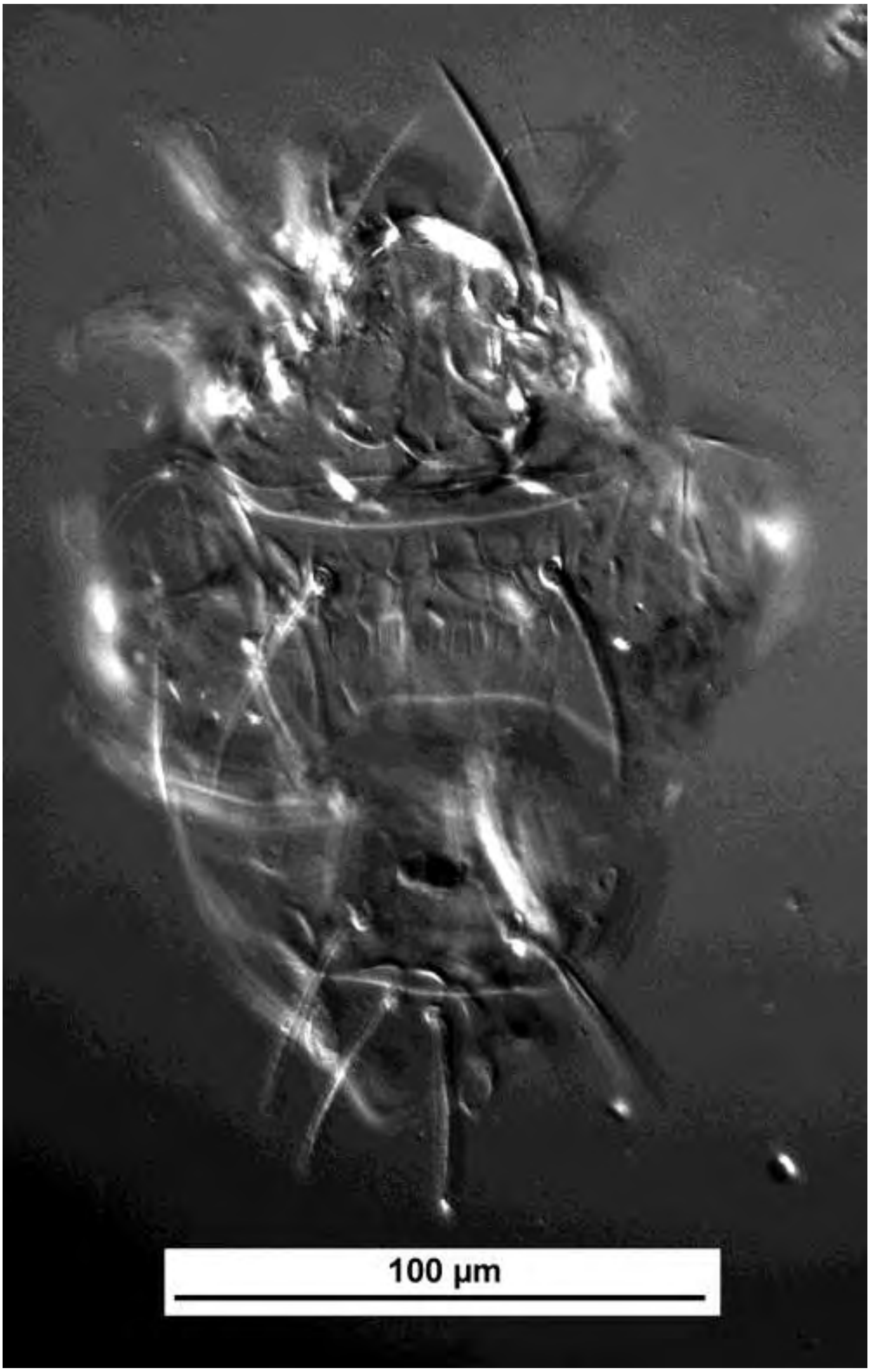

Fig. 23. *Daidalotarsonemus ginae* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

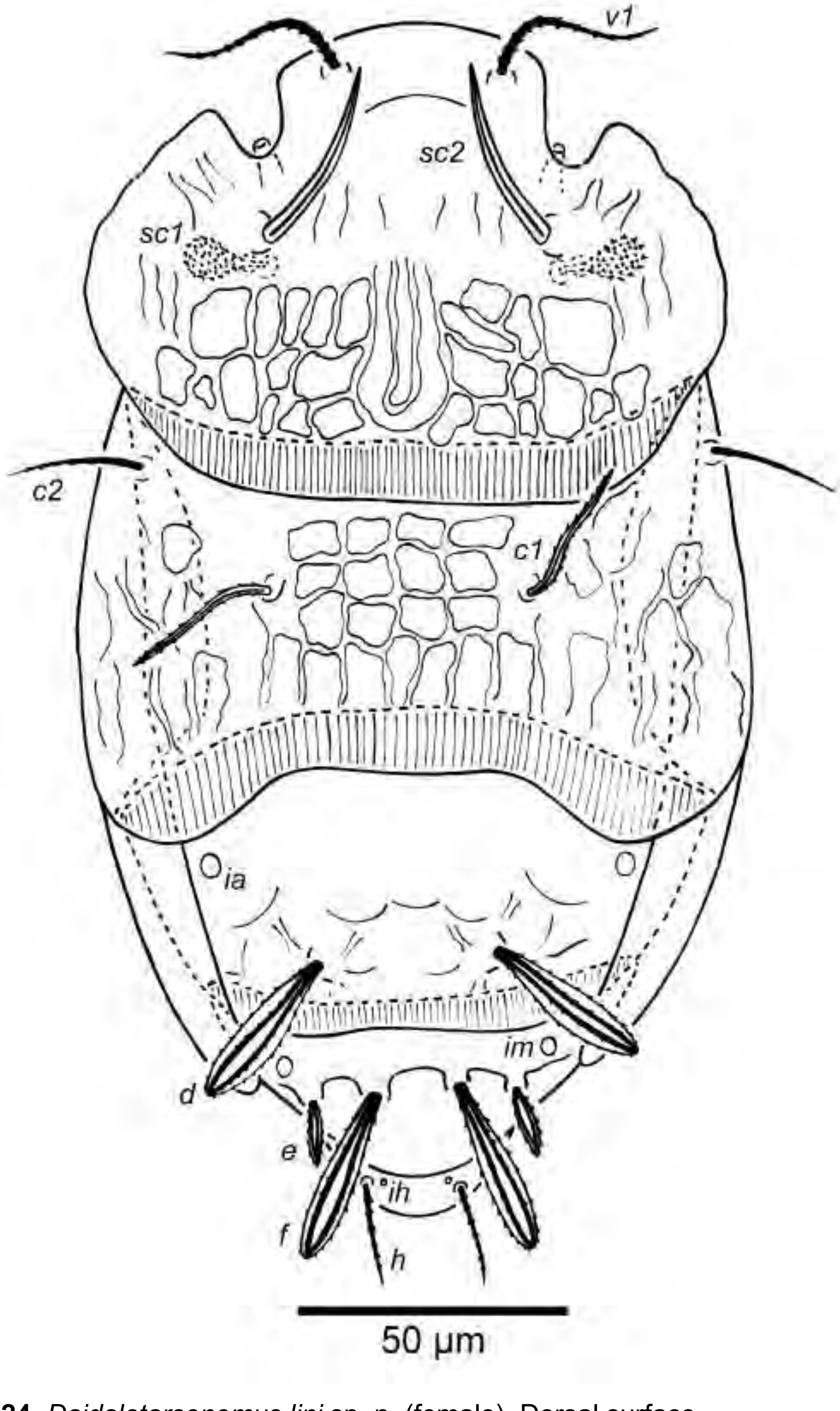

Fig. 24. *Daidalotarsonemus lini* sp. n. (female). Dorsal surface.

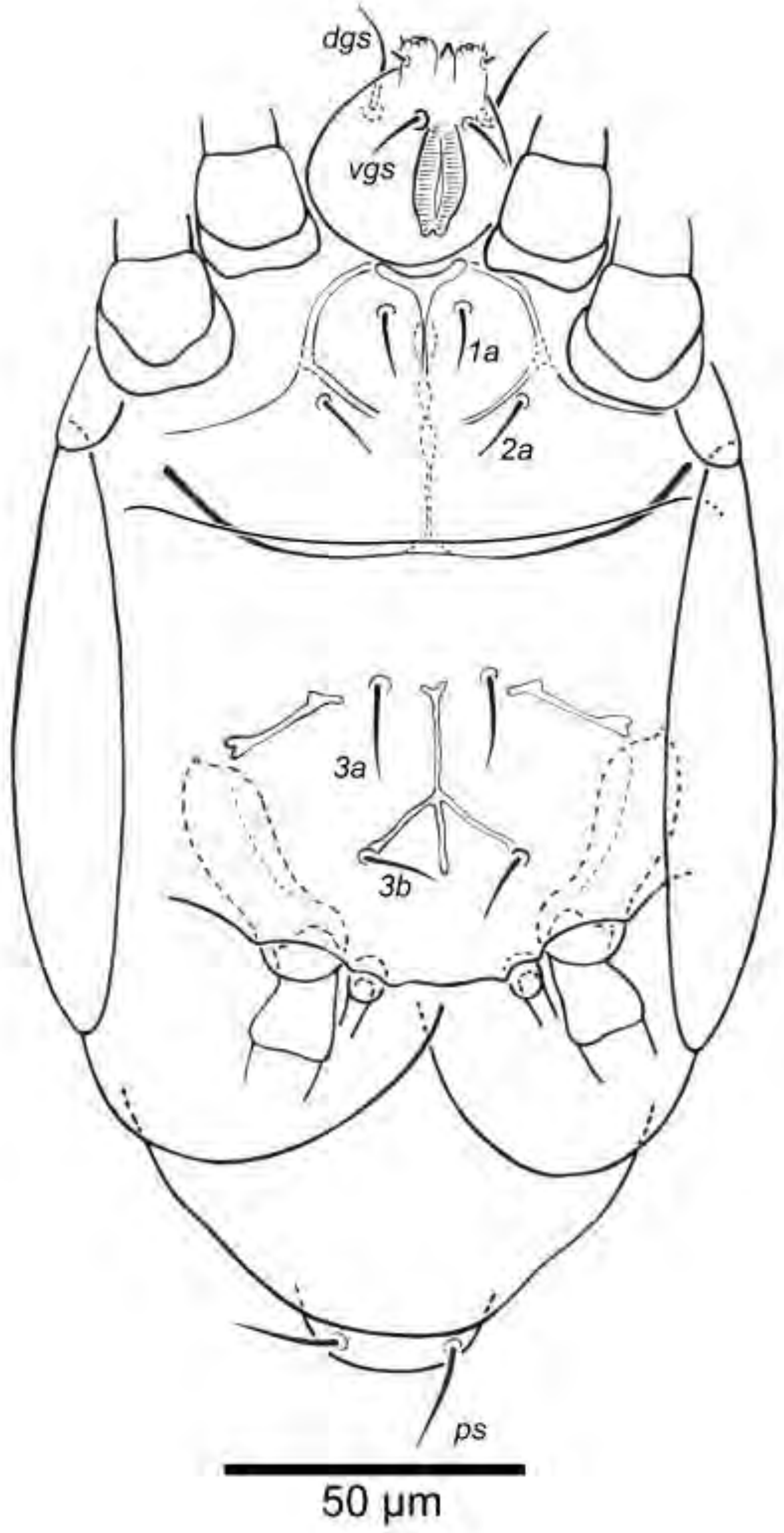

Fig. 25. *Daidalotarsonemus lini* sp. n. (female). Ventral surface.

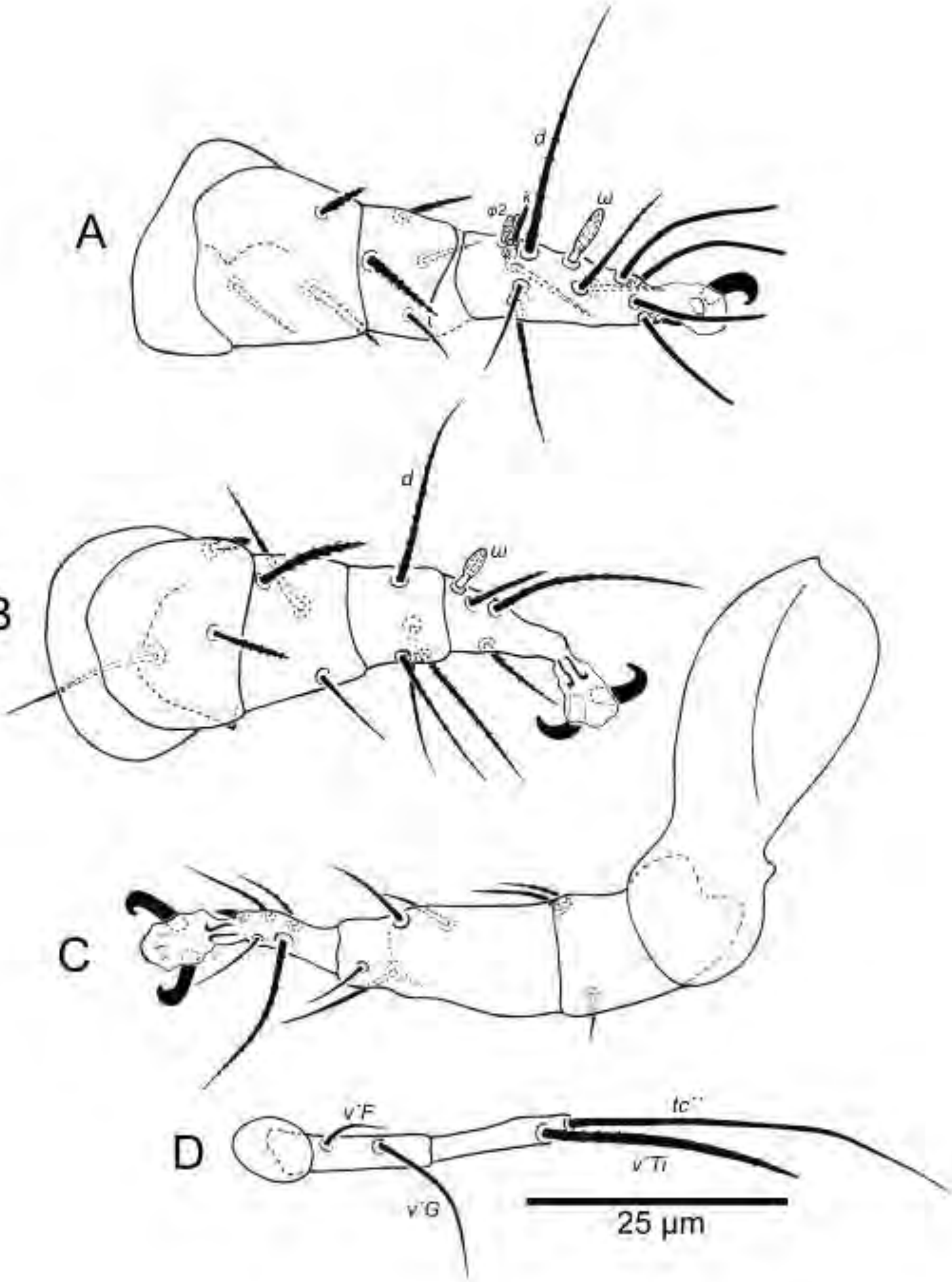

Fig. 26. *Daidalotarsonemus lini* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Fig. 27. *Daidalotarsonemus lini* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

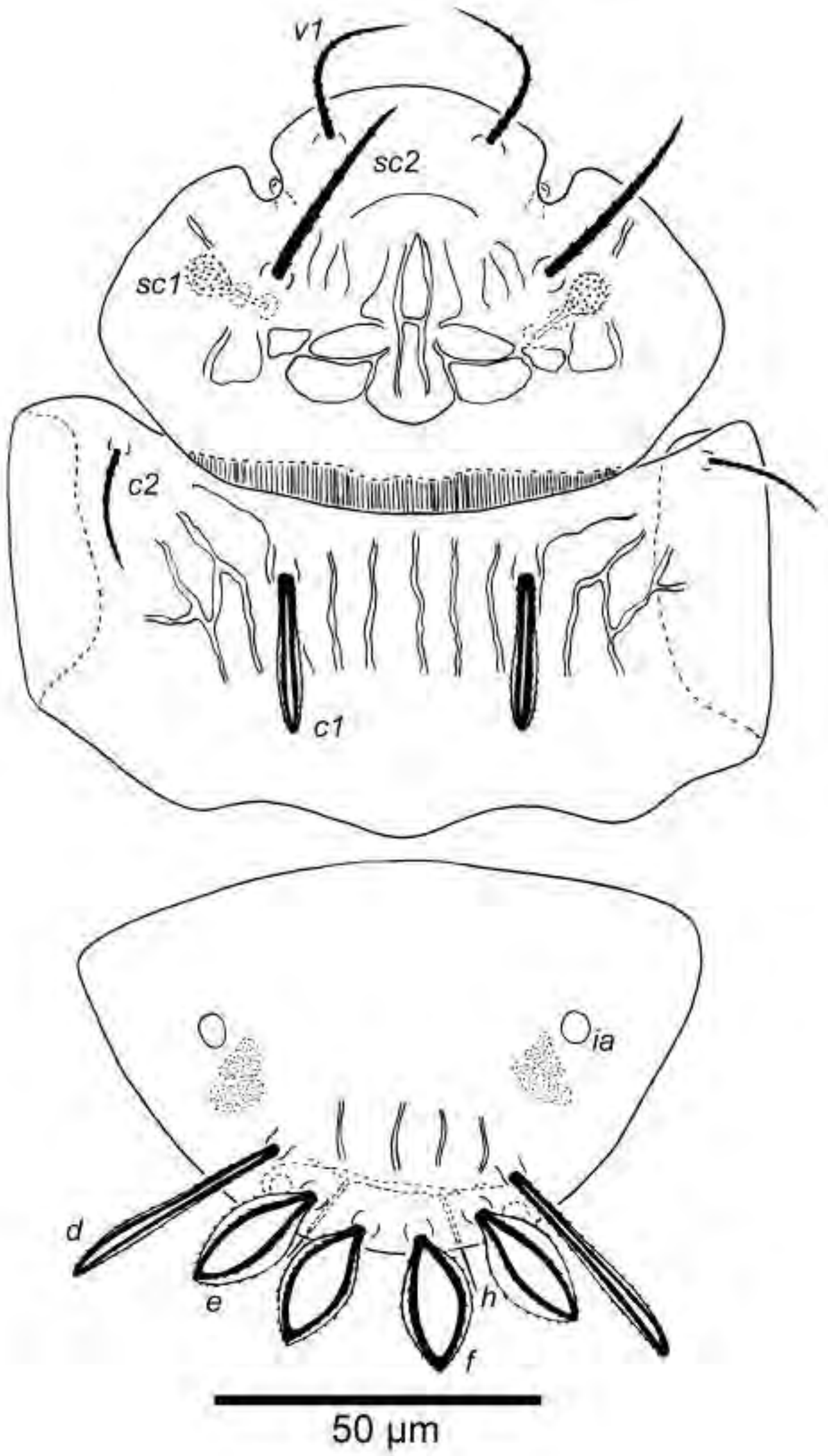

Fig. 28. *Daidalotarsonemus marini* sp. n. (female). Dorsal surface.

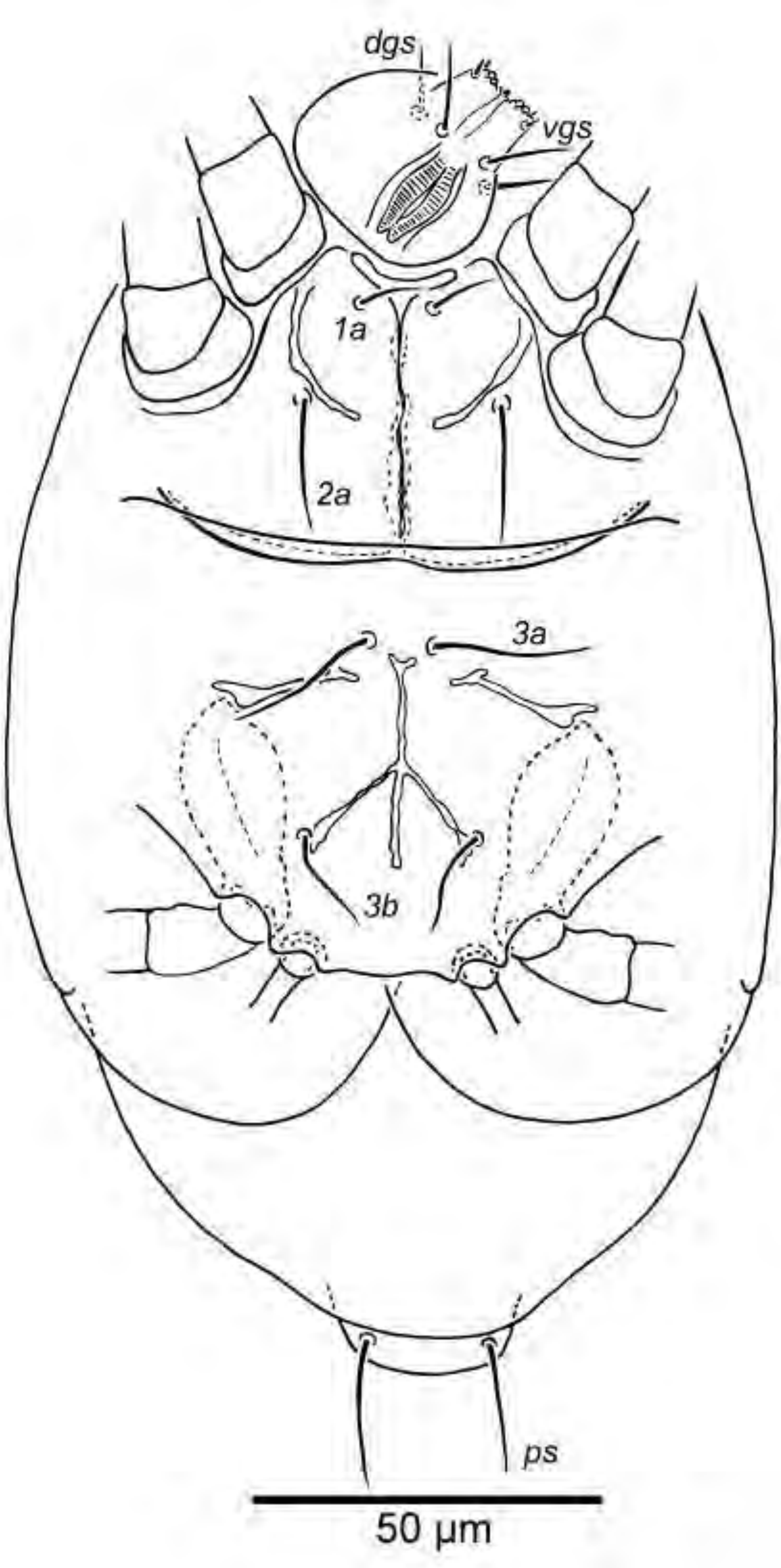

Fig. 29. *Daidalotarsonemus marini* sp. n. (female). Ventral surface.

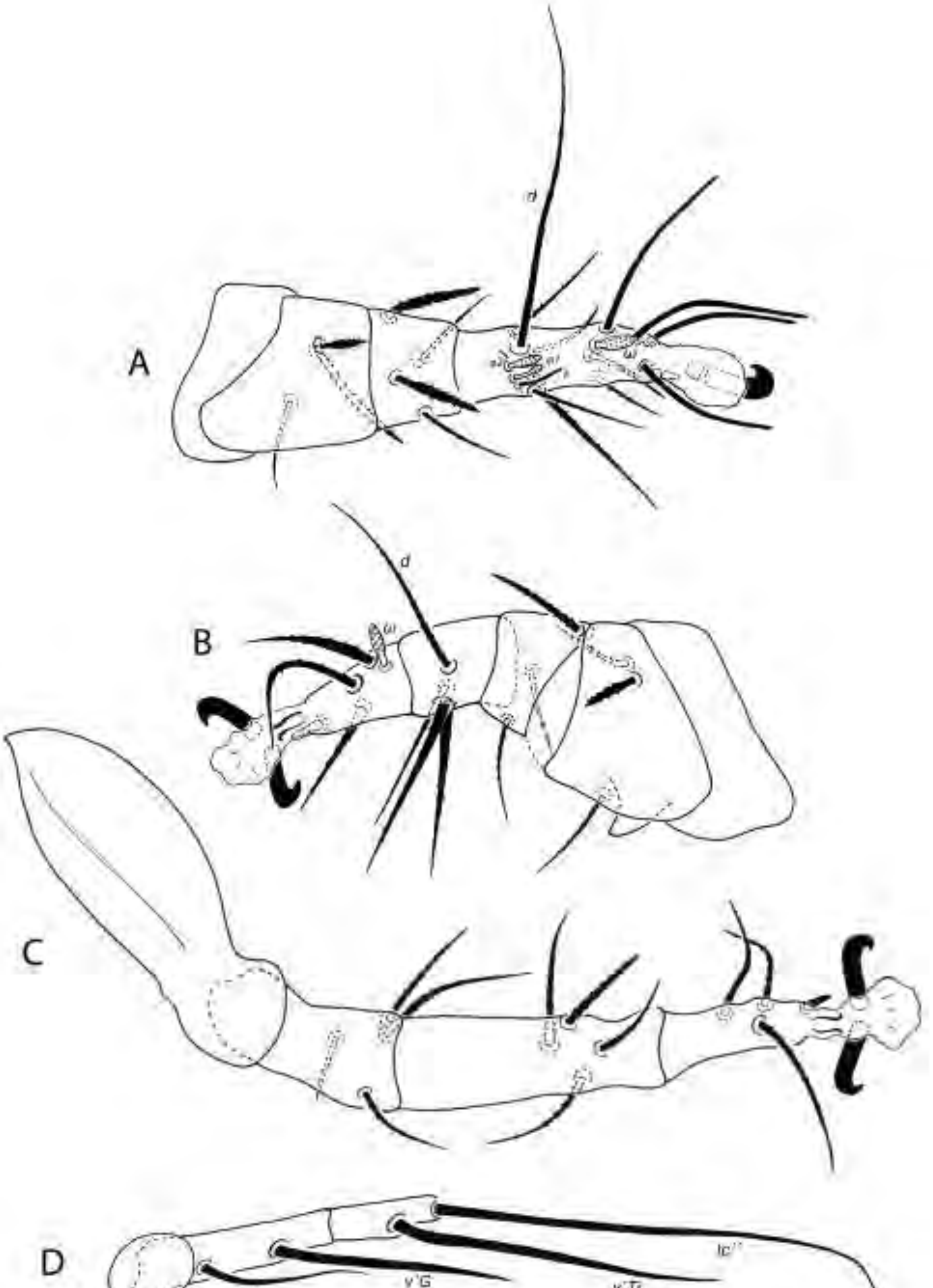

Fig. 30. *Daidalotarsonemus marini* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

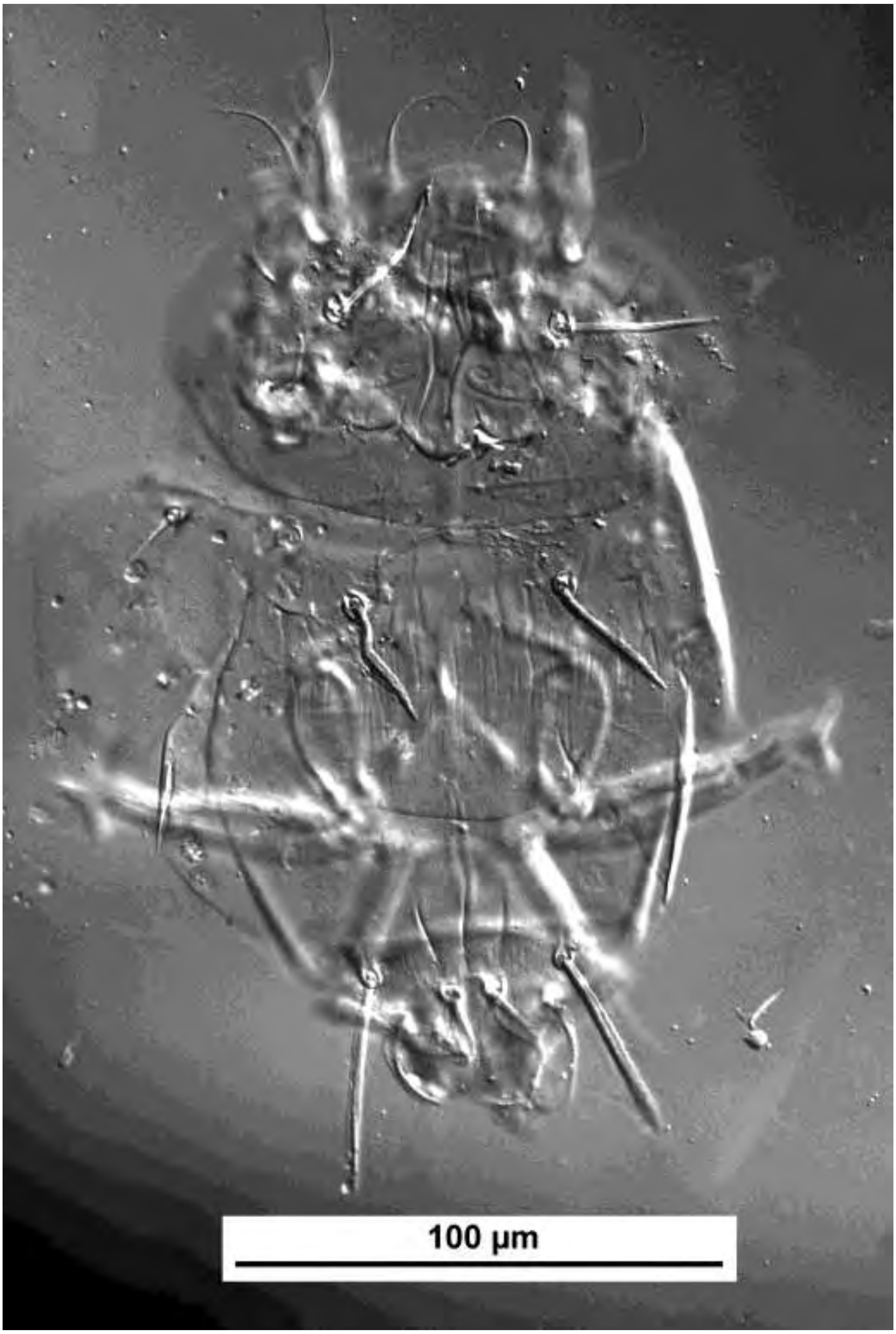

Fig. 31. *Daidalotarsonemus marini* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

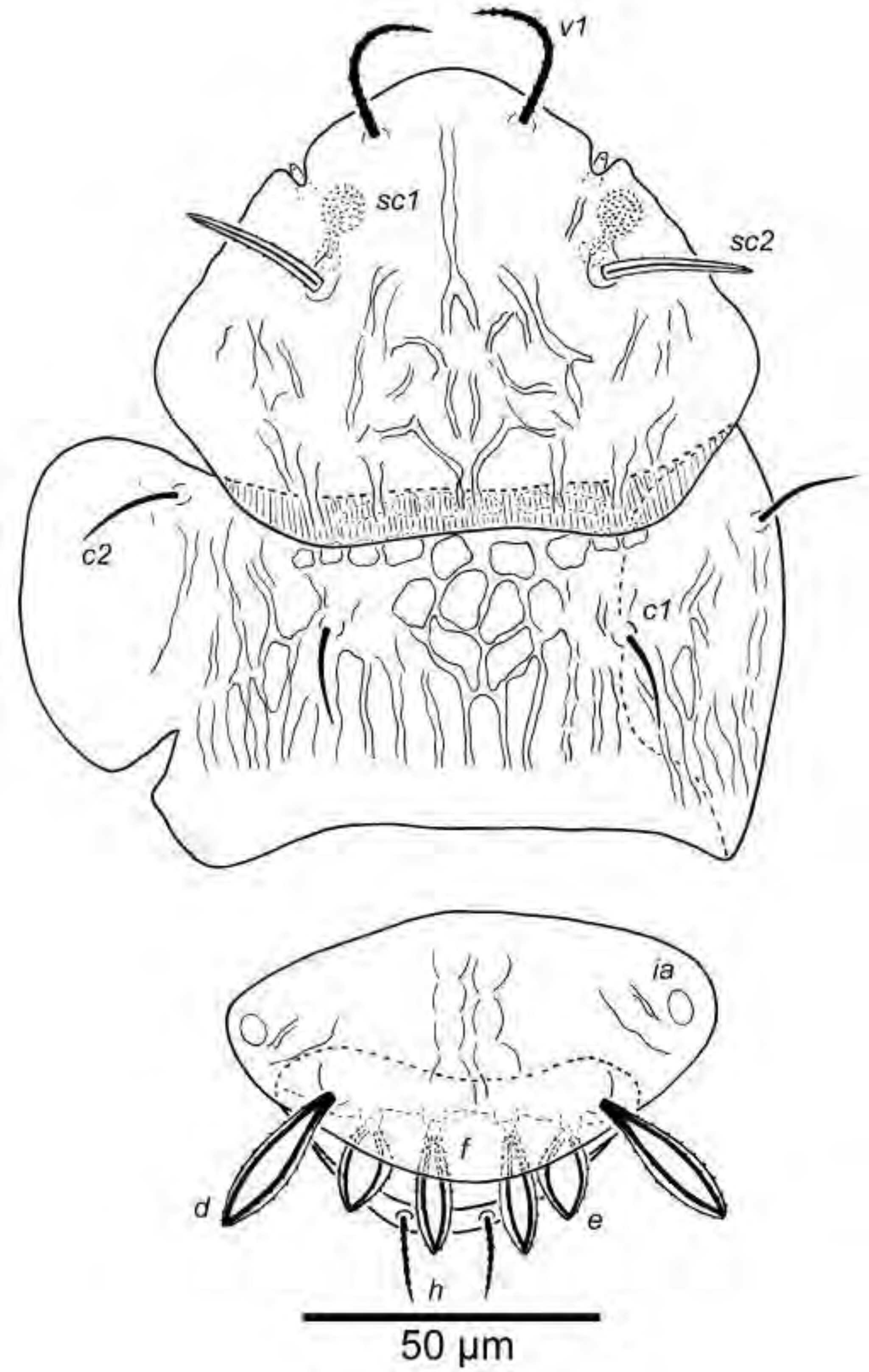

Fig. 32. *Daidalotarsonemus maryae* sp. n. (female). Dorsal surface.

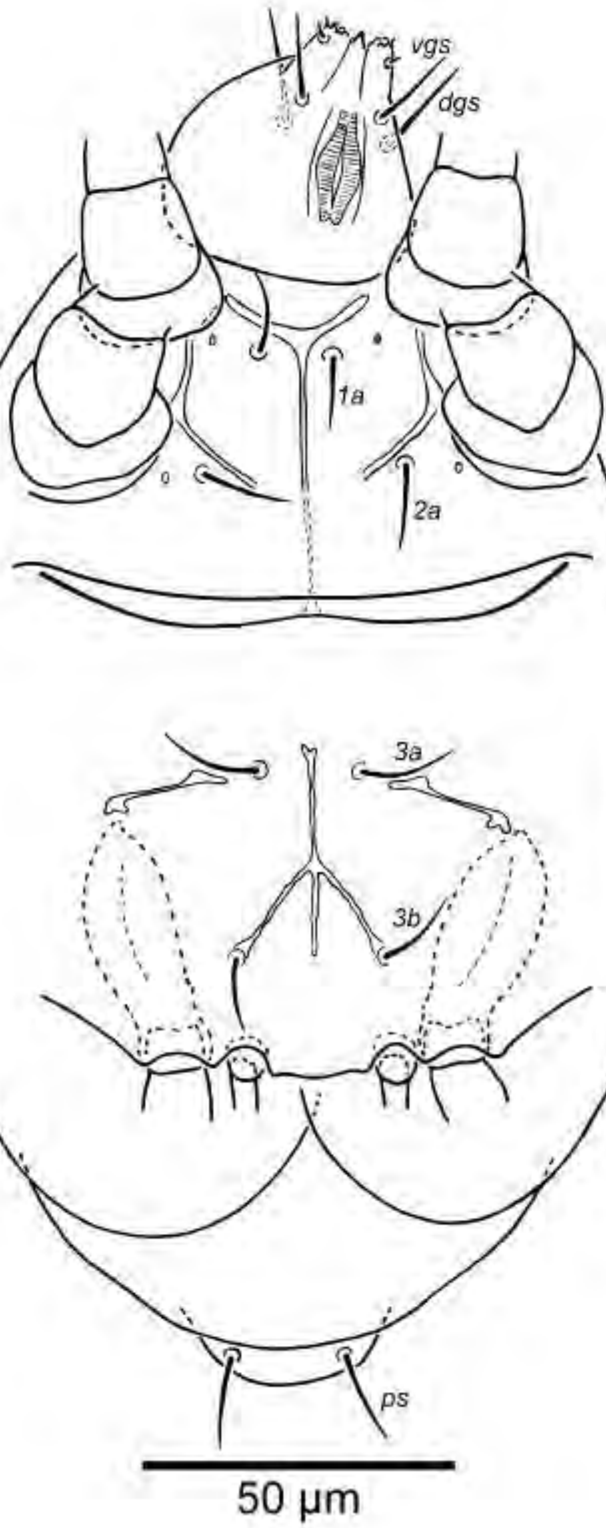

Fig. 33. *Daidalotarsonemus maryae* sp. n. (female). Ventral surface.

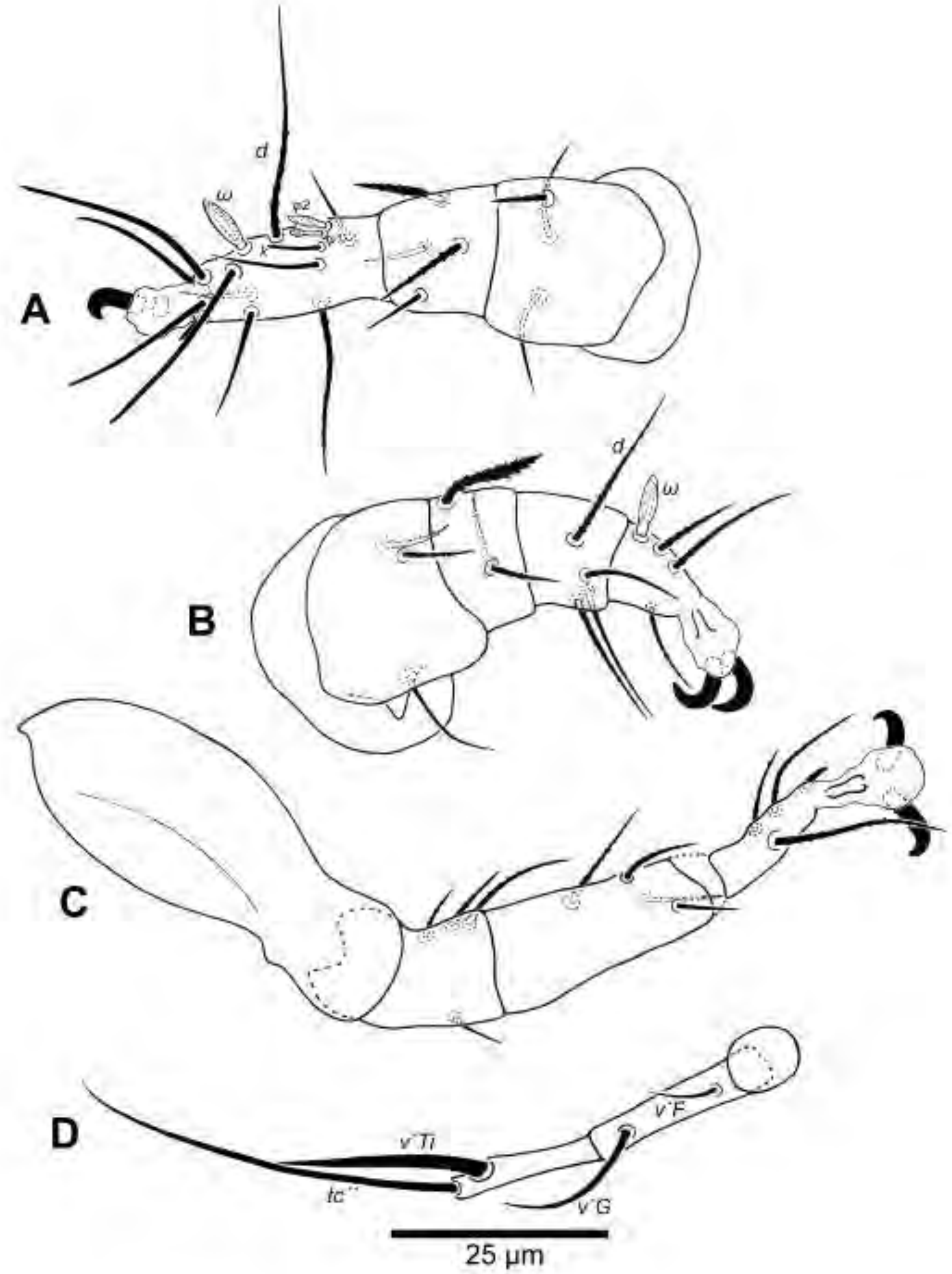

Fig. 34. *Daidalotarsonemus maryae* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

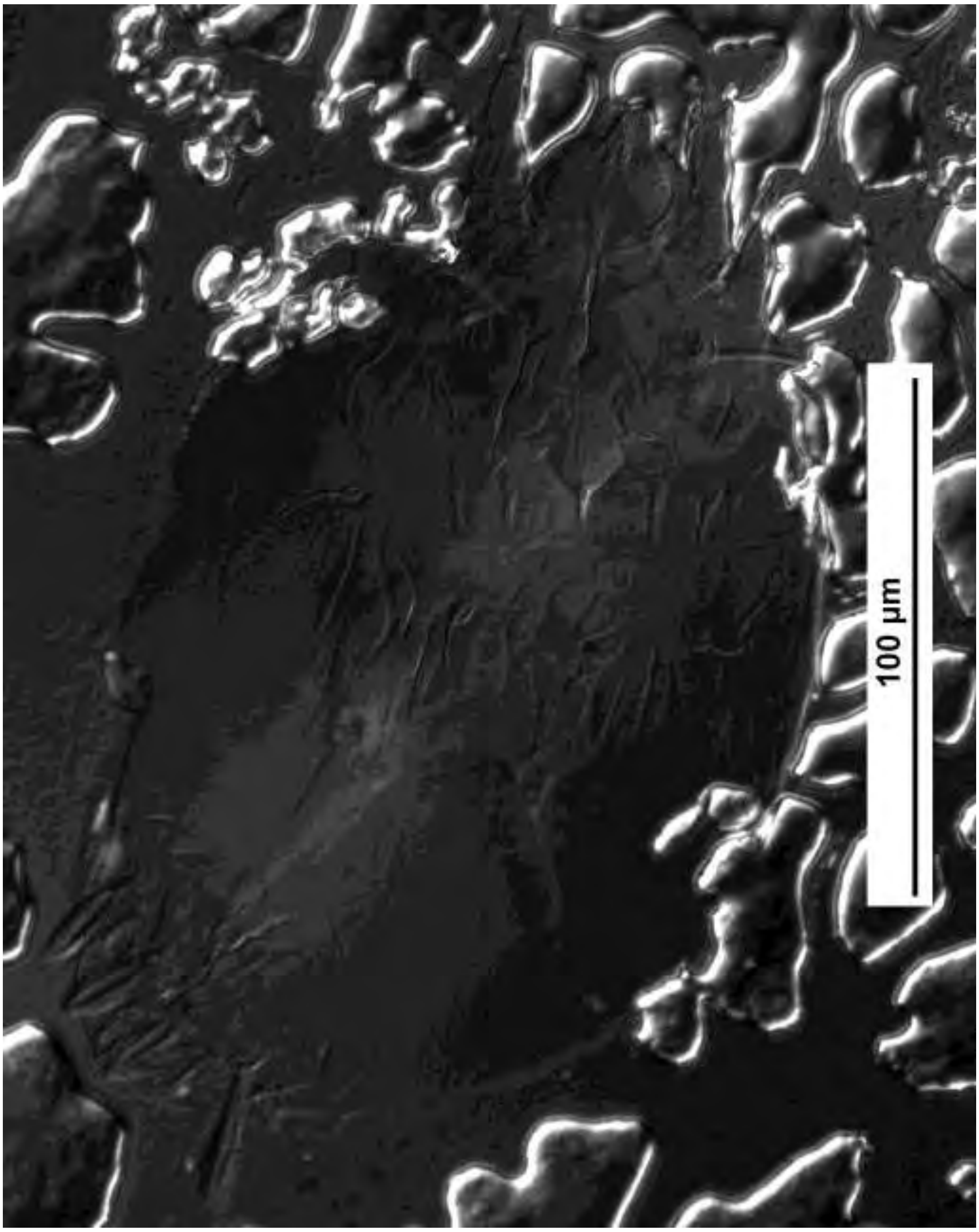

Fig. 35. *Daidalotarsonemus maryae* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

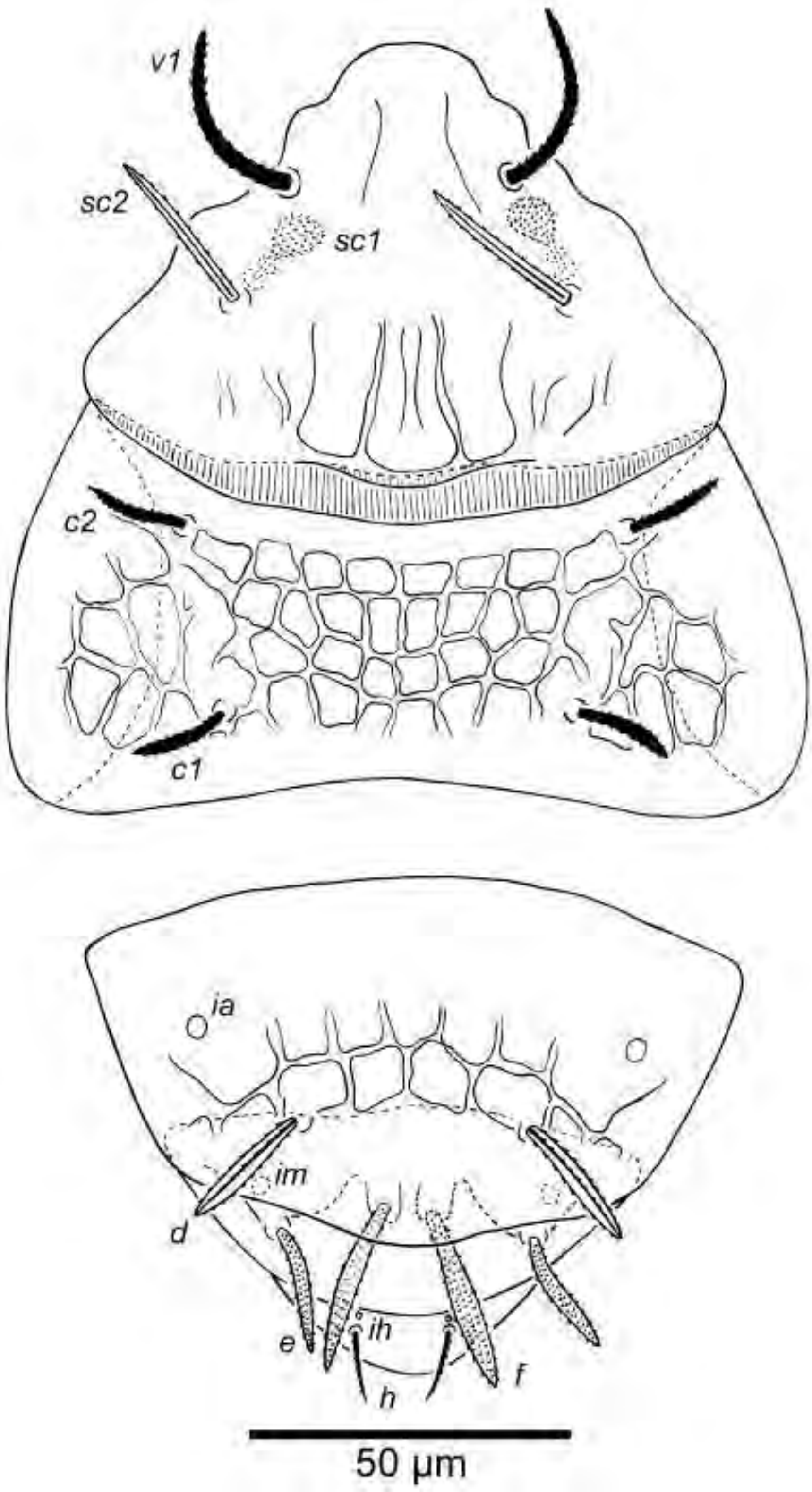

Fig. 36. *Daidalotarsonemus puntarenensis* sp. n. (female). Dorsal surface.

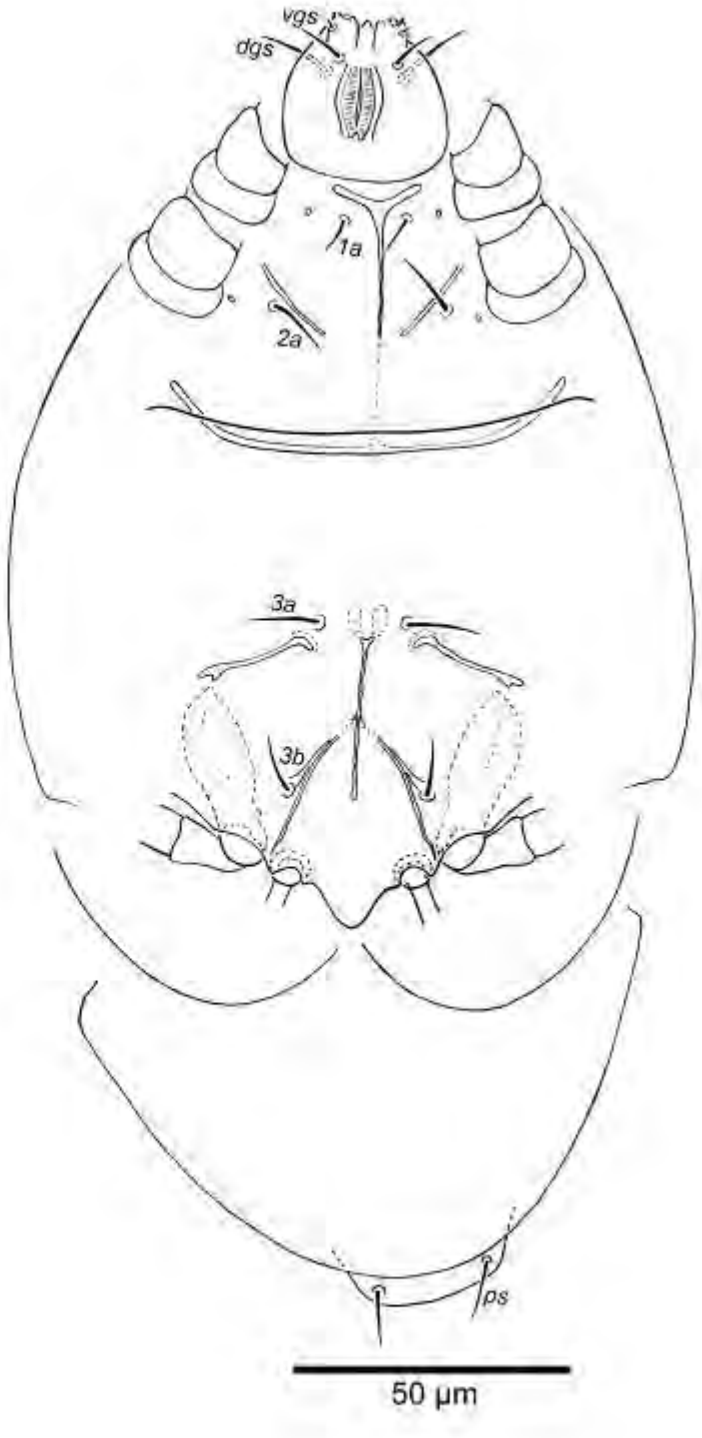

Fig. 37. *Daidalotarsonemus puntarenensis* sp. n. (female). Ventral surface.

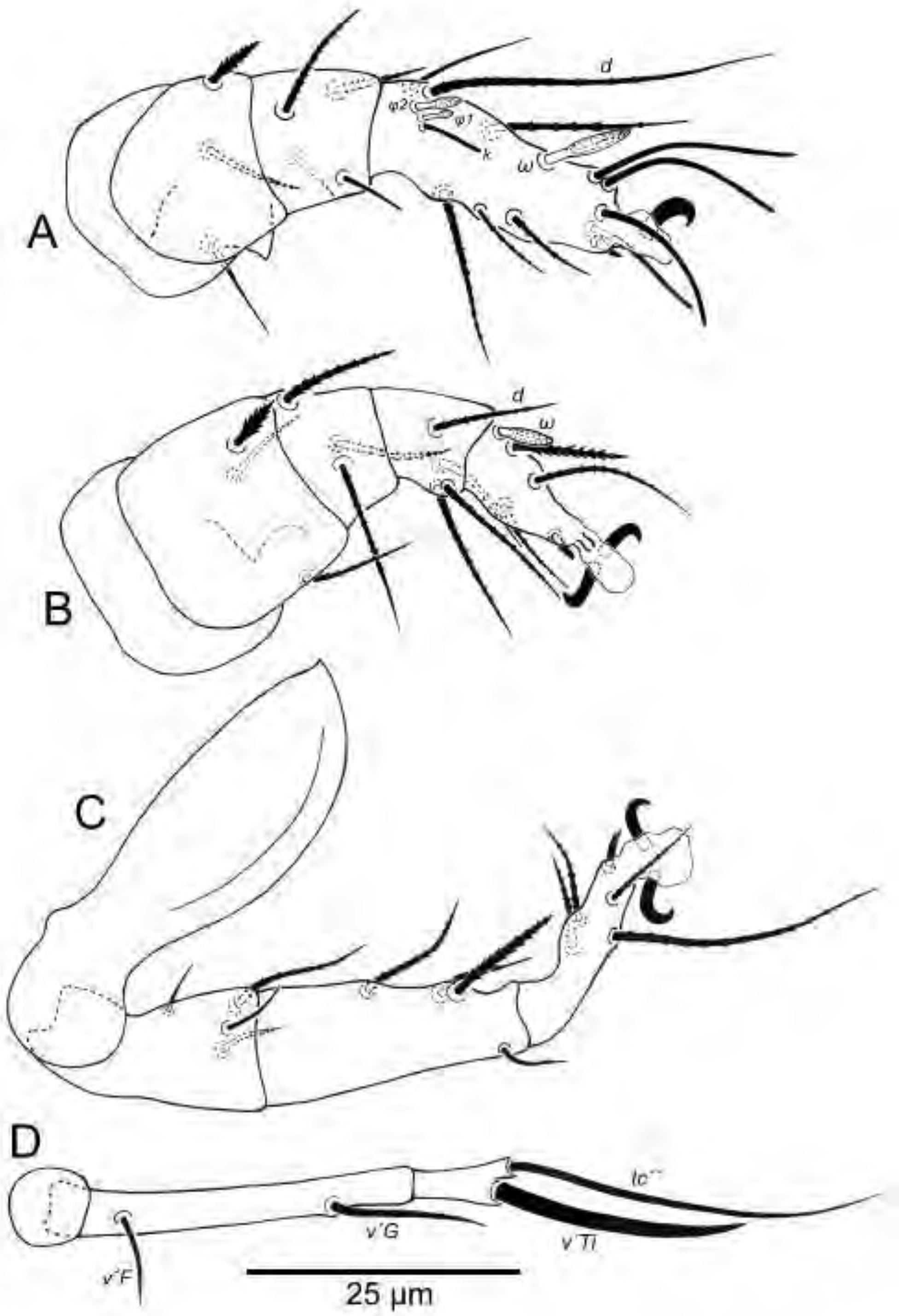

Fig. 38. *Daidalotarsonemus puntarenensis* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

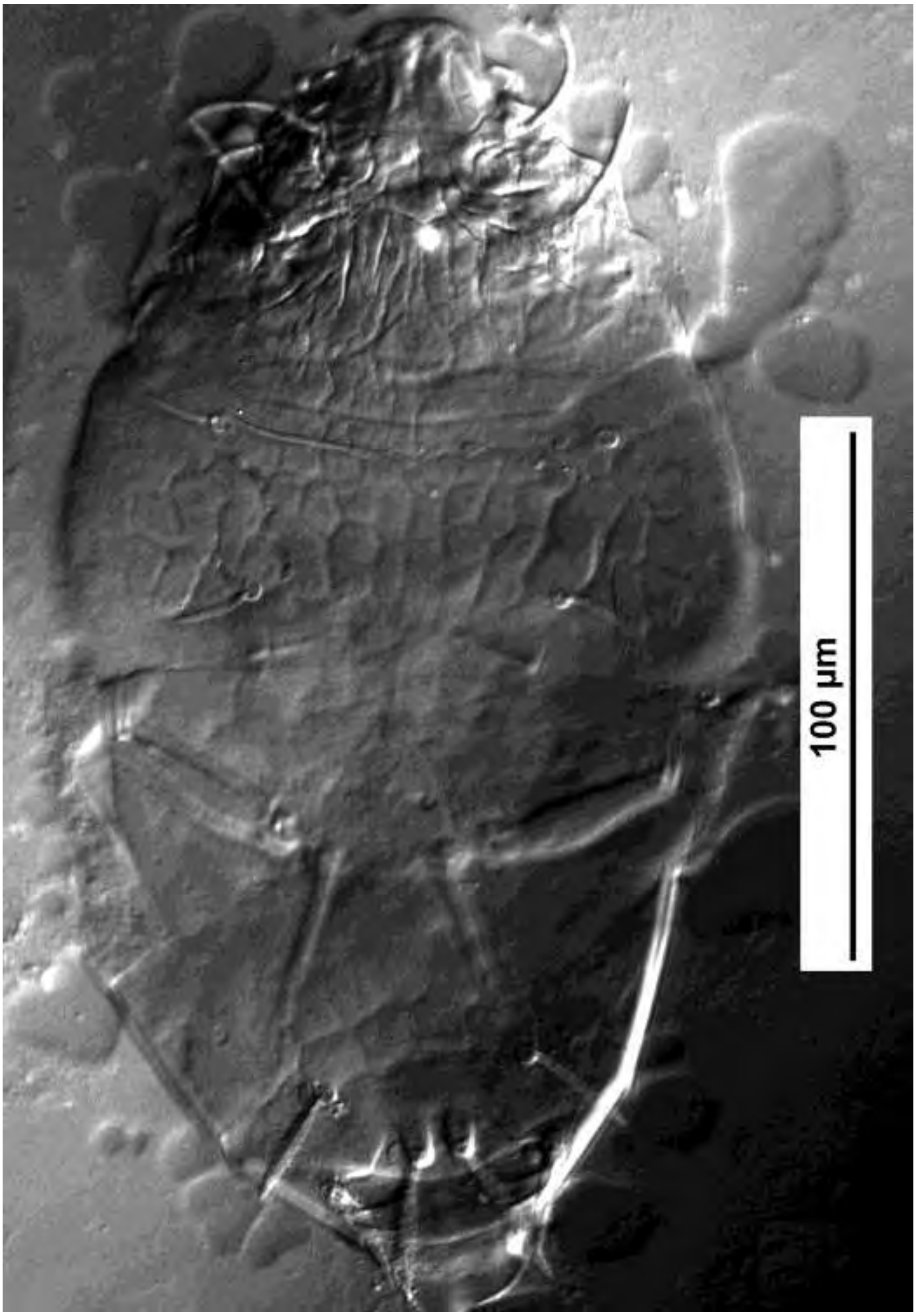

Fig. 39. *Daidalotarsonemus puntarenensis* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

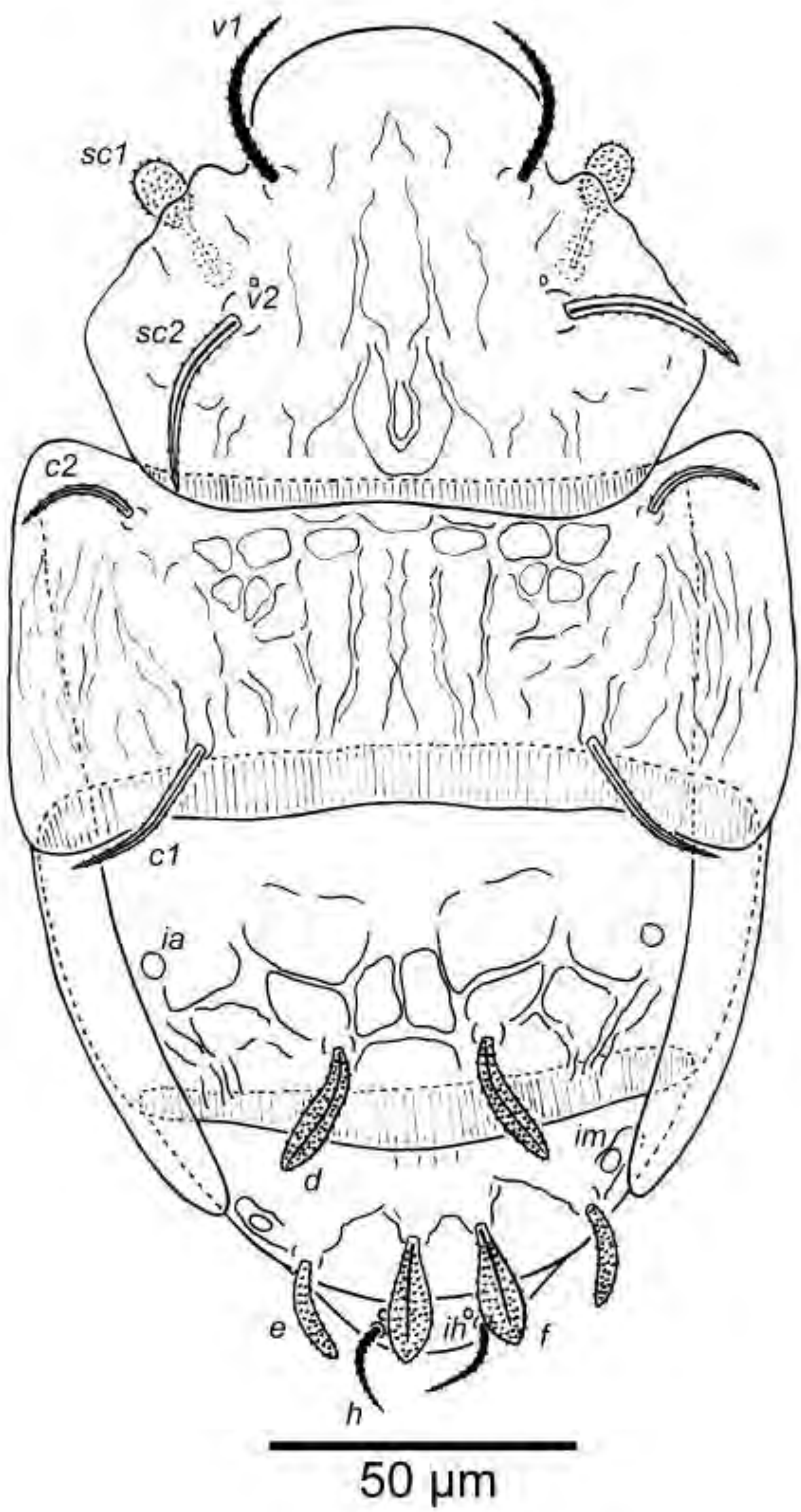

Fig. 40. *Daidalotarsonemus serratus* sp. n. (female). Dorsal surface.

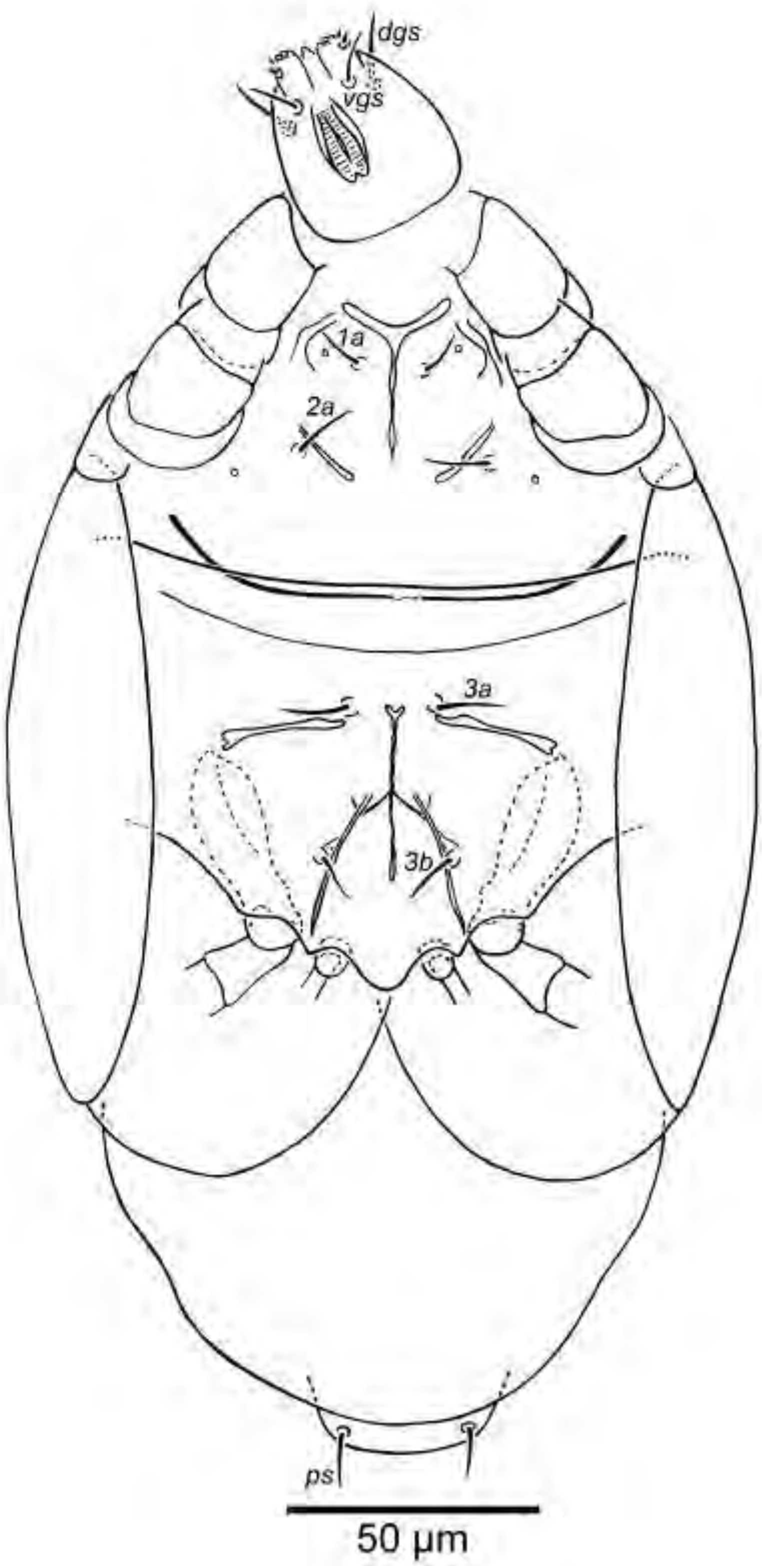

Fig. 41. *Daidalotarsonemus serratus* sp. n. (female). Ventral surface.

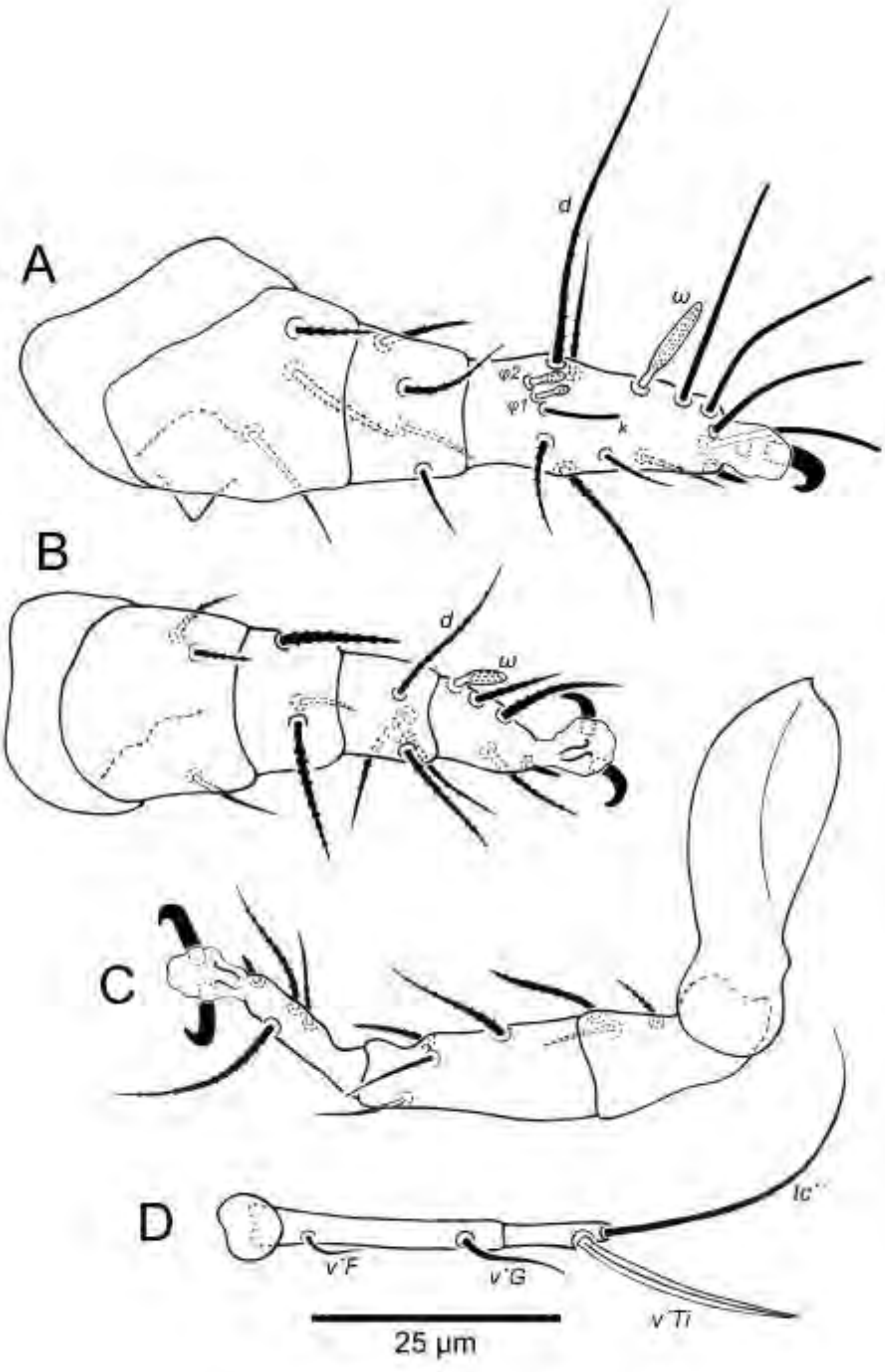

Fig. 42. *Daidalotarsonemus serratus* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

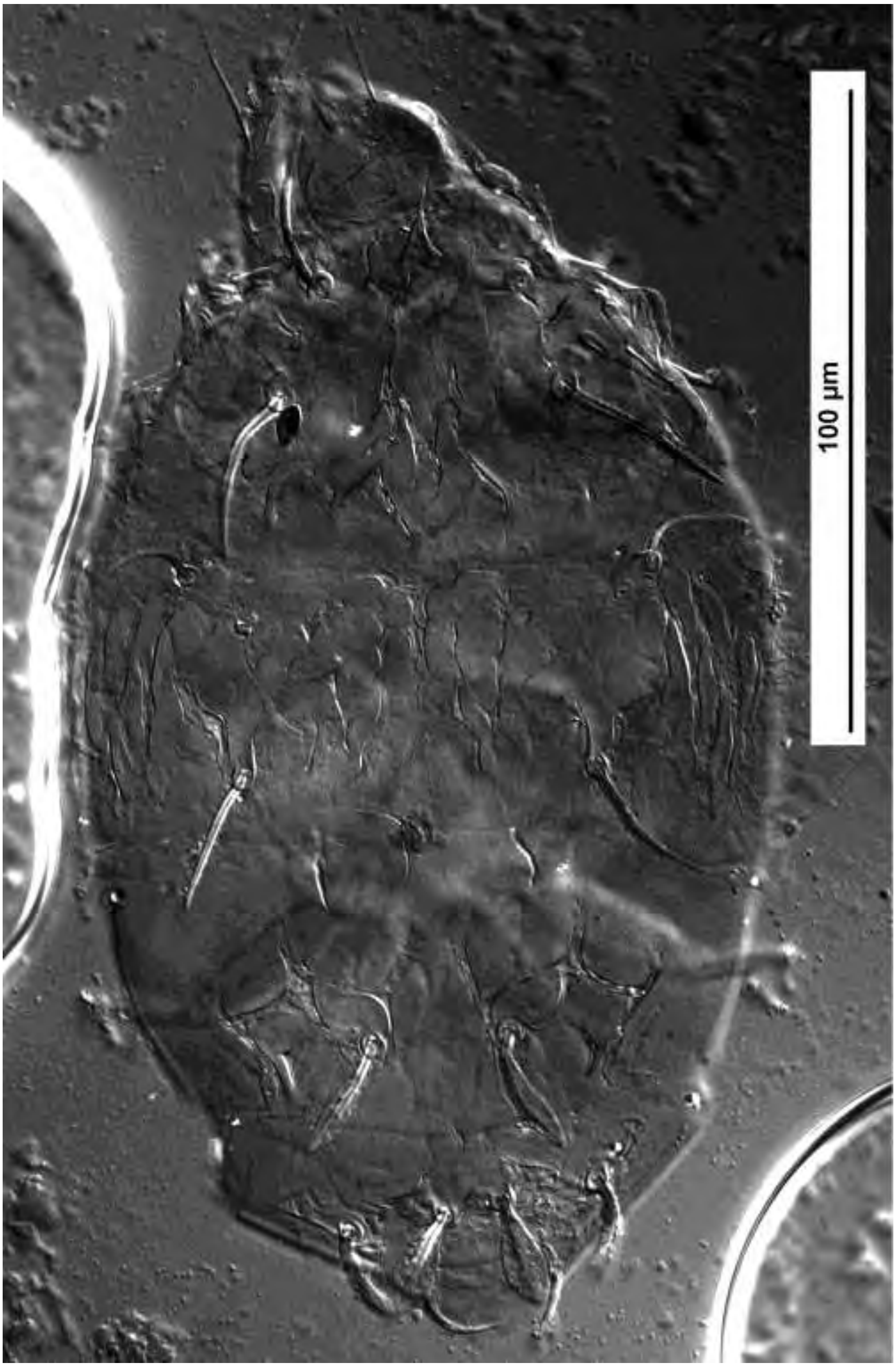

Fig. 43. *Daidalotarsonemus serratus* sp. n. (female). Differential interference contrast micrograph of the dorsal surface.

CHAPTER 3

TWO NEW SPECIES OF *DAIDALOTARSONEMUS* (ACARI: PROSTIGMATA: TARSONEMIDAE) FROM BRAZIL

Manuscript published in the periodic Acarologia on December 30, 2015

Authors: José M. Rezende, Antonio C. Lofego and Ronald Ochoa

Abstract

Two new tarsonemid species, *Daidalotarsonemus esalqi* sp. n. and *Daidalotarsonemus savanicus* sp. n., found on both native and crop plants in Brazil are described herein, based on adult females. Biological aspects of these species are briefly discussed. Individuals of *Daidalotarsonemus savanicus* sp. n. have been misidentified as *Daidalotarsonemus tessellatus* De Leon in previous reports of this species from Brazil. A key is provided to distinguish females of *Daidalotarsonemus* species known to occur in Brazil.

Keywords

Heterostigmata, Cerrado, rubber tree, taxonomy

Introduction

The genus *Daidalotarsonemus* De Leon (1956) (Prostigmata: Tarsonemidae) currently consists of 37 described species. It has been registered on all continents, except Antarctica, and is considered a plant inhabiting group with apparent preference for humid places, with an abundance of algae, lichen and fungi (Lindquist 1986; Lin and Zhang 2002; Lofego *et al.* 2005; Sousa *et al.* 2014; Rezende *et al.* 2015a; b).

Three species, *Daidalotarsonemus folisetae* Lofego & Ochoa, *D. annonae* Sousa, Lofego & Gondim Jr. and *D. oliveirai* Rezende, Lofego & Ochoa, have been described from Brazil (Lofego *et al.* 2005; Sousa *et al.* 2014; Rezende *et al.* 2015a). In addition, *Daidalotarsonemus fossae* De Leon was reported in the State of Pernambuco (Sousa *et al.* 2015). Based on an examination of specimens deposited in museum collections, two new Brazilian species of the genus, *Daidalotarsonemus esalqi* sp. n. and *Daidalotarsonemus savanicus* sp. n., found in rubber tree crops and found in Cerrado *sensu stricto* habitats, respectively, are described and illustrated.

Material and Methods

Specimens were examined from the mite collections of Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, Universidade de São Paulo, Escola Superior de Agricultura ―Luiz de Queiroz” (ESALQ/USP), Piracicaba; and Departamento de Zoologia e Botânica (DZSJRP), Universidade Estadual Paulista, São José do Rio Preto, both from State of São Paulo, Brazil. They were analyzed by two techniques: phase contrast microscopy (PC) and differential interference contrast microscopy (DIC). The specimens were examined, drawn and photographed using an optical microscope Leica® DFC 500.

The terminology used herein mainly follows Lindquist (1986), except for gnathosomal setae *dgs* and *vgs* (Magowski *et al.* 1998; Suski 1967). For each structure, the mean measurements are provided in micrometers (µm), followed in parentheses by the range of the specimens measured (when available), including the holotype. For the diagnoses, comparisons with previously described species were based on the study of the types. The following abbreviations are used for institutions where the types are deposited: DZSJRP, ESALQ/USP and USNM (United States National Museum of Natural History, Smithsonian Institution, National Insect and Mite Collection, USDA, SEL, Beltsville, Maryland, USA).

Results

Key to the species of *Daidalotarsonemus* from Brazil (based only on females)

1a. Setae *c1* inserted near posterior border of tergite C; tegula rounded apically…………………………………………………………………………**2**

1b. Setae *c1* inserted in the middle of the tergite C or near anterior border of this plate; tegula truncated……..………………………….……………….**3**

2a. Posterior dorsal setae *d*, *e* and *f* leaf-shaped……………………………..
..……………...***Daidalotarsonemus annonae*** **Sousa, Lofego & Gondim Jr.**

2b. Posterior dorsal setae *d*, *e* and *f* rod-shaped..
..........………………….…………..***Daidalotarsonemus fossae*** **De Leon**
3a. No rows of reticula on tergite C………………………………….....……**4**
3b. At least one row of reticula on tergite C……………...……...………...**5**
4a. Setae *c1* setiform; setae *e* phylliform..…..
....***Daidalotarsonemus folisetae*** **Lofego & Ochoa**
4b. Setae *c1* with rounded tip; setae *e* cordate……………………………..
........…………..***Daidalotarsonemus oliveirai*** **Rezende, Lofego & Ochoa**
5a. Setae *e* thin (± 3 µm); palps long (± 18 µm)………………………………
………...…………….…...***Daidalotarsonemus esalqi*** **sp. n. (Figures 1–4)**
5b. Setae *e* broad (± 17 µm); palps short (± 10 µm)…………………………
…………………..…..***Daidalotarsonemus savanicus*** **sp. n. (Figures 5–8)**

Daidalotarsonemus esalqi **sp. n.**
(Figures 1–4)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus venustus* Attiah (1970) by the reticulated ornamentation on tergite C and by the similar length of the dorsal setae *v1*, *sc2*, *c1*, *c2* and *h*. However, they differ by having the ornamentation pattern on tergite D reticulated only between setae *d* for *D. esalqi*; by the length of palps, longer for the new species; by pharynx shape, larger for *D. esalqi*; and by the shape, length and width of the posterior setae *d*, *e* and *f*, all smaller for this new species.

Adult female (three specimens measured).

Gnathosoma: covered by prodorsum, subtriangular in ventral view, length 34 (32–36), maximum width 24 (23–26); dorsal apodeme distinct. Setae *dgs* 10 (9–11) and *vgs* 7 (7–8) smooth; palps long 17 (17–18), with one small subterminal seta. Pharynx fusiform, 14 (13–16) long and 8 (7–10) wide at maximum width.

Idiosoma – dorsum (Figures 1 and 4): length 201 (198–207), width at level of *c1* 97 (95–102). Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Prodorsum with regular ornamentation covering it; tergite C with three transverse central rows of reticula and irregular ridges around it; tergite D with three central rows of reticula and irregular ridges around setae *d*. Lengths of setae: *v1* 25 (22–27), *sc1* 13 (13–14), *sc2* 27 (24–30), *c1* 18 (16–21), *c2* 17 (16–18), *d* 25 (24–26), *e* 13 (12–14), *f* 25 (24–27) and *h* 12 (11–13). Maximum width of expanded setae: *d* 5, *e* 3 and *f* 7. All dorsal setae serrate; except for *c1* and *c2* smooth. Setae *v1*, *c1*, *c2*, *d*, *e* and *f* inserted on tubercles. Setae *v1*, *sc2*, *c1*, *c2* and *h* setiform; setae *d*, *e* and *f* lanceolate with two central serrate veins. Distances between dorsal setae: *v1–v1* 28 (25–31), *sc2–sc2* 45 (42–48), *v1–sc2* 29 (27–31), *c1–c1* 50 (48–52), *c2–c2* 97 (94–101), *c1–c2* 41 (40–44), *d–d* 43 (42–44), *f–f* 10 (10–11), *e–f* 15 (15–16) and *h–h* 16 (14–17). Seta *sc2* inserted posterolateral to *sc1*.

Idiosoma – venter (Figure 2): setae *1a* 9 (9), posteriad of apodemes 1; *2a* 10 (10–11), posterolaterad of apodeme 2; *3a* 13 (12–15) near anteriomedial margins of apodemes 3; *3b* 11 (10–12) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long but not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to proximal end of apodeme 2, and diffuse from this point to sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near anterior end, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter III; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula wide 25 (23–26) and very short 5 (5); posterior margin slightly arched. Setae *ps* 15 (15–16) serrate.

Legs (Figure 3): lengths (femur to tarsus): leg I 57 (54–61), leg II 50 (48–52), leg III 84 (81–88). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)-7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion ω of tibiotarsus I 5 (5–6), stout, wider medially. Sensory cluster of tibia I complete, solenidion $\varphi 1$ 3 (3–4), slender, capitate; solenidion $\varphi 2$ 3 (3), robust, slightly capitate; famulus *k* 5 (5–6); all inserted at approximately same level. Seta *d* of tibia I 21 (20–24), serrate. Solenidion ω of tarsus II proximal, 4 (4) long, stout, wider medially. Seta *d* of tibia II 21 (19–24), serrate. Femorogenu IV 16 (15–17); tibiotarsus IV 10 (9–11). Length of leg IV setae: *v′* F 6 (6–7), *v′* G 10 (10–11), *v´* Ti 18 (17–20) and *tc″* 45 (45–46); all setae smooth, except for *v′* Ti serrate; *v′* Ti falcate.

Adult male and larva (Unknown).

Type material: Holotype and two paratypes. Holotype and paratypes from *Hevea brasiliensis* L. (Euphorbiaceae), 47°38´W 22°42´S, Universidade de São Paulo, Escola Superior de Agricultura —Luiz de Queiroz" (ESALQ/USP), Piracicaba, State of São Paulo, 02/X/2002, R.M.J. De Vis. Holotype and paratypes deposited at ESALQ/USP.

Etymology: the name *esalqi* is in honor of the university where this species was first registered. ESALQ is the acronym for Escola Superior de Agricultura —Luiz de Queiroz".

***Daidalotarsonemus savanicus* sp. n.**

(Figures 5–8)

Diagnosis: Females of this new species are most similar to *Daidalotarsonemus tessellatus* De Leon (1956) and *Daidalotarsonemus ethiopicus* Mahunka (1981) for the ornamentation pattern on tergite C and shape of anterior setae *v1*, *sc2*, *c1* and *c2*. They differ from the others by the ornamentation pattern on tergite D, with reticulation all over it including a rhomboid reticulum on the center of the plate; shape of posterior setae *d*, *e*, *f* and *h*; and shape of the setae *pl″* on tarsus II, which are stout and serrate.

Adult female (eight specimens measured).

Gnathosoma: covered by prodorsum, subtriangular in ventral view, length 31 (30–33), maximum width 20 (19–23); dorsal apodeme distinct. Setae *dgs* 13 (11–14) and *vgs* 9 (8–10) smooth; palps short 9 (9–10), with one small subterminal seta. Pharynx fusiform, 17 (15–18) long and wide10 (9–12) at maximum width.

Idiosoma – dorsum (Figures 5 and 8): length 228 (223–232), width at level of *c1* 141 (138–142); prodorsal shield with regular ornamentation. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with four transverse central rows of reticula and irregular ornamentation laterally. Tergite D with irregular ridges, including a rhomboid reticulum on center of plate. Lengths of setae: *v1* 27 (26–29), *sc1* 12 (11–14), *sc2* 38 (36–40), *c1* 18 (16–20), *c2* 17 (15–18), *d* 34 (33–36), *e* 24 (22–26), *f* 39 (37–40) and *h* 23 (22–25). Maximum width of expanded setae: *d* 7, *e* 17 (16–18) and *f* 6. All dorsal setae serrate; except for *sc2*, *c1* and *c2* smooth. Setae *v1*, *c1*, *c2* and *h* setiform; *sc2* falcate; *d* and *f* lanceolate with two veins; *e* asymmetrical, subelliptical, with one lateral vein. Distances between dorsal setae: *v1–v1* 28 (26–29), *sc2–sc2* 53 (50–54), *v1–sc2* 30 (29–31), *c1–c1* 56 (54–57), *c2–c2* 116 (115–117), *c1–c2* 37 (36–39), *d–d* 38 (37–40), *f–f* 14 (13–16), *e–f* 14 (12–15) and *h–h* 18 (17–20). Setae *sc2* inserted posteromedial to *sc1*.

Idiosoma – venter (Figure 6): setae *1a* 7 (6–9), posteriad of apodemes 1; *2a* 9 (8–9), posterolaterad and near middle of apodemes 2; *3a* 16 (15–18) near anteriomedial margins of apodemes 3; *3b* 15 (13–17) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where is fused with it. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 14 (12–15) wide and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 21 (19–22) serrate.

Legs (Figure 7): lengths (measured from femur to tarsus): leg I 45 (42–46), leg II 47 (45–48), leg III 85 (83–86). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-4-4-3(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 2 (2–3), robust, slightly capitate; famulus *k* 4 (4–5); all inserted at approximately same level. Seta *d* of tibia I 13 (12–15), serrate. Solenidion *ω* of tarsus II proximally inserted, 5 long, stout, wider medially; seta *pl″* of tarsus II stout and serrate. Seta *d* of tibia II 12 (11–14), serrate. Femorogenu IV 33 (31–34); tibiotarsus IV 9 (9). Length of leg IV setae: *v′* F 8 (7–9), *v′* G 17 (16–19), *v´* Ti 25 (23–26) and *tc″* 59 (58–62); all setae smooth, except for *v′* G serrate; *v′* Ti falcate.

Adult male and larva (Unknown).

Type material: Holotype and eleven paratypes. Holotype from *Caryocar brasiliense* Camb. (Caryocaraceae). Among paratypes, two from *Campomanesia pubescens* (DC.) Berg (Myrtaceae), one from *Miconia albicans* (Sw.) Triana (Melastomataceae), one from Myrtaceae sp., one from *Pouteria torta* (Mart.) Radlk. (Sapotaceae), 52°35'W 18°51'S, Chapadão do Sul, State of Mato Grosso do Sul, 26/I/2010, J.M. Rezende, A.C. Lofego & P.M. Paulon; one from *Bauhinia* sp. (Fabaceae), one from *Didymopanax vinosum* Cham. & Schltdl. (Araliaceae), one from Myrtaceae sp., 52°44'W 18°15'S, Chapadão do Céu, State of Goiás, 02/II/2010; one from *Genipa americana* L. (Rubiaceae), 51°45'W 17°51'S, Jataí, State of Goiás, 05/II/2010; one from *Xylopia aromatica* (Lam.) Mart. (Annonaceae), 48°54'W 18°31'S, Tupaciguara, State of Minas Gerais, 10/II/2010; one from *Caryocar brasiliense* Camb. (Caryocaraceae), 46°41'W 15°59'S, Unaí, State of Minas Gerais, 03/III/2010. Holotype and five paratypes deposited at DZSJRP; three paratypes deposited at ESALQ/USP; three paratypes deposited at USNM.

Etymology: the name *savanicus* refers to the Cerrado, a savannah biome in which this species is commonly found.

Remarks: Following an examination of voucher specimens, we conclude that individuals of this new species have been recorded as *Daidalotarsonemus tessellatus* De Leon in previous papers (Buosi *et al*. 2006, Demite *et al.* 2009, Feres *et al.* 2005, Lofego *et al.* 2005 and Sousa *et al.* 2015). The observations made by Lofego *et al.* (2005) regarding the habits for *Daidalotarsonemus tessellatus,* for which phytophagy was observed, should be conferred to *Daidalotarsonemus savanicus.*

Discussion

Although *Daidalotarsonemus* has almost always been found in sites having a humid environment, the record of *D. savanicus* in the Cerrado reinforces that this genus is not exclusively from such places. The Cerrado biome is very dry weather for at least half of the year (Ribeiro and Walter 1998). Another species, *Daidalotarsonemus ethiopicus* Mahunka (1981), is also described from a region with similar dry conditions. Such a range of distribution may represent an extraordinary adaptation of this genus to different levels of humidity, which partially explains the worldwide distribution of the taxon. Also, the diversity of host plants for *D. savanicus* suggests that there is not a host preference for this species; instead, environmental factors might be more important for its occurrence in the Cerrado biome.

The finding of a new species inhabiting rubber trees, a well studied crop around the world, demonstrates how poor our knowledge of the mite fauna of many areas remains. A large number of mite species have already been recorded in association with *Hevea brasiliensis* in Brazil (Hernandes and Feres 2006; Demite and Feres 2007; Bellini *et al.* 2008; Daud and Feres 2013; Nuvoloni *et al.* 2014; 2015). The added record of *D. esalqi* highlights the importance for a better understanding of host plant inhabiting tarsonemid associations, and their ecological role in natural environments and cultivated areas.

Acknowledgements

To FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) (Procs. 2011/19890-0 and 2013/08402-0) for the financial support. To Dr. Gilberto J. de Moraes (ESALQ/USP) for providing the specimens of *D. esalqi* for study. To Chris Pooley (ECMU-USDA) for his help with the micrographs. To the Smithsonian Natural History Museum (USNM), National Agricultural Library (NAL-USDA), and the Systematic Entomology Laboratory (SEL-USDA), for the support and assistance with references for this study. To Dr. Gregory Evans (APHIS-USDA) for the review and the comments. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA; USDA is an equal opportunity provider and employer.

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Figures

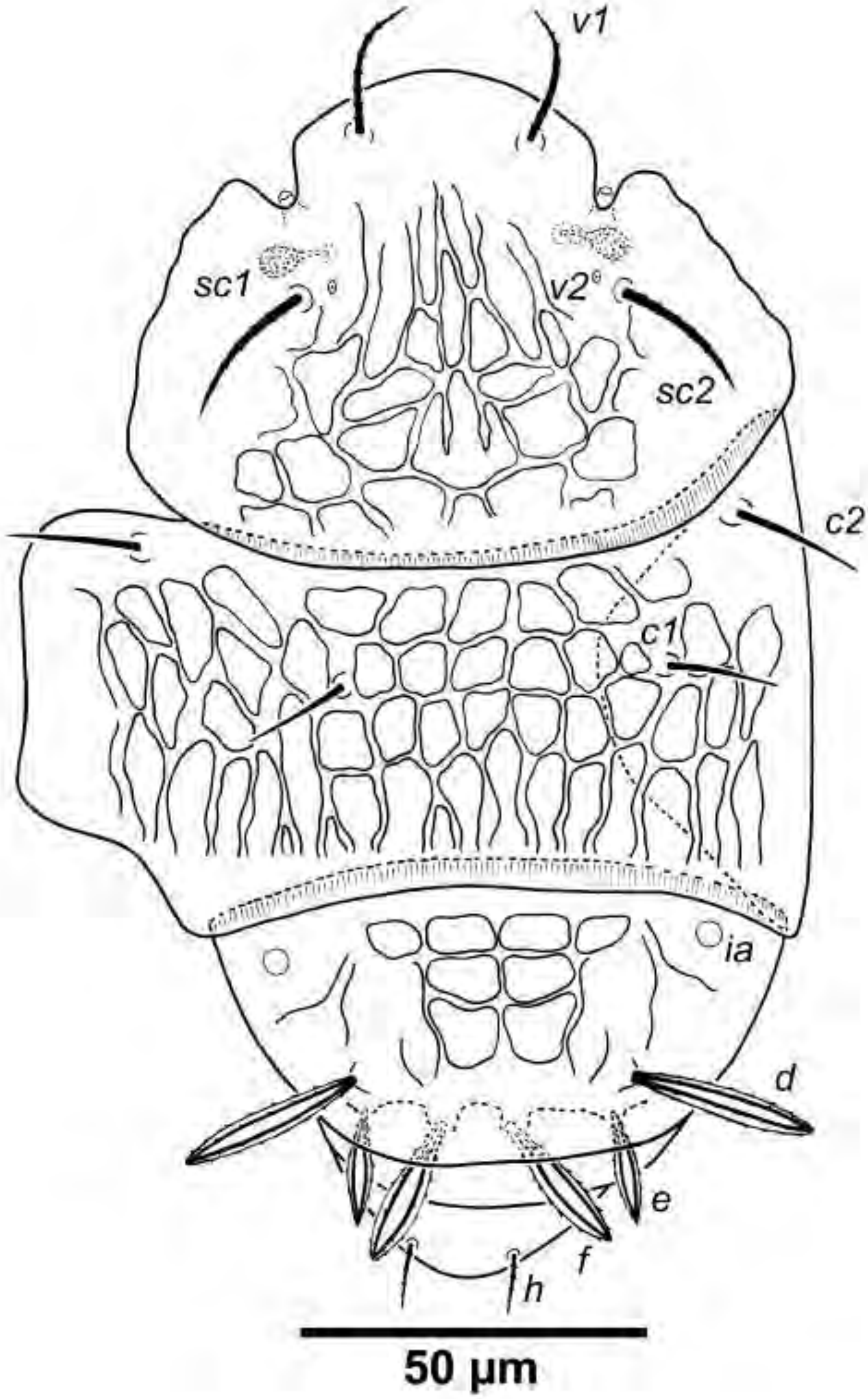

Figure 1. *Daidalotarsonemus esalqi* sp. n. (female). Dorsal surface of the idiosoma.

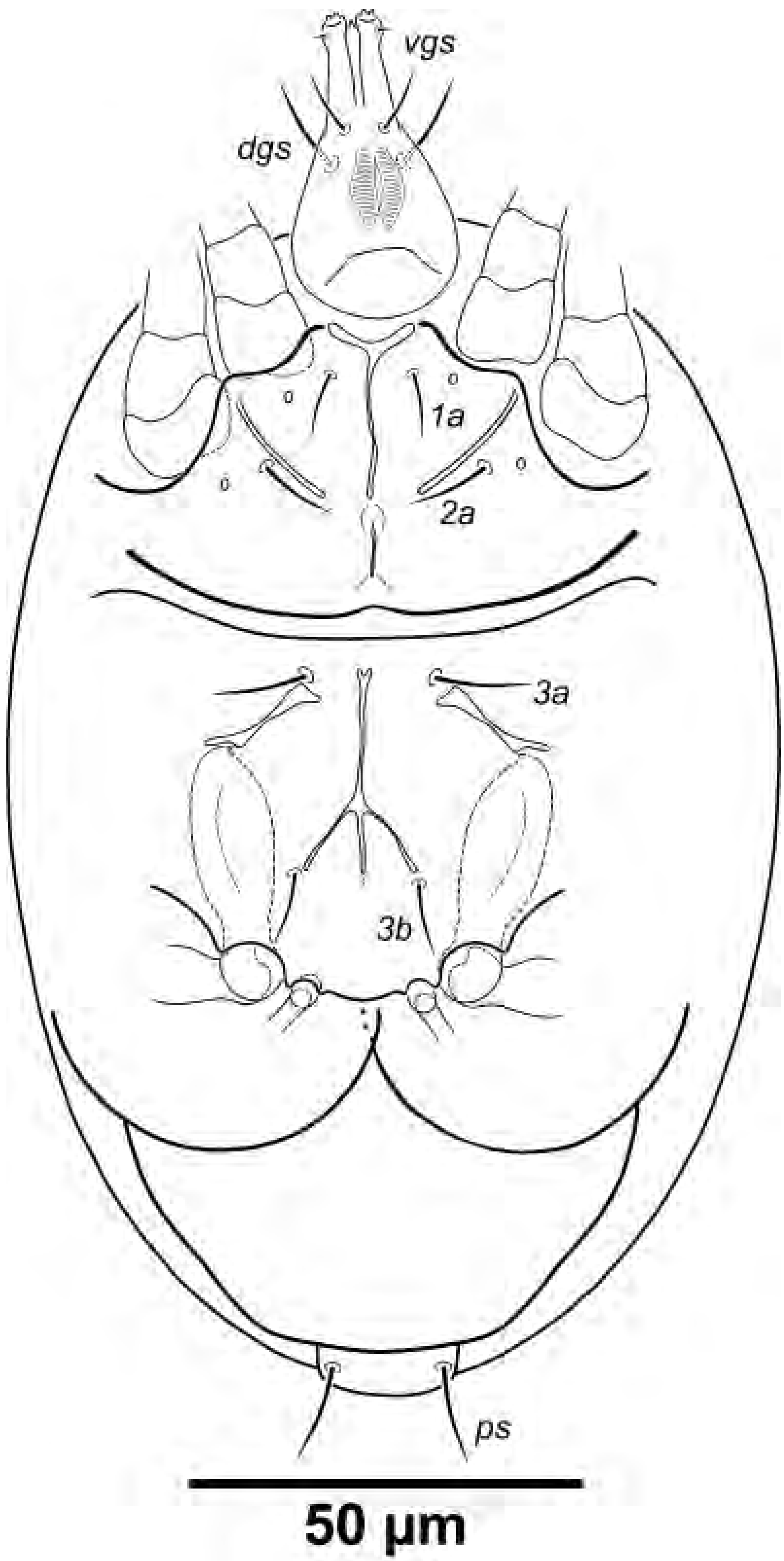

Figure 2. *Daidalotarsonemus esalqi* sp. n. (female). Ventral surface of the idiosoma.

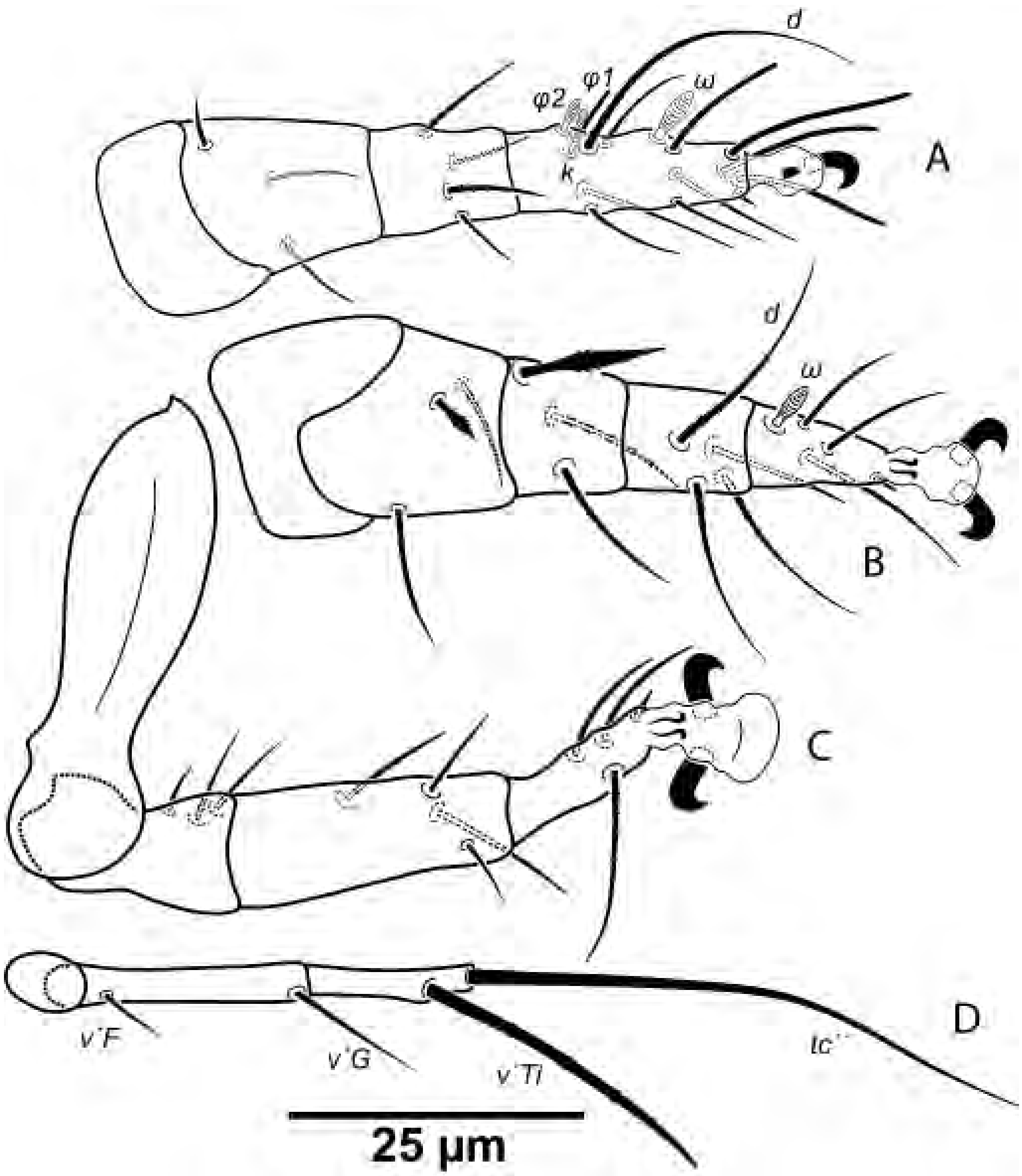

Figure 3. *Daidalotarsonemus esalqi* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 4. *Daidalotarsonemus esalqi* sp. n. (female). Dorsal micrograph of the idiosoma.

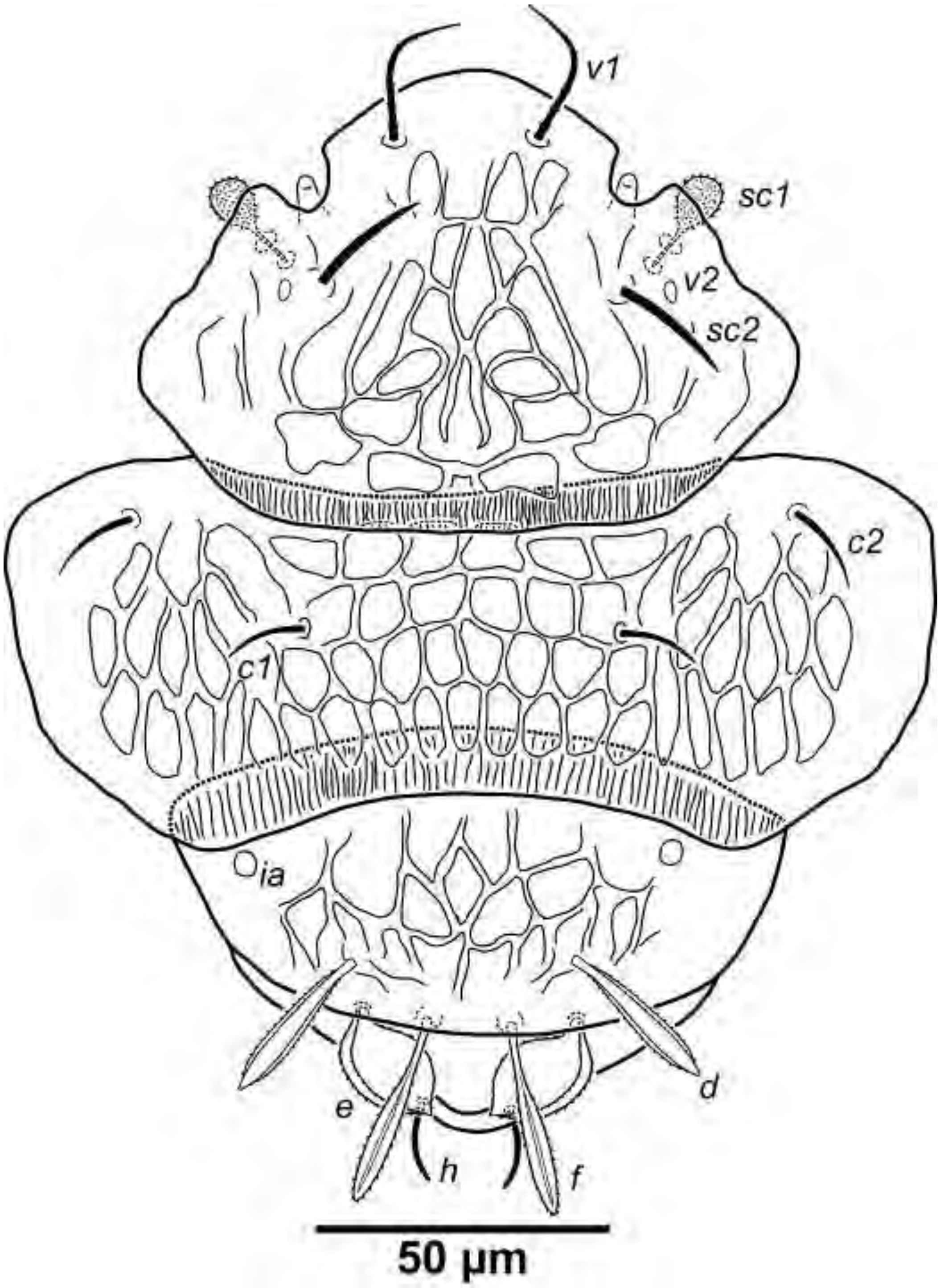

Figure 5. *Daidalotarsonemus savanicus* sp. n. (female). Dorsal surface of the idiosoma.

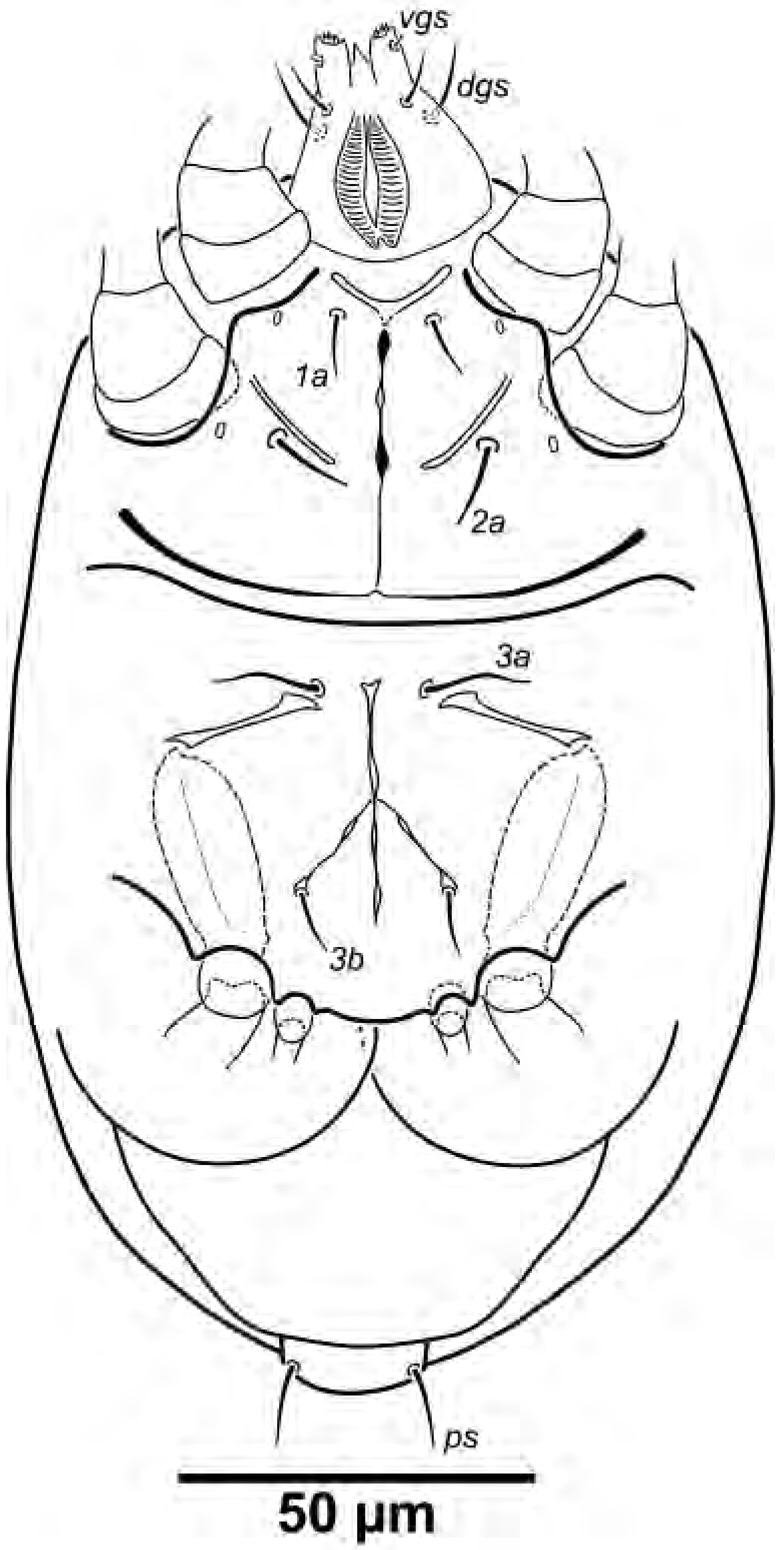

Figure 6. *Daidalotarsonemus savanicus* sp. n. (female). Ventral surface of the idiosoma.

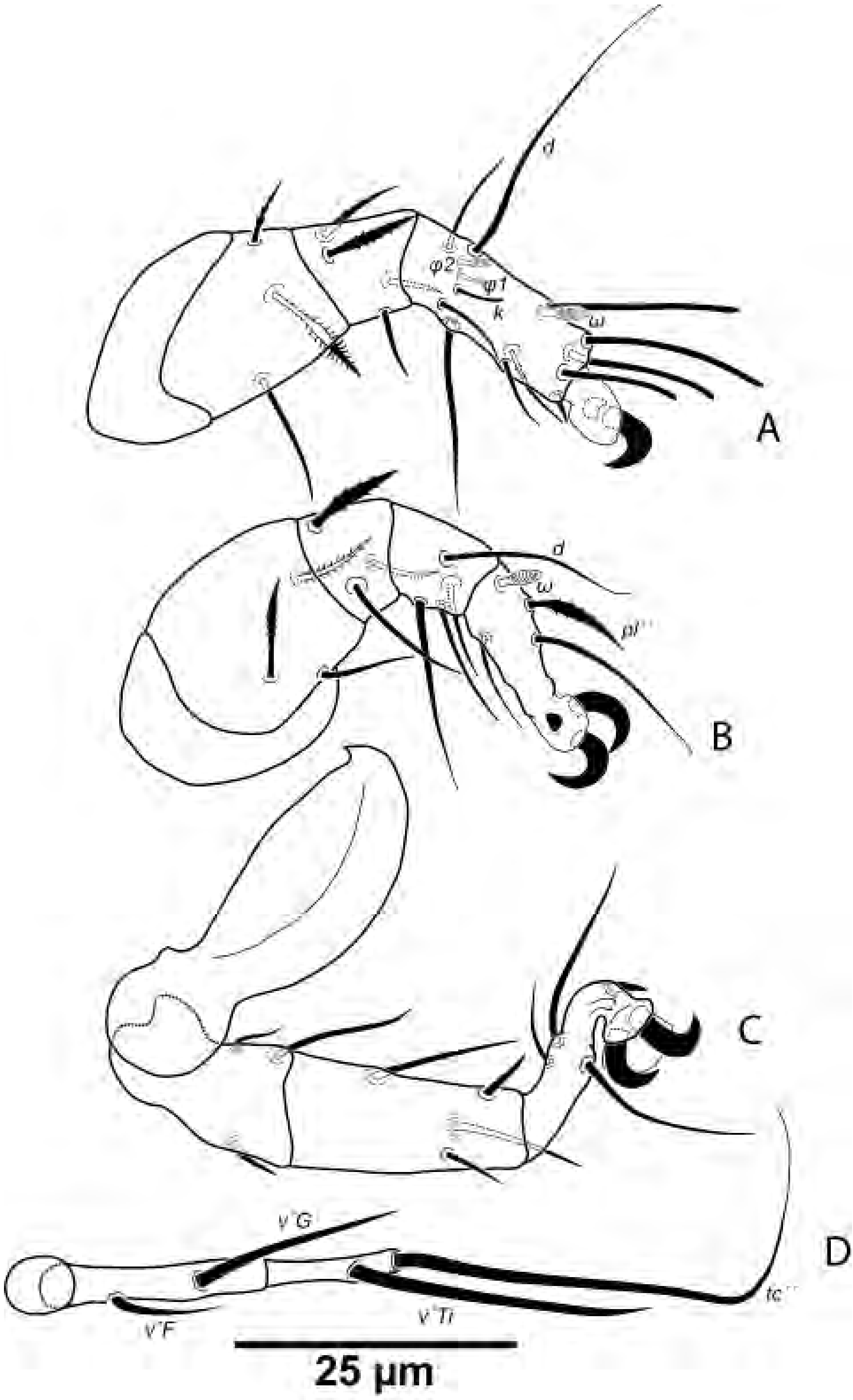

Figure 7. *Daidalotarsonemus savanicus* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

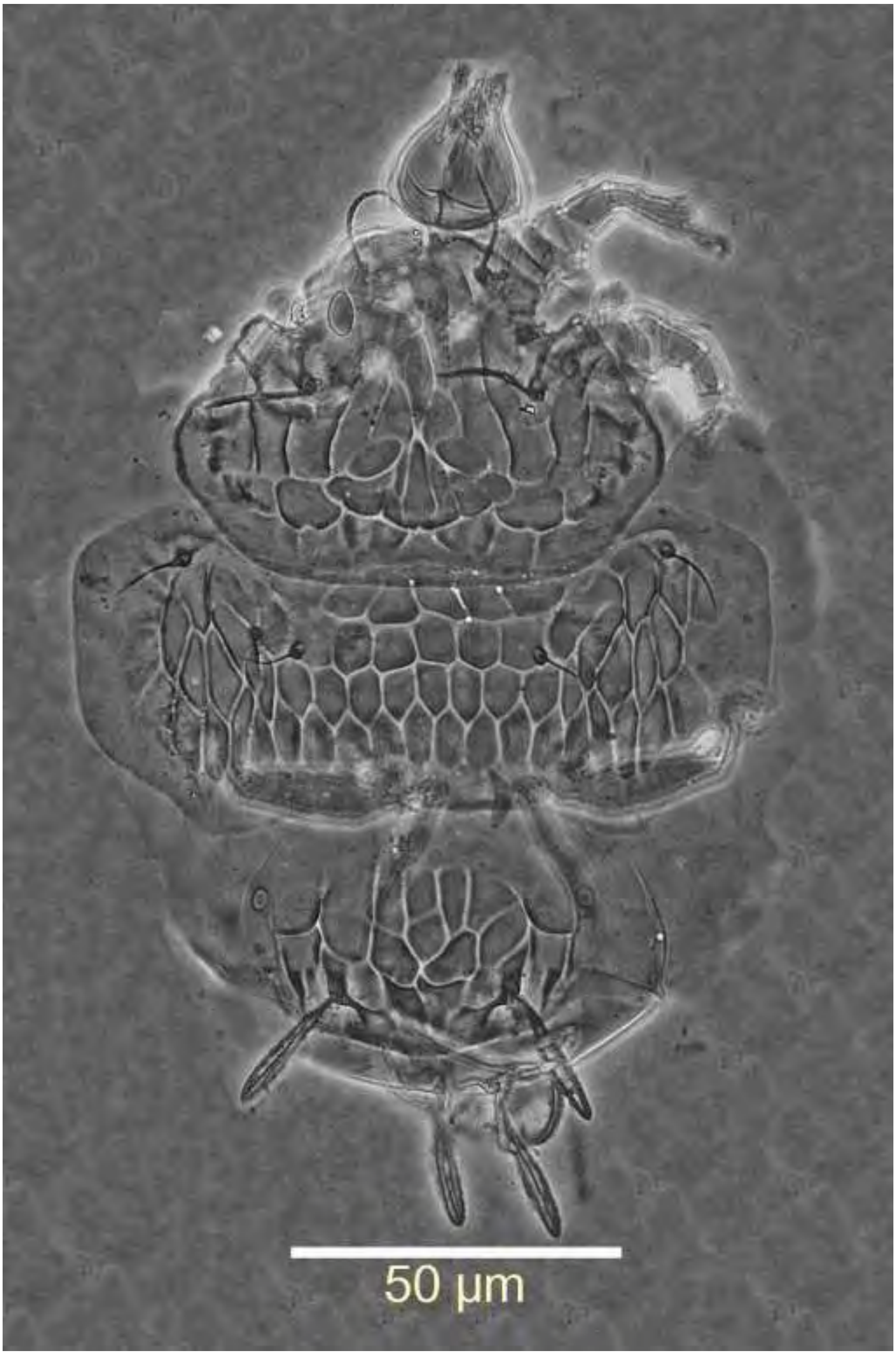

Figure 8. *Daidalotarsonemus savanicus* sp. n. (female). Dorsal micrograph of the idiosoma.

CHAPTER 4

TAXONOMIC REVISION AND PHYLOGENETIC ANALYSIS OF *DAIDALOTARSONEMUS* DE LEON AND *EXCELSOTARSONEMUS* OCHOA & NASKRECKI (ACARI: TARSONEMIDAE)

Manuscript in preparation for submission

Abstract

A complete revision is presented here for the genera *Daidalotarsonemus* and *Excelsotarsonemus* (Acari: Prostigmata), including information about taxonomy, phylogeny and distribution for 46 *Daidalotarsonemus* and seven *Excelsotarsonemus* species. Also, an identification key is provided for both genera. Thirty-seven *Daidalotarsonemus* and all *Excelsotarsonemus* species are analysed using cladistic methodology. A single most parsimonious tree was recovered from the analysis. The topology shows *Excelsotarsonemus* as an internal group of *Daidalotarsonemus*, indicating that these genera are not sister groups, but that *Excelsotarsonemus* is directly derived from *Daidalotarsonemus*. A branch of *Daidalotarsonemus* species, defined by the position of setae *c1* and the shape of the tegula is named as the *fossae* group. Other taxonomic, phylogenetic and biogeographical aspects for both genera are also discussed.

Keywords

Cladistics, Heterostigmata, Prostigmata, Taxonomy.

Introduction

The family Tarsonemidae Canestrini & Fanzago (Acari: Prostigmata) comprises about 530 described species and 40 genera (Walter *et al.* 2009). It is an important taxon for agriculture (Moraes and Flechtmann 2008) due to species such as *Polyphagotarsonemus latus*, *Phytonemus pallidus* and *Steneotarsonemus spinki*; which are pests of several crops (Gerson *et al.* 2003, Zhang 2003). Beyond the agricultural scope, there are just a few studies concerning this family, especially regarding systematic aspects (Lindquist 1986).

Currently, the genus *Daidalotarsonemus* consists of 39 described species (Attiah 1970, De Leon 1956, Lofego *et al.* 2005, Lin and Liu 1994, 1995, Lin *et al.* 1998, Mahunka 1972, 1974, 1981, Ochoa *et al.* 1991, Rezende *et al.* 2015a, b, c, Smiley 1967, 1969, Sousa *et al.* 2014, Suski

1967a, 1971, Yang *et al.* 1987). It is one of the few Tarsonemidae genera which have been reported to occur on all continents, except Antarctica (Lindquist 1986, Lin and Zhang 2002). There has been only one taxonomic revision for this genus (Smiley 1972), which included seven species. *Excelsotarsonemus* is smaller genus, with five described species (Ochoa *et al.* 1995, Ochoa and OConnor 1998, Rezende *et al.* 2015a). It has a restricted distribution, being reported to occur only in Brazil and Costa Rica thus far. For this genus, there is not a revision available. In the original description, *Excelsotarsonemus* was established as the sister group of *Daidalotarsonemus* (Ochoa *et al.* 1995). Both genera are considered plant inhabiting taxa with a preference for humid places and hosts with fungi and lichens attached (Lindquist 1986, Ochoa *et al.* 1995). They are not considered pests, despite being frequently found in crops and covered with bacteria and fungi (Rezende *et al.* 2015a).

Taxonomic history of *Daidalotarsonemus* and *Excelsotarsonemus*

De Leon (1956) established *Daidalotarsonemus* with the type species *D. tessellatus*, collected from *Litchi chinensis* (Sapindaceae) in Miami, Florida, USA. The genus was defined by the ornamented dorsal plates and distinctly large terminal dorsal setae (for females) and the longer dorsal setae (compared to other genera) and tibiae IV significantly longer than wider (for males). Due to the characters of males, *Daidalotarsonemus* was considered closer to *Hemitarsonemus* Ewing. De Leon (1956) also described *D. fossae* from specimens recorded on the same host plant and locality as that of the holotype, and distinguished these species by the lack of ornamentation on *D. fossae*.

After a lapse of more than a decade, desriptions of new species of *Daidalotarsonemus* began to appear apace, beginning with Suski (1967) who described *D. vandevriei* from apple trees from Poland. This species was considered similar to *D. fossae* except for the shape and length of the dorsal setae. Subsequently, Smiley (1969) described *D. jamesbakeri*, which was diagnosed as unique by the contiguous dorsomedian longitudinal plates of the hysterosoma.

Attiah (1970) affirmed that *Daidalotarsonemus* was morphologically close to *Metatarsonemus* Attiah (= *Tarsonemus*), due to character states found in males of these genera. In the same paper, three species were described: *D. somalatus*, *D. seitus* and *D. venustus*, all collected on citrus from Florida, USA. The author compared only *D. venustus* with other species described so far, considering it similar to *D. tessellatus*, except for the arrangement of tergites C, D and EF. Attiah (1970) concluded two species described by Smiley (1967) belong to *Daidalotarsonemus*, *D. deleoni* and *D. leonardi*. Both species were described based only on males.

Suski (1971) described *D. gutierrezi* from individuals collected on an unknown host in Madagascar. This species was considered similar to *D. vandevriei*, except for the longer length of some of its dorsal setae. One year later, Mahunka (1972) described another two species: *D. costulatus* and *D. ostracodes*; both found in litter from New Guinea.

Smiley (1972) reviewed *Daidalotarsonemus,* but did not include *D. costulatus* and *D. ostracodes,* and only mentioned *D. deleoni* and *D. leonardi.* He provided a dichotomous key and diagnoses for the following seven species: *D. fossae*, *D. jamesbakeri*, *D. seitus*, *D. somalatus*, *D. tessellatus*, *D. vandevriei* and *D. venustus*.

Mahunka (1974) added one more species to the genus, *D. hewitti*, from England. Only one individual was found, attached to human clothes. As stated by the author, this species is similar to *D. somalatus*, but differs by having the prodorsal setae longer than the posterior tergal setae. Later, Mahunka (1981) described *D. ethiopicus* which, according to the author, differs from all of the other species in the genus by the shape of the tergite D and posterior setae *f*, *h* and *ps*.

In his worldwide revision for Tarsonemidae, Lindquist (1986) stated that *Daidalotarsonemus* is morphologically and phylogenetically closer to the genus *Ceratotarsonemus*, by 11 character states shared by both genera, including: the presence of enlarged and serrate dorsal setae; absence of setae *l″* on femur I, *pv″* on tarsi II-III and *pl″* on tarsus II. Also, according to this study, females of both genera are similar by having the prodorsum deeply emarginated on either side to accommodate the stigmata and the pits *v2* in the anteromedian position compared to setae *sc2*.

Yang *et al.* (1987) described three other *Daidalotarsonemus* species from Shanghai, China: *D. euonymus*, *D. hexagonus* and *D. serissae*. As reported by the authors, the first species is close to *D. venustus*, except by the ornamentation on the propodosoma. The second one is similar to *D. tessellatus*, except by the shape of humeral setae. *Daidalotarsonemus serissae* is distinguished from all others by the ornamentation pattern on the dorsal plates.

Ochoa *et al.* (1991) described two more species collected in Costa Rican rainforests: *D. limonensis* and *D. ternifoliae*. The first was described based on females and it was considered morphologically similar to *D. jamesbakeri*, except by the reticulation pattern on dorsal plates. *Daidalotarsonemus ternifoliae* was described only from males. According to the authors, it is similar to *D. leonardi* and *D. somalatus*. However, in *D. ternifoliae*, the solenidia of tarsi I and II are longer than those species.

During the 1990s, three papers were published on *Daidalotarsonemus* species from China. Lin and Liu (1994) described *D. notochism*, considered morphologically close to *D. gutierrezi*. Lin and Liu (1995) described *D. biovatus*, similar to *D. somalatus*, except mainly for the setae *f* located in the anteromedian portion of tergite EF. Three years later, Lin *et al.* (1998) described three more species: *D. cornutus*, *D. digital* and *D. duolamella*. The first species was considered similar to *D. hexagonus*, differing mainly by the prosternal apodeme united to the sejugal apodeme. The second species was thought to be closer to *D. euonymus*, except for having the *d* setae inserted in toe-shaped tubercles.

The last species, *D. duolamella*, was considered distinct from all other species of the genus due by the shape of the tergite EF.

Lofego *et al.* (2005) described *D. folisetae,* the first new species of the genus from Brazil. This species was found in Cerrado areas and it is similar to *D. jamesbakeri*, but differs by the shape of the setae *e*. Almost 10 years later, Sousa *et al.* (2014) described another Brazilian species, *D. annonae*. This species is very similar to *D. serissae*, except for the shape of the setae *c2*.

In 2015, thirteen new species of *Daidalotarsonemus* were described, all from the American continent. Of these, three are from Brazil, *D. oliveirai*, *D. esalqi* and *D. savanicus* (Rezende *et al.* 2015a, c) and the other ten from Costa Rica, *D. alas*, *D. azofeifai*, *D. bauchani*, *D. cuadradus*, *D. ginae*, *D. lini*, *D. marini*, *D. maryae*, *D. puntarenensis* and *D. serratus* (Rezende *et al.* 2015b). Herein we add another five more species.

Ochoa *et al.* (1995) described *Excelsotarsonemus* to accommodate the new species *E. kaliszewskii*. The genus was considered close to *Ceratotarsonemus* and *Daidalotarsonemus* by the shape of setae *sc2*, *c1* and *d*, which are elliptical, heavily veined and inserted on tubercles. Ochoa and OConnor (1998) described two more species of *Excelsotarsonemus*: *E. kimhansenae* and *E. mariposa*. The first species resembles *E. kaliszewskii*, but differs by the general shape of the dorsal setae *c2* and *sc2;* the latter, *E. mariposa* was differentiated from all other species by the asymmetrical shape of the setae *d*. Rezende *et al.* (2015a) described *Excelsotarsonemus caravelis* and *E. tupi* from Brazil.

In summary, since the last revision of the genus *Daidalotarsonemus* 43 years ago, and the description of dozens of species, a revision of the genus is needed. In addition, it is necessary to test the hypothesis of that *Daidalotarsonemus* and *Excelsotarsonemus* are sister groups through a phylogenetic analysis of all species, and also update information about geographical distribution of both genera.

Material and Methods

Taxonomic revision and description of new species

Types of *Daidalotarsonemus* and *Excelsotarsonemus* were obtained from several colections around the world and analysed by two microscopy techniques: phase-contrast (PC) and differential interference contrast (DIC). Individuals of *Daidalotarsonemus somalatus* Attiah were also photographed by low temperature scanning electron microscopy (LT-SEM). These specimens were prepared and observed with an LT-SEM using the same techniques as described in Bolton *et al.* (2014). Briefly, live specimens were secured to 15 cm × 30 cm copper plates using ultra smooth, round (12 mm diameter), carbon adhesive tabs (Electron Microscopy Sciences, Inc., Hatfield, PA). The specimens were frozen in a Styrofoam box, by placing the plates on the surface of a pre-cooled (-196 °C) brass bar whose lower half was submerged in liquid nitrogen (LN2). After 20-30 seconds, the holders containing the frozen samples were transferred to Quorum PP2000 cryo-prep chamber (Quorum Technologies, East Sussex, UK) attached to an S-4700 field emission scanning electron microscope (Hitachi High Technologies America, Inc., Dallas, TX). The specimens were etched inside the cryotransfer system to remove any surface contamination (condensed water vapour) by raising the temperature of the stage to -90 °C for 10-15 minutes. Following etching, the temperature inside the chamber was lowered below -130 °C, and the specimens were coated with a 10 nm layer of platinum using a magnetron sputter head equipped with a platinum target. The specimens were transferred to a pre-cooled (-130 °C) cryostage in SEM for observation. An accelerating voltage of 5 kV was used to view the specimens. Images were captured using a 4pi Analysis System (Durham, NC). For the PC and DIC micrographs, a Zeiss Axioscope™ microscope with differential interference contrast (DIC) 100× Plan Apochromatic objective with a NA

1.4 was used. For the drawings, a Leica® DM 2500 microscope with a drawing tube attached was used. Images were sized and placed together to produce a single illustrative plate using the software Adobe® Photoshop CS 5.0 and Adobe® Illustrator CS 5.0.

Access to type specimens of the following ten *Daidalotarsonemus* species was not possible: *D. biovatus*; *D. cornutus*; *D. duolamella*; *D. euonymus*; *D. gutierrezi*; *D. hexagonus*; *D. limonensis*; D*. notochism; D. serissae* and *D. ternifoliae*. The holotype of *D. gutierrezi* was cited in the original description as deposited at the Museum and Institute of Zoology, Polish Academy of Sciences (MIZ-PAS). According to the current curator, Dr. Tomasz Huflejt, it was not possible to locate the referred slide. Also, he has no information about where it could be. This is the same situation for *D. limonensis* and *D. ternifoliae* types, both deposited at the Collection of Acarology, Faculty of Agronomy, University of Costa Rica (CALFAUCR). According to the curator, Dr. Hugo Aguilar, both types are missing. The other seven species are from China. An attempt was made to borrow them, but the request was denied due to Chinese law. For the species *D. biovatus*, *D. cornutus*, *D. duolamella* and *D. serissae* Dr. Jianzhen Lin (IPP-FAAS – Institute of Plant Protection, Fujian Academy of Agricultural Sciences, Fuzhou, China) graciously provided micrographs of the holotypes for study.

The terminology used herein mainly follows Lindquist (1986), except for gnathosomal setae *dgs* and *vgs* (Suski 1967b, Magowski *et al.* 1998). For each structure, the mean measurements are provided in micrometres (µm), followed in parentheses by the range of the specimens measured (when available), including the holotype. Leg measurements do not include the length of pretarsus. The specimens were examined, drawn and photographed using a Zeiss Axioplan microscope.

The following abbreviations are used for institutions where the types were deposited: Canadian National Collection of Insects, Arachnids and Nematodes (CNC), Ottawa, Ontario, Canada; Collection of Acarology, Faculty of Agronomy, University of Costa Rica (CALFAUCR), San Jose, Costa Rica; Collection of ALAS-INBio, La Selva, Costa Rica; Collection of Proyecto MIP, CATIE, Costa Rica; Department of Biology, Fudan University (DBFU), Shanghai, China; Department of Entomology, Phytopathology and Agricultural Zoology, Escola Superior de Agricultura ―Luiz de Queiroz”, University of São Paulo (ESALQ/USP), Piracicaba, São Paulo, Brazil; Department of Zoology and Botany (DZSJRP), São Paulo State University, São José do Rio Preto, São Paulo, Brazil; Division of Plant Industry, Florida Department of Agriculture and Consumer Services (DPI-FDACS), Gainesville, Florida, USA; Faculty of Agronomy (CIPROC), Costa Rica University, San Jose, Costa Rica; Florida State Collection of Arthropods (FSCA), Gainesville, Florida, USA; Hungarian Natural History Museum (HNHM), Budapest, Hungary; Institute of Plant Protection, Fujian Academy of Agricultural Sciences (FAAS), Fuzhou, Fujian Province, China; National Museum of Costa Rica (NMCR), Department of Natural History, San Jose, Costa Rica; Queensland Museum (QM), South Brisbane, Queensland, Australia; United States National Museum of Natural History (USNM), Smithsonian Institution, National Insect and Mite Collection, Beltsville, Maryland, USA; The Natural History Museum (TNHM), London, United Kingdom; University of Michigan, Museum of Zoology (UMMZ), Ann Arbor, Michigan, USA; Zoological Museum of Polish Academy of Sciences (ZMPAS), Warsaw, Poland.

Phylogenetic analysis

The ingroup consists of most *Daidalotarsonemus* and all species of *Excelsotarsonemus*. The outgroup is composed of *Polyphagotarsonemus latus* (Tarsonemidae) and *Pyemotes* sp. (Pyemotidae). Only females were analysed; the species *D. deleoni*, *D. leonardi* and *D. ternifoliae*, known only by males, were not included. Also four species*, D. euonymus*, *D. hexagonus, D. gutierrezi* and *D. limonensis*, described from females, were not included because slides and micrographs were unavailable for study.

Daidalotarsonemus notochism was not included because, in fact, it does not belong to the genus *Daidalotarsonemus*, as explained in the next section. Characters were treated as hypotheses of homology following Nixon and Carpenter (2012). Most characters were treated as binary, but some present more than two states (multistate characters) (Scotland and Pennington 2000, Wiley and Lieberman 2011).

The dataset consisted of 67 morphological characters (Appendix A) treated as non-additive. They were extracted from dorsal chaetotaxy, tergites, gnathosoma, ventral chaetotaxy and ventral plates. Terminals with unobserved states were coded with a ‗?‘, and those with inapplicable states with ‗-‘. Most species (30 of 42) have not been re-collected since their original descriptions; making the use of molecular and ecological characters impractical. The matrix (Appendix B) was created using software Mesquite 3.04 (Maddison and Maddison 2015) and the parsimony searches were performed using software TNT and algorithms: *Ratchet*, with 200 iterations and the perturbation phase adjusted to 4 for both up-weighting and down-weighting; *Tree-Drifting*, with 20 iterations per replication; and *Sectorial Searching*, with sectors chosen by *Random sectorial search* (RSS) (Goloboff *et al.* 2008). The Bremer decay analysis (Bremer 1988) was calculated for the topology obtained.

Geographical distribution

Information about the geographical distribution of both genera was taken from the literature (Attiah 1970, Buosi *et al*. 2006, De Leon 1956, Demite *et al.* 2009, Feres *et al.* 2005, Ito 1963, Lin and Liu 1995, Lin *et al.* 1998, Lofego *et al.* 2005, Mahunka 1972, 1974, 1981, Meyer *et al.* 1973, Ochoa *et al.* 1991, 1995, Ochoa and OConnor 1998, Rezende *et al.* 2015a, b, Smiley 1967, 1969, 1972, Sousa *et al.* 2014, 2015, Suski 1967a, 1971, Yang *et al.* 1987) and new records herein reported (Tab. 1). Based on this information, a map was produced (Fig. 91), using the software Adobe® Photoshop CS 5.0 and Adobe® Illustrator CS 5.0.

Results and Discussion

Taxonomic revision and description of new species

Family Tarsonemidae Canestrini & Fanzago, 1877

Subfamily Tarsoneminae Canestrini & Fanzago, 1877

Tribe Tarsonemini Canestrini & Fanzago, 1877

Genus *Daidalotarsonemus* De Leon, 1956

Daidalotarsonemus De Leon, 1956: 163; Smiley, 1972: 89; Lindquist, 1986: 316.

Type species: *Daidalotarsonemus tessellatus* De Leon, 1956; by original designation.

Diagnosis: the revision corroborates the diagnosis provided by Lindquist (1986). Females have distinctive reticulation on prodorsum and tergites C, D and EF and distinct form of most setae on these plates. Usually, setae of tergites C and H are slightly barbed and moderately short; and setae of the tergites D and EF are barbed, thickened, and mostly either lanceolate or clavate, though *e* is sometimes expanded, round-phylliform. On adult males, tibia IV is elongated, three to five times longer than the tarsus.

***Daidalotarsonemus alas* Ochoa, Rezende & Lofego 2015**

Type material: holotype and 27 paratype ♀ deposited at NMCR (for holotype); USNM (for 19 paratypes); CIPROC (for three paratypes); CNC (for two paratypes); DZSJRP (for one paratype) and TNHM (two paratypes).

Hosts: a non identified Moraceae (for holotype and five paratypes); *Bolbitis portoricensis* (Spreng.) Hennipman (Dryopteridaceae) (for one paratype); *Cyathea* sp. (Cyatheaceae) (for two paratypes); *Guarea guidonia* (L.) Sleumer (Meliaceae) (for two paratypes); a non identified

Melastomataceae (for three paratypes); a non identified Myristicaceae (for one paratype); *Nephrolepis* sp. (Nephrolepidaceae) (for one paratype); a non identified Ochnaceae (for one paratype); a non identified Arecaceae (for one paratype); *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for one paratype); a non identified Phytolaccaceae (for one paratype); a non identified Piperaceae (for one paratype); a non identified Rhamnaceae (for one paratype); a non identified Rubiaceae (for one paratype); a non identified Sapindaceae (for one paratype); a non identified Simaroubaceae (for one paratype); a non identified Violaceae (for two paratypes); *Theobroma cacao* L. (Malvaceae) (for one paratype).

Records: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus annonae* Sousa, Lofego & Gondim Jr., 2014**

Type material: holotype and six paratype ♀ deposited at DZSJRP.

Hosts: *Annona coriacea* Mart. (Annonaceae) (for holotype and four paratypes); *Annona muricata* L. (Annonaceae) (for two paratypes).

Remarks: individuals of *D. annonae* have been registered in the Amazon forest region, city of Cotriguaçu, State of Mato Grosso, Brazil; in *Trichilia casaretti* C.DC. (Euphorbiaceae), city of Sales, State of São Paulo, Brazil; in *Calliandra americana* (Fabaceae), *Clerodendron japonica* (Lamiaceae), *Hibiscus rosa-sinensis* L. (Malvaceae), *Quercus virginiana* Mill. (Fagaceae), city of Coral Gables, State of Florida, USA; in *Chrysobalanus icaco* L. (Chrysobalanaceae), city of Homestead, Florida USA; and in *Viburnum obovatum* (Caprifoliaceae), city of Rockledge, State of Florida, USA.

Records: Goiana, State of Pernambuco, Brazil (7°38'16"S; 34°57'9"W); Cotriguaçu, State of Mato Grosso, Brazil (9°57'S; 58°24'W); Sales, State of São Paulo, Brazil (21º24'S; 49º29'W); Coral Gables, State of Florida, USA (25°43'N; 80°16'W); Homestead, State of Florida, USA (25°28'N; 80°28'W); Rockledge, State of Florida, USA (28°18'N; 80°43'W).

Description, differential diagnosis and images: see Sousa *et al.* 2014.

Daidalotarsonemus azofeifai **Ochoa, Rezende & Lofego 2015**

Type material: holotype ♀, 27 paratype ♀ and seven paratype ♂ deposited at NMCR (for holotype); USNM (for 17 paratype females and two paratype males); CIPROC (for two paratype females and one paratype male); CNC (for two paratype females and one paratype male); DZSJRP (for two paratype females and one paratype male); FAAS (for one paratype female); FSCA (for one paratype female and one paratype male); QM (for one paratype female and one paratype male) and TNHM (two paratype females).

Hosts: a non identified Arecaceae (for holotype female, five paratype females and seven paratype males); a non identified Burseraceae (for one paratype female); a non identified Caesalpinaceae (for two paratype females); a non identified Ochnaceae (for two paratype females); *Cyathea* sp. (Cyatheaceae) (for one paratype female); *Guarea guidonia* (L.) Sleumer (Meliaceae) (for two paratype females); *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for one paratype female).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

Daidalotarsonemus bauchani **Rezende, Ochoa & Lofego 2015**

Type material: holotype and two paratype ♀ deposited at NMCR (for holotype) and USNM (for two paratypes).

Hosts: *Goethalsia meiantha* (Donn. Sm.) Burret (Malvaceae) (for holotype); *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for two paratypes).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

Daidalotarsonemus biovatus **Lin & Liu, 1995**

(Fig. 1)

Type material: holotype and three paratype ♀ deposited at FAAS.

Hosts: *Phyllostachys pubescens* (Pradelle) Mazel ex J. Houz (Poaceae) (for holotype and one paratype); *Tectaria subtriphylla* (Hook & Arn) Copel. (Tectariaceae) (for one paratype); *Camellia sinensis* (L.) Kuntze (Theaceae) (for one paratype).

Records: Fujian Province, China (25°11'N; 116°45'E / 25°45'N; 116°45'E / 27°44'N; 118°01'E).

Translation of the original description:

Differential diagnosis: it is similar to *Daidalotarsonemus somalatus* Attiah, but the differences are: 1. Setae *f* is towards the front in the middle of the dorsal shield EF; 2. No stripe or markings on shield EF; 3. Setae *1a* is beside apodeme 1.

Females: length 250 (230–280), width 151 (142–160).

Gnathosoma: length 37 (36–40); width 33 (23–24); dorsal setae 13–14; ventral setae 9 (8–10). Pharynx large, heavily sclerotized.

Dorsal view: length 237 (226–250), anterior edge of propodorsal shield ‗cups‘ gnathosoma. Posteromedial prodorsal shield ornamented with two connecting ‗w‘-shape patterns, each part of ‗w‘ with anterior oval shapes; medial prodorsal shield with upside-down ‗Y‘-shape pattern, flanked by connecting ‗w‘-shape pattern. Tergite C with irregular pattern. Setae *v1* curved; *sc2*, *c2* setae smooth; setae *d* and *f* rod-shaped, bearing pilose hair; setae *e* leaf-shaped, located on each sides of the dorsal shield EF; setae *c1* and *h* short with serrations. Setae length: *v1* 27 (26–28), *sc2* 28 (26–30), *c1* 16, *c2* 20, *d* 37 (34–40), *e* 20, *f* 45(42–46), *h* 17 (I6–18). Distance between setae bases: *v1–v2* 31 (31–32), *sc2–sc2* 52 (50–54), *c1–c2* 122 (120–123), *c1–c1* 61 (60–64), *d–d* 47 (46–48), *e–e* 45 (44–46), *f–f* 17 (16–18), *h–h* 23 (22–24).

Ventral view: prosternal apodeme and apodeme 1 connected, not connected with apodeme 2. Setae *1a* located behind apodeme 1, beside small apodeme; setae *2a* right behind apodeme 2; setae *3a* located in front of apodeme 3. Poststernal apodeme divided in two; apodeme 3 posteriorly connected to trochanter III; apodeme 4 curved anteriorly, with base setae grown within in it. Setae *1a*, *2a*, *3a*, *3b* and *ps* smooth. Setae length: *1a* 6, *2a* 9(8–10), *3a* 17 (16–18), *3b* 10 (8–12), *ps* 18 (16–20). Distance between setae base *1a–1a* 10, *2a–2a* 30 (30–31), *3a–3a* 18 (17–20), *3b–3b* 25 (24–26), *ps–ps* 17 (16–18).

Legs: leg I with single claw; legs II-III with symmetric double claws. Leg I with setal count (femur-tarsus) 3-4-8(2*φ*)+8(1*ω*); tarsi sensillum *ω* 5.1 (4.8–5.6). Leg II: 3-3-4-5(1*ω*); tarsi II *pl”* 11.2, knife-shaped; tarsi sensillum *ω* 4.5 (4.0–4.8). Leg III setae: 1+3-4-4. Setae length of leg IV: *v′* F 16, *v′* G 28.8 (28.0–30.4), *v′* Ti 38.1 (34.4-40.0), *tc″* 76.8 (72.0-80.0).

Daidalotarsonemus cornutus **Lin, Chen & Zhang, 1998**

(Fig. 2)

Type material: holotype and three paratype ♀ deposited at FAAS.

Hosts: bark from *Diospyros oleifera* Cheng (Ebenaceae) (for holotype) and mosses on the bark of *Sabina chinensis* (L.) Antoine (for three paratypes).

Record: Fujian Province, China.

Description, differential diagnosis and images: see Lin *et al.* 1998.

Daidalotarsonemus costulatus **Mahunka, 1971**

(Figs. 3-6)

Material examined: holotype ♀ deposited at HNHM.

Host: unknown (Berlese funnel extraction of litter collected near large trees in virgin forest).

Record: New Guinea.

Differential diagnosis: this species is similar to *Daidalotarsonemus folisetae* Lofego & Ochoa by the irregular pattern of prodorsal ornamentation. It differs by having setae *h*, femur II *l′* and genu III *v′* leaf-shaped and serrate. Also, the sejugal apodeme of *D. costulatus* enlarges in its medial portion, fusing to the prosternal apodeme.

Redescription:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 25; dorsal apodeme distinct. Setae *dgs* 12 and *vgs* 8 smooth; palps moderately long 9, with two small subterminal setae and terminal projections. Pharynx fusiform, length 18 and 7 at maximum width.

Idiosoma – dorsum (Figs. 3 and 6): length 220, width at level of *c1* 119; prodorsal shield with irregular ornamentation. Stigma located near lateral notches of prodorsal shield, which are equidistant to *v1* and *sc2* setal bases. Tergite C with inconspicuous reticulation. Tergite D with irregular reticulation. Lengths of setae: *v1* 30, *sc1* 14, *sc2* 29, *c1* 19, *c2* 29, *d* 43, *e* 24, *f* 34 and *h* 23. Maximum width of expanded setae: *d* 8, *e* 16 and *f* 7. All dorsal setae serrate; except *sc2*, *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1* and *c2* setiform; *sc2* falcate; *d* and *f* linear elongated; *e* elliptical with two veins. All inserted on tubercles; except for *c1* and *c2*. Distances between dorsal setae: *v1–v1* 25, *sc2–sc2* 49, *v1–sc2* 29, *c1–c1* 46, *c2–c2* 91, *c1–c2* 41, *d–d* 38, *f–f* 11, *e–f* 11 and *h–h* 12. Setae *sc2* inserted posterior to *sc1*.

Idiosoma – venter (Fig. 4): setae *1a* 7 (7–8), posteriad of apodemes 1; *2a* 9, posterolaterad of apodemes 2; *3a* 19 near anteriomedial margins of apodemes 3; *3b* 16 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme fused with sejugal apodeme and conspicuous from junction with apodeme 1 to the middle portion of sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from the middle of the poststernal apodeme to base of seta *3b*. Poststernal apodeme not seen. Tegula 16 wide and very short 6; posterior margin slightly arched. Setae *ag* 6 and *ps* 8 smooth.

Legs (Fig. 5): lengths (measured from femur to tarsus): leg I 41, leg II 36, leg III 84. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-6(2)+7(1), leg II: 3-4-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 18, serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 13, serrate. Femorogenu IV 14; tibiotarsus IV 9. Length of leg IV setae: *v′* F 10, *v′* G 21, *v′* Ti 26 and *tc″* 40; *v′* Ti ensiform.

Daidalotarsonemus cuadradus **Ochoa, Rezende & Lofego 2015**

Type material: holotype and three paratype ♀ deposited at NMCR (for holotype) and USNM (for three paratypes).

Hosts: *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for holotype and two paratypes); a non identified Melastomataceae (for one paratype).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

Daidalotarsonemus deleoni **(Smiley), 1967**

(Figs. 7-10)

Material examined: holotype ♂ deposited at USNM.

Host: *Hibiscus* sp. (Malvaceae).

Record: Tonga Islands.

Differential diagnosis: This species is similar to males of *Daidalotarsonemus tessellatus* De Leon by the rounded tip of the setae *sc1*, *sc2*, *c1* and *d*. It differs by the length of the palps, which are shorter by about 10 µm in *D. deleoni*; by the length of the setae *d*, longer in *D. deleoni*; and by the rounded tip of the setae *v2*.

Redescription:

Gnathosoma: subtriangular in ventral view, length 30, maximum width 26; dorsal apodeme distinct. Setae *dgs* 12 serrate and *vgs* 8 smooth; Palps moderately long 10, with 2 small subterminal setae and terminal projections. Pharynx fusiform, length 15 and width 7 at widest region.

Idiosoma – dorsum (Fig. 7): length 190, maximum width 100. Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 29, *v2* 17, *sc1* 65, *sc2* 20, *c1* 45, *c2* 41, *d* 51, *f* 54. All setae slender and serrate. Distances between dorsal setae: *v1–v1* 8, *sc1–sc1* 30, *sc2–sc2* 46, *v1–sc2* 39, *c1–c1* 88, *c2–c2* 93, *c1–c2* 56, *d–d* 51, *f–f* 18. Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Figs. 8 and 10): setae *1a* 6 posteriad apodemes 1; setae *2a* 10 located in center of coxisternal plates II; setae *3a* 16 located near anterior end of apodemes 3; and setae *3b* 13 located posteromedial margins of apodemes 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but inconspicuous between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous; connecting between 3, 4 and poststernal apodemes diffuse.

Legs (Fig. 9): lengths (measured from femur to tarsus): leg I 64, leg II 57, leg III 93, leg IV 154. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(1)+5(1), leg II: 3-2-4-4(1), leg III: 1-2-2-1. Due to type condition, it was not possible to count precisely all setae on legs. Solenidion *ω* of tarsus I 5, stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3, and famulus *k* 4, both inserted at approximately same level. Seta *d* of tibia I 12 serrate.

Solenidion ω of tarsus II proximally inserted, length 8, stout, wider medially. Seta *d* of tibia II 15 serrate. Trochanter IV slightly wider than long, seta *v′* 4, serrate. Femorogenu IV length 81 and width 30 at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third. Seta *v′* F 7 serrate. Setae *v′* G 38 and *l″* G 13 serrate. Tibia IV length 47; solenidion φ 8; seta *v′* Ti 77, serrate. Tarsus IV short, bearing 3 smooth setae, lengths: *tc″* 8, *pv″* 6 and *u′* 5. Claw well developed.

***Daidalotarsonemus digital* Lin, Chen & Zhang, 1998**

(Fig. 11)

Type material: holotype and 10 paratype ♀ deposited at FAAS.

Host: mosses from the trunk base of *Sabina chinensis* (L.) Antoine (for holotype and ten paratypes).

Record: Fujian Province, China.

Description, differential diagnosis and images: see Lin *et al.* 1998.

***Daidalotarsonemus duolamella* Lin, Chen & Zhang, 1998**

(Fig. 12)

Type material: holotype ♀ deposited at FAAS.

Host: *Camellia sinensis* (L.) Kuntze (Theaceae).

Record: Fujian Province, China.

Description, differential diagnosis and images: see Lin *et al.* 1998.

***Daidalotarsonemus esalqi* Rezende, Lofego & Ochoa**

Type material: holotype and two paratype ♀ deposited at ESALQ/USP.

Host: *Hevea brasiliensis* L. (Euphorbiaceae).

Remarks: individuals have been also registered in *Myrciaria plinioides* D. Legrand (Myrtaceae), city of Lajeado, State of Rio Grande do Sul, Brazil; and in Rubiaceae sp., city of Nova Granada, State of São Paulo, Brazil.

Records: Universidade de São Paulo, Escola Superior de Agricultura —Luiz de Queiroz” (ESALQ/USP), Piracicaba, State of São Paulo, Brazil (10°26′S; 84°1′W); Lajeado, State of Rio Grande do Sul, Brazil (29º26'S; 51º57'W); Nova Granada, State of São Paulo, Brazil (20º31′S; 49º19′W).

Description, differential diagnosis and images: see Chapter 3.

Daidalotarsonemus ethiopicus **Mahunka, 1981**

(Figs. 13-16)

Material examined: holotype ♀ deposited at HNHM.

Host: unknown (Berlese funnel extraction of litter).

Record: Addis Ababa, Ethiopia.

Differential diagnosis: this species is similar to *Daidalotarsonemus tessellatus* De Leon by the reticulate pattern of ornamentation on the prodorsum and tergite C. It differs by the shape of dorsal setae *d*, *e* and *f*; the distinct reticulate pattern on tergite D; and by the length of the palps, which are much shorter on *D. ethiopicus*.

Redescription:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 21; dorsal apodeme distinct. Setae *dgs* 9 and *vgs* 5 smooth; palps moderately long 10, with two small subterminal setae and terminal projections. Pharynx fusiform, length 18 and 8 at maximum width.

Idiosoma – dorsum (Figs. 13 and 16): length 214, width at level of *c1* 119; prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C and D with a reticulate ornamentation pattern covering all tergite. Lengths of setae: *v1* 21, *sc1* 18, *sc2* 26, *c1* 22, *c2* 20, *d* 31, *e* 19, *f* 31 and *h* 9. Maximum width of expanded setae: *d* 5, *e* 10 and *f* 7. All dorsal setae serrate; except *sc2*, *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* linear elongated with two veins; *e* elliptical with two veins; *f* lanceolate with two veins. All inserted on tubercles; except for *v1* and *h*. Distances between dorsal setae: *v1–v1* 31, *sc2–sc2* 56, *v1–sc2* 34, *c1–c1* 62, *c2–c2* 105, *c1–c2* 43, *d–d* 50, *f–f* 17, *e–f* 14 and *h–h* 19. Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 14): setae *1a* 7 posteriad apodemes 1; *2a* 15 posterolaterad of apodemes 2; *3a* 13 near anteriomedial margins of apodemes 3; *3b* 11 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where is inconspicuous. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 15 wide and very short 5; posterior margin slightly arched. Setae *ps* 17 serrate.

Legs (Fig. 15): lengths (measured from femur to tarsus): leg I 57, leg II 49, leg III 85. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-6(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 4, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 2, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 8; all inserted at approximately same level. Seta *d* of tibia I 32, serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 17, serrate. Femorogenu IV 18; tibiotarsus IV 12. Length of leg IV setae: *v′* F 11, *v′* G 23, *v´* Ti 35 and *tc″* 48; all setae smooth, except *v´* Ti; *v′* Ti ensiform.

***Daidalotarsonemus euonymus* Yang, Ding & Zhou, 1987**

Type material: holotype ♀ deposited at DBFU.

Host: *Euonymus alatus* (Thunb.) Siebold (Celastraceae).

Record: Shanghai, China (31°16'N; 121°31'E).

Images: see Yang *et al.* (1987).

Translation of the original description:

Differential diagnosis: this species is similar to *Daidalotarsonemus venustus* Attiah, but the setae *d* have two mid veins. Also, their ornamentation on prodorsal shields are very different.

Females: oval-shaped body, 154 in length, 81 in width. Yellowish brown when alive.

Gnathosoma: 30 in length, rounded in the base; 23 in width; palps tube-like.

Dorsal view: prodorsal shield, with symmetric ornamentation, partially covers the gnathosoma, 76 in length, 89 in width. Notches on two sides of front dorsal shield. Setae *v1* strong and curved, 23 in length, close to anterior end of prodorsal shield, 26 of distance between two setae. Setae *sc2* hard, pointed, smooth, straight up, 30 in length, 52 of distance between them. Tergite C almost covers middle part of body, 68 in length, ornamentation similar to symmetric cobblestones. Setae *c1* 17 smooth and pointing towards end. Setae *c2* 17 in length, 52 of distance between them. Setae *d* lanceolate with mid vein, smooth, 34 in length, 5 in width, 13 of distance between them. Tergite EF with no ornamentation. Setae *f* lanceolate with two mid vein, serrate on sides, 34 in length, 13 of distance between them. Seta *e* wide with no mid vein, serrate on sides, 18 in length, 10 in width, 34 of distance between them. Tergite H smooth, 34 in length. Setae *h* located on posterior end, 18 in length and 18 of distance between them.

Ventral view: apodemes 1 missing; apodemes 2 located between prosternal apodeme and bases of legs I and II, not fused. Setae *2a* located below middle-lower point of apodeme 2, 10 in length. Prosternal apodeme very long. Anterior part connected with base of gnathosoma, posterior part fused with sejugal apodeme. Apodeme 3 strong. Setae *3a* 18. Inner side of apodeme 4 fused with middle point of poststernal apodeme. Setae *3b* thin, located at end of apodeme 4, 10 in length. Four pairs of legs. Leg I, II and III with normal claws. Setae on tarsus IV strong.

Daidalotarsonemus folisetae **Lofego & Ochoa, 2005**

(Fig. 17)

Type material: holotype and eight paratype ♀ deposited at ESALQ/USP (for holotype and five paratypes) and USNM (for three paratypes).

Hosts: *Psidium guajava* L. (Myrtaceae) (for holotype and five paratypes); *Psidium cinereum* Mart Ex DC. (Myrtaceae) (for three paratypes).

Remarks: This species was also recorded in *Duguetia furfuracea* (A. St.-Hil.) Benth & Hook (Annonaceae) and *Qualea grandiflora* Mart. (Vochysiaceae); in a Cerrado fragment (Rezende *et al.* 2014).

Records: Pirassununga and Luiz Antonio, State of São Paulo, Brazil (21°33'S; 47°41'W / 21°59'S; 47°25'W) (Lofego *et al.* 2005); Unaí, Minas Gerais, Brazil (15°59'S; 46°59'W) (Rezende *et al.* 2014).

Description, differential diagnosis and images: see Lofego *et al.* 2005.

Daidalotarsonemus fossae **De Leon, 1956**

(Figs. 18-21)

Material examined: holotype ♀ deposited at USNM.

Host: *Litchi chinensis* Sonn. (Sapindaceae).

Remarks: This species was also recorded from *Annona coriacea* Mart. (Annonaceae), Goiana, State of Pernambuco, Brazil (Sousa *et al.* 2015); in *Quercus virginiana* Mill. (Fagaceae), city of Coral Gables, State of Florida, USA; and from *Chrysobalanus icaco* L. (Chrysobalanaceae), city of Homestead, Florida USA. De Leon (1956) diagnosed *D. fossae* as lacking ornamentation on the dorsal plates, but after studying the types, it was observed that this statement is incorrect.

Records: Miami, State of Florida, USA (25°45'N;80°11'W) (De Leon 1956); Goiana, State of Pernambuco, Brazil (7°38'16"S; 34°57'9"W)

(Sousa *et al.* 2015); Coral Gables, State of Florida, USA (25°43'N; 80°16'W); Homestead, State of Florida, USA (25°28'N; 80°28'W).

Differential diagnosis: this species is similar to *Daidalotarsonemus puntarenensis* Rezende, Ochoa & Lofego and *Daidalotarsonemus serratus* Rezende, Ochoa & Lofego by insertion of the setae *c1* near the border of the tergite D, and the tegula rounded apically. *Daidalotarsonemus fossae* differs from these by all the setae of tergites C, D and EF being stout and capitate. The ornamentation pattern is also different among these species.

Redescription:

Gnathosoma: subtriangular in ventral view, length 40, maximum width 26; dorsal apodeme distinct. Setae *dgs* 15 and *vgs* 12 smooth; palps moderately long 17, with two small subterminal setae and terminal projections. Pharynx fusiform, length 13 and 7 at maximum width.

Idiosoma – dorsum (Figs. 18 and 21): length 193, width at level of *c1* 108; prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D completely reticulate. Lengths of setae: *v1* 27, *sc1* 14, *sc2* 30, *c1* 22, *c2* 19, *d* 20, *e* 15, *f* 22 and *h* 13. Maximum width of expanded setae: *d* 4, *e* 3 and *f* 4. All dorsal setae serrate; *c1*, *c2*, *d*, *e* and *f* scaled. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1* and *h* slender; *sc2* ensiform; *c1*, *c2*, *d*, *e* and *f* stout and capitate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 29, *sc2–sc2* 49, *v1–sc2* 24, *c1–c1* 55, *c2–c2* 79, *c1–c2* 36, *d–d* 44, *f–f* 16, *e–f* 13 and *h–h* 26. Setae *sc2* inserted at same level to *sc1*.

Idiosoma – venter (Fig. 19): setae *1a* 7 posteriad apodemes 1; *2a* 11 posterolaterad of apodemes 2; *3a* 12 near anteriomedial margins of apodemes 3; *3b* 9 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to level of apodemes 2. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 13 wide and very short 6; posterior margin heavily arched. Setae *ps* 7 smooth.

Legs (Fig. 20): lengths (measured from femur to tarsus): leg I 55, leg II 47, leg III 84. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 18, serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 14, serrate. Femorogenu IV 23; tibiotarsus IV 9. Length of leg IV setae: *v′* F 7, *v′* G 11, *v´* Ti 18 and *tc″* 29; all setae smooth; *v′* Ti ensiform.

***Daidalotarsonemus ginae* Ochoa, Rezende & Lofego 2015**

Type material: holotype and 15 paratype ♀ deposited at NMCR (for holotype); USNM (for eight paratypes); CIPROC (for three paratypes); CNC (for one paratype); DZSJRP (for one paratype); FAAS (for one paratype) and TNHM (for one paratype).

Hosts: a non identified Moraceae (for holotype); a non identified Melastomataceae (for one paratype); *Goethalsia meiantha* (Donn.Sm.) Burret (Malvaceae) (for one paratype); *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for 14 paratypes).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus gutierrezi* Suski, 1971**

Type material: holotype ♀ deposited at ZMPAS.

Remarks: according to the current curator of the Insect and Acari Collection of ZMPAS, Dr. Tomasz Huflejt, the holotype of *D. gutierrezi* is not deposited in there and the location of the type is unknown to him.

Host: unknown.

Record: Forest reservation of Aganvokely, Manjakandriana, Madagascar (18°54'S; 47°50'E).

Description, differential diagnosis and images: see Suski 1971.

***Daidalotarsonemus hexagonus* Yang, Ding & Zhou, 1987**

Type material: holotype ♀ deposited at DBFU.

Host: *Serissa serissoides* (DC) Druce (Rubiaceae).

Record: Shanghai, China (31°16'N;121°31'E).

Images: see Yang *et al.* (1987).

Translation of the original description:

Differential diagnosis: this species is similar to *D. tesselatus* De Leon, but the setae *c1* and *c2* are both smooth, and *d* is short. Setae *c1* and *c2* of *D. tesselatus* have little spikes; and *d* is triangular to oval shape.

Females: oval-shaped, 206 in length, 96 in width. Brown when alive. Posterior body with yellow dots.

Gnathosoma: 36 in length and 26 in width. Palps tube-shaped. Anterior edge of propodorsal shield covers gnathosoma.

Dorsal view: Propodorsal shield 68 with peanut shell ornamentations. Setae *v1* strong and curvy with fine spikes located on a swollen base with a total length of 20; distance between bases of setae 24. Setae *sc2* smooth, 26 in length, swollen base, distance between setae bases 44. Posterior body with hexagon ornamentation. Tergite C with 57 in length, with 2 pairs of smooth setae *c1* and *c2*; *c2* 10 in length, distance between setae bases 91; *c1* 14 in length, distance between setae bases 54. Tergite D without ornamentations 49 in length; tergite EF 66. Setae *e* and *f* narrowly lanceolate. Setae *e* 16 in length and 3 in width, distance between setae bases 44, setae *f* 8 in length and 2 in width, distance between setae bases 44.

Ventral view: ventral apodeme apparent. Prosternal apodeme curvy and merged to a ‗Y‘ shape with apodeme 2. Apodemes 2 between prosternal apodeme and legs II. Setae *1a* 12 and *2a* 9, both located middle lower side of apodeme 1 and 2. Apodeme 3 with nodes on two ends. Setae *3a* with 12 in length. Setae *3b* located on exterior of apodeme 4 and 9 in length. First three pair of legs with strong claws. Leg III longest. Leg IV thick.

Daidalotarsonemus hewitti **Mahunka, 1974**

(Figs. 22-25)

Material examined: holotype ♀ deposited at HNHM.

Host: unknown (collected from clothes‘ shakings of humans).

Record: Sheviock, Cornwall, England (50°22'N; 4°17'W).

Differential diagnosis: this species differs from all others of the genus by the morphology of the setae *f*, which has long and short serration intercalated. Also, the setae *h* of this species are heavily serrated. The ornamentation pattern on the prodorsum and tergite D are also unique.

Redescription:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 29; dorsal apodeme distinct. Setae *dgs* 9 and *vgs* 6 smooth; palps moderately long 10, with two small subterminal setae and terminal projections. Pharynx fusiform, length 19 and 10 at maximum width.

Idiosoma – dorsum (Figs. 22 and 25): length 199, width at level of *c1* 110; prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with three rows of reticles between level of setae *c1*. Tergite D with irregular ornamentation. Lengths of setae: *v1* 35, *sc1* 11, *sc2* 27, *c1* 12, *c2* 16, *d* 28, *e* 17, *f* 28 and *h* 14. Maximum width of expanded setae: *d* 4, *e* 11 and *f* 10. All dorsal setae serrate; except for *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* linear elongated with one central vein; *e* elliptical; *f* lanceolate with two veins. All inserted on tubercles. Distances between dorsal setae: *v1–v1* 32, *sc2–sc2* 55, *v1–sc2* 33, *c1–c1* 59, *c2–c2* 123, *c1–c2* 40, *d–d* 41, *f–f* 14, *e–f* 13 and *h–h* 28. Setae *sc2* inserted at same level to *sc1*.

Idiosoma – venter (Fig. 23): setae *1a* 7 posteriad apodemes 1; *2a* 10 posterolaterad of apodemes 2; *3a* 13 near anteriomedial margins of apodemes 3; *3b* 7 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where is inconspicuous. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme not bifurcated anteriorly. Tegula 19 wide and very short 5; posterior margin slightly arched. Setae *ps* 15 smooth.

Legs (Fig. 24): lengths (measured from femur to tarsus): leg I 47, leg II 45, leg III 81. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-4(2)+7(1), leg II: 3-3-4-4(1), leg III: 1-4-4. Due to type conditions, it was not possible to count precisely all setae on tibiotarsus I and femogenu III. Tarsal solenidion *ω* of tibiotarsus I 4, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 5; all inserted at approximately same level. Seta *d* of tibia I 14, smooth. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 20, serrate. Femorogenu IV 15; tibiotarsus IV

12. Length of leg IV setae: *v′* F 7, *v′* G 15, *v´* Ti 22 and *tc″* 45; all setae smooth; *v′* Ti ensiform.

***Daidalotarsonemus jamesbakeri* Smiley, 1969**

(Figs. 26-29)

Type deposition: USNM (holotype and paratypes lost).

Material examined: neotype ♀ deposited at DPI-FDACS.

Records: Ivanhoe, State of North Carolina, USA (34°35'N; 78°14'W); Gainesville, State of Florida, USA (29°39'N;82°19'W); Thailand.

Remarks: female individuals have been registered in *Ilex vomitoria* Sol. ex Aiton (Aquifoliaceae) from Gainesville, State of Florida, USA (designated neotype); and in *Vanda* sp. (Orchidaceae) from Thailand.

Differential diagnosis: this species is similar to *Daidalotarsonemus jamesbakeri* by the shape of ornamentation of tergites C and D, which are longitudinal and waved continuous ridges. It differs by the shape of the setae *e*, which in *D. jamesbakeri* is lanceolate and L-shaped (extremely curved).

Redescription (based on the neotype):

Gnathosoma: partially covered by prodorsum, subtriangular in ventral view, length 32 (31–34), maximum width 26 (25–27); dorsal apodeme distinct. Setae *dgs* 17 (16–19) and *vgs* 12 (11–14) serrate; palps moderately long 13 (12–14), with two small subterminal setae and terminal projections. Pharynx fusiform, length 19 (18–21) and 9 (8–11) at maximum width.

Idiosoma – dorsum (Figs. 26 and 29): length 210 (206–217), width at level of *c1* 120 (118–127); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C completely covered with waved and continuous ridges covering all plate. Tergite D with irregular reticulation. Lengths of setae: *v1* 27 (24–29), *sc1* 14 (12–16), *sc2* 31 (29–35), *c1* 20 (18–24), *c2* 19 (17–21), *d* 37 (36–39), *e*

18 (16–20), *f* 37 (37–38) and *h* 10 (9–11). Maximum width of expanded setae: *d* 5, *e* 8 and *f* 6. All dorsal setae serrate; except *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *sc2*, *c1*, *c2* and *h* setiform; *d* and *f* lanceolate with two veins; *e* lanceolate, curving inwards. All inserted on tubercles. Distances between dorsal setae: *v1–v1* 30 (29–33), *sc2–sc2* 56 (52–59), *v1–sc2* 27 (25–29), *c1–c1* 56 (55–58), *c2–c2* 108 (105–113), *c1–c2* 37 (36–40), *d–d* 46 (45–48), *f–f* 15 (13–18), *e–f* 15 (13–17) and *h–h* 24 (24–26). Setae *sc2* inserted at the same level as *sc1*.

Idiosoma – venter (Fig. 27): setae *1a* 7 (7–8), posteriad apodemes 1; *2a* 11 (9–13), posterolaterad of apodemes 2; *3a* 14 (14–15) near anteriomedial margins of apodemes 3; *3b* 11 (10–12) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short but not fused to prosternal apodeme. Prosternal apodeme inconspicuous from junction with apodeme 1 to middle portion of sejugal apodeme. Sejugal apodeme uninterrupted, with a median furrow. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 18 (16–22) wide and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 14 (12–16) smooth.

Legs (Fig. 28): lengths (measured from femur to tarsus): leg I 58 (56–61), leg II 64 (63–66), leg III 85 (84–87). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+2-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, widest medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (6–7); all inserted at approximately same level. Seta *d* of tibia I 30 (30–31), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, widest medially. Seta *d* of tibia II 24 (23–26), serrate. Femorogenu IV 18 (17–19); tibiotarsus IV 12 (12–13). Length of leg IV setae: *v′* F 10 (9–12), *v′* G 21 (19–23), *v´* Ti 35 (34–37) and *tc″* 26 (44–47); all setae smooth, except for *v′* G; *v′* Ti ensiform.

***Daidalotarsonemus leonardi* (Smiley), 1967**

(Figs. 30-33)

Material examined: holotype ♂ deposited at USNM.

Host: *Citrus sinensis* (L.) (Rutaceae).

Record: Jamaica.

Differential diagnosis: This species is unique among all others by the shape of the setae *sc1*, which is falcate and heavily serrate. Other characters related to the form of dorsal setae are similar to *D. deleoni*.

Redescription:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 27; dorsal apodeme distinct. Setae *dgs* 14 serrate and *vgs* 8 smooth; Palps moderately length 8, with 2 small subterminal setae and terminal projections. Pharynx fusiform, length 14 and width 8 at widest region.

Idiosoma – dorsum (Figs. 30 and 33): length 165, maximum width 93. Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 25, *v2* 20, *sc1* 49, *sc2* 23, *c1* 26, *c2* 28, *d* 37, *f* 40. All setae slender and serrate. Distances between dorsal setae: *v1–v1* 11, *sc1–sc1* 35, *sc2–sc2* 49, *v1–sc2* 33, *c1–c1* 75, *c2–c2* 93, *c1–c2* 58, *d–d* 55, *f–f* 22. Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Fig. 31): setae *1a* 5 posteriad apodemes 1; setae *2a* 12 located in center of coxisternal plates II; setae *3a* 13 located near anterior end of apodemes 3; and setae *3b* 15 located posteromedial margins of apodemes 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but inconspicuous between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous; connecting between 3, 4 and poststernal apodemes diffuse.

Legs (Fig. 32): lengths (measured from femur to tarsus): leg I 66, leg II 51, leg III 82, leg IV 130. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 2-4-3(1)+5(1), leg II: 3-3-3-4(1), leg III: 1-3-4-3. Due to type conditions, it was not possible to count precisely all setae on legs. Solenidion *ω* of tarsus I 4, stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3, and famulus *k* 4, both inserted at approximately same level. Seta *d* of tibia I 18 serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 19 serrate. Trochanter IV slightly wider than long, seta *v′* 8, serrate. Femorogenu IV length 70 and width 31 at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third. Seta *v′* F 7 serrate. Setae *v′* G 34 and *l″* G 13 serrate. Tibia IV length 38; solenidion *φ* 8; seta *v′* Ti 86, serrate. Tarsus IV short, bearing 3 smooth setae of following length: *tc″* 7, *pv″* 6 and *u′* 5. Claw well developed.

Daidalotarsonemus limonensis **Ochoa, 1991**

Type material: holotype ♀ deposited at CALFAUCR.

Remarks: the current curator, Dr. Hugo Aguilar, informed the holotype of *D. limonensis* is missing.

Host: *Annona muricata* L. (Annonaceae).

Record: Limon, Costa Rica (9°59'N;83°01'W).

Description, differential diagnosis and images: see Ochoa *et al.* 1991.

Daidalotarsonemus lini **Ochoa, Rezende & Lofego 2015**

Type material: holotype and eight paratype ♀ deposited at NMCR (for holotype); USNM (for four paratypes); CIPROC (for two paratypes); CNC (for one paratype) and DZSJRP (for one paratype).

Hosts: *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for holotype and three paratypes); a non identified Ochnaceae (for one paratype); *Nephrolepis* sp. (for one paratype); *Goethalsia meiantha* (Donn.Sm.) Burret (Malvaceae) (for three paratypes).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus marini* Ochoa, Rezende & Lofego 2015**

Type material: holotype and 23 paratype ♀ deposited at NMCR (for holotype); USNM (for 14 paratypes); CIPROC (for three paratypes); CNC (for two paratypes); DZSJRP (for one paratype); FAAS (for one paratype) and TNHM (for two paratypes).

Hosts: a non identified Arecaceae (for holotype); unknown host (for eight paratypes); a non identified Malvaceae (for one paratype); a non identified Moraceae (for nine paratypes); *Theobroma cacao* L. (Malvaceae) (for five paratypes).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus maryae* Ochoa, Rezende & Lofego 2015**

Type material: holotype and one paratype ♀ deposited at NMCR (for holotype) and USNM (for one paratype).

Host: *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for holotype and paratype).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus oliveirai* Rezende, Lofego & Ochoa, 2015**

Type material: holotype ♀, nine paratype ♀, one allotype ♂ and two paratype ♀ deposited at DZSJRP.

Hosts: *Theobroma cacao* L. (Malvaceae) (for holotype female, allotype male, six paratype females and two paratype males); *Annona muricata* L. (Annonaceae) (for one paratype female); *Spondias purpurea* L. (Anacardiaceae) (for two paratype females).

Remarks: individuals of *D. oliveirai* have been also recorded in *Hevea brasiliensis* Müll.Arg. (Euphorbiaceae) from Igrapiúna, State of Bahia, Brazil and from the Amazon forest region, Cotriguaçu, State of Mato Grosso, Brazil.

Records: Ilhéus and Igrapiúna, State of Bahia, Brazil (14°47'S;39°10'W / 13°50'S;39°06'W); Cotriguaçú, State of Mato Grosso, Brazil (9°57'S;58°24'W).

Description, differential diagnosis and images: see Chapter 1.

Daidalotarsonemus ostracodes **Mahunka, 1974**

(Figs. 34-37)

Material examined: holotype ♀ deposited at HNHM.

Host: unknown (Berlese funnel extraction of litter collected near large trees in virgin forest).

Record: New Guinea.

Differential diagnosis: this species is similar to *D. cuadradus* and *Daidalotarsonemus somalatus* Attiah by the shape of the seta *e*, which is asymmetric. It differs from them by the lack of reticulation on the tergite D and shape of the setae *d* and *f*, which are lanceolate, wide and similar to each other.

Redescription:

Gnathosoma: subtriangular in ventral view, length 25, maximum width 17; dorsal apodeme distinct. Setae *dgs* 10 and *vgs* 7 smooth; palps moderately long 10, with two small subterminal setae and terminal projections. Pharynx fusiform, length 15 and width 8 at maximum width.

Idiosoma – dorsum (Figs. 34 and 37): length 188, width at level of *c1* 122; prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Apparently, stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C completely covered with reticulation. Tergite D with irregular ornamentation. Lengths of setae: *v1* 28, *sc1* 12, *sc2* 30, *c1* 18, *c2* 15, *d* 35, *e* 18, *f* 31 and *h* 24. Maximum width of expanded setae: *d* 10, *e* 17 and *f* 6. All dorsal setae serrate; except for sc2, *c1* and *c2* smooth. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* lanceolate with two veins; *e* asymmetric and elliptical; *f* lanceolate with two veins. All inserted on tubercles, except for *c1* and *c2*. Distances between dorsal setae: *v1–v1* 21, *sc2–sc2* 48, *v1–sc2* 40, *c1–c1* 49, *c2–c2* 105, *c1–c2* 38, *d–d* 23, *f–f* 7, *e–f* 11 and *h–h* 14. Setae *sc1* inserted anteriorly at level to *sc2*.

Idiosoma – venter (Fig. 35): setae *1a* 10 posteriad apodemes 1; *2a* 13 posterolaterad of apodemes 2; *3a* 18 near anteriomedial margins of apodemes 3; *3b* 11 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to middle portion of sejugal apodeme, where is inconspicuous. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 16 wide and very short 6; posterior margin slightly arched. Setae *ps* 9 smooth.

Legs (Fig. 36): lengths (measured from femur to tarsus): leg I 41, leg II 36, leg III 84. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively, at least: leg I: 3-2-4(2)+4, leg II: 3-3-4-4(1), leg III: 3-4-4. Due to type conditions, it was not possible to count precisely all setae on tibiotarsus I. Sensory cluster of tibia I complete, solenidion *φ1*

2, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 17, serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 20, smooth. Femorogenu IV 14; tibiotarsus IV 9. Length of leg IV setae: *v′* F 10, *v′* G 21, *v´* Ti 26 and *tc″* 40; all setae smooth, except for *v′* Ti serrate and ensiform.

***Daidalotarsonemus puntarenensis* Rezende, Ochoa & Lofego 2015**

Type material: holotype and three paratype ♀ deposited at NMCR (for holotype) and USNM (for one paratype).

Host: *Elaeis guineensis* Jacq. (Arecaceae), (for holotype and three paratypes).

Record: Quepos, Puntarenas, Costa Rica (9°25′N; 84°25′W).

Description, differential diagnosis and images: see Chapter 2.

***Daidalotarsonemus savanicus* Rezende, Lofego & Ochoa**

Type material: holotype and eleven paratype ♀ deposited at DZSJRP (for holotype and five paratypes); ESALQ/USP (for three paratypes) and USNM (for three paratypes).

Hosts: *Caryocar brasiliense* Camb. (Caryocaraceae) (for holotype and one paratype); *Bauhinia* sp. (for one paratype); *Campomanesia pubescens* (DC.) Berg. (Myrtaceae) (for two paratypes); *Didymopanax vinosum* Cham. & Schltdl. (Araliaceae) (for one paratype); *Genipa americana* L. (Rubiaceae) (for one paratype); *Miconia albicans* (Sw.) Triana (Melastomataceae) (for one paratype); a non identified Myrtaceae (for two paratypes); *Pouteria torta* (Mart.) Radlk. (Sapotaceae) (for one paratype); *Xylopia aromatica* (Lam.) Mart. (Annonaceae) (for one paratype).

Records: Chapadão do Sul, State of Mato Grosso do Sul, Brazil (52°35'W; 18°51'S) (for holotype and five paratypes); Chapadão do Céu, State of Goiás, Brazil (52°44'W; 18°15'S) (for three paratypes); Jataí, State of Goiás, Brazil (51°45'W; 17°51'S) (for one paratype); Tupaciguara, State of Minas Gerais, Brazil (48°54'W; 18°31'S) (for one paratype); Unaí, State of Minas Gerais, Brazil (46°41'W; 15°59'S) (for one paratype).

Remarks: After checking voucher specimens, it was concluded that individuals of this species have been recorded as *Daidalotarsonemus tessellatus* De Leon in previous papers (Buosi *et al*. 2006, Demite *et al.* 2009, Feres *et al.* 2005, Lofego *et al.* 2005 and Sousa *et al.* 2015).

Description, differential diagnosis and images: see Chapter 3.

***Daidalotarsonemus seitus* Attiah, 1970**

(Figs. 38-41)

Material examined: holotype and one paratype ♀ deposited at USNM.

Host: *Citrus* sp. (Rutaceae).

Record: Fort Pierce, State of Florida, USA (27°26'N;80°19'W).

Differential diagnosis: this species is similar to *D. alas* and *D. oliveirai* by the irregular ornamentation on tergites C and D; and by the ovate shape of setae *e*. It differs by the ornamentation of the tergite D being restricted to just between the bases of setae *d*; and by the reticulation present on the tergite EF, which is unusual for the genus.

Redescription:

Gnathosoma: subtriangular in ventral view, length 31 (30–33), maximum width 29 (28–30); dorsal apodeme distinct. Setae *dgs* 10 (9–11) serrate and *vgs* 6 (6–7) smooth; palps moderately long 10, with two small subterminal setae and terminal projections. Pharynx fusiform, length 12 (11–13) and 9 at maximum width.

Idiosoma – dorsum (Figs. 38 and 41): length 217 (214–220), width at level of *c1* 115 (113–117); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergite C with waved and continuous ridges covering all plate. Tergite D with waved and continuous ridges between setae *d*. Lengths of setae: *v1* 27 (26–30), *sc1* 15, *sc2* 32 (31–34), *c1* 13 (13–14), *c2* 14 (13–15), *d* 51 (49–53), *e* 27 (26–28), *f* 42 and *h* 14 (13–15). Maximum width of expanded setae: *d* 7, *e* 13 and *f* 6. All dorsal setae serrate, except for *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1* and *c2* slender; *sc2* ensiform; *d* and *f* lanceolate with two veins; *e* cordate with two veins. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 27 (26–28), *sc2–sc2* 59 (58–60), *v1–sc2* 33 (33–34), *c1–c1* 50 (48–52), *c2–c2* 107 (105–110), *c1–c2* 36 (33–40), *d–d* 46 (46–47), *f–f* 14 (14–15), *e–f* 13 and *h–h* 24 (23–25). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 39): setae *1a* 7 posteriad apodemes 1; *2a* 13 (12–14) posterolaterad of apodemes 2; *3a* 16 (16–17) near anteriomedial margins of apodemes 3; *3b* 11 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long and fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 14 (14–15) wide and very short 5 (5–6); posterior margin slightly arched. Setae *ps* 15 (14–16) serrate.

Legs (Fig. 40): lengths (measured from femur to tarsus): leg I 47 (44–51), leg II 37 (36–38), leg III 94 (92–95). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6 (6–7); all inserted at approximately same level. Seta *d* of tibia I 26 (26–27), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 14 (13–15), serrate. Femorogenu IV 19 (16–22); tibiotarsus IV 14 (14–15). Length of leg IV setae: *v′* F 15 (14–16), *v′* G 27

(27–28), *v´* Ti 29 (29–30) and *tc″* 59 (59–60); all setae smooth, except for *v′* G and *v´* Ti serrate; *v′* Ti ensiform.

Daidalotarsonemus serratus **Rezende, Ochoa & Lofego 2015**

Type material: holotype and two paratype ♀ deposited at NMCR (for holotype) and USNM (for two paratypes).

Host: *Nephrolepis* sp. (Nephrolepidaceae) (for holotype and two paratypes).

Record: La Selva Biological Station, Heredia, Costa Rica (10°26′N; 84°1′W).

Description, differential diagnosis and images: see Chapter 2.

Daidalotarsonemus serissae **Yang, Ding & Zhou, 1987**

(Fig. 42)

Type material: holotype ♀ deposited at DBFU.

Host: *Serissa serissoides* (DC) Druce (Rubiaceae).

Record: Shanghai, China (31°16'N;121°31'E).

Translation of the original description:

Differential diagnosis: only a small part of the genus *Daidalotarsonemus* has lanceolate posterior dorsal setae. This species has all the posterior dorsal setae in big lanceolate shape. The ornamentation on tergite EF and prodorsal shield are completely different from known species.

Females: Oval-shaped; 159 in length, 88 in width; brown when alive; dorsal shield strongly swollen; opisthosoma has small yellow dots.

Gnathosoma: 31 in length, 21 wide in the base, all covered with prodorsal shield extension.

Dorsal view: Prodorsal shield 72 in length, ornamentation unique. Setae *v1* strong, curved with dense fine spikes on setae, 34 in length. Setae *sc2* strong and smooth, 45 in length, 49 between bases of them. Tergite C 60 in length, 83 in width. Setae *c1* and *c2* lanceolate shaped with a mid vein; *c1* serrated edge, 25 um in length, 3 um in width, 62 of distance between bases of them. Setae *c2* smooth edge, 39 in length, 5 in width. Tergite D membranous covering part of tergite EF. Tergite EF strongly sclerotized, swollen, wavy on edge, 52 in length. Setae *d*, *e* and *f* lanceolate in shape with mid vein, serrate on edges. Mid veins of setae *e* and *f* with dense fine spikes. Setae *d* 26 in length, 13 in width, 26 distance between bases of them. Setae *e* 23 in length, 8 in width, 44 between bases. Setae *f* 28 in length, 10 in width, 16 distance between bases. Setae *h* v-shaped, curved and strong with dense fine spikes, 16 in length, 22 between bases.

Ventral view: Apodeme 1 located on inner side of coxisternal plate I, merged in middle with prosternal apodeme. Setae *1a* located in middle of apodeme 1, 7 in length. Prosternal apodeme visible on 2/3 anterior part, not 1/3 posterior part. Apodeme 2 not connected with prosternal apodeme, both ends of apodeme 2 heavily sclerotized. Setae *2a* located posteriad middle point of apodeme, 13 in length. Apodeme 3 strong, not merged with poststernal apodeme. Setae *3a* located on base of apodeme 3, 10 in length. Middle point of poststernal apodeme slightly swollen; where both apodeme merge. Setae *3b* located at where apodeme 4 ends, 10 in length. First three legs strong. Setae of tarsi IV strong and pointing.

Daidalotarsonemus somalatus **Attiah, 1970**

(Figs. 43-49)

Material examined: holotype and three paratype ♀ deposited at USNM.

Host: *Citrus* sp. (Rutaceae).

Remarks: This species was also recorded in *Capparis jamaicensis* Jacq. (Brassicaceae) and *Litchi chinensis* Sonn. (Sapindaceae), city of Miami, State of Florida, USA; in *Fraxinus caroliniana* Mill. (Oleaceae), Alva, State of Florida, USA; in *Rhododendron* sp. (Ericaceae), city of Gainesville, State of Florida, USA; and in *Salix caroliniana* Michx. (Salicaceae), city of Ridge Manor, State of Florida, USA.

Records: Vero Beach, State of Florida, USA (27°38'N;80°23'W); Miami, State of Florida, USA (25°45'N;80°11'W); Alva, State of Florida, USA

(26°42'N; 81°36'W); Gainesville, State of Florida, USA (29°39'N;82°19'W); Ridge Manor, State of Florida, USA (28°29'N; 82°10'W).

Differential diagnosis: this species is similar to *D. cuadradus* and *D. ostracodes* by the asymmetric shape of the setae *e* and the reticulate ornamentation pattern on tergite C. It differs from them by the rounded tip of the setae *e* and the reticulate pattern on tergite D.

Redescription:

Gnathosoma: subtriangular in ventral view, length 36 (35–38), maximum width 25 (24–26); dorsal apodeme distinct. Setae *dgs* 15 serrate and *vgs* 10 (9–11) smooth; palps moderately long 12, with two small subterminal setae and terminal projections. Pharynx fusiform, length 21 (19–23) and 11 (11–12) at maximum width.

Idiosoma – dorsum (Figs. 43, 46 and 47): length 235 (229–242), width at level of *c1* 148 (146–150); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D completely reticulated. Lengths of setae: *v1* 26 (25–27), *sc1* 16 (16–17) (Fig. 49), *sc2* 39, *c1* 25, *c2* 18 (18–19), *d* 45 (44–46), *e* 32 (30–34), *f* 45 (41–48) and *h* 18. Maximum width of expanded setae: *d* 5, *e* 28 and *f* 4. All dorsal setae serrate, except for *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1* and *c2* slender; *sc2* ensiform; *d* and *f* lanceolate with two veins; *e* asymmetric with two veins. Distances between dorsal setae: *v1–v1* 32 (31–33), *sc2–sc2* 58 (58–59), *v1–sc2* 33 (33–34), *c1–c1* 59 (59–60), *c2–c2* 141 (130–152), *c1–c2* 41 (41–42), *d–d* 47 (47–48), *f–f* 17 (16–18), *e–f* 13 and *h–h* 23 (23–24). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Figs. 44 and 48): setae *1a* 5 (5–6) posteriad apodemes 1; *2a* 11 (11–12) posterolaterad of apodemes 2; *3a* 14 near anteriomedial margins of apodemes 3; *3b* 9 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme.

Prosternal apodeme conspicuous from junction with apodeme 1 to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 16 (16–17) wide and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 19 (18–20) serrate.

Legs (Fig. 45): lengths (measured from femur to tarsus): leg I 70, leg II 72 (71–73), leg III 107 (104–110). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 4-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 7; all inserted at approximately same level. Seta *d* of tibia I 30 (30–31), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 30 (30–31), serrate. Femorogenu IV 23; tibiotarsus IV 12 (12–13). Length of leg IV setae: *v′* F 12 (12–13), *v′* G 21 (20–22), *v´* Ti 30 (28–33) and *tc″* 50 (50–51); all setae smooth, except for *v′* G; *v′* Ti ensiform.

***Daidalotarsonemus* sp. n. 1**

(Figs. 50-53)

Material examined: holotype and paratype ♀ deposited at USNM.

Etymology: -

Host: *Hibiscus rosa-sinensis* L. (Malvaceae).

Record: Coral Gables, State of Florida, USA (25°43'N;80°16'W).

Collector: D. De Leon.

Remarks: individuals of *Daidalotarsonemus* sp. n. 1 were collected by Dr. Donald De Leon, presumably. They were stored in the USNM as *Daidalotarsonemus* sp. n. It is expected that he intended to describe them but he passed away before doing that.

Differential diagnosis: this new species is similar to *D. fossae* by the insertion of the setae *c1* near border of the tergite D; and tegula rounded apically. *Daidalotarsonemus* sp. n. 1 differs by the setae *c1*, *c2*, *d*, *e* and *f*, which are similar in size and leaf-shaped; and by ornamentation between setae *c1*, which are in parenthesis shape.

Description: (two specimens measured).

Gnathosoma: subtriangular in ventral view, length 37 (36–38), maximum width 26 (26–27); dorsal apodeme distinct. Setae *dgs* 12 serrate and *vgs* 7 smooth; palps moderately long 12, with two small subterminal setae and terminal projections. Pharynx fusiform, length 12 (12–13) and 7 at maximum width.

Idiosoma – dorsum (Figs. 50 and 53): length 194 (192–198), width at level of *c1* 98 (96–102); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D with waved continuous ridges between dorsal setae of plates. Lengths of setae: *v1* 23 (22–25), *sc1* 15, *sc2* 36 (34–38), *c1* 25 (24–26), *c2* 22 (20–24), *d* 23, *e* 14 (14–15), *f* 15 (13–17) and *h* 13 (13–14). Maximum width of expanded setae: *d* 8, *e* 7 and *f* 5. All dorsal setae serrate, except for *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1* and *h* slender; *sc2* ensiform; *c1*, *c2*, *d*, *e* and *f* lanceolate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 31 (30–33), *sc2–sc2* 49 (48–50), *v1–sc2* 22 (22–23), *c1–c1* 52 (52–53), *c2–c2* 63 (62–64), *c1–c2* 30, *d–d* 28 (27–29), *f–f* 10 (9–11), *e–f* 17 and *h–h* 23 (23–24). Setae *sc1* inserted anteriorly to *sc2*.

Idiosoma – venter (Fig. 51): setae *1a* 5 (5–6) posteriad apodemes 1; *2a* 8 (8–9) posterolaterad of apodemes 2; *3a* 14 near anteromedial margins of apodemes 3; *3b* 9 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to apodemes 2. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 12 wide and very short 7; posterior margin slightly arched. Setae *ps* 7 smooth.

Legs (Fig. 52): lengths (measured from femur to tarsus): leg I 53 (51–55), leg II 49 (49–50), leg III 82 (81–84). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 27 (25–29), serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 17 (16–18), serrate. Femorogenu IV 11; tibiotarsus IV 14 (14–15). Length of leg IV setae: *v′* F 5 (5–6), *v′* G 8, *v´* Ti 19 and *tc″* 22; all setae smooth, except for *v′* G and *v′* Ti; *v′* Ti ensiform.

***Daidalotarsonemus* sp. n. 2**

(Figs. 54-57)

Material examined: holotype and paratype ♀ deposited at USNM.

Etymology: -

Host: a non identified Orchidaceae.

Records: Thailand and Taiwan.

Collector: -

Remarks: individuals intercepted by the USDA quarantine system.

Differential diagnosis: this new species is similar to *D. ostracodes* and *Daidalotarsonemus* sp. n. 7 by the asymmetric shape of the setae *e*. It also resembles *Daidalotarsonemus* sp. n. 7 by tergite D with reticulate ornamentation. This new species differs from *D. ostracodes* by having this ornamentation on tergite D; and also differs from *Daidalotarsonemus* sp. n. 7 by the shape of setae *f*, which are linear.

Description: (two specimens measured).

Gnathosoma: subtriangular in ventral view, length 36 (36–37), maximum width 29 (29–30); dorsal apodeme distinct. Setae *dgs* 13 and *vgs* 7 smooth; palps moderately long 11, with two small subterminal setae and terminal projections. Pharynx fusiform, length 13 (12–15) and 7 at maximum width.

Idiosoma – dorsum (Figs. 54 and 57): length 204 (200–207), width at level of *c1* 108 (106–110); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D completely reticulated. Lengths of the setae: *v1* 29 (27–31), *sc1* 16, *sc2* 31 (30–33), *c1* 25 (25–26), *c2* 21 (20–22), *d* 42 (41–44), *e* 24 (22–26), *f* 45 and *h* 23 (21–24). Maximum width of expanded setae: *d* 7, *e* 26 and *f* 4. All dorsal setae serrate, except for *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* and *f* linear; *e* cordate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 33, *sc2–sc2* 53 (51–55), *v1–sc2* 30 (29–32), *c1–c1* 48 (46–50), *c2–c2* 103 (100–105), *c1–c2* 38 (36–40), *d–d* 40 (39–41), *f–f* 13, *e–f* 15 and *h–h* 19 (19–20). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 55): setae *1a* 6 posteriad apodemes 1; *2a* 11 (11–12) posterolaterad of apodemes 2; *3a* 16 near anteromedial margins of apodemes 3; *3b* 12 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to apodemes 2 and inconspicuous from that point to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 15 (15–16) wide and very short 4; posterior margin slightly arched. Setae *ps* 18 smooth.

Legs (Figs. 56): lengths (measured from femur to tarsus): leg I 65 (64–67), leg II 58 (56–60), leg III 94 (92–96). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 2, slender, capitate; solenidion *φ2* 3, robust, slightly capitate; famulus *k* 5; all inserted at approximately same level. Seta *d* of tibia I 26 (25–28), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 20 (19–21), serrate. Femorogenu IV 22; tibiotarsus IV 12 (11–14). Length of leg IV setae: *v′* F 13 (11–14), *v′* G 20 , *v´* Ti 28 (27–30) and *tc″* 37 (36–39); all setae smooth, except for *v′* G and *v′* Ti; *v′* Ti ensiform.

***Daidalotarsonemus* sp. n. 3**

(Figs. 58-61)

Material examined: holotype and 20 paratype ♀ deposited at USNM (for holotype and five paratypes); CNC (for three paratypes); DZSJRP (for three paratypes); DPI-FDACS (for three paratypes); CIPROC (for two paratypes); FAAS (for one paratype) and QM (for three paratypes).

Etymology: -

Host: *Camellia sinensis* (L.) Kuntze (Theaceae).

Records: Charleston, South Carolina, USA (32°46'N;79°55'W).

Collector: C. Childers.

Differential diagnosis: this new species is similar to *D. bauchani* by lacking rows of reticulation on the tergite D, small size of setae *e*, and setae *tc″* on tarsus II lanceolate. It differs by the setae *c1* longer than on *D. bauchani* (ca. 25 μm); and the irregular ornamentation on the tergite D.

Description: (twelve specimens measured).

Gnathosoma: subtriangular in ventral view, length 33 (31–36), maximum width 26 (24–28); dorsal apodeme distinct. Setae *dgs* 15 (14–15) and *vgs* 7 (7–8) smooth; palps moderately long 12 (11–14), with two small subterminal setae and terminal projections. Pharynx fusiform, length 18 (16–19) and 7 (7–8) at maximum width.

Idiosoma – dorsum (Figs. 58 and 61): length 206 (205–208), width at level of *c1* 129 (125–133); prodorsal shield covers the gnathosoma, with irregular ornamentation. Stigmata located near lateral notch of prodorsal shield, equidistant to *v1* and *sc2* setal bases. Tergite C completely reticulate; tergite D with waved continuous ridges between setae *d.* Lengths of the setae: *v1* 29 (27–31), *sc1* 16 (16–17), *sc2* 30 (28–32), *c1* 26 (24–27), *c2* 23 (21–25), *d* 36 (33–37), *e* 18 (17–20), *f* 31 (29–33) and *h* 17 (15–19). Maximum width of expanded setae: *d* 8, *e* 3 and *f* 10. All dorsal setae serrate, except for *sc2*, *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* setiform; *sc2* falcate; *d*, *e* and *f* lanceolate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 33 (31–36), *sc2–sc2* 58 (56–63), *v1–sc2* 31 (29–34), *c1–c1* 53 (52–55), *c2–c2* 104 (101–107), *c1–c2* 41 (39–43), *d–d* 36 (35–39), *f–f* 9 (9–10), *e–f* 18 (18–20) and *h–h* 22 (20–25). Setae *sc1* at the same level of *sc2*.

Idiosoma – venter (Fig. 59): setae *1a* 9 (8–11) posteriad apodemes 1; *2a* 11 (11–12) posterolaterad of apodemes 2; *3a* 14 (13–16) near anteriomedial margins of apodemes 3; *3b* 9 (9–11) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to apodemes 2 and inconspicuous from that point to sejugal apodeme. Sejugal apodeme interrupted in middle part. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 14 (13–15) wide and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 15 (14–19) smooth.

Legs (Fig. 60): lengths (measured from femur to tarsus): leg I 49 (48–53), leg II 58 (56–60), leg III 93 (92–96). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+6(1), leg II: 3-3-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 33 (31–35), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 24 (22–26), serrate. Femorogenu IV 13 (12–15); tibiotarsus IV 11 (11–12). Length of leg IV setae: *v′* F 6 (6–8), *v′* G 15 (14–18), *v´* Ti 28 (27–30) and *tc″* 34 (32–36); all setae smooth, except for *v′* G; *v′* Ti ensiform.

***Daidalotarsonemus* sp. n. 4**

(Figs. 62-64)

Material examined: holotype and four paratype ♀ deposited at USNM.

Etymology: -

Host: *Camellia* sp. (Theaceae)

Record: Japan.

Collector: -

Remarks: individuals intercepted by the USDA quarantine system.

Differential diagnosis: this new species is similar to *D. costulatus* and *Daidalotarsonemus tessellatus* De Leon by the completely ornamentatied tergite D; and its ornamentation having a reticulate pattern. It differs from these by the prosternal apodeme being bifurcated at the level of the apodemes 2.

Description: (five specimens measured).

Gnathosoma: subtriangular in ventral view, length 30 (28–31), maximum width 26 (25–27); dorsal apodeme distinct. Setae *dgs* 12 (11–13) and *vgs*

8 smooth; palps moderately long 13, with two small subterminal setae and terminal projections. Pharynx fusiform, length 17 (16–19) and 8 (8–9) at maximum width.

Idiosoma – dorsum (Fig. 62): length 203 (200–205), width at level of *c1* 118 (116–120); prodorsal shield, with irregular ornamentation, partially covers the gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D completely reticulated. Length of setae: *v1* 24 (22–26), *sc1* 14 (14–15), *sc2* 33 (32–35), *c1* 23 (23–24), *c2* 18 (27–20), *d* 36 (35–38), *e* 23 (23–24), *f* 36 (35–38) and *h* 18 (17–20). Maximum width of expanded setae: *d* 5, *e* 15 and *f* 9. All dorsal setae serrate, except for *sc2*, *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* linear; *e* cordate; *f* lanceolate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 30 (30–31), *sc2–sc2* 60 (57–64), *v1–sc2* 29 (28–31), *c1–c1* 60 (58–63), *c2–c2* 104 (103–107), *c1–c2* 36 (35–39), *d–d* 45 (44–47), *f–f* 15 (15–16), *e–f* 13 (11–15) and *h–h* 27 (25–29). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 63): setae *1a* 7 posteriad apodemes 1; *2a* 9 posterolaterad of apodemes 2; *3a* 17 (17–18) near anteriomedial margins of apodemes 3; *3b* 9 (9–10) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to apodemes 2 becoming bifurcated in that point, and inconspicuous from this to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 16 wide and very short 6 (6–7); posterior margin slightly arched. Setae *ps* 18 smooth.

Legs (Fig. 64): lengths (measured from femur to tarsus): leg I 70 (68–73), leg II 60 (58–62), leg III 94 (92–96). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 28 (28–29), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 23 (20–24), serrate. Femorogenu IV 18 (17–20); tibiotarsus IV 15 (15–17). Length of leg IV setae: *v′* F 8 (8–9), *v′* G 20 (19–22), *v´* Ti 29 (28–31) and *tc″* 51 (49–52); all setae smooth; *v′* Ti ensiform.

***Daidalotarsonemus* sp. n. 5**
(Figs. 65-68)
Material examined: holotype and four paratype ♀ deposited at CNC.
Etymology: -
Host: *Acer saccharum* Marsh. (Sapindaceae)
Record: Ontario, Canada (45°14'N;78°38'W).
Collectors: F. Beaulieu and I. M. Smith.
Differential diagnosis: This new species is similar to *D. ethiopicus* by the tergite D with two square-like reticles on the central position of the plate between the basis of setae *f*; and by setae *f* with two central veins. It differs from this species by the presence of four setae on the femorogenu III (seta *l″* present).
Description: (five specimens measured).
Gnathosoma: subtriangular in ventral view, length 44 (43–46), maximum width 26 (25–27); dorsal apodeme distinct. Setae *dgs* 16 (16–17) and *vgs* 11 smooth; palps moderately long 16 (16–17), with two small subterminal setae and terminal projections. Pharynx fusiform, length 24 (23–26) and 12 (11–14) at maximum width.

Idiosoma – dorsum (Figs. 65 and 68): length 264 (260–268), width at level of *c1* 149 (147–153); prodorsal shield with irregular ornamentation and covering gnathosoma. Stigmata located near lateral notch of prodorsal shield, which is equidistant to the *v1* and *sc2* setal bases. Tergites C and D completely reticulate. Length of setae: *v1* 30 (28–32), *sc1* 13 (12–15), *sc2* 33 (32–35), *c1* 22 (20–24), *c2* 19 (17–21), *d* 35 (33–37), *e* 23 (23–24), *f* 36 (35–38) and *h* 17 (16–18). Maximum width of expanded setae: *d* 5, *e* 11 and *f* 7. All dorsal setae serrate, except for *sc2*, *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1* and *c2* slender; *sc2* ensiform; *d* linear; *e* cordate; *f* lanceolate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 36 (34–37), *sc2–sc2* 63 (61–66), *v1–sc2* 39 (37–40), *c1–c1* 69 (67–70), *c2–c2* 140 (135–146), *c1–c2* 40 (37–44), *d–d* 51 (50–53), *f–f* 14 (12–16), *e–f* 14 (12–16) and *h–h* 16 (14–17). Setae *sc2* inserted at same level as *sc1*.

Idiosoma – venter (Fig. 66): setae *1a* 7 (7–8) posteriad apodemes 1; *2a* 8 (8–9) posterolaterad of apodemes 2; *3a* 13 (12–13) near anteriomedial margins of apodemes 3; *3b* 7 (7–8) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to apodemes 2 and inconspicuous from this point to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 16 wide and very short 4 (4–5); posterior margin slightly arched. Setae *ps* 12 (12–13) serrate.

Legs (Fig. 67): lengths (measured from femur to tarsus): leg I 67 (65–71), leg II 63 (62–65), leg III 94 (92–96). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 4-4-4. Tarsal solenidion *ω* of tibiotarsus

I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 5; all inserted at approximately same level. Seta *d* of tibia I 35 (33–36), serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 24 (22–25), serrate. Femorogenu IV 20 (19–21); tibiotarsus IV 11 (11–12). Length of leg IV setae: *v′* F 11 (10–13), *v′* G 17 (16–18), *v´* Ti 33 (31–35) and *tc″* 47 (46–49); all setae smooth; *v′* Ti ensiform.

***Daidalotarsonemus ternifoliae* Ochoa, 1991**

Type material: holotype and one paratype ♂ deposited at CALFAUCR.

Remarks: the current curator, Dr. Hugo Aguilar, informed the types of *D. ternifoliae* are missing.

Hosts: *Macadamia ternifolia* F. Muell. (Proteaceae) (for holotype); *Persea americana* Mill. (Lauraceae) (for one paratype).

Records: Desamparados, San José, Costa Rica (9°53'N;84°03'W) (for holotype); Zarcero, Alfaro-Alajuela, Costa Rica (10°14'N;84°25'W) (for two paratypes).

Description, differential diagnosis and images: see Ochoa *et al.* 1991.

***Daidalotarsonemus tessellatus* De Leon, 1956**

(Figs. 69-74)

Material examined: holotype ♀ and allotype ♂ deposited at USNM.

Host: *Litchi chinensis*. Sonn. (Sapindaceae).

Record: Miami, State of Florida, USA (25°45'N; 80°11'W).

Remarks: the author cited seven paratypes (five ♀ and two ♂) were collected with the holotype. Those paratypes were not found in the USNM. Furthermore, the examined slides were damaged, being impossible to check some characters on the specimens. Ito (1963) recorded *D. tessellatus* in Tokyo. The slides of Dr. Ito were not studied for this paper, but we suspect that the individuals collected by him belong to another species, because *D. tessellatus* has not been recorded by us in other countries. For this reason, the specimens collected by Dr. Ito are cited in this paper as *Daidalotarsonemus* sp.

Differential diagnosis: Females of this species are similar to *D. costulatus* and *Daidalotarsonemus venustus* Attiah by the ornamentation pattern on the prodorsum and tergite C. They differ from *D. costulatus* by the slender shape of the setae *h*; and from both by the length of palps, which are much longer in *D. tessellatus* (ca. 20 µm). Males of this species are similar to *D. deleoni* by the chaetotaxy of the prodorsum. They differ mainly by the length of the palps, which are much longer in *D. tessellatus* (ca. 20 µm).

Redescription:

Female:

Gnathosoma: subtriangular in ventral view, length 36, maximum width 24; dorsal apodeme distinct. Setae *dgs* 19 and *vgs* 9 smooth; palps long 19, with two small subterminal setae and terminal projections. Pharynx fusiform, length 15 and 7 at maximum width.

Idiosoma – dorsum (Fig. 69): length 215, width at level of *c1* 125; prodorsal shield covers partially the gnathosoma, with irregular ornamentation and reticulation on the central and posterior areas. Stigma located near lateral notch of prodorsal shield, which is equidistant to the *v1* and *sc2* setal bases. Tergite C completely reticulated. Tergite D partially destroyed, but with reticulation between setae *d.* Setae *sc1* and *f* lost during the remounting. Lengths of the setae: *v1* 23, *sc2* 62, *c1* 22, *c2* 20, *d* 33, *e* 17 and *h* 15. Maximum width of expanded setae: *d* 6 and *e* 10. All dorsal setae serrate, except for *h*. Setae *v1*, *c1* and *c2* setiform; *sc2* falcate; *d* lanceolate with two veins; *e* ovate with two veins. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 36, *sc2–sc2* 60, *v1–sc2* 27, *c1–c1* 52, *c2–c2* 114, *c1–c2* 38, *d–d* 37, *f–f* 13, *e–f* 16 and *h–h* 20.

Idiosoma – venter (Fig. 70): setae *1a* 7 posteriad apodemes 1; *2a* 12 posterolaterad of apodemes 2; *3a* 6 near anteriomedial margins of apodemes 3; *3b* 7 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 14 wide and very short 4; posterior margin slightly arched. Setae *ps* 17 smooth.

Legs (Fig. 71): lengths (measured from femur to tarsus): leg I 55, leg II 46, leg III 93. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 5, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 37 serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 26 serrate. Femorogenu IV 23; tibiotarsus IV 12. Length of leg IV setae: *v′* F 7, *v′* G 17, *v´* Ti 25 and *tc″* 40; all setae smooth, except for *v′* G and *v´* Ti; *v′* Ti ensiform.

Male:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 27; dorsal apodeme distinct. Setae *dgs* 14 serrate and *vgs* 8 smooth; Palps moderately long 14, with 2 small subterminal setae and terminal projections. Pharynx fusiform, length 14 and 8 at widest region.

Idiosoma – dorsum (Fig. 72): length 160, maximum width 95. Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 25, *v2* 15, *sc1* 45, *sc2* 18, *c1* 29, *c2* 26, *d* 35, *f* 34. All setae slender and serrate. Distances between dorsal setae: *v1–v1* 14, *sc1–sc1* 31, *sc2–sc2* 45, *v1–sc2* 27, *c1–c1* 84, *c2–c2* 91, *c1–c2* 50, *d–d* 47, *f–f* 16. Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Fig. 73): setae *1a* 6 posteriad apodemes 1; setae *2a* 7 located in center of coxisternal plates II; setae *3a* 12 located near anterior end of apodemes 3; and setae *3b* 13 located posteromedial margins of apodemes 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but inconspicuous between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous; connecting between 3, 4 and poststernal apodemes diffuse.

Legs (Fig. 74): lengths (measured from femur to tarsus): leg I 66, leg II 69, leg III 82, leg IV 104. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(1)+6(1), leg II: 3-3-3-4(1), leg III: 1-3-4-2. Due to type condition, it was not possible to count precisely all setae on legs. Solenidion *ω* of tarsus I 4, stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3, and famulus *k* 4, both inserted at approximately same level. Seta *d* of tibia I 18 serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 20 serrate. Trochanter IV slightly wider than long, seta *v′* 18, serrate. Femorogenu IV length 46 and width 28 at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third. Seta *v′* F 8 smooth. Setae *v′* G 31 and *l″* G 13 serrate. Tibia IV 39 long; solenidion *φ* 8; seta *v′* Ti 86, serrate. Tarsus IV short, bearing 3 smooth setae of following length: *tc″* 7, *pv″* 6 and *u′* 5. Claw well developed.

***Daidalotarsonemus vandevriei* Suski, 1967**

(Figs. 75-81)

Material examined: holotype ♀ and allotype ♂ deposited at ZMPAS.

Host: *Malus* sp. (Rosaceae).

Records: Koszalin, Poland (54°11'N; 16°10'E); Serooskerke, Netherlands (51°33'N; 3°36'E).

Remarks: individuals of *D. vandevrei* have been also registered in *Aesculus hippocastanum* L. (Hippocastanaceae), Vancouver, British Columbia, Canada; and in *Malus* sp., Portugal.

Differential diagnosis: Females of this species are similar to *D. fossae* by the stout and capitate shape of the setae *d*, *e* and *f*; and by the irregular ornamentation on the prodorsum. It differs by the setiform shape on setae *c1* and *c2*; and by the shape of the ornamentation on tergites C and D. Males are similar to *D. azofeifai* by the shape and length of setae *v1*, *v2* and *sc2*. They differ by having longer setae *sc1, c1* and *d,* which also have pointed tips.

Redescription:

Female:

Gnathosoma: subtriangular in ventral view, length 36, maximum width 24; dorsal apodeme distinct. Setae *dgs* 17 serrate and *vgs* 10 smooth; palps length 18, with two small subterminal setae and terminal projections. Pharynx fusiform, length 13 and 7 at maximum width.

Idiosoma – dorsum (Figs. 75 and 78): length 203, width at level of *c1* 147; prodorsal shield completely reticulate, partially covering gnathosoma. Stigma not easily seen. Tergite C covered with waved, continuous ridges. Tergite D with three rows of reticulation between setae *d.* Lengths of the setae: *v1* 34, *sc1* 16, *sc2* 32, *c1* 61, *c2* 15, *d* 21, *e* 20 and *h* 12. Maximum width of expanded setae: *d* 3, *e* 3 and *f* 3. All dorsal setae serrate, except for *c1*, *c2* and *h*. Setae *v1*, *c1* and *c2* setiform; *sc2* falcate; *d*, *e* and *f* scaled, stout and capitate. All inserted on tubercles, except for *h*. Distances between dorsal setae: *v1–v1* 27, *sc2–sc2* 52, *v1–sc2* 28, *c1–c1* 52, *c2–c2* 136, *c1–c2* 46, *d–d* 64, *f–f* 8, *e–f* 49 and *h–h* 9.

Idiosoma – venter (Fig. 76): setae *1a* 8 posteriad apodemes 1; *2a* 14 posterolaterad of apodemes 2; *3a* 9 near anteromedial margins of apodemes 3; *3b* 10 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to level of apodemes 2. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 10 wide and very short 11; posterior margin heavily arched. Setae *ps* 9 smooth.

Legs (Fig. 77): lengths (measured from femur to tarsus): leg I 58, leg II 52, leg III 86. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 3-4-4. Tarsal solenidion *ω* of tibiotarsus I 4, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* not visible; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 5; all inserted at approximately same level. Seta *d* of tibia I 28 serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 18 serrate. Femorogenu IV 15; tibiotarsus IV 9. Length of leg IV setae: *v'* F 9, *v'* G 17, *v´* Ti 24 and *tc"* 26; all setae smooth, except for *v'* G; *v'* Ti ensiform.

Male:

Gnathosoma: subtriangular in ventral view, length 32, maximum width 24; dorsal apodeme distinct. Setae *dgs* 14 serrate and *vgs* 9 smooth. Palps moderately long 16, with 2 small subterminal setae and terminal projections. Pharynx fusiform, length 15 and 7 at widest region.

Idiosoma – dorsum (Fig. 79): length 179, maximum width 116. Prodorsal shield trapezoidal. Length of dorsal setae: *v1* 29, *v2* 22, *sc1* 51, *sc2* 30, *c1* 38, *c2* 37, *d* 54, *f* 49. All setae slender and serrate. Distances between dorsal setae: *v1–v1* 14, *sc1–sc1* 21, *sc2–sc2* 39, *v1–sc2* 24, *c1–c1* 101, *c2–c2* 84, *c1–c2* 62, *d–d* 58, *f–f* 19. Seta *sc2* laterad and slightly posterior to *sc1*; seta *c1* closer to *d* than to *c2*, anterolateral to latter.

Idiosoma – venter (Fig. 80): setae *1a* 7 posteriad apodemes 1; setae *2a* 10 located in center of coxisternal plates II; setae *3a* 11 located near anterior end of apodemes 3; and setae *3b* 13 located posteromedial margins of apodemes 4. Apodeme 1 fused to anterior end of prosternal apodeme; apodeme 2 not fused to prosternal apodeme. Prosternal apodeme conspicuous between coxisternal plates I but inconspicuous between coxisternal plates II, extending close to sejugal apodeme. Sejugal apodeme conspicuous. Lines of fusion between coxae III and IV with venter of idiosoma mostly conspicuous; connecting between 3, 4 and poststernal apodemes diffuse.

Legs (Fig. 81): lengths (measured from femur to tarsus): leg I 64, leg II 63, leg III 81, leg IV 137. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(1)+6(1), leg II: 3-3-4-4(1), leg III: 1-3-4-4. Solenidion *ω* of tarsus I 5, stout, wider medially. Sensory cluster of tibia I composed of *φ1* 3, and famulus *k* 4, both inserted at approximately same level. Seta *d* of tibia I 14 serrate. Solenidion *ω* of tarsus II proximally inserted, length 8, stout, wider medially. Seta *d* of tibia II 16 serrate. Trochanter IV slightly wider than long, seta *v′* 18, smooth. Femorogenu IV length 65 and width 34 at *v′* F level; anterior margin convex, posterior margin slightly convex at proximal third. Seta *v′* F 7 smooth. Setae *v′* G 28 and *l″* G 13 serrate. Tibia IV length 40; solenidion *φ* 8; seta *v′* Ti 54, serrate. Tarsus IV short, bearing 3 smooth setae of following lengths: *tc″* 7, *pv″* 6 and *u′* 5. Claw well developed.

***Daidalotarsonemus venustus* Attiah, 1970**

(Figs. 82-85)

Material examined: holotype ♀ deposited at USNM.

Host: *Citrus* sp. (Rutaceae).

Remarks: This species was also recorded from *Camellia sinensis* (L.) Kuntze (Theaceae), city of Charleston, State of South Carolina, USA; ex *Carpinus caroliniana* Walter (Betulaceae), city of Gainesville, State of Florida, USA; ex *Chrysobalanus icaco* L. (Chrysobalanaceae), city of Homestead, State of Florida, USA; ex *Cupressocyparis leylandii* A. B. Jacks. & Dallim. (Cupressaceae), city of Interlachen, State of Florida, USA; ex *Diospyros virginiana* L. (Ebenaceae), city of Fort Pierce, State of Florida, USA; ex *Fraxinus caroliniana* Mill. (Oleaceae), city of Alva, State of Florida, USA; ex *Juniperus chinensis* L. (Cupressaceae), city of Brooksville, State of Florida, USA; ex *Lagerstroemia indica* L. (Lythraceae), city of Jacksonville, State of Florida, USA; ex *Ligustrum sinense* Lour. (Oleaceae), Hillsborough County, State of Florida, USA; ex *Quercus virginiana* Mill. (Fagaceae), city of Coral Gables, State of Florida, USA; ex *Rhododendron* sp. (Ericaceae), city of Alachua, State of Florida, USA; and from *Viburnum obovatum* (Caprifoliaceae), city of Sumterville, State of Florida, USA.

Records: Melbourne, State of Florida, USA (28°05'N;80°36'W); Charleston, State of South Carolina, USA (32°46'N;79°55'W); Gainesville, State of Florida, USA (29°39'N;82°19'W); Homestead, State of Florida, USA (25°28'N; 80°28'W); Interlachen, State of Florida, USA (29°37'N;81°53'W); Fort Pierce, State of Florida, USA (27°26'N; 80°19'W); Alva, State of Florida, USA (26°42'N; 81°36'W); Brooksville, State of Florida, USA (28°33'N; 82°23'W); Jacksonville, State of Florida, USA (30°19'N; 81°39'W); Coral Gables, State of Florida, USA (25°43'N; 80°16'W); Alachua, State of Florida, USA (29°47'N; 82°29'W); Sumterville, State of Florida, USA (28°44'N; 82°03'W).

Differential diagnosis: This species is similar to *D. ethiopicus* in almost all characters, except by the tergite D with one rounded-like reticle on the central position of the plate, between the basis of setae *f*; and by the setae *f* with one central vein.

Redescription:

Gnathosoma: subtriangular in ventral view, length 41, maximum width 22; dorsal apodeme distinct. Setae *dgs* 12 and *vgs* 6 smooth; palps moderately long 12, with two small subterminal setae and terminal projections. Pharynx fusiform, length 17 and 11 at maximum width.

Idiosoma – dorsum (Figs. 82 and 85): length 202, width at level of *c1* 112; prodorsal shield, with irregular ornamentation, partially covers gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D completely reticulated. Length of setae: *v1* 29, *sc1* 16, *sc2* 37, *c1* 18, *c2* 19, *d* 39, *e* 22, *f* 38 and *h* 19. Maximum width of expanded setae: *d* 7, *e* 16 and *f* 5. All dorsal setae serrate, except for *sc2*, *c1* and *c2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1*, *c1*, *c2* and *h* slender; *sc2* ensiform; *d* linear with one central vein; *e* ovate with two veins; *f* lanceolate with two veins. All inserted on tubercles, except for *c2* and *h*. Distances between dorsal setae: *v1–v1* 29, *sc2–sc2* 60, *v1–sc2* 35, *c1–c1* 63, *c2–c2* 99, *c1–c2* 33, *d–d* 48, *f–f* 15, *e–f* 14 and *h–h* 25. Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 83): setae *1a* 3 posteriad apodemes 1; *2a* 11 posterolaterad of apodemes 2; *3a* 14 near anteriomedial margins of apodemes 3; *3b* 8 on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 short and not fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 15 wide and very short 5; posterior margin slightly arched. Setae *ps* 18 smooth.

Legs (Fig. 84): lengths (measured from femur to tarsus): leg I 63, leg II 62, leg III 99. Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 4-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 3, slender, capitate; solenidion *φ2* 4, robust, slightly capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 37 serrate. Solenidion *ω* of tarsus II proximally inserted, length 5, stout, wider medially. Seta *d* of tibia II 19, serrate. Femorogenu IV 17; tibiotarsus IV 15. Length of leg IV setae: *v′* F 9, *v′* G 23, *v´* Ti 28 and *tc″* 47; all setae smooth, except for *v′* G and *v′* Ti; *v′* Ti ensiform.

Genus *Excelsotarsonemus* Ochoa & Naskrecki, 1995

Excelsotarsonemus Ochoa *et al.* 1995: 68; Ochoa & Oconnor 1998: 180.

Type species: *Daidalotarsonemus kaliszewskii* Ochoa & Naskrecki, 1995; by original designation.

Diagnosis: species of the genus *Excelsotarsonemus* can be distinguished by the characteristic form of seta *sc2*, *c1* and *d*, which are elliptical heavily veined and inserted on tubercles (Ochoa *et al.* 1995).

***Excelsotarsonemus caravelis* Rezende, Lofego & Ochoa, 2015**

Type material: holotype and four paratype ♀ deposited at DZSJRP.

Host: *Theobroma cacao* L. (Malvaceae).

Record: Ilhéus, State of Bahia, Brazil (14°47'S; 39°10'W).

Description, differential diagnosis and images: see Chapter 1.

***Excelsotarsonemus kaliszewskii* Ochoa & Naskrecki, 1995**

Type material: holotype and two paratype ♀ deposited at CNC.

Host: *Theobroma cacao* L. (Malvaceae).

Record: Turrialba, Cartago, Costa Rica (9°53'N; 83°39'W).

Description, differential diagnosis and images: see Ochoa *et al.* 1995.

***Excelsotarsonemus kimhansenae* Ochoa & OConnor, 1998**

Type material: holotype and twelve paratype ♀ deposited at CNC (for holotype and one paratype); UMMZ (for one paratype); USNM (for two paratypes); CATIE (for three paratypes) and ALAS-INBio (for five paratypes).

Hosts: *Theobroma cacao* L. (Malvaceae) (for holotype and six paratypes) and *Ocotea* sp. (Lauraceae) (for six paratypes).

Record: Turrialba, Cartago, Costa Rica (9°53'N; 83°39'W) (for holotype and six paratypes); La Selva Biological Station, Heredia, Costa Rica (10°25'N; 84°01'W) (for six paratypes).

Description, differential diagnosis and images: see Ochoa & OConnor 1998.

***Excelsotarsonemus mariposa* Ochoa & OConnor, 1998**

Type material: holotype and twelve paratype ♀ deposited at CNC (for holotype and one paratype) and ALAS-INBio (for one paratype).

Hosts: *Pentaclethra macroloba* (Willd.) Kuntze (Fabaceae) (for holotype and one paratype) and *Dendropanax arboreus* (L.) Decne. & Planch. (Araliaceae) (for one paratype).

Record: La Selva Biological Station, Heredia, Costa Rica (10°25'N; 84°01'W).

Description, differential diagnosis and images: see Ochoa & OConnor 1998.

***Excelsotarsonemus* sp. n.**

(Figs. 86-89)

Material examined: holotype and two paratype ♀ deposited at DZSJRP.

Etymology: -

Hosts: *Campomanesia guazumifolia* (Cambess.) O. Berg. (Myrtaceae) (for holotype); *Eugenia umbelliflora* O. Berg. (Myrtaceae) (for one paratype); a non identified Myrtaceae (for one paratype).

Records: E. E. Caetetus, Gália, State of São Paulo, Brazil (22°41'S; 49°10'W); Garuva, State of Santa Catarina, Brazil (26°01'S; 48°57'W); P. E. Ilha do Cardoso, State of São Paulo, Brazil (25°04'S; 47°55'W).

Collectors: P. R. Demite, J. C. Santos and J. C. Souza.

Differential diagnosis: This new species is similar to *E. caravelis* and *E. kimhansenae* by the ensiform shape of the setae *sc2*; and leaf shape of the setae *d*. It differs from them by the leaf shape of the setae *h*.

Description: (three specimens measured).

Gnathosoma: subtriangular in ventral view, length 30 (29–32), maximum width 27 (26–28); dorsal apodeme distinct. Setae *dgs* 10 (9–12) and *vgs* 8 (8–9) smooth; palps moderately long 16 (16–17), with two small subterminal setae and terminal projections. Pharynx fusiform, length 16 (15–18) and 8 (8–10) at maximum width.

Idiosoma – dorsum (Figs. 86 and 89): length 231 (227–235), width at level of *c1* 129 (127–132); prodorsal shield, with irregular bumps between setae *sc2*, partially covers gnathosoma. Stigma located near lateral notch of prodorsal shield, which is equidistant to *v1* and *sc2* setal bases. Tergites C and D wrinkled around setal tubercles. Length of setae: *v1* 32 (30–34), *sc1* 15 (14–17), *sc2* 41 (39–43), *c1* 51 (48–54), *c2* 12 (10–14), *d* 40 (38–42), *e* 26 (24–27), *f* 42 (40–44) and *h* 17 (16–18). Maximum width of expanded setae: *c1* 14, *d* 18 *e* 10, *f* 9 and *h* 4. All dorsal setae serrate, except for *sc2*. Bothridial setae *sc1* capitate, with tiny spines. Setae *v1* and *c2* slender; *sc2* ensiform; *c1*, *d*, *e*, *f* and *h* lanceolate.All inserted on tubercles. Distances between dorsal setae: *v1–v1* 29 (27–31), *sc2–sc2* 55 (52–57), *v1–sc2* 26 (25–28), *c1–c1* 38 (37–40), *c2–c2* 110 (108–112), *c1–c2* 55 (53–57), *d–d* 47 (45–48), *f–f* 16, *e–f* 13 (13–14) and *h–h* 15 (14–17). Setae *sc2* inserted anteriorly to *sc1*.

Idiosoma – venter (Fig. 87): setae *1a* 8 (9–9) posteriad apodemes 1; *2a* 13 (13–14) posterolaterad of apodemes 2; *3a* 15 (14–16) near anteriomedial margins of apodemes 3; *3b* 13 (13–14) on posterior margins of apodemes 4. Apodeme 1 conspicuous, fused to anterior end of prosternal apodeme. Apodeme 2 long and fused to prosternal apodeme. Prosternal apodeme conspicuous from junction with apodeme 1 to sejugal apodeme. Sejugal apodeme uninterrupted. Apodeme 3 with a constriction near its middle, extending diagonally from proximity of base of seta *3a* to anterior margin of trochanter 3; apodeme 4 extending diagonally from middle of poststernal apodeme to base of seta *3b*. Poststernal apodeme bifurcated anteriorly. Tegula 17 (17–18) wide and very short 4; posterior margin slightly arched. Setae *ps* 8 (7–9) serrate.

Legs (Fig. 88): lengths (measured from femur to tarsus): leg I 60 (58–61), leg II 57 (55–59), leg III 98 (96–100). Number of setae (solenidia in parentheses) on femur, genu, tibia and tarsus, respectively: leg I: 3-4-5(2)+7(1), leg II: 3-3-4-4(1), leg III: 1+3-4-4. Tarsal solenidion *ω* of tibiotarsus I 6, stout, wider medially. Sensory cluster of tibia I complete, solenidion *φ1* 4, slender, capitate; famulus *k* 6; all inserted at approximately same level. Seta *d* of tibia I 38 (36–40), serrate. Solenidion *ω* of tarsus II proximally inserted, length 4, stout, wider medially. Seta *d* of tibia II 24 (22–25), serrate. Femorogenu IV 24 (22–25); tibiotarsus IV 19 (17–20). Length of leg IV setae: *v′* F 9 (9–10), *v′* G 15 (14–17), *v´* Ti 26 (24–27) and *tc″* 38 (37–42); all setae smooth, except for *v´* Ti; *v′* Ti ensiform.

Excelsotarsonemus tupi **Rezende, Lofego & Ochoa 2015**

Type material: holotype and two paratype ♀ deposited at DZSJRP.

Host: *Theobroma cacao* L. (Malvaceae).

Record: Ilhéus, State of Bahia, Brazil (14°47'S; 39°10'W).

Description, differential diagnosis and images: see Chapter 1.

Key to the species of *Daidalotarsonemus* and *Excelsotarsonemus* (based only on females):

1a. Prodorsum and tergites C and sometimes D heavily ornamented; scapular (*sc2*) setae short (*sc2* about 1/3 as long as the width of the

prodorsum); setae *c1* moderately short (shorter than 20 μm)……………...
……………………………………………..……***Daidalotarsonemus***……….**2**

1b. Prodorsum and tergites slightly ornamented; scapular (*sc2*) setae long (*sc2* at least 1/2 as long as the width of the prodorsum); setae *c1* moderately long (longer than 20 μm……………………..…………………..
…………………………………....…...…..***Excelsotarsonemus***……….**38**

2a. Insertion of the setae *c1* near border of the tergite D; tegula rounded apically; one pair of fissures overlapping apodemes IV……….……………**3**

2b. Insertion of the setae *c1* not as above; tegula truncated; no pairs of fissures overlapping apodemes IV……..……………………….………….**8**

3a. All Setae *c1*, *c2*, *d*, *e* and *f* stout and capitate (Figures 18-21)……...…
………………...……….….………..***Daidalotarsonemus fossae*** **De Leon**

3b. Setae *c1*, *c2*, *d*, *e* and *f* not as above…………...….………………**4**

4a. Setae *c1*, *c2*, *d*, *e* and *f* similar in shape and length; ornamentation between setae *c1* parentheses-like, comprsing longitudinal lines of joined reticulation (Figures 50-53)…………………...***Daidalotarsonemus*** **sp. n. 1**

4b. Setae *c1*, *c2*, *d*, *e* and *f* not similar in shape and length; ornamentation between setae *c1* reticulate……….……....……...………………..**5**

5a. Setae *e* and *f* barbed just along their borders; setae *e* leaf-shaped…..**6**

5b. Setae *e* and *f* heavily barbed or scaled around all their surfaces; setae *e* not leaf-shaped…………………………………………………….…**7**

6a. Setae *c2* leaf-shaped (Figure 42)……………………………….….…
…………………….……***Daidalotarsonemus serissae*** **Yang, Ding & Zhou**

6b. Setae *c2* slender...…
....................***Daidalotarsonemus annonae*** **Sousa, Lofego & Gondim Jr.**

7a. Setae *f* elongated (ca. 34 μm) with no visible central vein; four rows of reticula covering tergite C...……………..
.............***Daidalotarsonemus puntarenensis*** **Rezende, Lofego & Ochoa**

7b. Setae *f* shorter (ca.18 μm), leaf-shaped and with visible central vein; just one row of reticula completely formed on the tergite C……………..…..
.......................***Daidalotarsonemus serratus*** **Rezende, Ochoa & Lofego**

8a. No rows of reticula on the tergite C……………………………………….**9**
8b. At least one row of reticula on the tergite C………………………….……**18**
9a. No rows of reticula on the tergite D……………………….………….**10**
9b. Three rows of reticula on the tergite D (Figures 75-78)..........................
…..…………………….…………***Daidalotarsonemus vandevriei* Suski**
10a. Setae *c1* leaf-shaped……………………………….…………….…….**11**
10b. Setae *c1* slender…………………………..……………………….**12**
11a. Setae *sc2* and *d* long (ca. 40 and 50 µm, respectively); setae *e* and *f* similar in shape and size…...………………………….………………..…
***Daidalotarsonemus marini* Ochoa, Rezende & Lofego**
11b. Setae *sc2* and *d* short (around 15 and 25 µm, respectively); setae *e* and *f* different in shape and size……………………………….....…………
……………………………………...***Daidalotarsonemus limonensis* Ochoa**
12a. Setae *e* asymmetric (Figure 12)……………………………...…….….
……………………***Daidalotarsonemus duolamella* Lin, Chen & Zhang**
12b. Setae *e* symmetric……………………..………………………….**13**
13a. Setae *e* not ovate and curved inwards to midline of body..…………**14**
13b. Setae *e* ovate and straight……………………………...…………**15**
14a. Setae *e* heavily curved and thin (ca. 5 µm); setae *e* and *f* linear (Figures 26-29)………………..…***Daidalotarsonemus jamesbakeri* Smiley**
14b. Setae *e* phylliform and large (ca. 10 µm); setae *e* and *f* lanceolate (Figure 17)…………..……***Daidalotarsonemus folisetae* Lofego & Ochoa**
15a. Tergite D ornamentation restricted to between setae *d;* reticulation present on the tergite EF (Figures 38-41)……………………………………..
……………………………………………***Daidalotarsonemus seitus* Attiah**
15b. Tergite D completely ornamented; reticulation absent on the tergite EF…...……...**16**
16a. Prosternal apodeme bifurcated at the level of apodemes 2 (Figure 11)....……………………….***Daidalotarsonemus digital* Lin, Chen & Zhang**
16b. Prosternal apodeme not bifurcated at the level of apodemes 2..…..**17**

17a. Tip of the setae *c1* pointed; Setae *d* with two central veins……………
..……………….………***Daidalotarsonemus alas*** **Ochoa, Rezende & Lofego**

17b. Tip of the setae *c1* rounded; Setae *d* without central veins……………
……........……***Daidalotarsonemus oliveirai*** **Rezende, Lofego & Ochoa**

18a. Setae *e* narrow (at most 3 μm)…………………………………………**19**

18b. Setae *e* wider (at least 8 μm)…………………..……….……………..**23**

19a. Reticulation between setae *c1* comprising six cells; palps long (ca.15 μm)……………...***Daidalotarsonemus esalqi*** **Rezende, Lofego & Ochoa**

19b. Reticulation between setae *c1* comprising four cells; palps short (ca.10 μm)……………………………………………………………………**20**

20a. Three rows of reticulation on the tergite D (Figure 2)….......................
..………………………..***Daidalotarsonemus cornutus*** **Lin, Chen & Zhang**

20b. Without rows of reticulation on the tergite D…………………………..**21**

21a. Setae *c1* leaf-shaped; setae *tc´´* on tarsus II slender…………………..
..........…………………***Daidalotarsonemus lini*** **Ochoa, Rezende & Lofego**

21b. Setae *c1* slender; setae *tc´´* on tarsus II narrowly lanceolate……….**22**

22a. Setae *c1* short (ca.15 μm); without ornamentation on the tergite D…..……..…***Daidalotarsonemus bauchani*** **Rezende, Ochoa & Lofego**

22b. Setae *c1* long (ca. 25 μm); with irregular ornamentation on the tergite D (Figures 58-61)……..……..……………………***Daidalotarsonemus*** **sp. n. 3**

23a. Setae *e* asymmetric and wider (ca. 25 μm)……………….….……….**24**

23b. Setae *e* symmetric and narrow (ca. 15 μm)………..………….………..**28**

24a. Tip of the setae *e* rounded (Figures 43-49)………………………………
………………………………….……***Daidalotarsonemus somalatus*** **Attiah**

24b. Tip of the setae *e* pointed………………………………………….....**25**

25a. Setae *c1* leaf-shaped……..…....
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25b. Setae *c1* slender……………………………………………………..**26**

26a. Tergite D without reticulation (Figures 34-37)...…………………………
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26b. Tergite D with reticulation…………………………….……………**27**

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27b. Setae *f* linear; reticulation of the tergite D not as above (Figures 54-57).........……………………...………..………***Daidalotarsonemus* sp. n. 2**
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38b. Setae *sc2* leaf-shaped………………………………………………**41**

39a. Setae *h* leaf-shaped (Figures 86-89).….***Excelsotarsonemus* sp. n. 1**

39b. Setae *h* slender………..…………**40**

40a. Setae *e* symmetric………..……………..
...........................***Excelsotarsonemus kimhansenae* Ochoa & OConnor**

40b. Setae *e* asymmetric..……...……….
.......................***Excelsotarsonemus caravelis* Rezende, Lofego & Ochoa**

41a. Setae *d* asymmetric...
..................................***Excelsotarsonemus mariposa* Ochoa & OConnor**

41b. Setae *d* symmetric...**42**

42a. Setae *c2* leaf-shaped..
…………………....***Excelsotarsonemus kaliszewskii* Ochoa & Naskrecki**

42b. Setae *c2* slender...
..............................***Excelsotarsonemus tupi* Rezende, Lofego & Ochoa**

Biological aspects of these mites can be inferred from their morphology. Some species presented visibly longer palps than others, e.g. *D. esalqi*, *D. tessellatus* and *D. vandevriei*; giving a beaklike form to their gnathosomal capsules. Variance in the gnathosoma may suggest different feeding habits in tarsonemids, as predicted by Lindquist (1986) and Lofego *et al.* (2005). *Daidalotarsonemus* specimens have been found in completely different areas, e.g. rainforests, savannahs, temperate forests; and isolate places, e.g. Tonga Islands (Smiley 1967), leading to possibility of diversification of their feeding habits.

Lin and Liu (1994) described *D. notochism* from individuals collected in China. Based on the drawings provided, it is clear this species does not belong to this genus. The drawings do not show key *Daidalotarsonemus* characters on this species, e.g. dorsal setae enlarged and distinctive reticulation on tergites C and D (De Leon 1956, Lindquist 1986). For this reason, this species was not mentioned in the revision.

Lindquist (1986) stated that a careful review would demonstrate the synonymy of several nominal *Daidalotarsonemus* species due to the high number of poor descriptions. That was not the case here. Morphological differences have been found among all the types studied, corroborating the hypothesis they are valid species. The phylogenetic analysis presented below also points in this way.

Phylogenetic analysis

The analysis returned a single most-parsimonious tree of 241 steps (CI: 27, RI: 56) (Fig. 90). The monophyly of the ingroup was supported by six synapomorphies (0, 2, 21, 29, 40 and 63), most related to the posterior dorsal setae.

Based on this study, *Daidalotarsonemus* is paraphyletic, as *Excelsotarsonemus* is a monophyletic group derived from inside *Daidalotarsonemus*. Ochoa *et al.* (1995) affirmed *Excelsotarsonemus* is a valid genus based on a phylogeny made using the genera *Ceratotarsonemus*, *Daidalotarsonemus*, *Excelsotarsonemus*, *Deleonia* and *Rhynchotarsonemus* as terminal groups, and all characters provided by Lindquist (1986). Here, it was including a considerable number of terminal taxa (42) as ingroup and used different characters, related to specific conditions observed only for these groups. Despite the reliability of the results presented here, it was decided to wait for the publication of this data in a scientific periodic to decide the taxonomic status of *Excelsotarsonemus*, mainly to avoid problems with the principle of priority of the International Code of Zoological Nomenclature. Therefore, for the moment, *Excelsotarsonemus* maintains its status as a valid genus.

The ingroup is only collapsed with eight additional steps in the Bremer analysis. *Daidalotarsonemus vandevriei* is positioned as the earliest branch, supported by four homoplasies. It is positioned as the sister group of two major branches. Its basal position is probably due to some character states shared with both clusters. It shares the rounded tips of posterior setae *d*, *e* and *f* (characters 24, 32 and 43) with *D. fossae* and *D. serratus*; and also it shares the longer length of palps with *D. tessellatus* and *D. esalqi*.

The first major branch is defined by three homoplasious states (characters 7, 56 and 64), related to the setae *sc2*, ornamentation of tergite EF and sejugal apodeme, respectively. There are two well defined groups inside this branch as each are collapsed with more than five additional steps. The first is named here *fossae* group by its oldest representative, *D. fossae*; the second one is formed by the *Excelsotarsonemus* species and *D. marini*. The two groups also form a monophyletic group that is defined by three synapomorphies (characters 25, 33 and 44), all related to the presence of veins on posterior setae. These structures are important for all species studied, since they probably provide the necessary mechanism for raising up their leaf-shaped setae.

The *fossae* group shows two synapomorphies (characters 16 and 66) that are easily recognized: position of setae *c1* near the tergite D border, and the heavily arched shape of the tegula. *Daidalotarsonemus fossae* and *D. puntarenensis* are closely related, both two synapomorphies (characters 10 and 18): the stout shape of setae *c1* and *c2*, respectively. Except for *D. serissae*, all species of the *fossae* group have been found just in Americas (De Leon 1956, Yang *et al.* 1987, Sousa *et al.* 2014, Rezende *et al.* 2015b).

The second group is defined here by two synapomorphies (characters 11 and 15) related to the shape and presence of veins in the setae *c1*. Despite its position in the topology, *D. marini* was recently described as a *Daidalotarsonemus* species (Rezende *et al.* 2015b) and it does not fit the diagnoses for *Excelsotarsonemus* (Ochoa *et al.* 1995). In the same cluster, there is a branch formed by *E. kaliszewskii*, *E. mariposa* and *E. tupi* and supported by four synapomorphies (characters 3, 6, 28 and 46). Among them, the asymmetric shape of setae *f* is the most prominent. It is still not entirely clear the function of asymmetric setae on these mites, but they may be related to protection, entrapping fungal spores and improving the aerodynamic characteristics (Rezende *et al.* 2015a). Because of their idiosomal morphology, this is the most astonishing and derivative branch of the entire group.

This second branch is composed only by *Daidalotarsonemus* species. One homoplasy (character 54), related to the ornamentation on tergite C, supports the entire cluster. Phylogenetic relations in this group are hard to define, probably due to slightly different ornamentation and reticulation patterns on tergites C and D. Such characters may be altered during mounting by poor preparations (Walter and Krantz 2009). Instead, characters like these would be better observed and less altered from their natural state if the specimens were prepared and analyzed using SEM techniques and imagery (Bauchan *et al.* 2011).

The second major group has only one well defined branch, grouped by one synapomorphy and one homoplasy (characters 31 and 36, respectively), both related to setae *e*. It is composed of four species: *D. bauchani*, *D. cornutus*, *D. lini* and *Daidalotarsonemus* sp. n. 3. In these species, setae *e* is linear-shaped and smaller. These features contrast with all other species observed. Because of their reduced size, setae *e* has no apparent specialised function for these species; at least not those attributed to these setae in other species. Relations of all other species in this second major branch are still not sufficiently clear. One of its clusters, formed by *D. cuadradus*, *D. duolamella*, *D. ostracodes*, *D. savanicus*, *D. somalatus* and *Daidalotarsonemus* sp. n. 2, is defined by two homoplasies (characters 35 and 38) also related to the setae *e*. In this case, these setae are larger than usual for the genus and asymmetric, a condition observed only in *Excelsotarsonemus* species. The asymmetry of setae *e* may have evolved more than once for the species studied.

Most of the characters used in the phylogenetic analysis are related to the dorsal setae, which are certainly the major source of characters for these taxa. They are longer and greatly enlarged compared to those of other tarsonemid genera (De Leon 1956, Smiley 1972, Lindquist 1986, Ochoa *et al.* 1995). Dispersion may be the main function of these setae, clearly one, especially for *Excelsotarsonemus* species, as they are present only on females and only female tarsonemid mites are thought to disperse. Both genera probably raise up the posterior setae to become airborne (Rezende *et al.* 2015a). For *Excelsotarsonemus,* these setae become even more complex; with longer, wider and sometimes asymmetrical shapes (Ochoa and OConnor 1998). For example, for *E. tupi*, it may be inferred that the size, shape and presence of bumps and secondary veins of the *c1* and *d* setae, allow these species to use the wind currents more effectively to disperse (Rezende *et al.* 2015a). Possibly, *Daidalotarsonemus* and *Excelsotarsonemus* are adapted to reach different heights in canopies. Also, *Excelsotarsonemus* individuals are apparently able to glide within canopies for greater distances than its correlated genus, based on the design of their setae.

Geographical distribution

Daidalotarsonemus species have been recorded in 25 countries (Australia, Brazil, Canada, China, Costa Rica, England, Ethiopia, India, Israel, Jamaica, Japan, Madagascar, Malasia, Mexico, Netherlands, New Guinea, New Zealand, Poland, Portugal, Singapore, South Africa, Tonga Islands, USA, Vietnam and Zimbabwe), from all continents and zoogeographical regions (Cox and Moore 2005), except for the Antarctica (Fig. 91). Concerning species of *Excelsotarsonemus*, they have been recorded only in Brazil and Costa Rica, both from the Neotropical region.

Most *Daidalotarsonemus* species (23) are restricted to the American continent, *D. alas*, *D. annonae*, *D. azofeifai*, *D. bauchani*, *D. cuadradus*, *D. esalqi*, *D. folisetae*, *D. fossae*, *D. ginae*, *D. leonardi*, *D. limonensis*, *D. lini*, *D. marini*, *D. maryae*, *D. oliveirai*, *D. savanicus*, *D. seitus*, *D. somalatus*, *Daidalotarsonemus* sp. n. 1, *Daidalotarsonemus* sp. n. 3, *Daidalotarsonemus* sp. n. 5, *D. tessellatus* and *D. venustus*. This may not be just an indication of the high diversity found in Americas, but also of the result of considerable sampling efforts in this region. However, the small number of European species suggests it is not diverse in this well-sampled region.

Only *D. jamesbakeri* and *D. vandevriei* specimens have been found on two different continents. Individuals of *D. vandevriei* have been recorded in Europe (Suski 1967) and Canada inhabiting two different crops, including apple *Malus* sp. (Rosaceae). It is known that apple trees have been spread throughout the world over the last centuries (Zohary *et al.* 2012). Therefore, the presence of this mite in a worldwide cultivated plant may be a major factor in explaining its distribution. *Daidalotarsonemus jamesbakeri* has been recorded on orchids, *Vanda* spp. (Orchidaceae) by the USDA quarantine service. Similar to apple trees, orchids have been cultivated around the world, which may have influenced the distribution of this mite.

Specimens of *D. annonae* and *D. fossae* have been found from North and South Americas, in the USA and Brazil, respectively. For *D. annonae*, it has been sampled in following three biomes in Brazil: Amazon, Atlantic (Sousa *et al.* 2014) and Semidecious Forests. For *D. fossae*, it has been recorded only in the in Atlantic forest areas of the Northeastern region of this country. In the USA, both species are restricted to the State of Florida so far, which has a similar climate to the Brazilian biomes in some regions.

This could indicate a preference of both species for the warm subtropical and tropical regions.

Finally, most of the described species of *Daidalotarsonemus* and *Excelsotarsonemus* species have not been collected again since their original descriptions. In total, twenty-two *Daidalotarsonemus* and three *Excelsotarsonemus* species have only one record from a single location. According to the results presented here, it is clear that their distribution may be larger than expected. It is also clear that more new species are likely to be found as more unexplored natural areas are surveyed for tarsonemids.

Acknowledgements

To FAPESP (Fundação de Amparo a Pesquisa do Estado de São Paulo) (Procs. 2011/19890-0 and 2013/08402-0) for its financial support. To Prof. Dr. Anibal R. Oliveira (UESC) for his support during samplings in Bahia State. To Prof. Dr. Evert E. Lindquist (CANACOLL-AC) for his support and suggestions in the study of the mites. To Drs. André Matioli (IB – Instituto Biológico, Campinas, Brazil), Carl Childers (CREC-UF – Citrus Research and Education Center, University of Florida, Lake Alfred, USA), Eddie Ueckermann (BD-ARC – Biosystematics Division, Agricultural Research Council, Pretoria, South Africa), Frederic Beaulieu (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada), Gilberto J. de Moraes (ESALQ/USP – Escola Superior de Agricultura Luis de Queiroz, Universidade de São Paulo, Piracicaba, Brazil), Jim Amrine (DPSS-WVU – Division of Plant and Soil Sciences, West Virginia University, Morgantown, USA), Jurgen Otto (AIMS – Australian Institute of Marine Sciences, Townsville, Australia), László Dányi (HNHM-SZC – Hungarian Natural History Museum, Soil Zoology Collection, Budapest, Hungary), Owen Seeman (QM – Queensland Museum, Brisbane, Australia), Tomasz Huflejt (MIZ-PAS – Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland), Wayne Knee (CNC – Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada), for providing the specimens of for studying. To Dr. Jianzhen Lin (IPP-FAAS – Institute of Plant Protection, Fujian Academy of Agricultural Sciences, Fuzhou, China) and his daughter, Ms. Gongyu Lin, for providing micrographs of the Chinese species and translating the description of them, from Mandarim to English. To Dr. Krishna Karmakar (BCKV – Acarology Laboratory, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India) for providing micrographs of *Daidalotarsonemus* individuals from India; To Nit Malikul, Debra Creel (SEL-USDA) for their technical support and to Chris Pooley (ECMU-USDA) for their help with the LT-SEM images. To Dr. Gregory Evans (APHIS-USDA) and Cal Welbourn (DPI-FDACS), for helpful suggestions and careful review of the manuscript. To the Willi Hennig Society for making available the software TNT, used in the phylogenetic analysis. To the Smithsonian Natural History Museum (USNM) and National Agricultural Library (NAL-USDA), SEL-USDA for support and assistance with references for this study. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA; USDA is an equal opportunity provider and employer.

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Figures

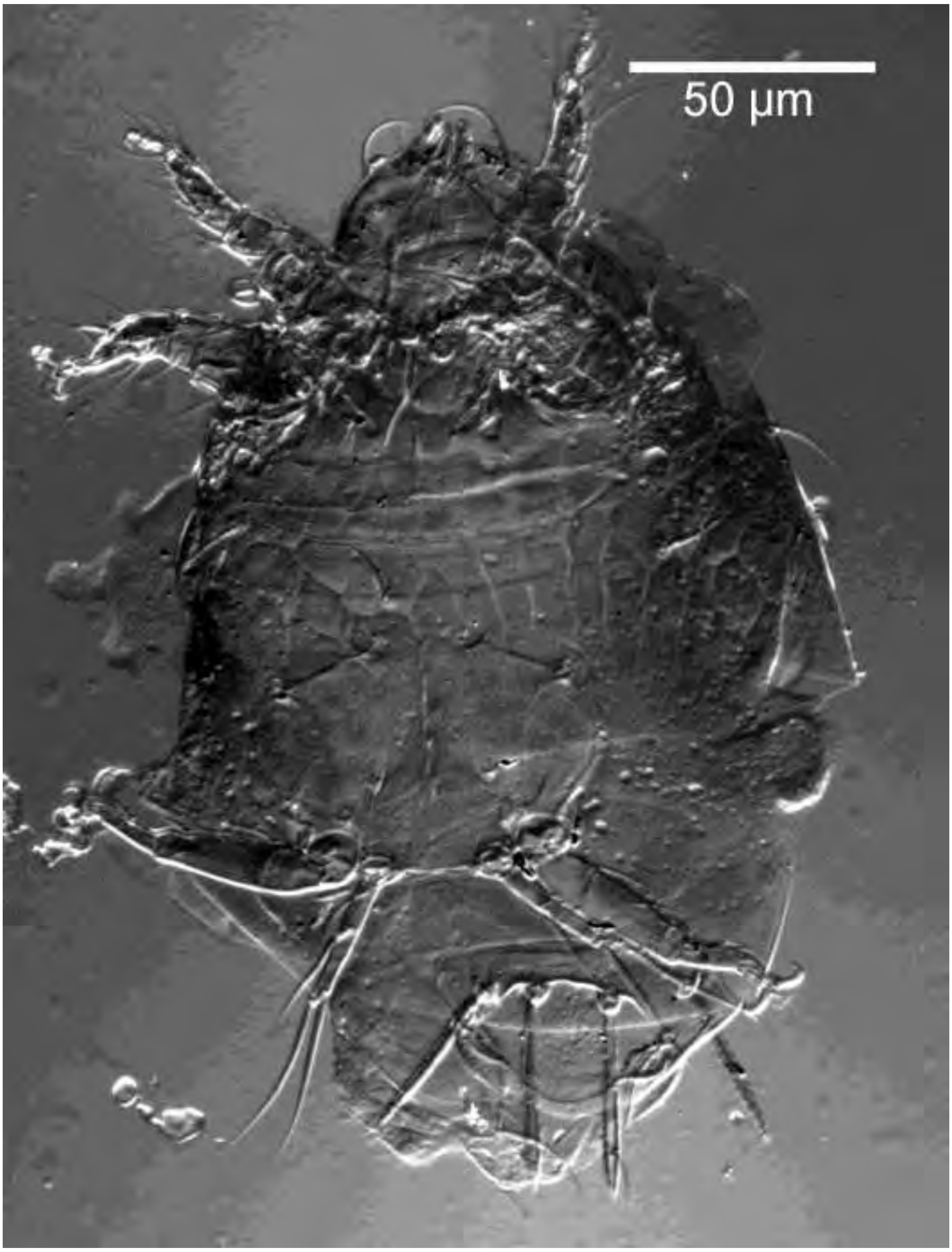

Figure 1. *Daidalotarsonemus biovatus* Lin & Liu. (female). Dorsal DIC micrograph of the idiosoma.

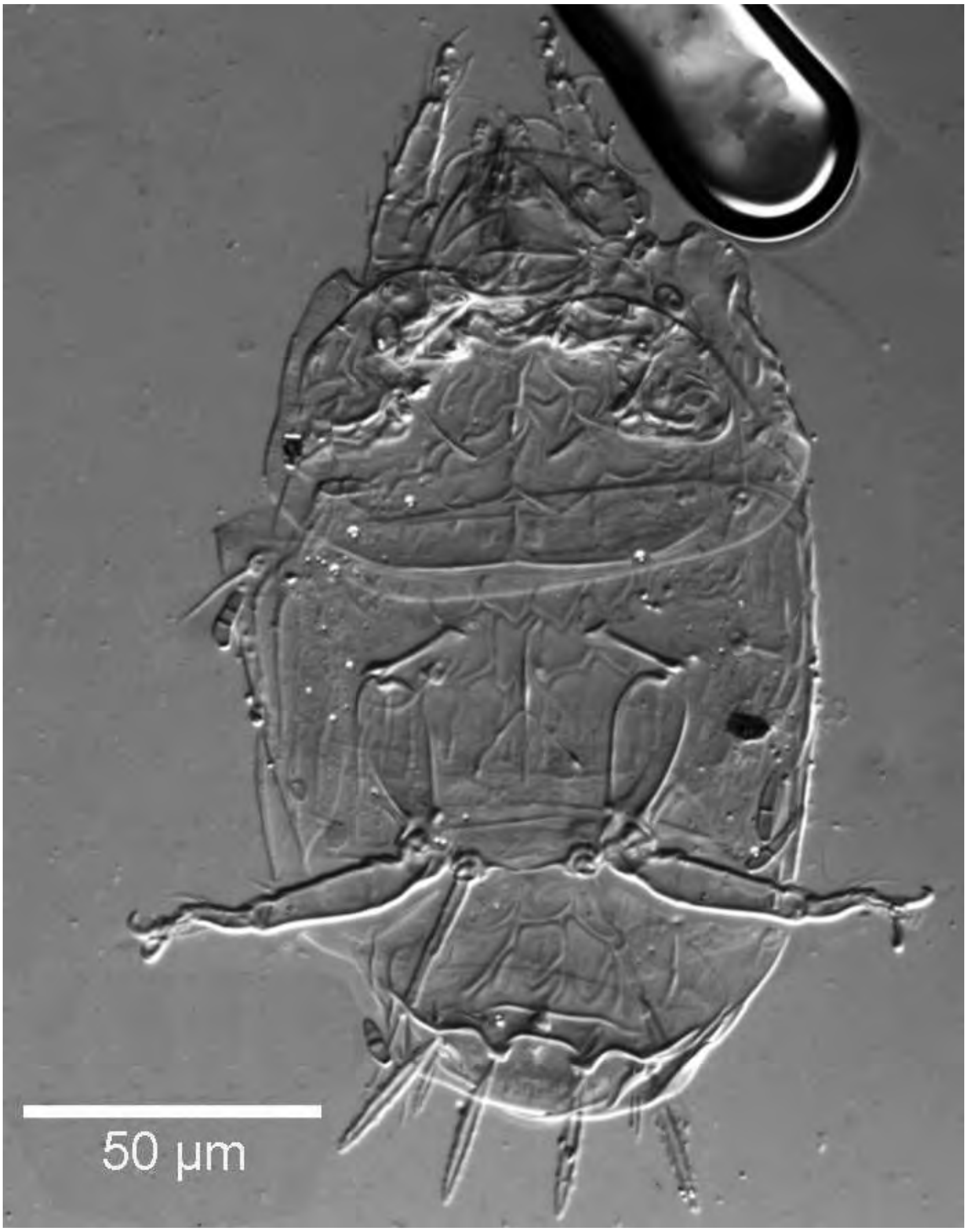

Figure 2. *Daidalotarsonemus cornutus* Lin, Chen & Zhang. (female). Dorsal DIC micrograph of the idiosoma.

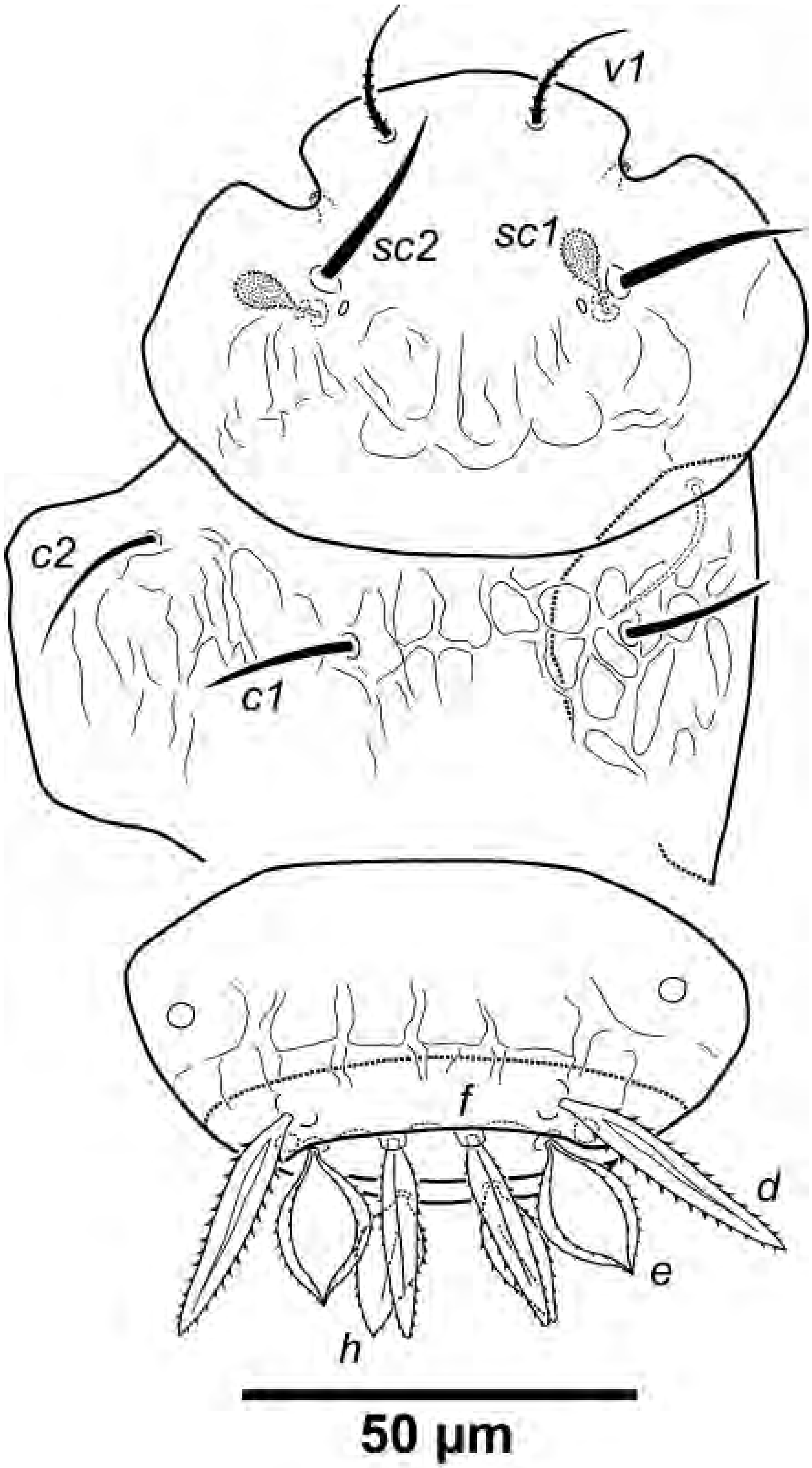

Figure 3. *Daidalotarsonemus costulatus* Mahunka (female). Dorsal surface of the idiosoma.

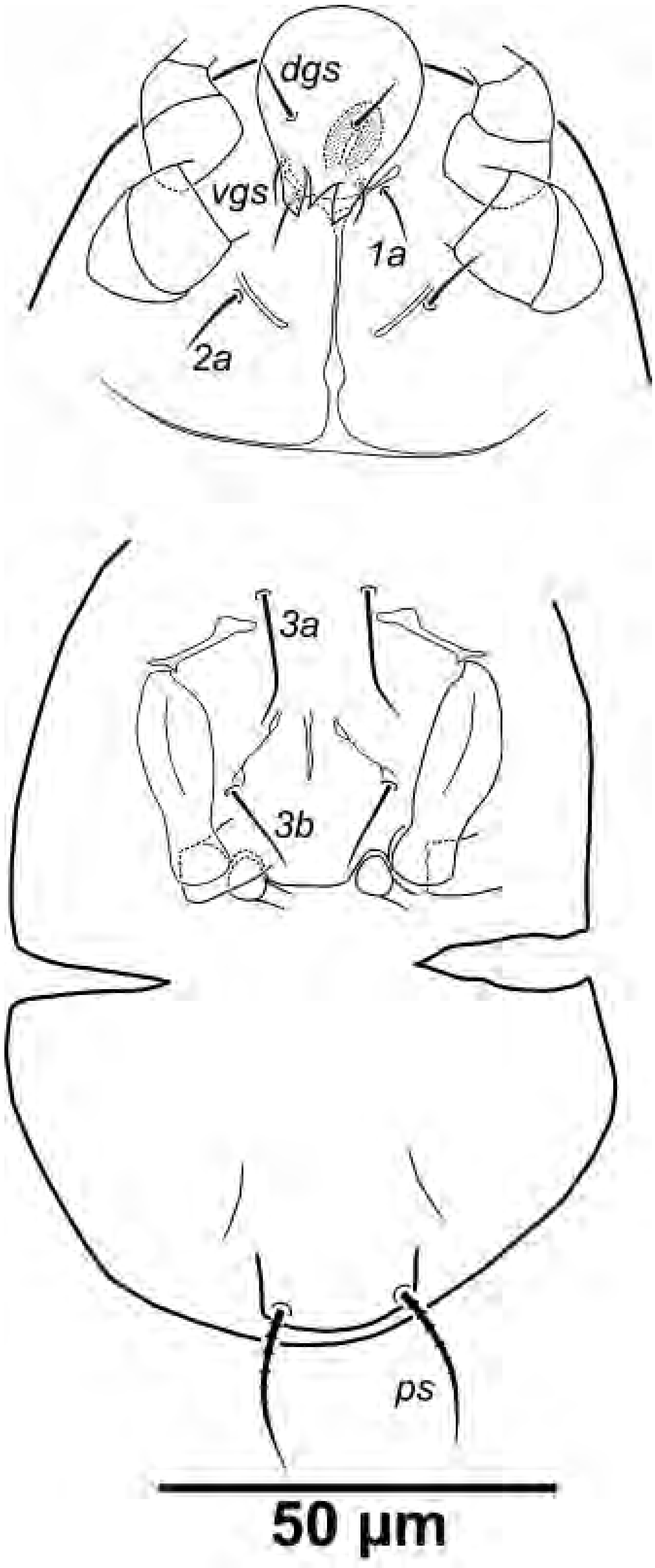

Figure 4. *Daidalotarsonemus costulatus* Mahunka (female). Ventral surface of the idiosoma.

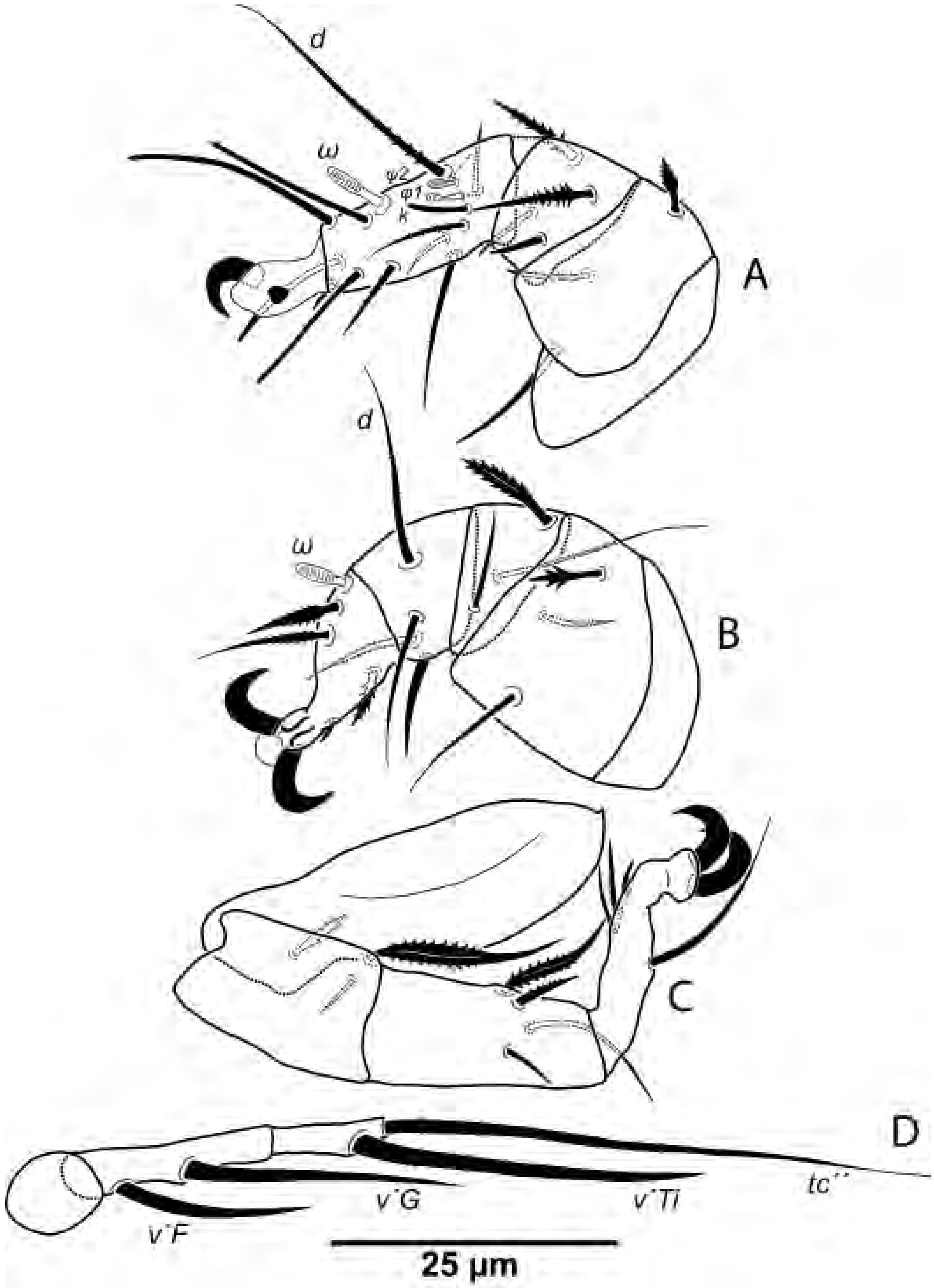

Figure 5. *Daidalotarsonemus costulatus* Mahunka (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

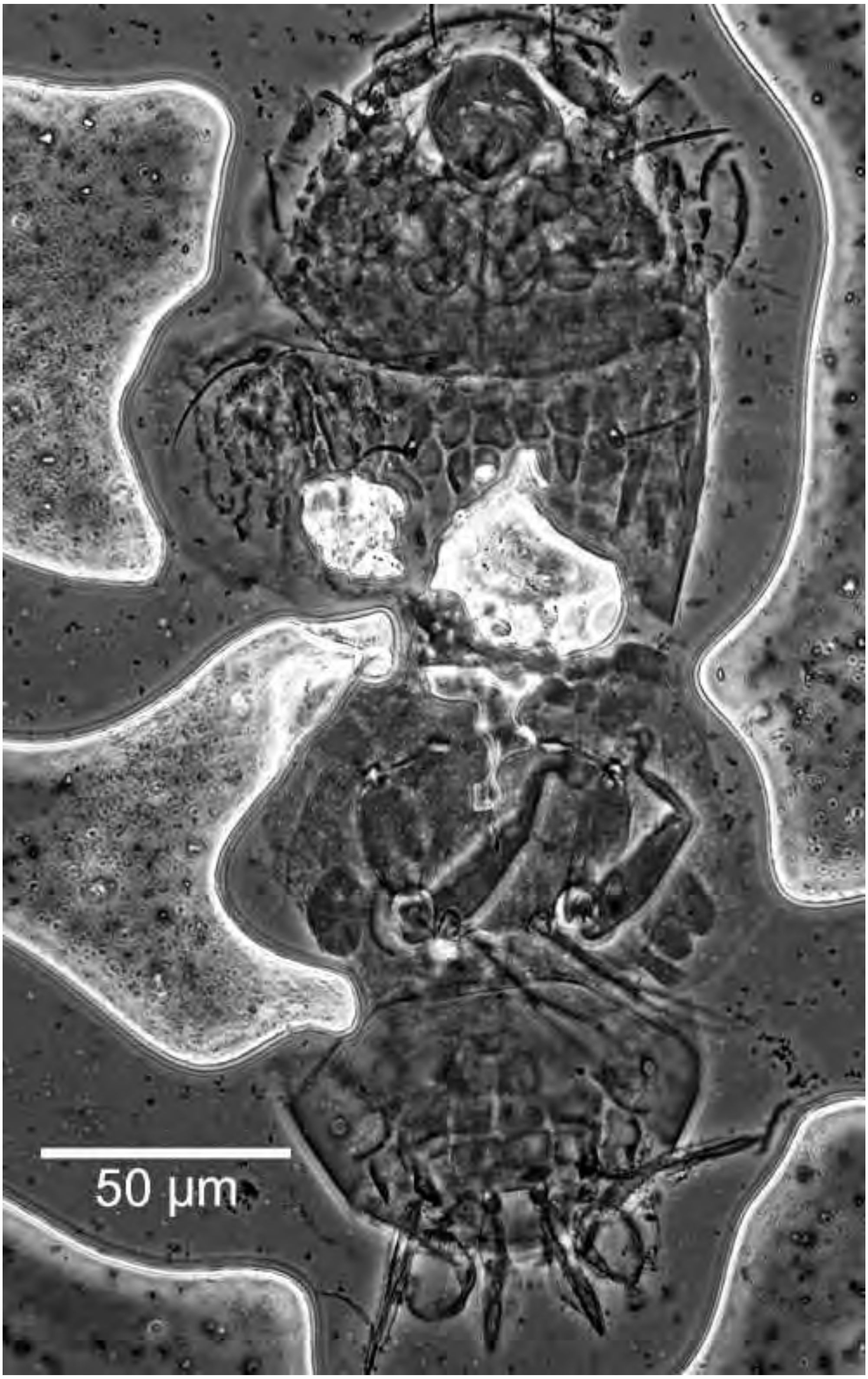

Figure 6. *Daidalotarsonemus costulatus* Mahunka (female). Dorsal PC micrograph of the idiosoma.

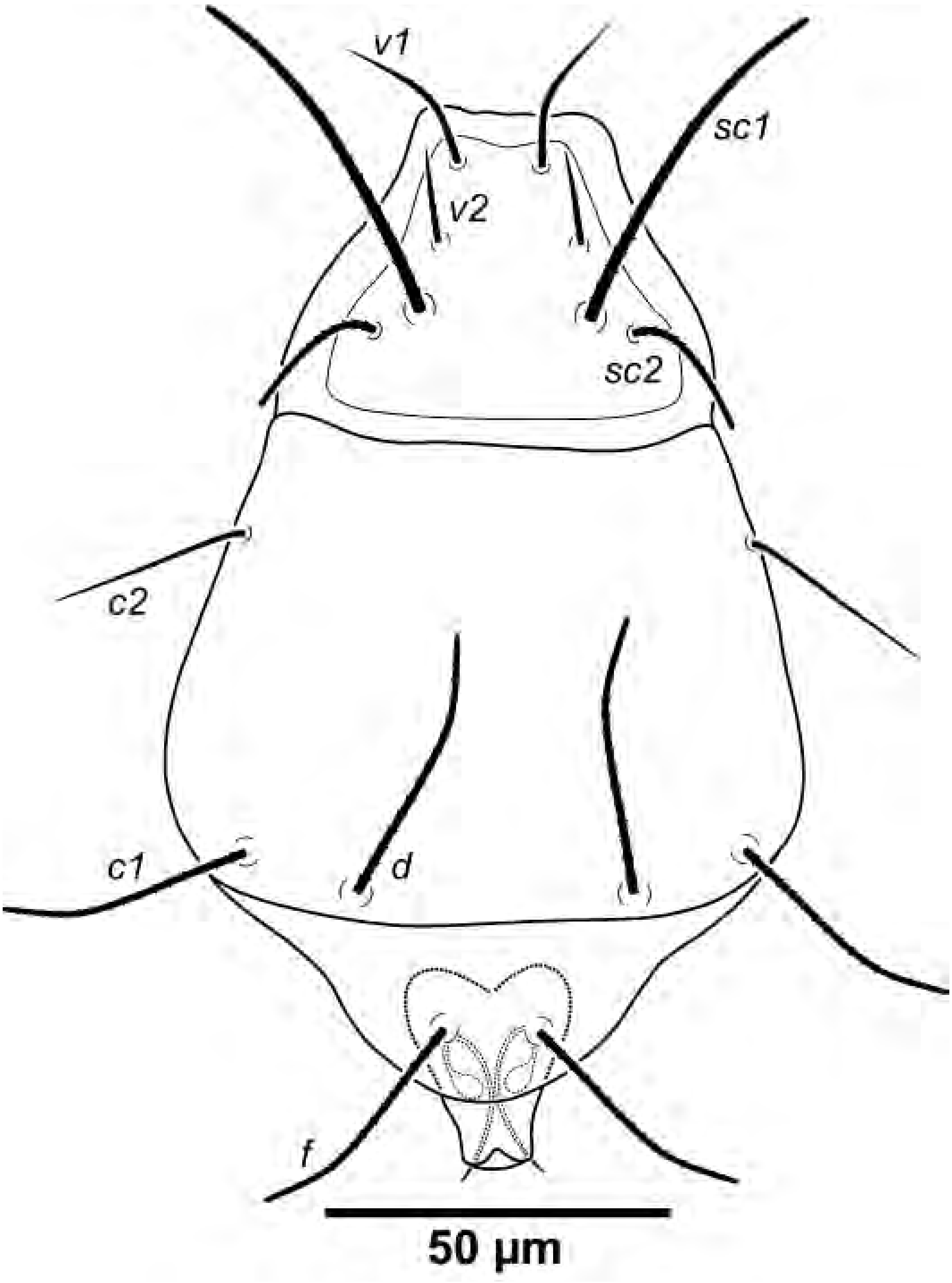

Figure 7. *Daidalotarsonemus deleoni* (Smiley) (male). Dorsal surface of the idiosoma.

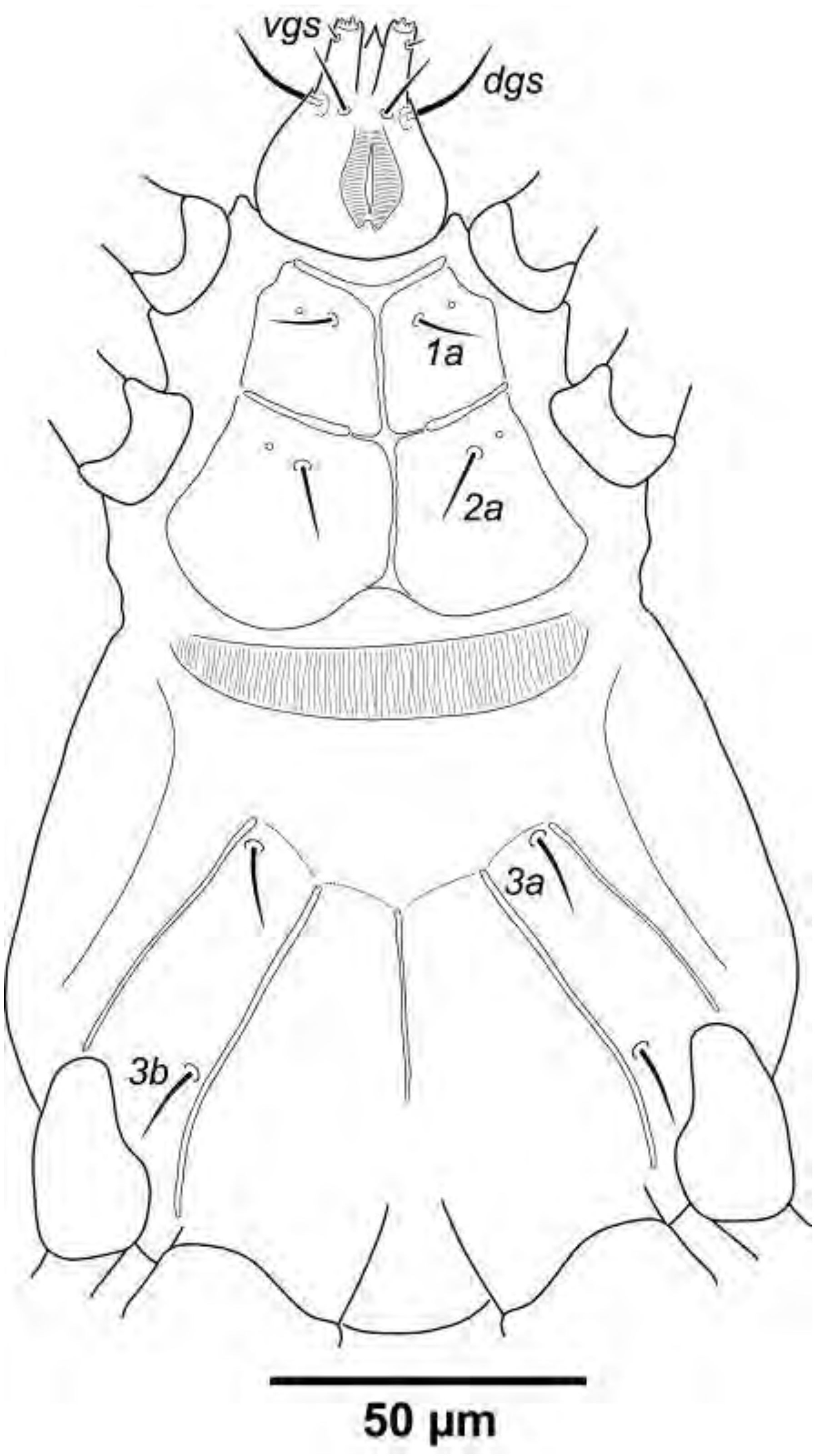

Figure 8. *Daidalotarsonemus deleoni* (Smiley) (male).Ventral surface of the idiosoma.

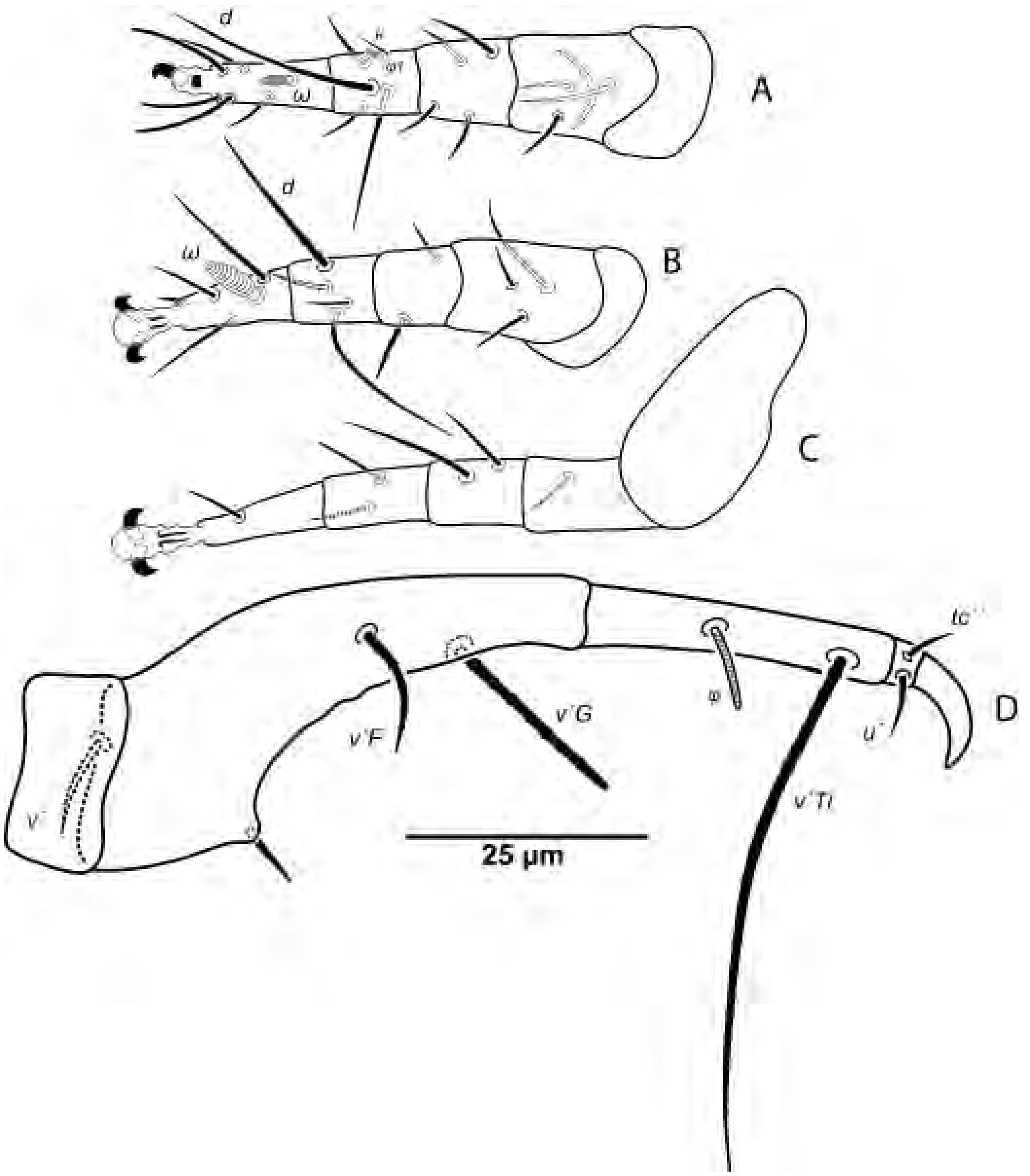

Figure 9. *Daidalotarsonemus deleoni* (Smiley) (male). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

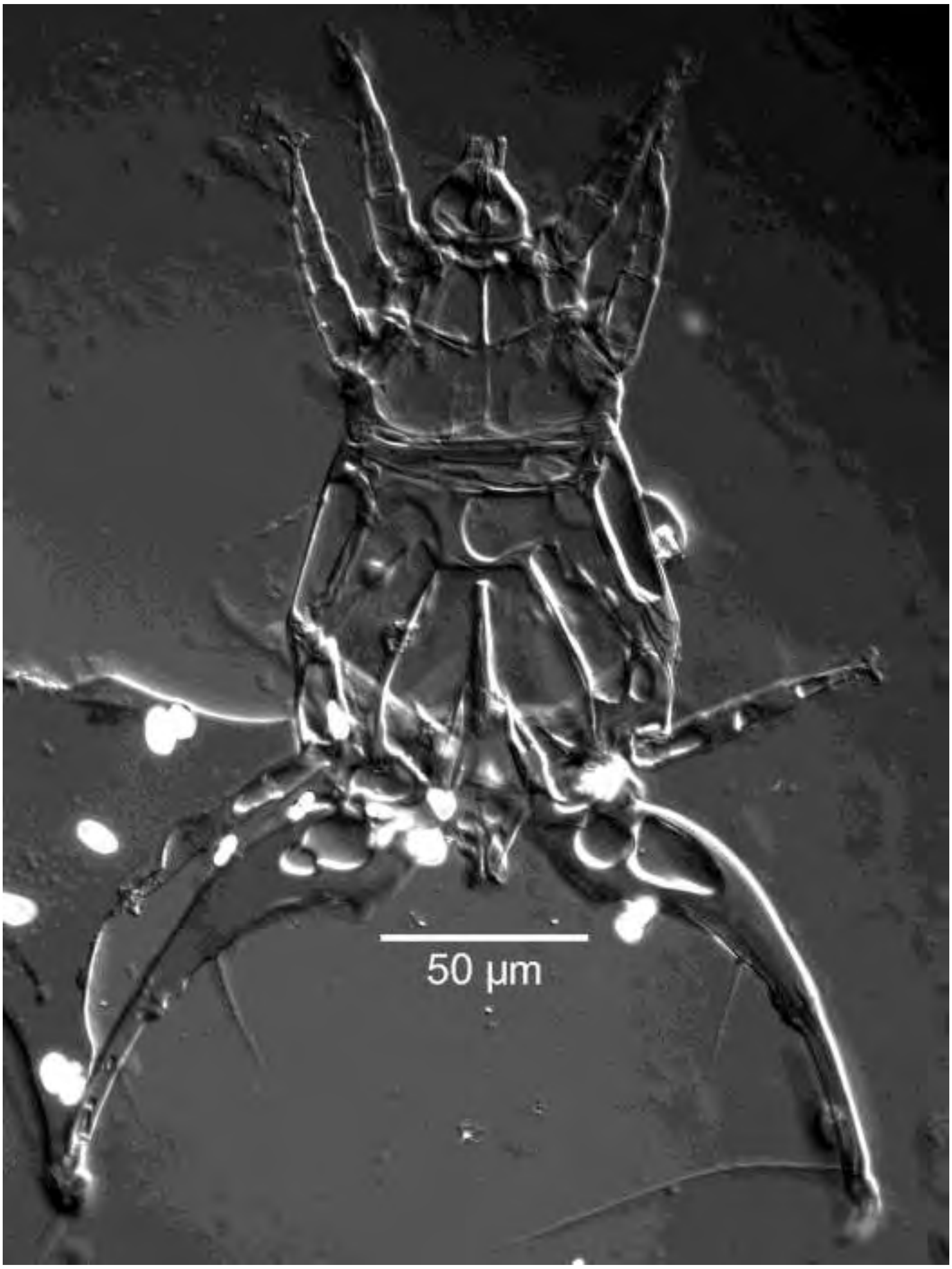

Figure 10. *Daidalotarsonemus deleoni* (Smiley) (male). Dorsal DIC micrograph of the idiosoma.

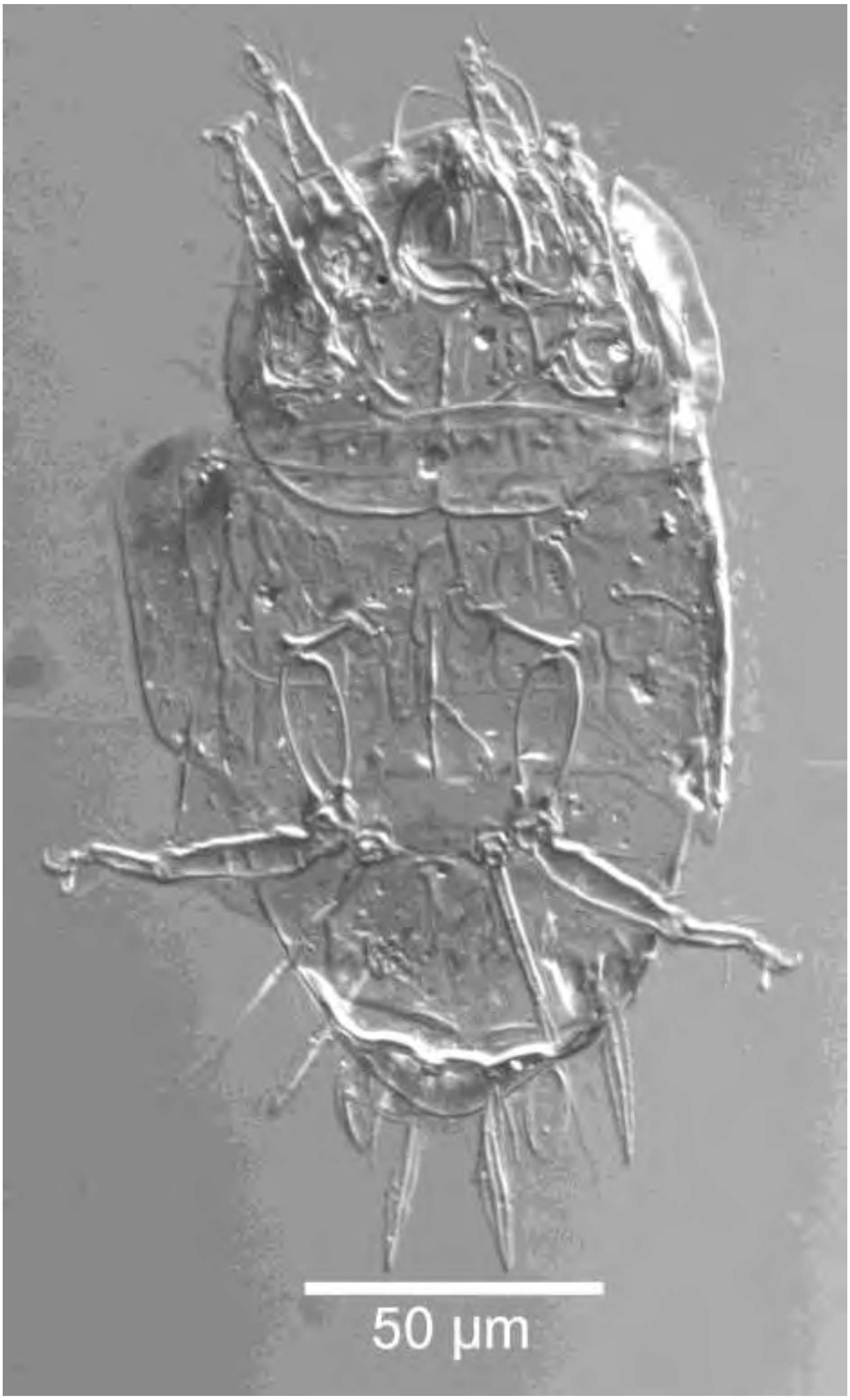

Figure 11. *Daidalotarsonemus digital* Lin, Chen & Zhang. (female). Dorsal DIC micrograph of the idiosoma.

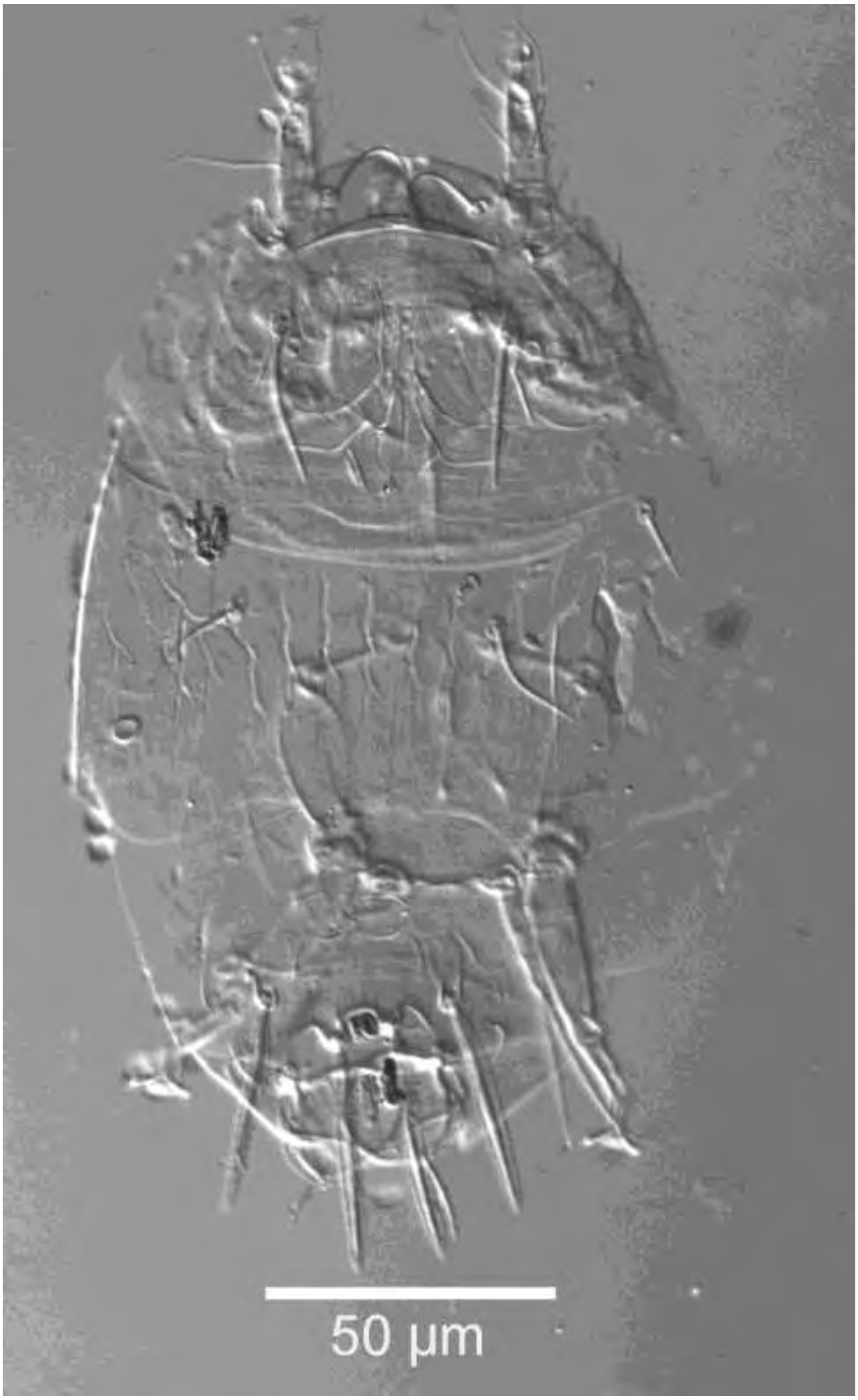

Figure 12. *Daidalotarsonemus duolamella* Lin, Chen & Zhang. (female). Dorsal DIC micrograph of the idiosoma.

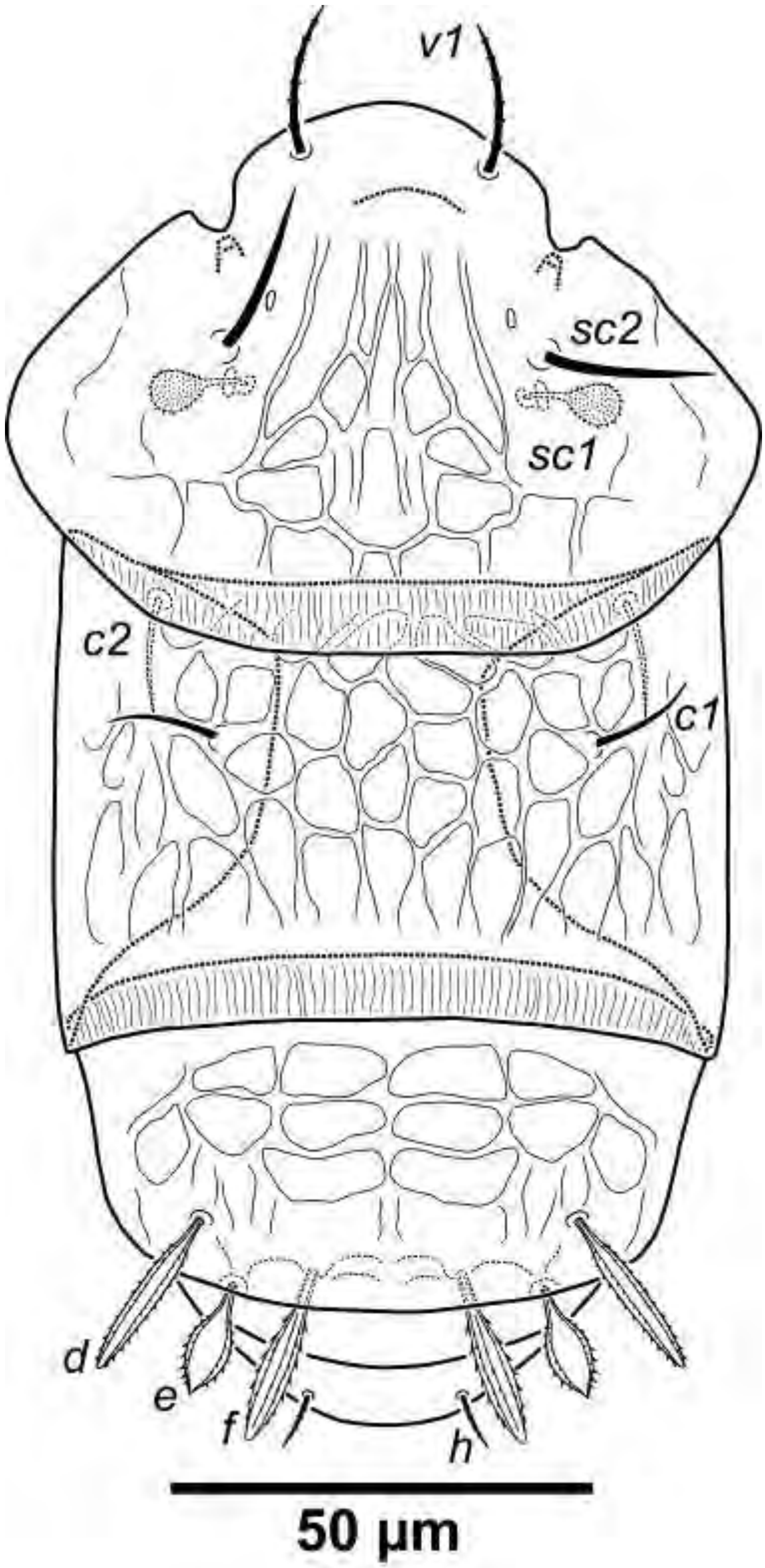

Figure 13. *Daidalotarsonemus ethiopicus* Mahunka (female). Dorsal surface of the idiosoma.

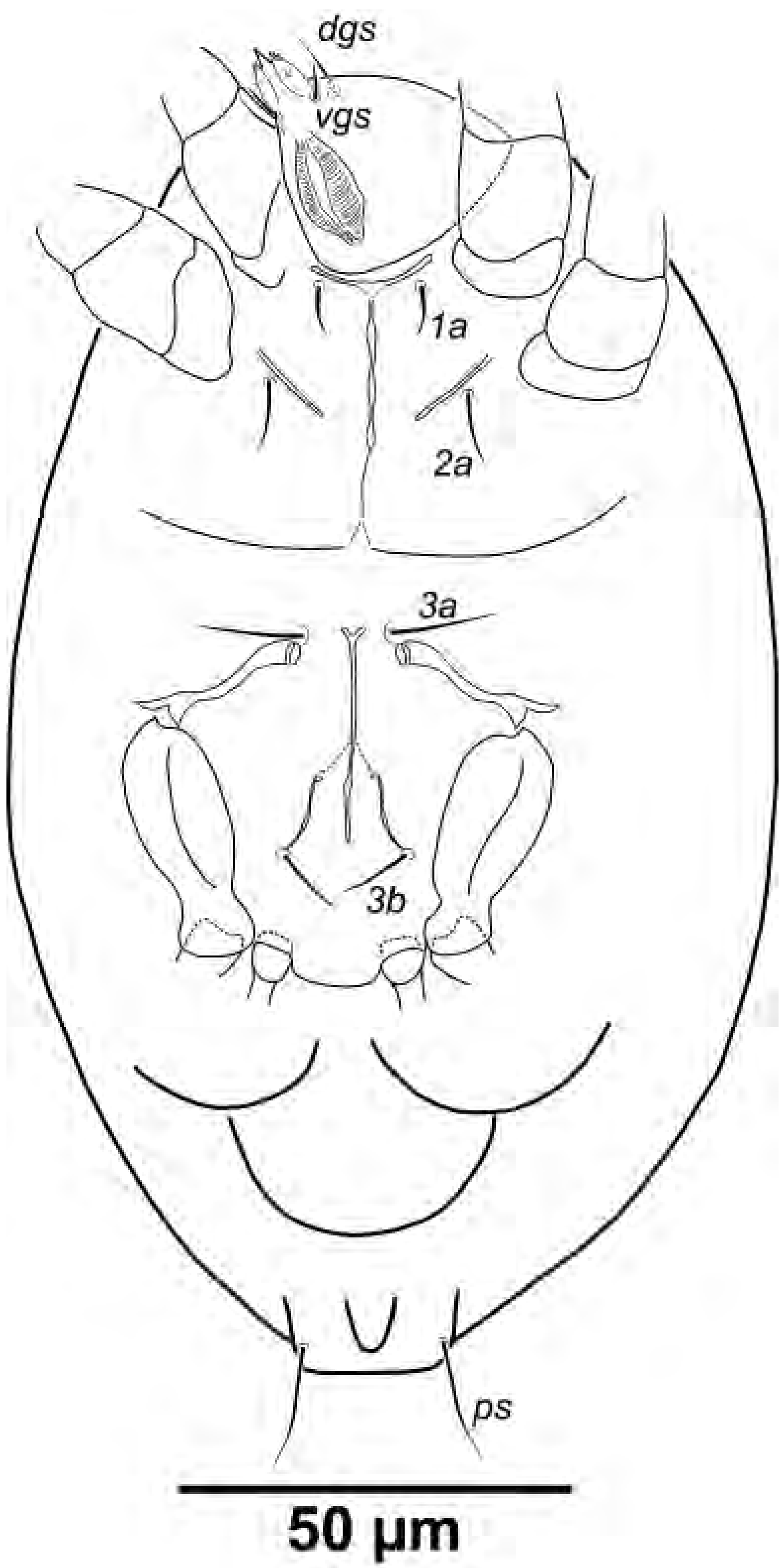

Figure 14. *Daidalotarsonemus ethiopicus* Mahunka (female). Ventral surface of the idiosoma.

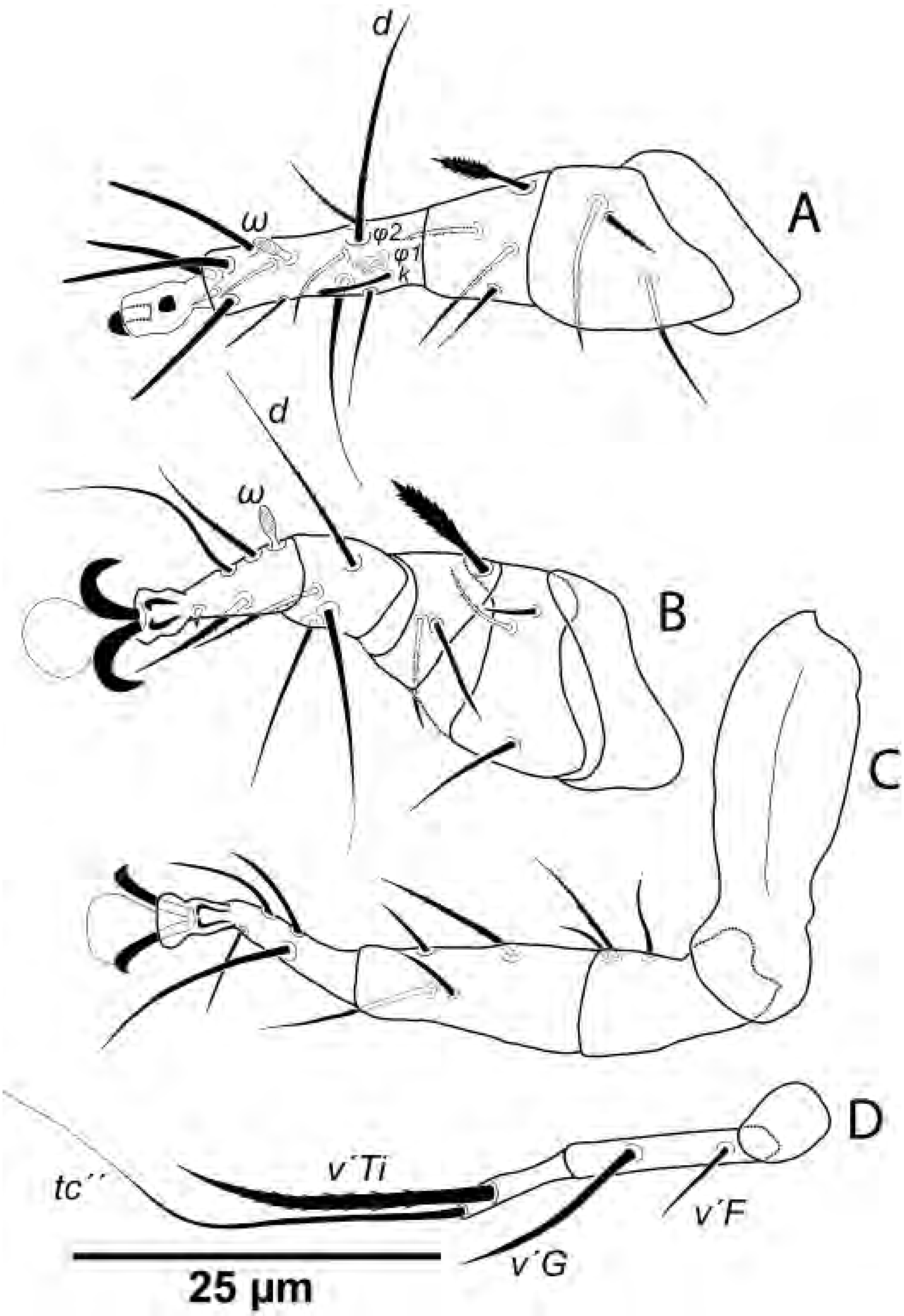

Figure 15. *Daidalotarsonemus ethiopicus* Mahunka (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 16. *Daidalotarsonemus ethiopicus* Mahunka (female). Dorsal PC micrograph of the idiosoma.

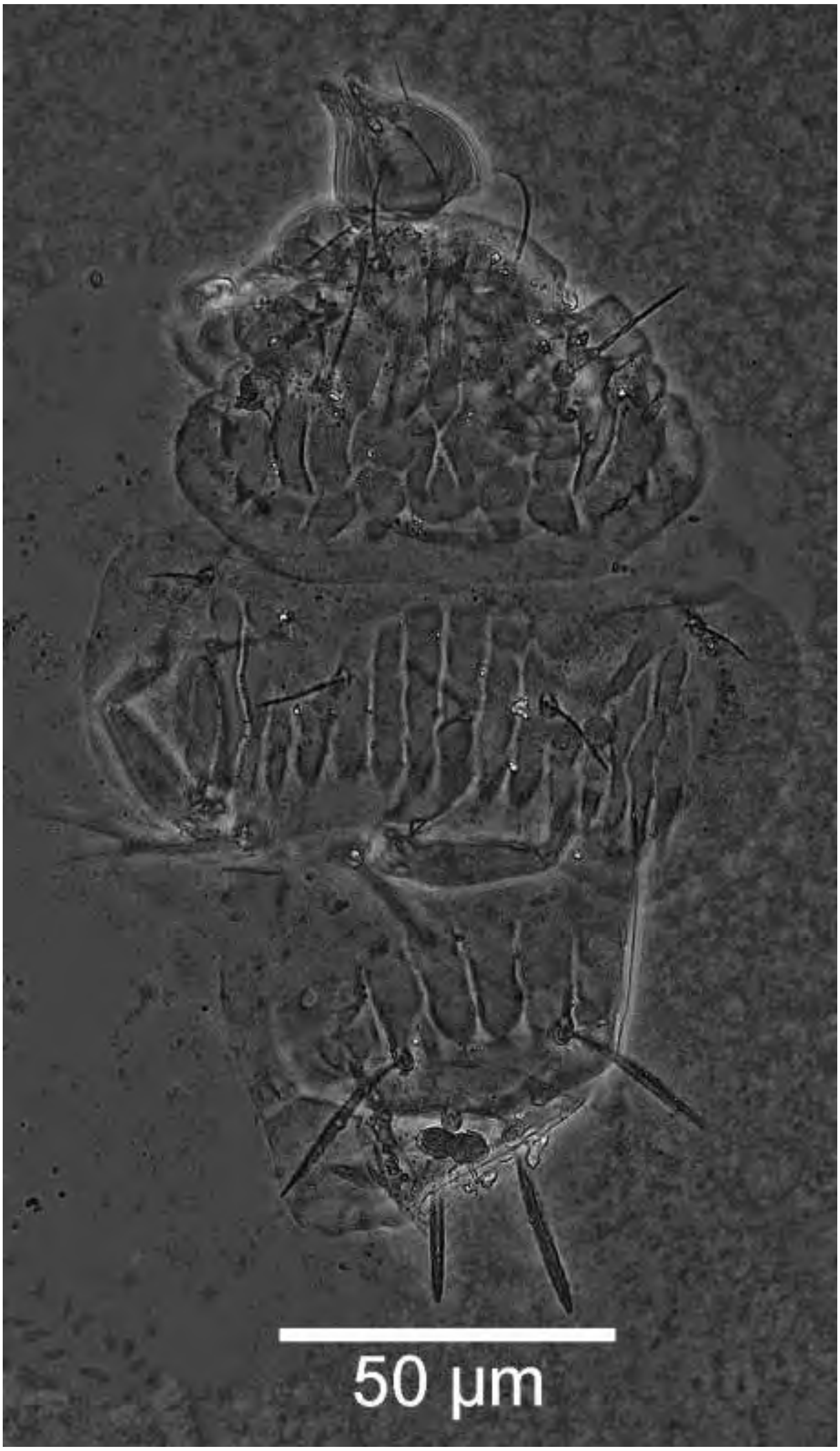

Figure 17. *Daidalotarsonemus folisetae* Lofego & Ochoa (female). Dorsal PC micrograph of the idiosoma.

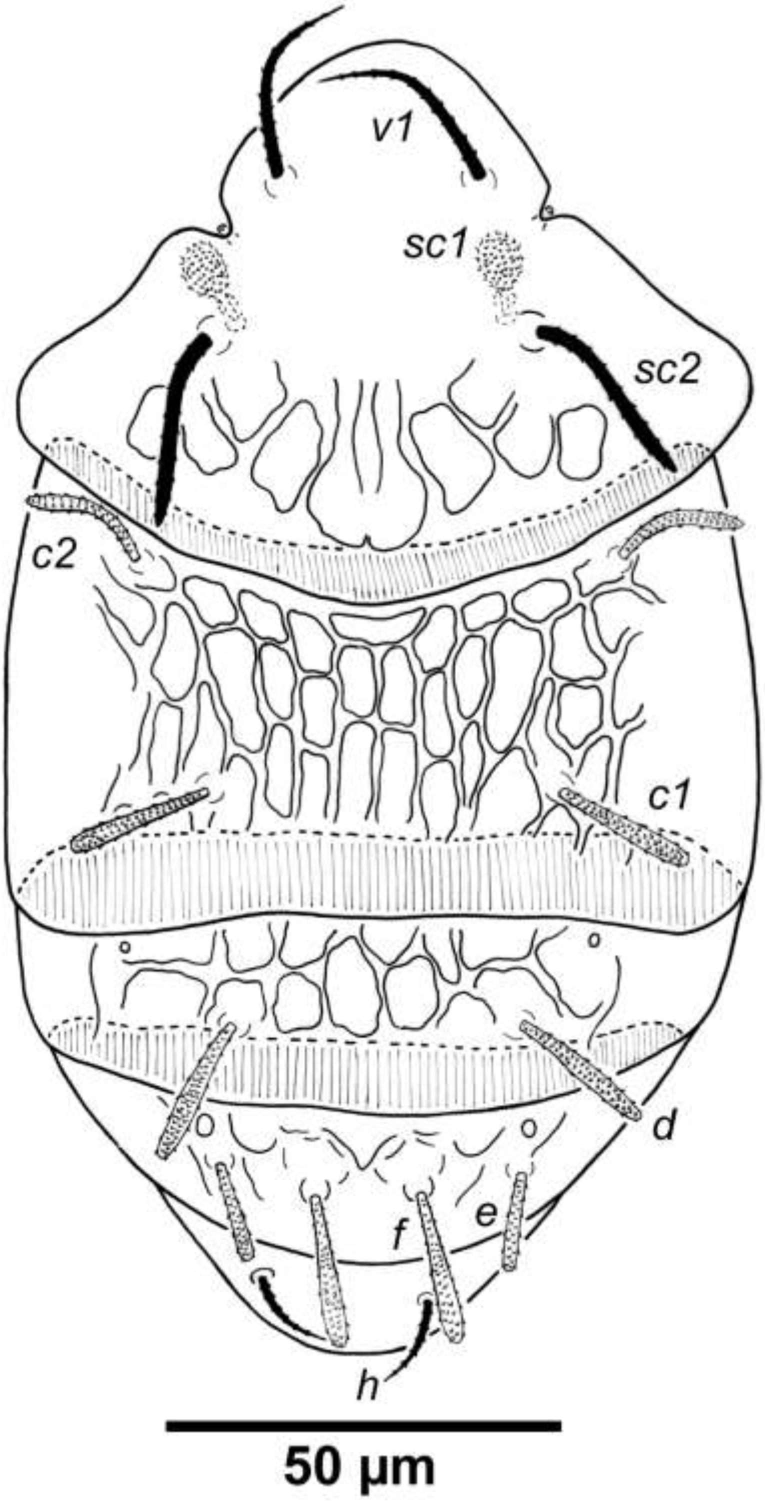

Figure 18. *Daidalotarsonemus fossae* De Leon (female). Dorsal surface of the idiosoma.

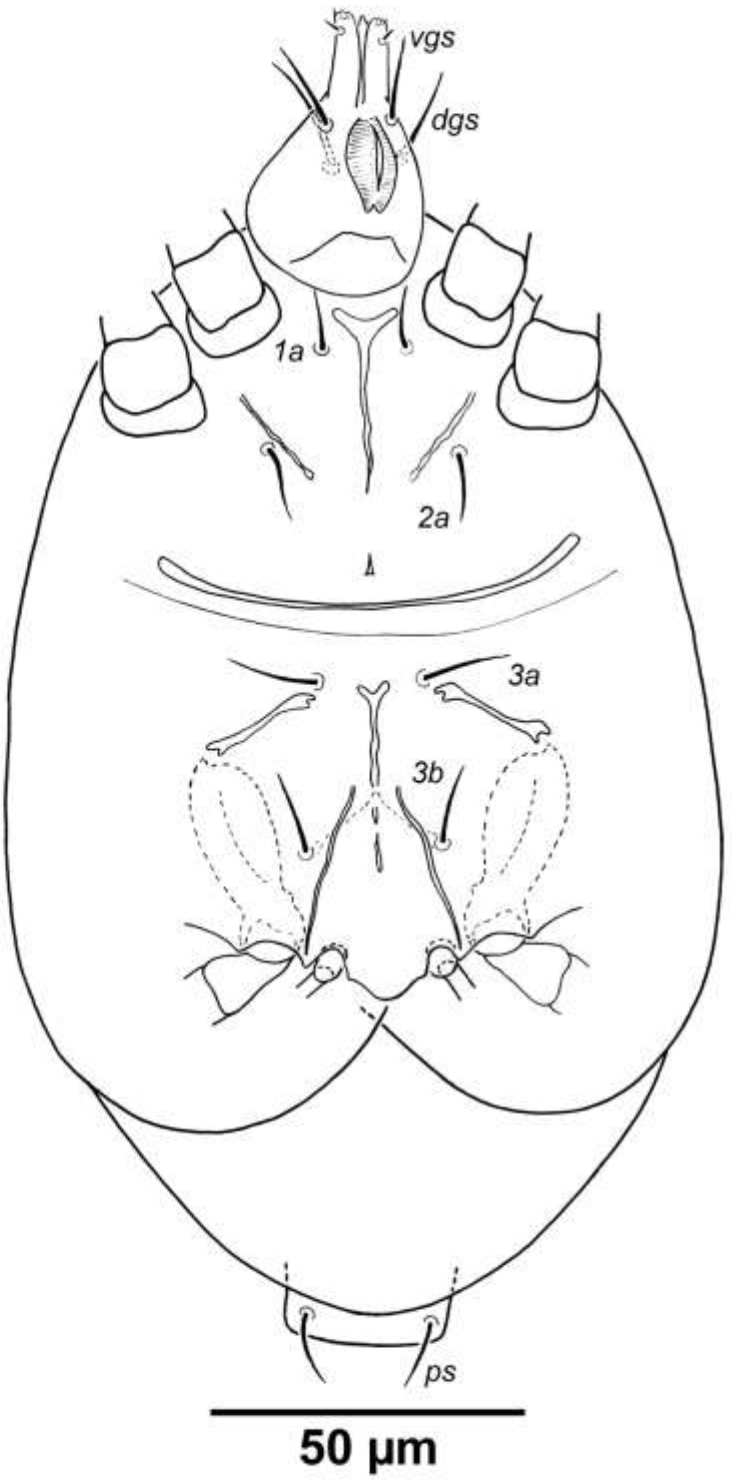

Figure 19. *Daidalotarsonemus fossae* De Leon (female). Ventral surface of the idiosoma.

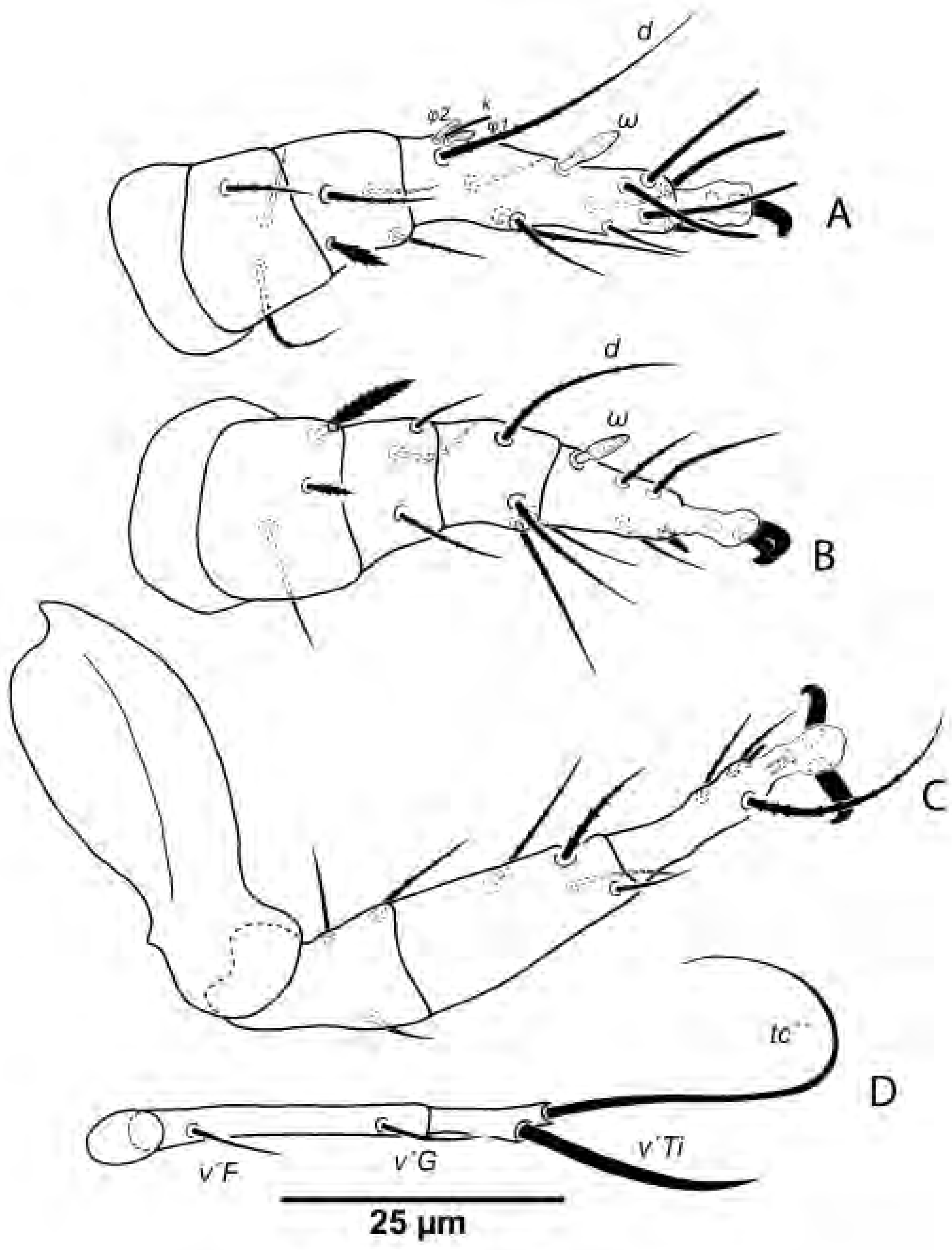

Figure 20. *Daidalotarsonemus fossae* De Leon (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

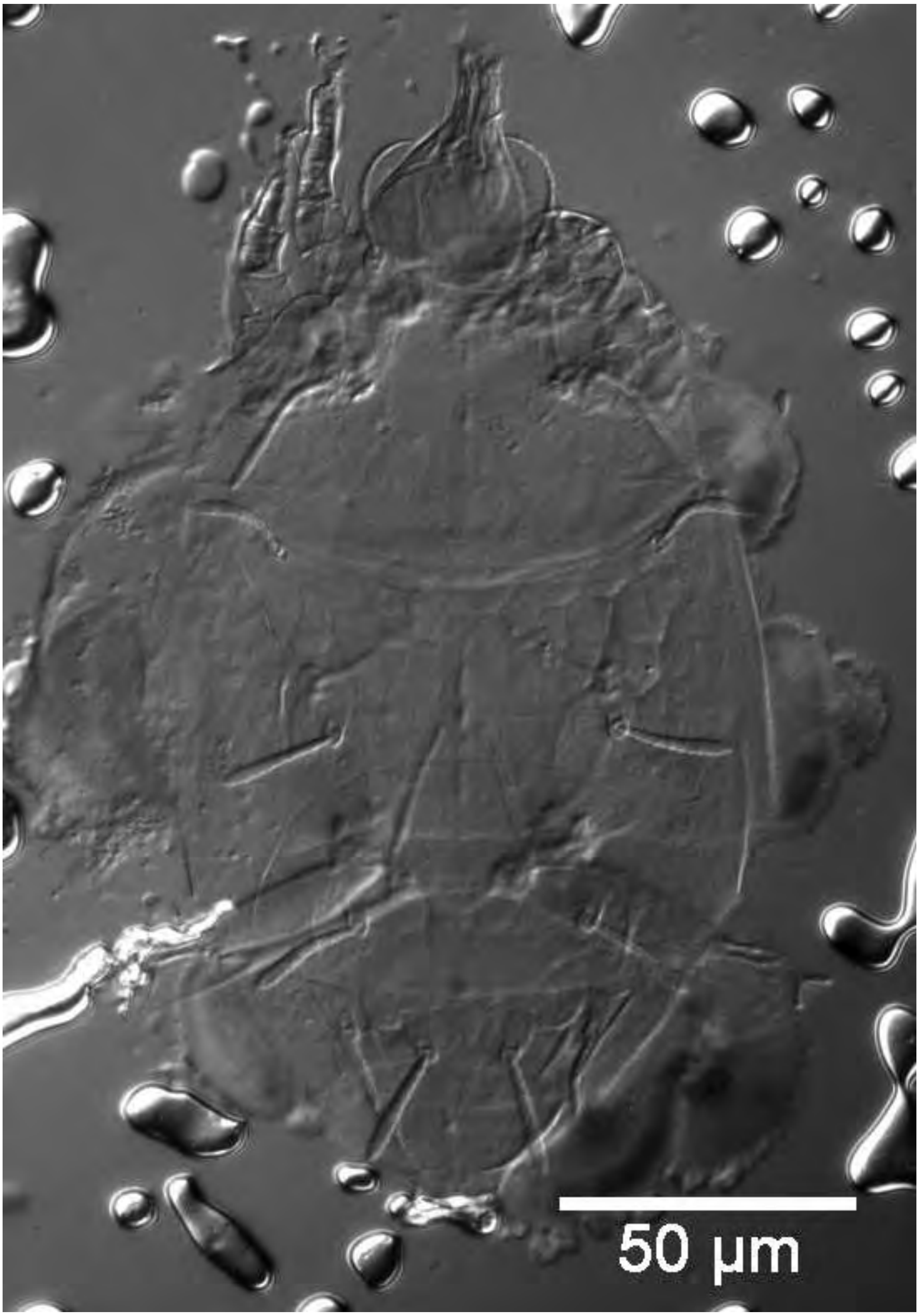

Figure 21. *Daidalotarsonemus fossae* De Leon (female). Dorsal DIC micrograph of the idiosoma.

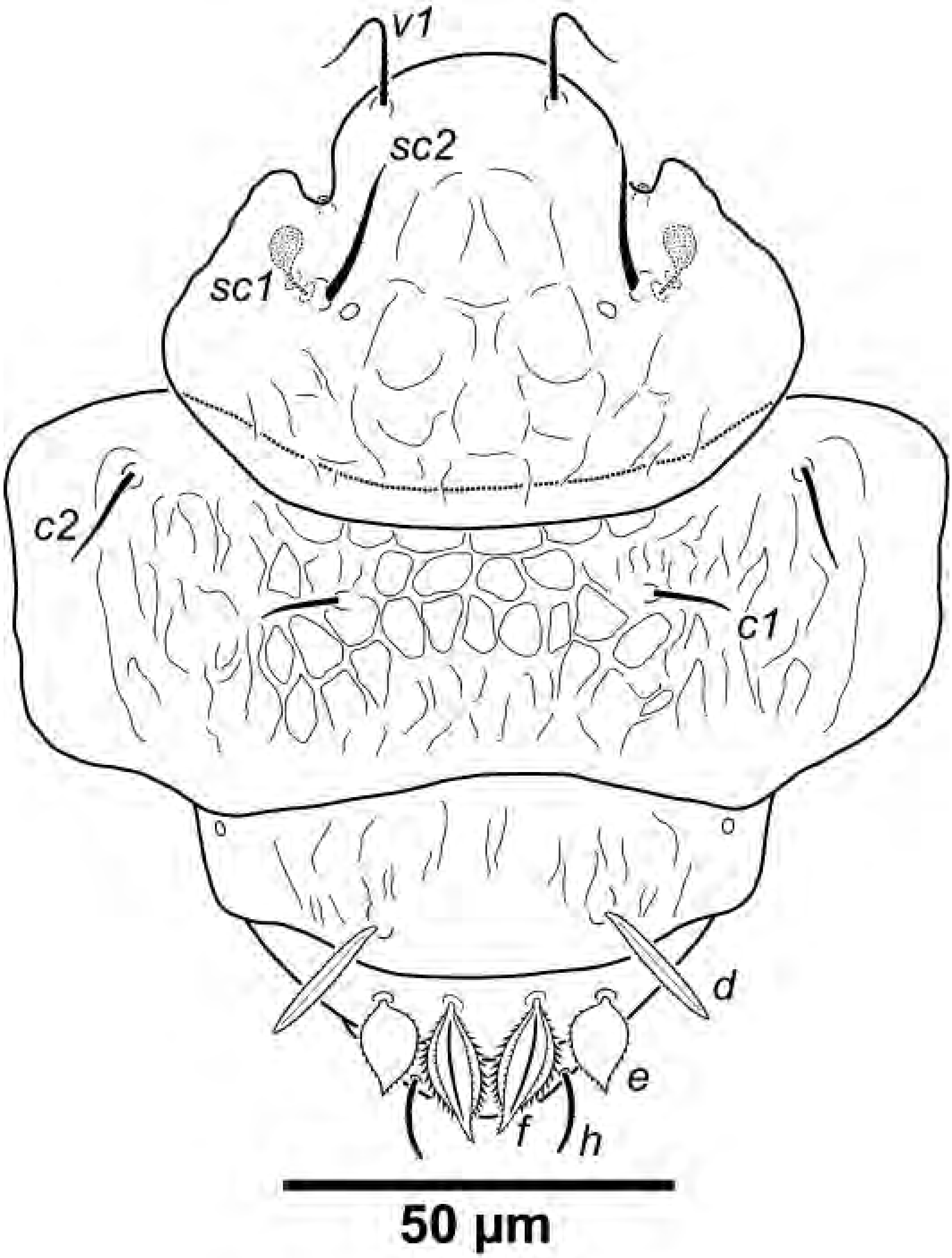

Figure 22. *Daidalotarsonemus hewitti* Mahunka (female). Dorsal surface of the idiosoma.

of the idiosoma.

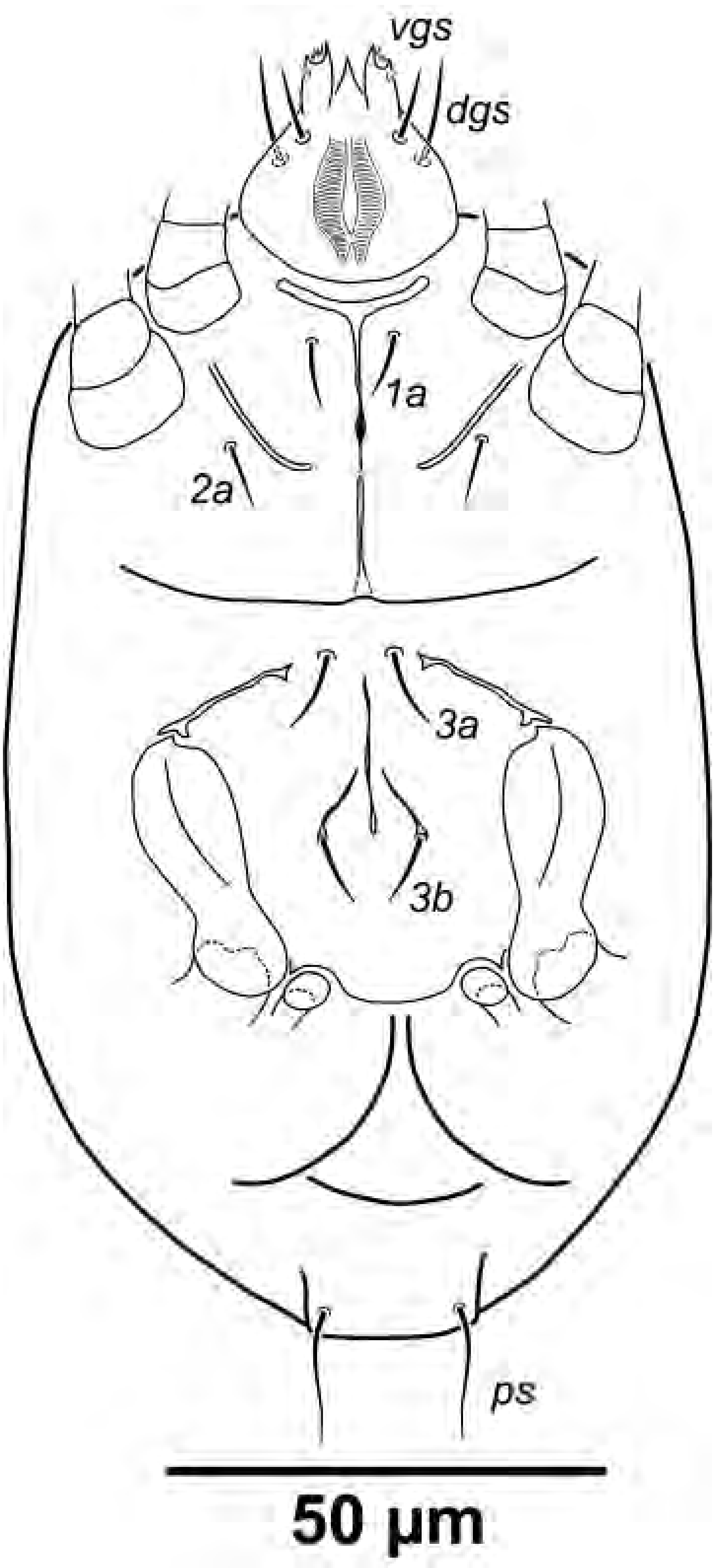

Figure 23. *Daidalotarsonemus hewitti* Mahunka (female). Ventral surface of the idiosoma.

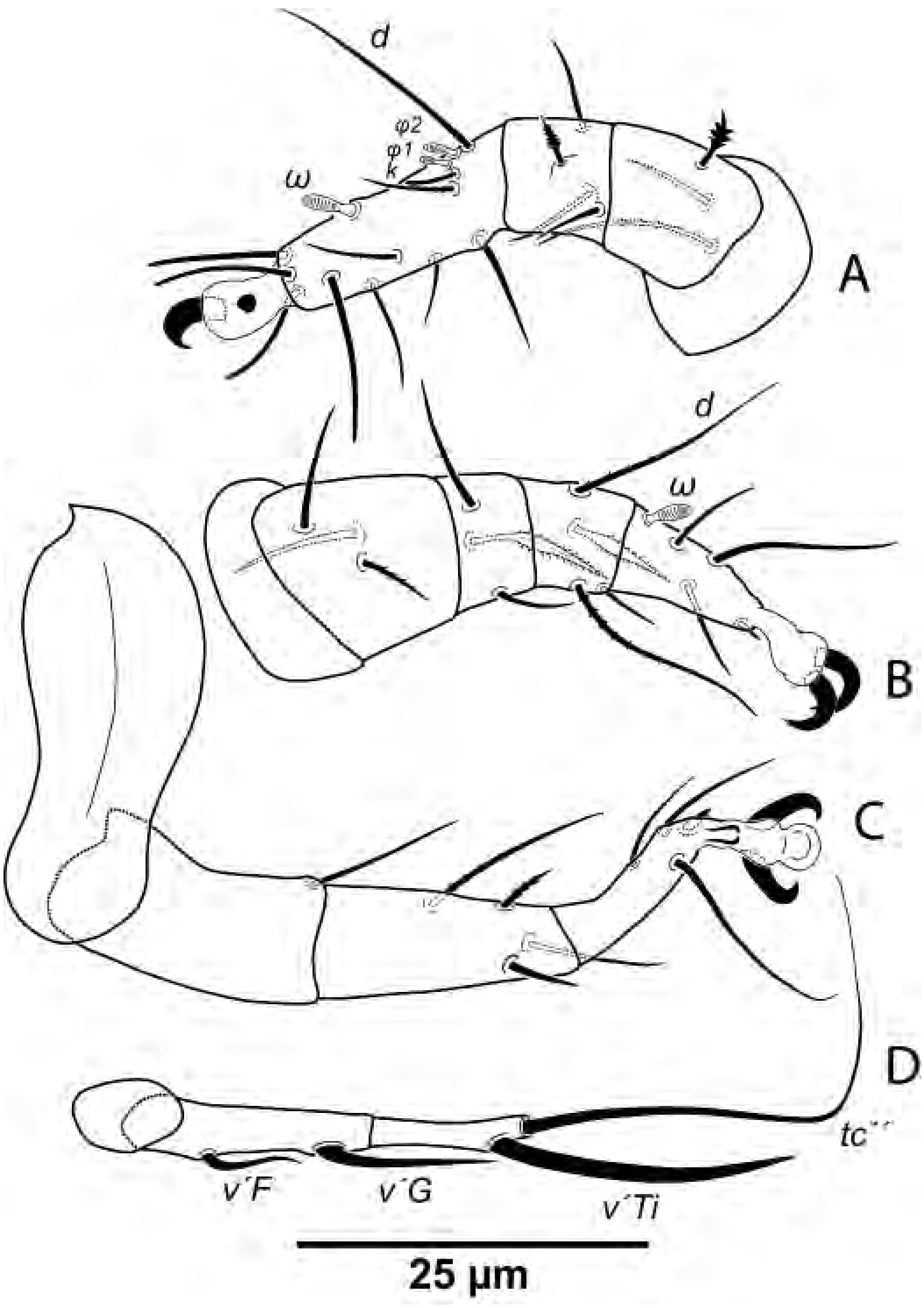

Figure 24. *Daidalotarsonemus hewitti* Mahunka (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 25. *Daidalotarsonemus hewitti* Mahunka (female). Dorsal PC micrograph of the idiosoma.

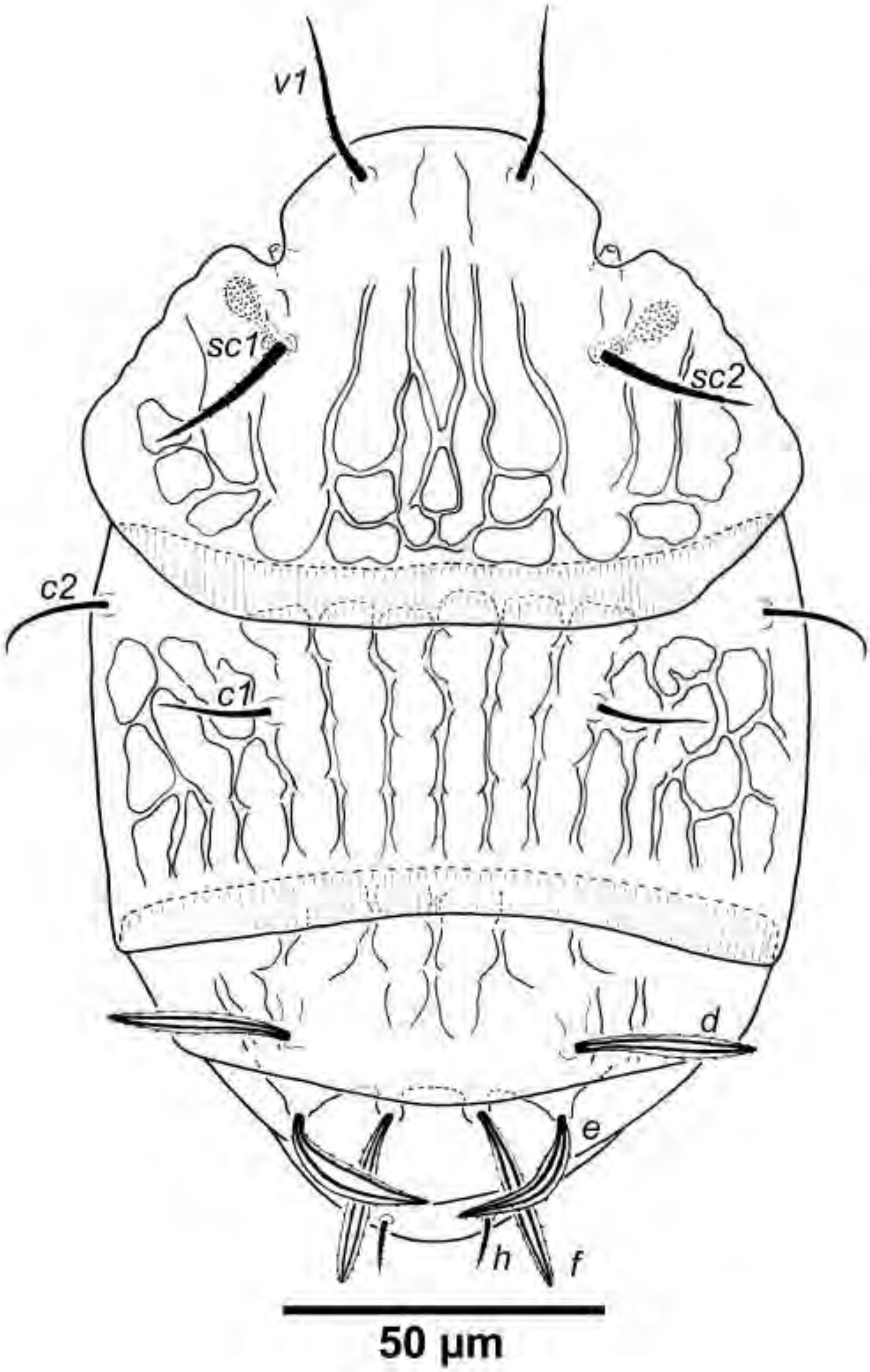

Figure 26. *Daidalotarsonemus jamesbakeri* Smiley (female). Dorsal surface of the idiosoma.

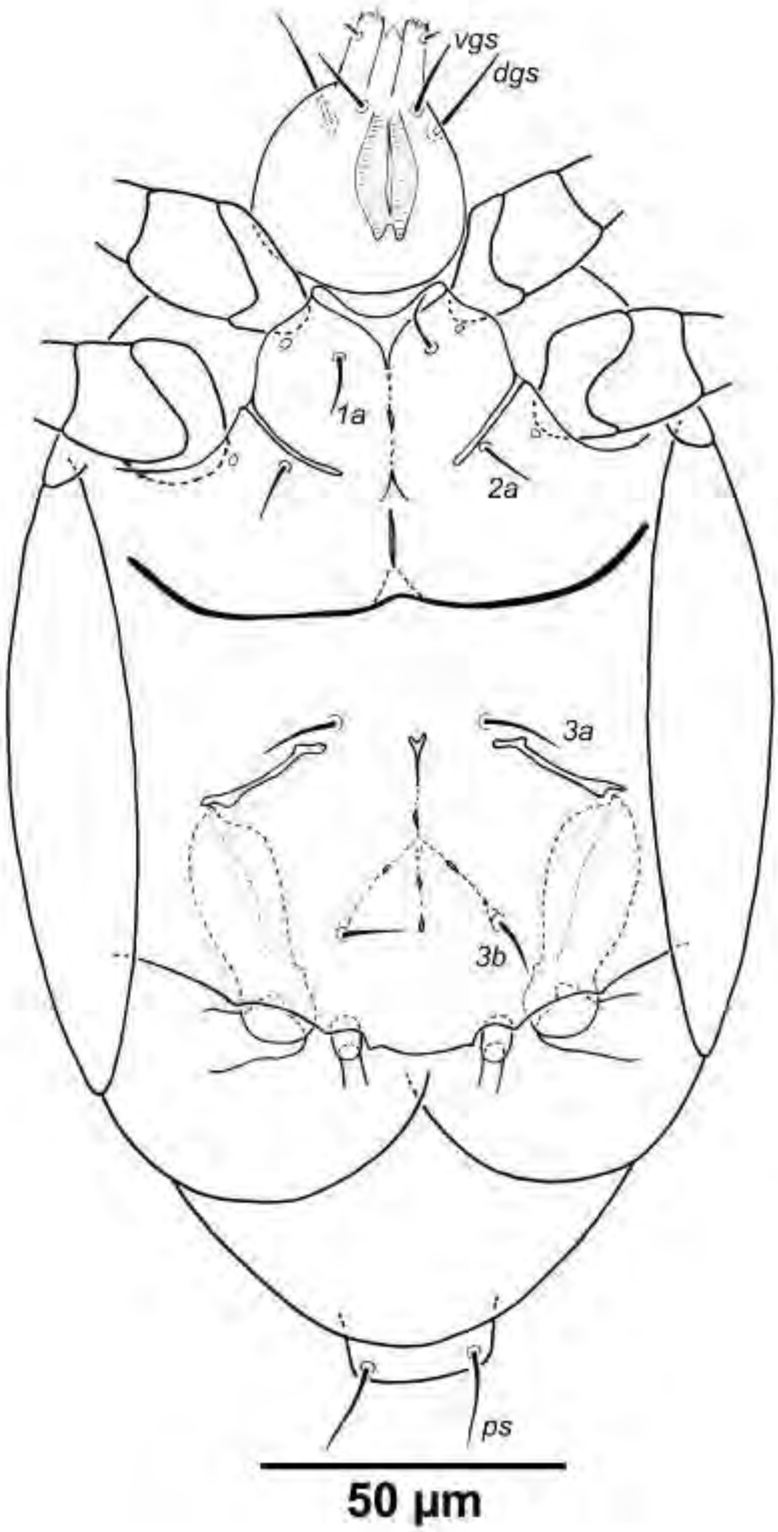

Figure 27. *Daidalotarsonemus jamesbakeri* Smiley (female). Ventral surface of the idiosoma.

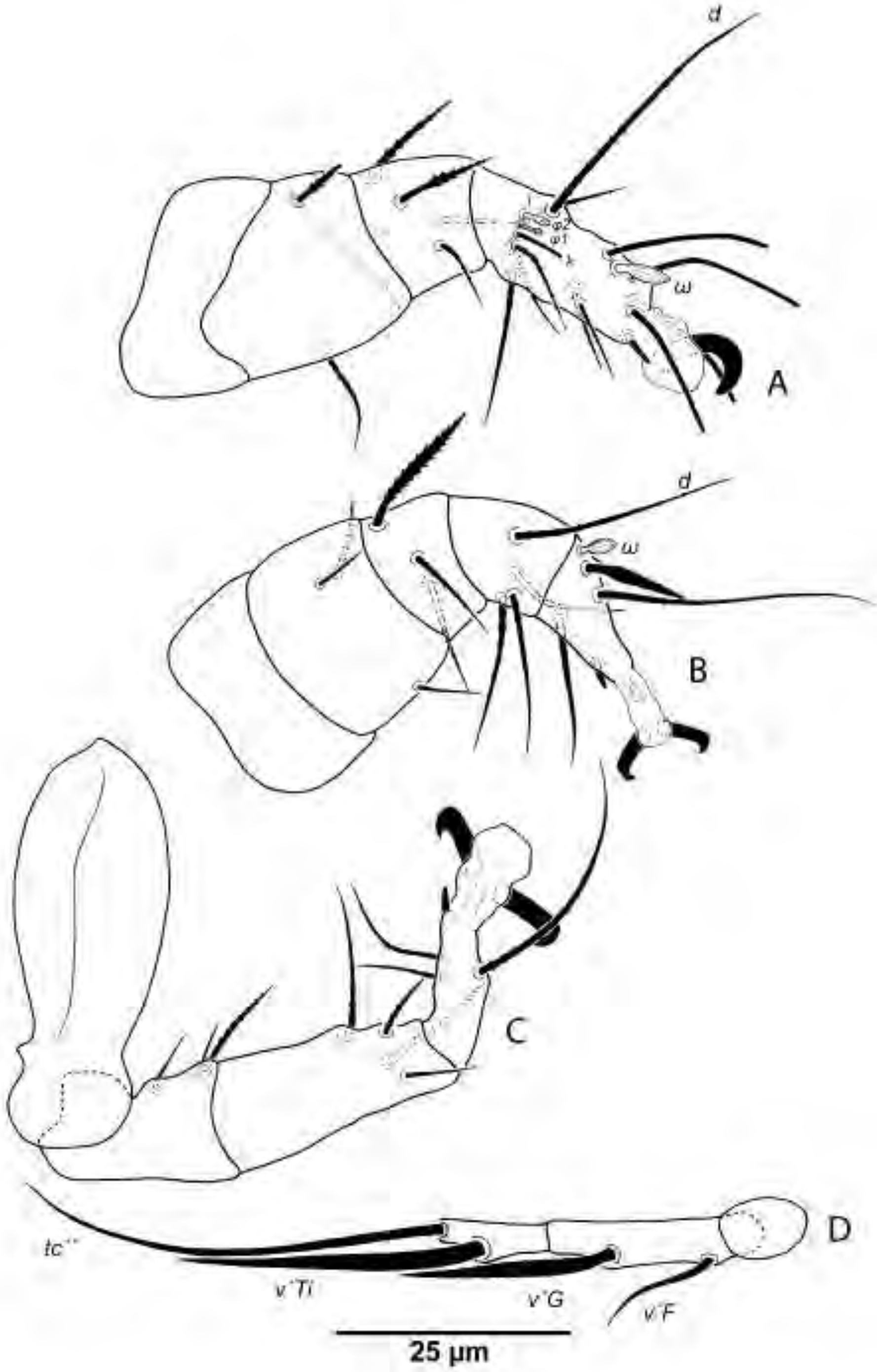

Figure 28. *Daidalotarsonemus jamesbakeri* Smiley (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 29. *Daidalotarsonemus hewitti* Mahunka (female). Dorsal DIC micrograph of the idiosoma.

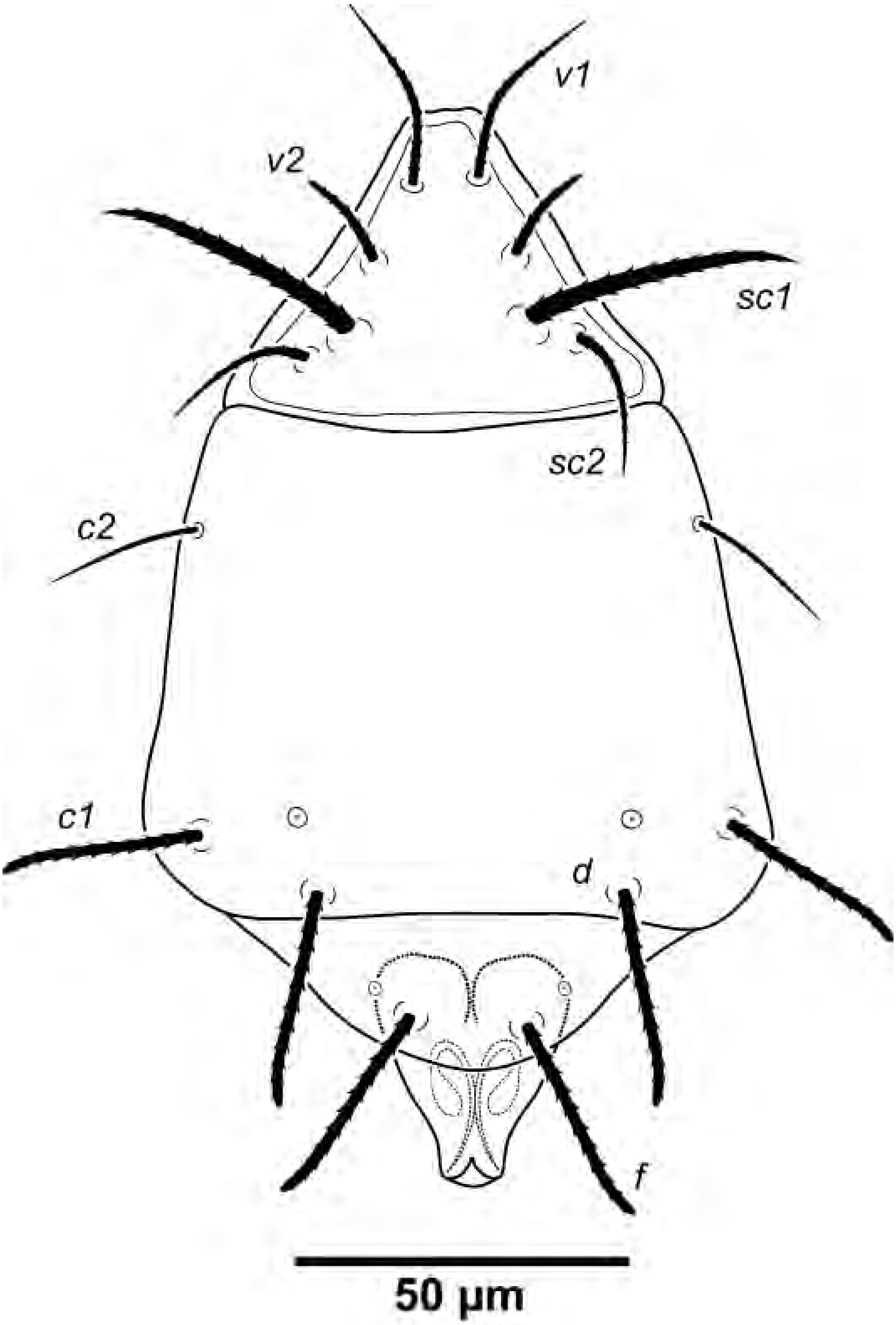

Figure 30. *Daidalotarsonemus leonardi* (Smiley) (male). Dorsal surface of the idiosoma.

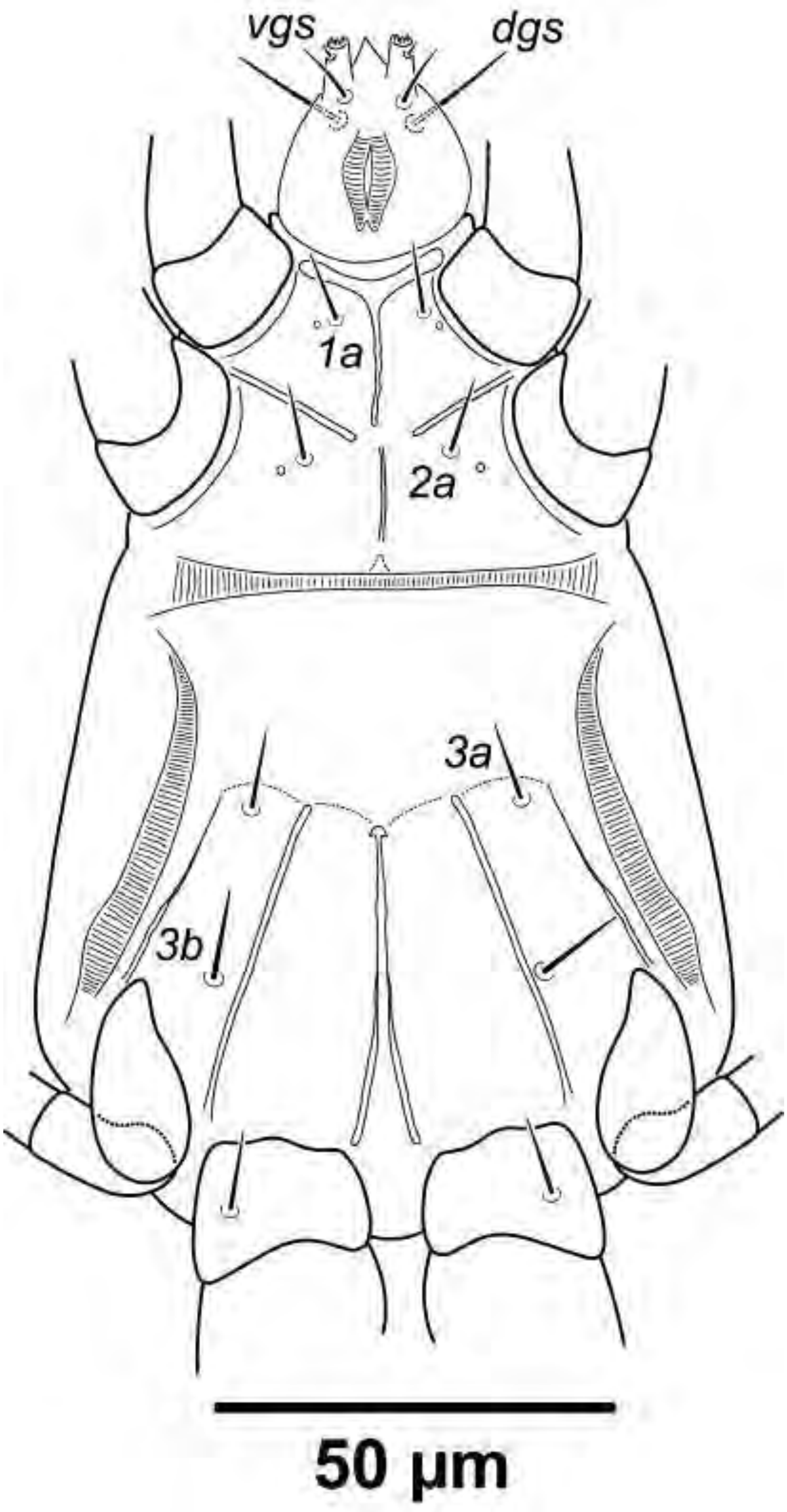

Figure 31. *Daidalotarsonemus leonardi* (Smiley) (male). Ventral surface of the idiosoma.

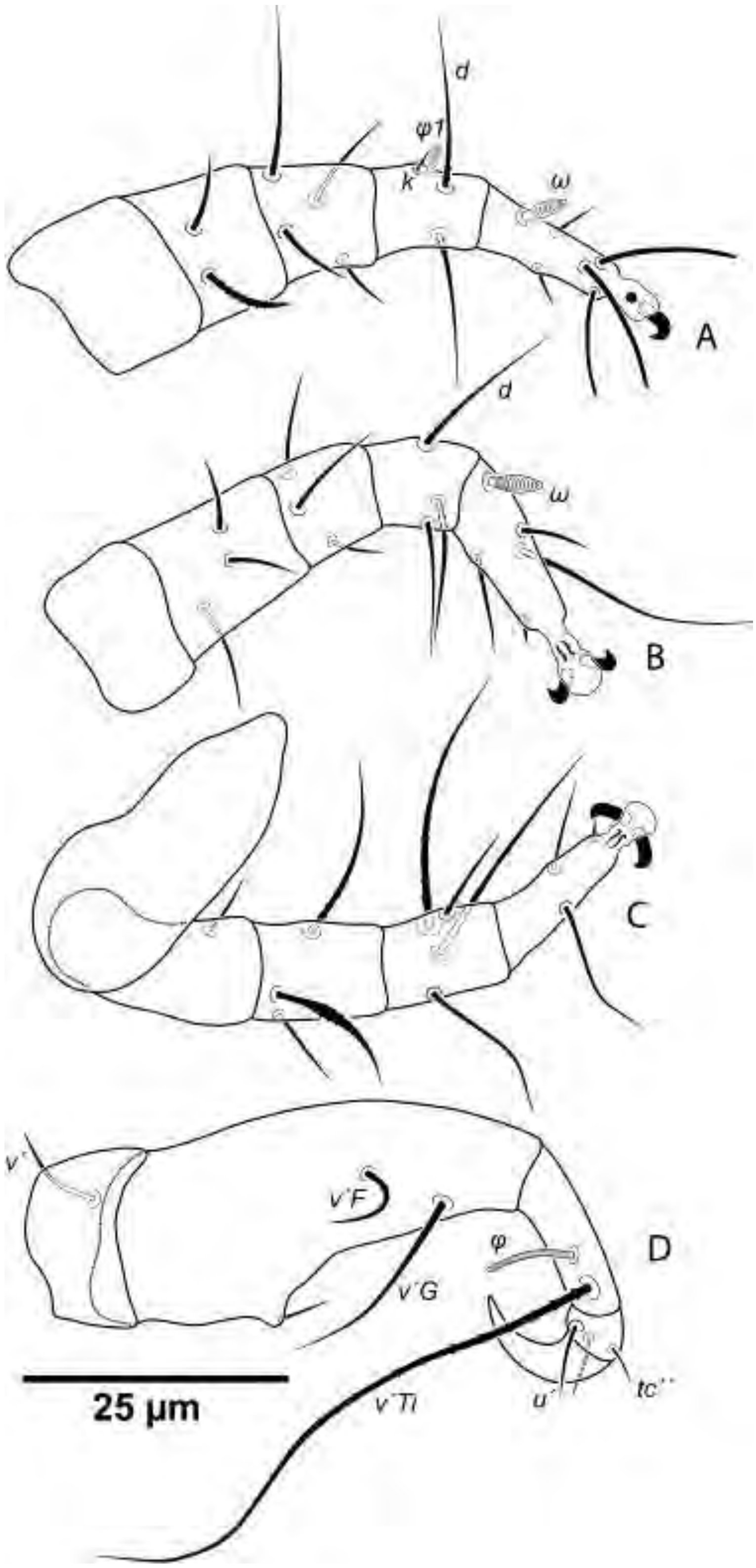

Figure 32. *Daidalotarsonemus leonardi* (Smiley) (male). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

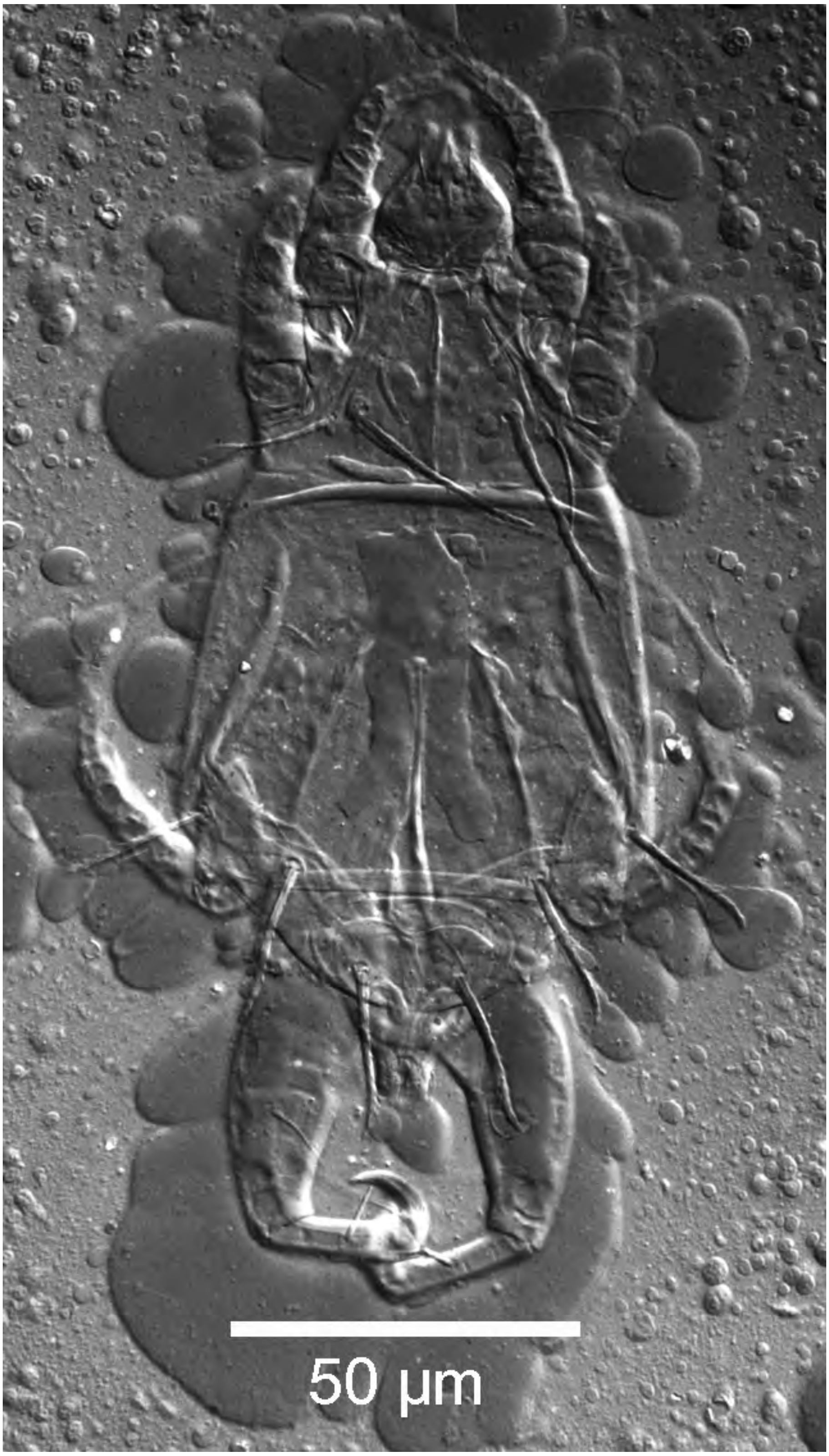

Figure 33. *Daidalotarsonemus leonardi* (Smiley) (male). Dorsal DIC micrograph of the idiosoma.

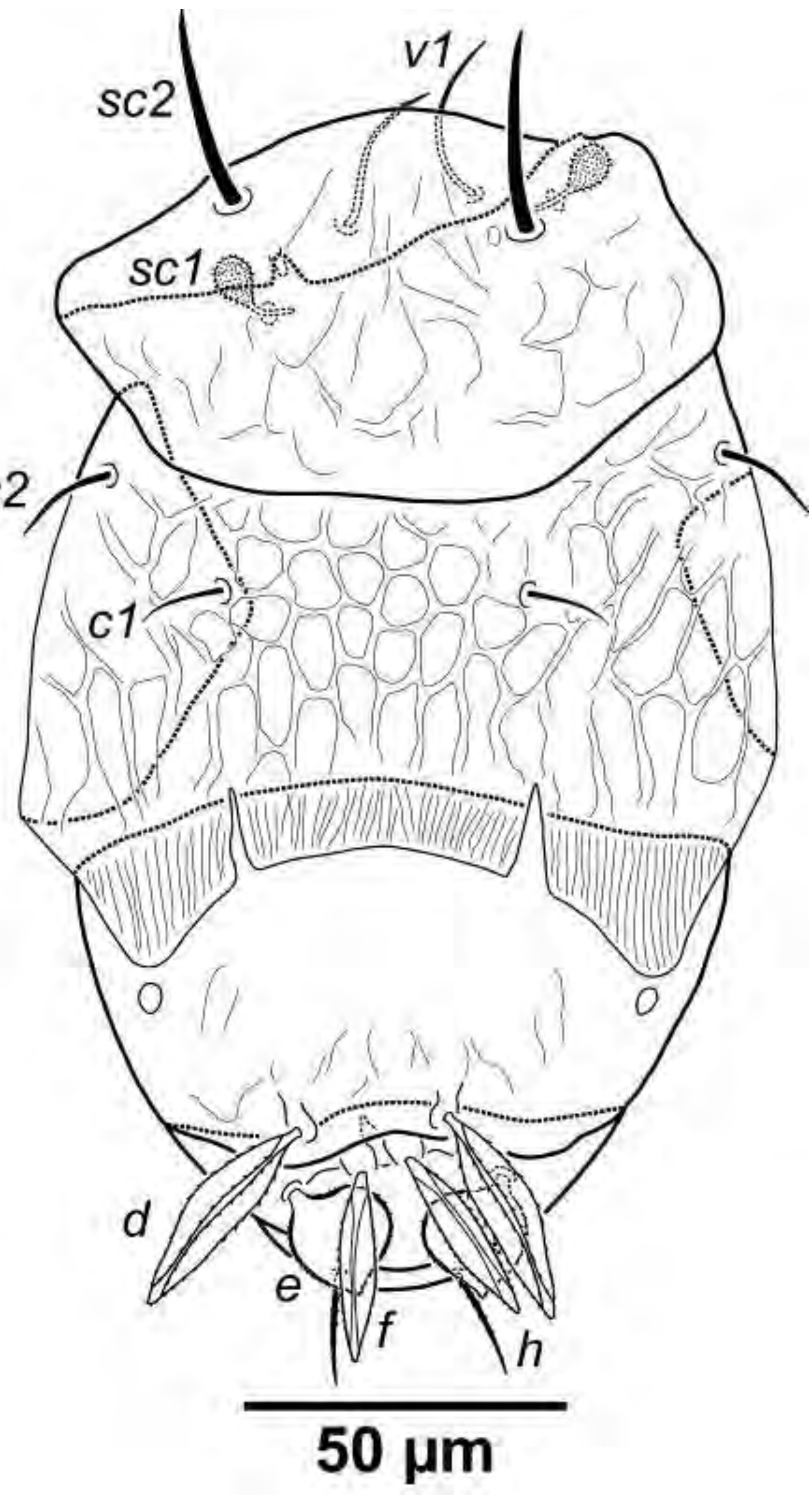

Figure 34. *Daidalotarsonemus ostracodes* Mahunka (female). Dorsal surface of the idiosoma.

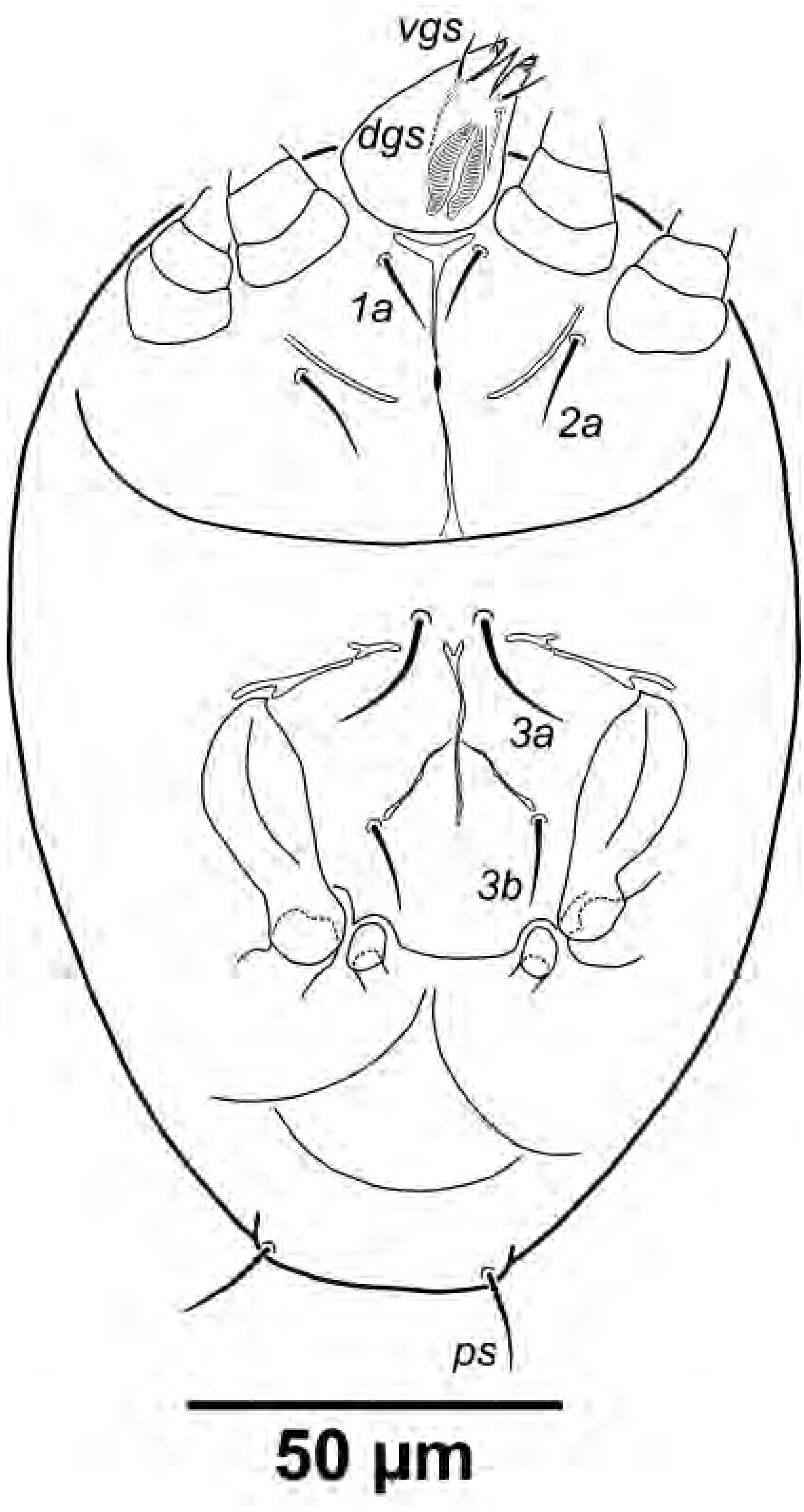

Figure 35. *Daidalotarsonemus ostracodes* Mahunka (female). Ventral surface of the idiosoma.

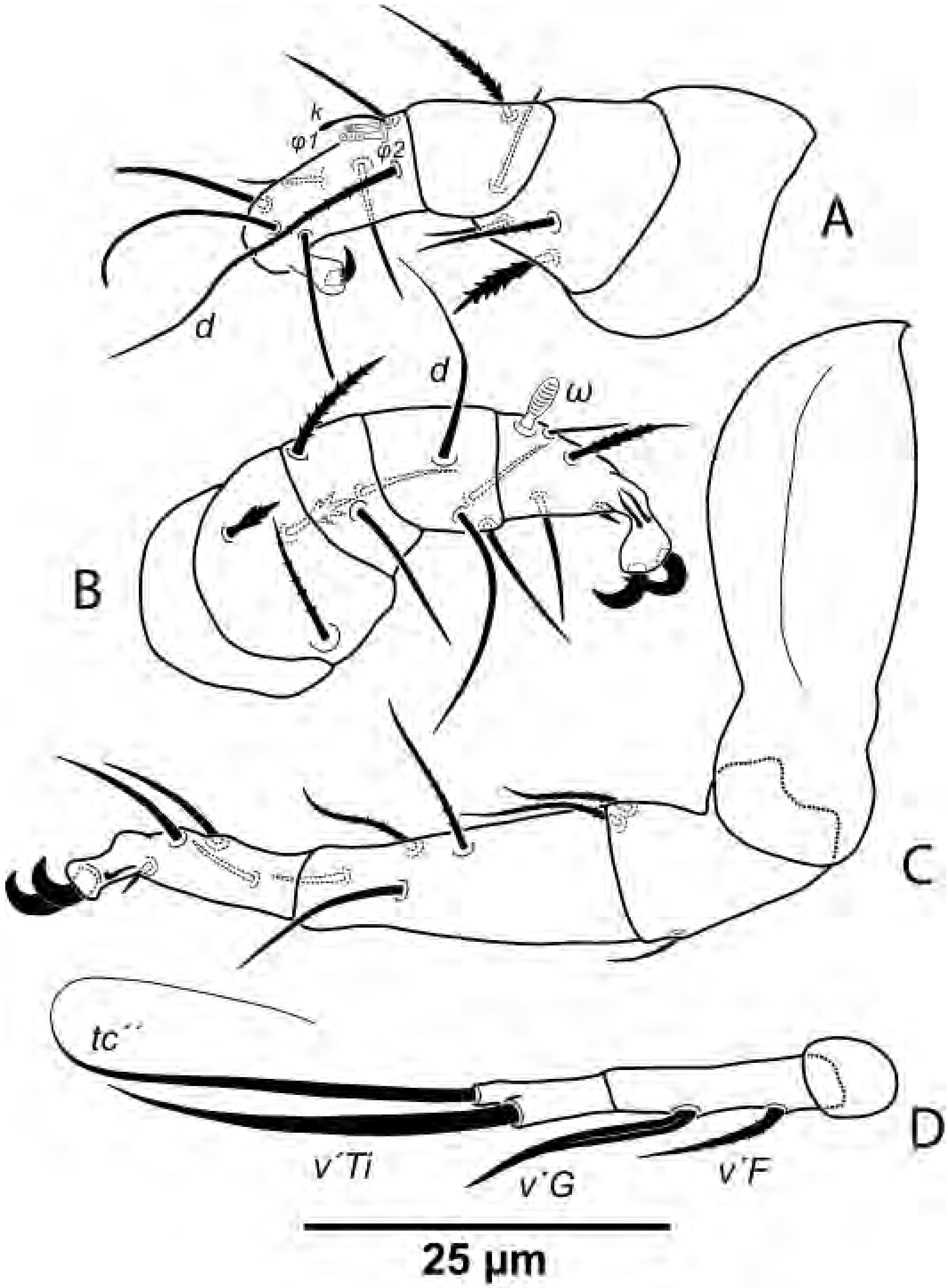

Figure 36. *Daidalotarsonemus ostracodes* Mahunka (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

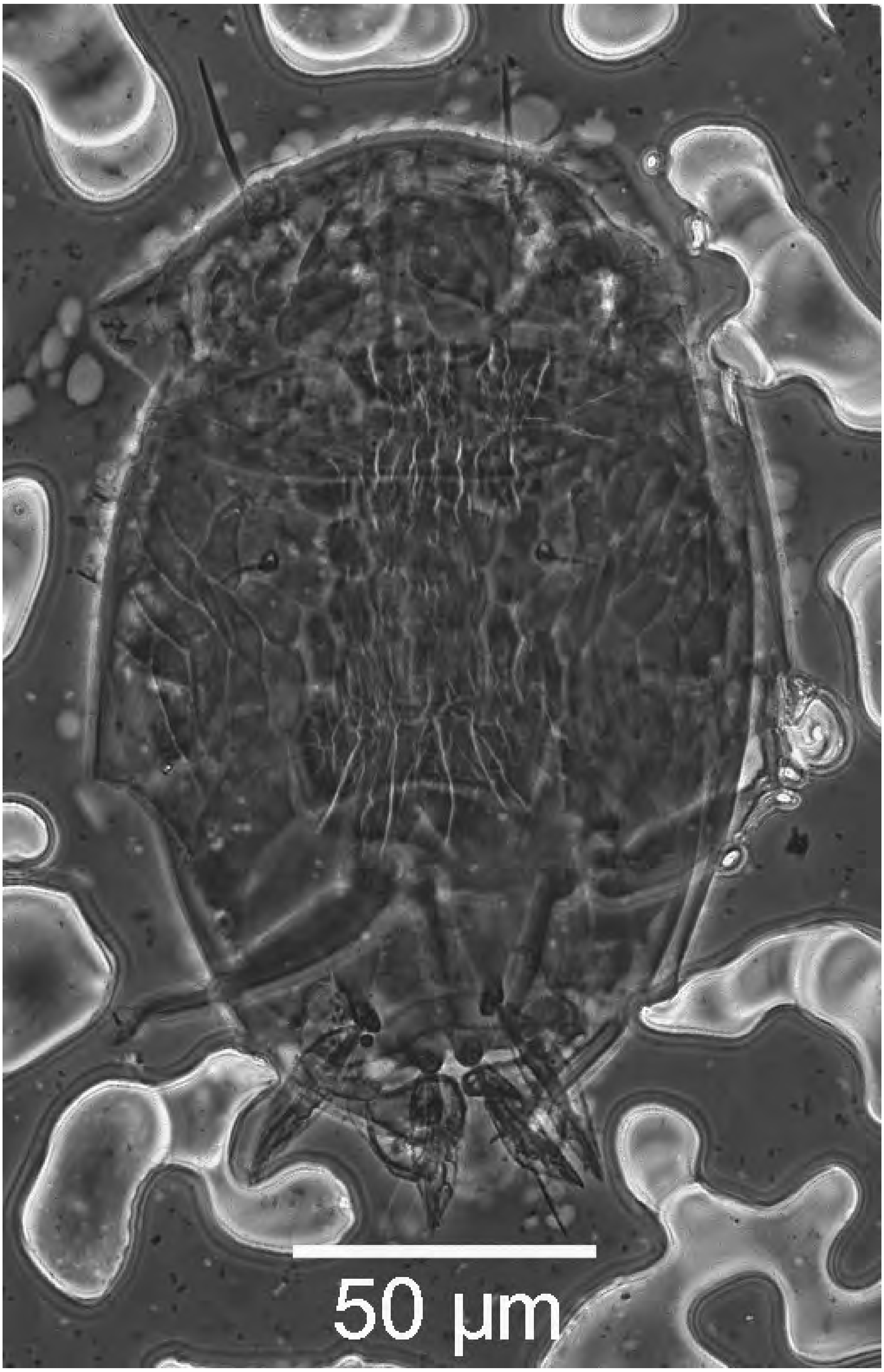

Figure 37. *Daidalotarsonemus ostracodes* Mahunka (female). Dorsal PC micrograph of the idiosoma.

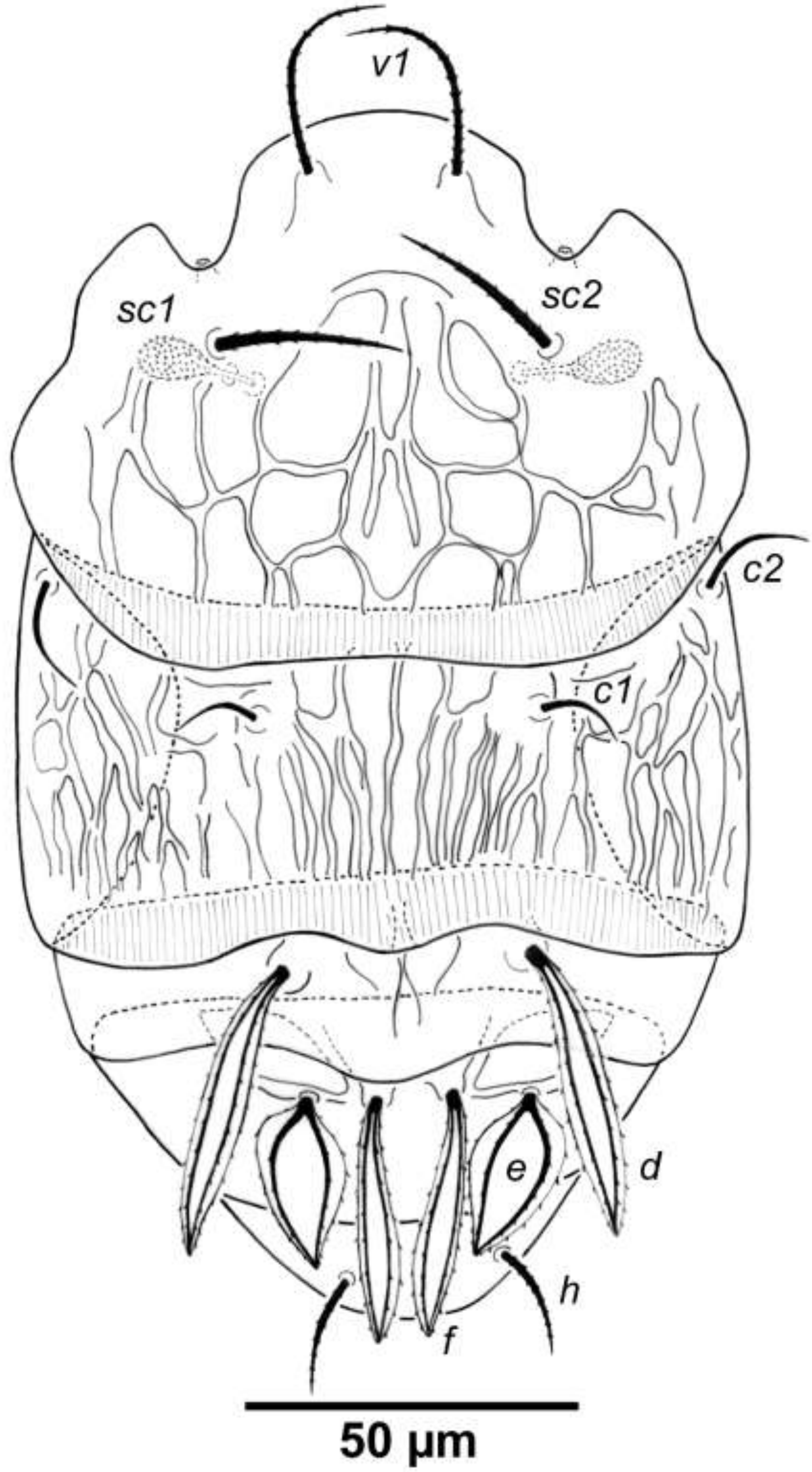

Figure 38. *Daidalotarsonemus seitus* Attiah (female). Dorsal surface of the idiosoma.

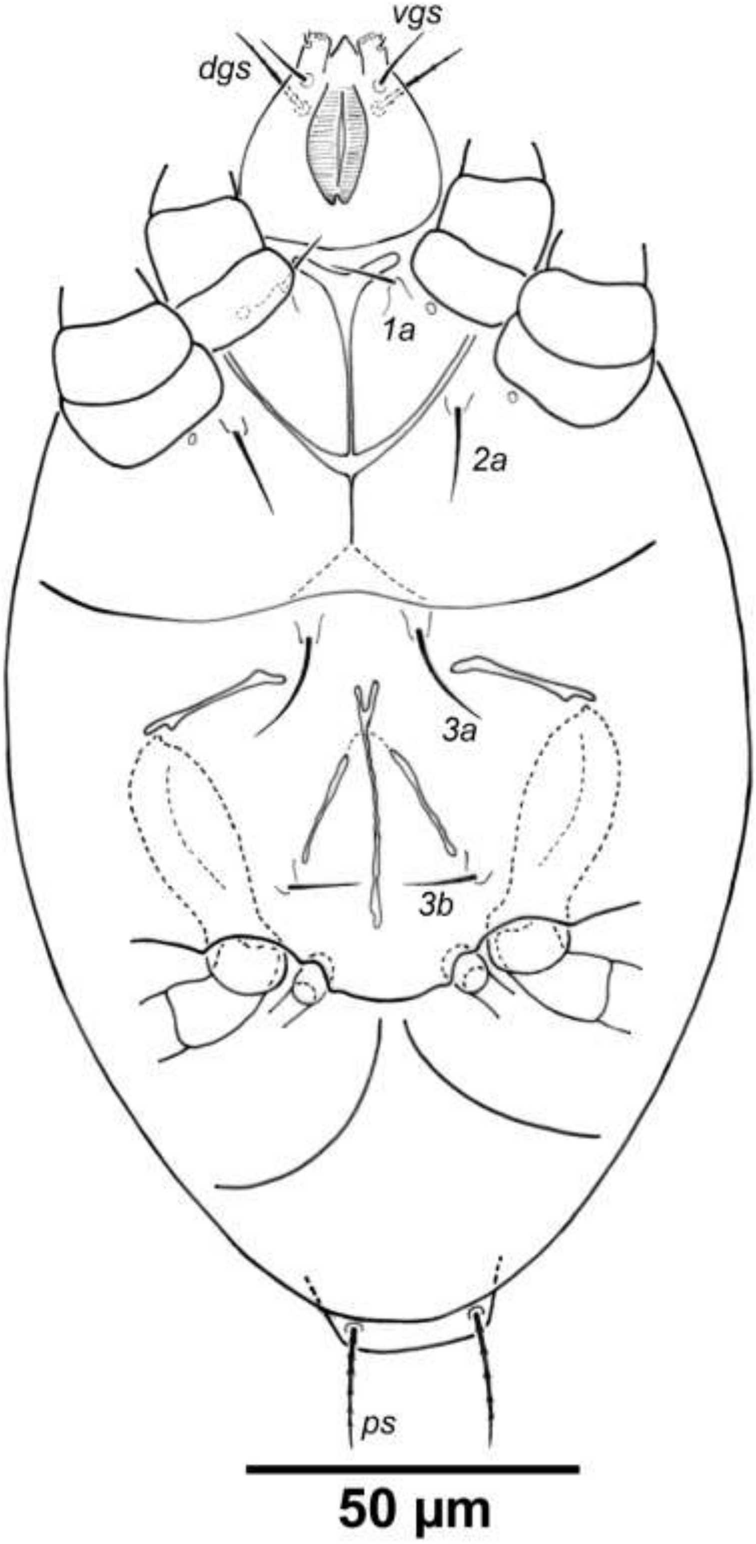

Figure 39. *Daidalotarsonemus seitus* Attiah (female). Ventral surface of the idiosoma.

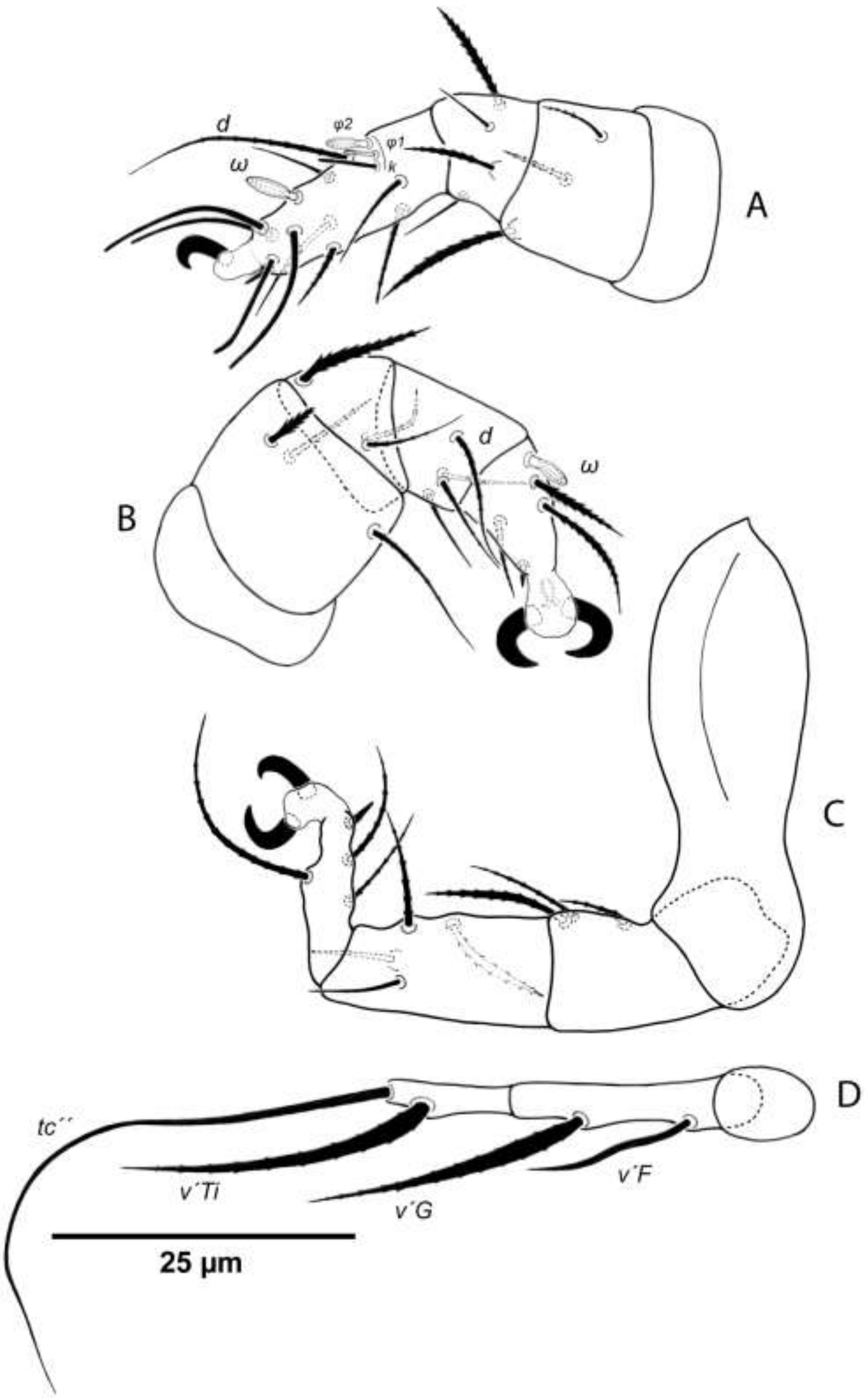

Figure 40. *Daidalotarsonemus seitus* Attiah (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 41. *Daidalotarsonemus seitus* Attiah (female). Dorsal PC micrograph of the idiosoma.

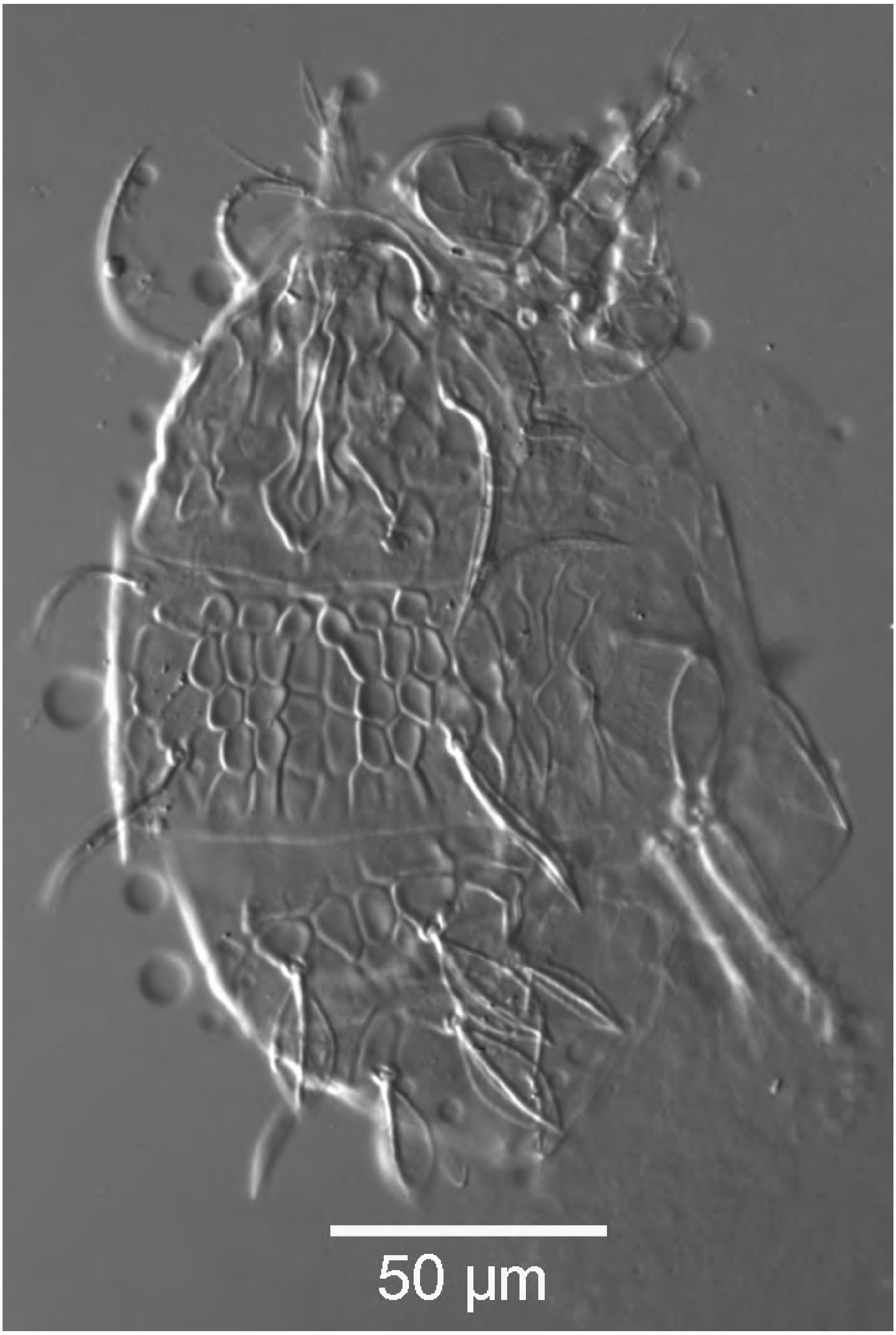

Figure 42. *Daidalotarsonemus serissae* Yang, Ding & Zhou (female). Dorsal DIC micrograph of the idiosoma.

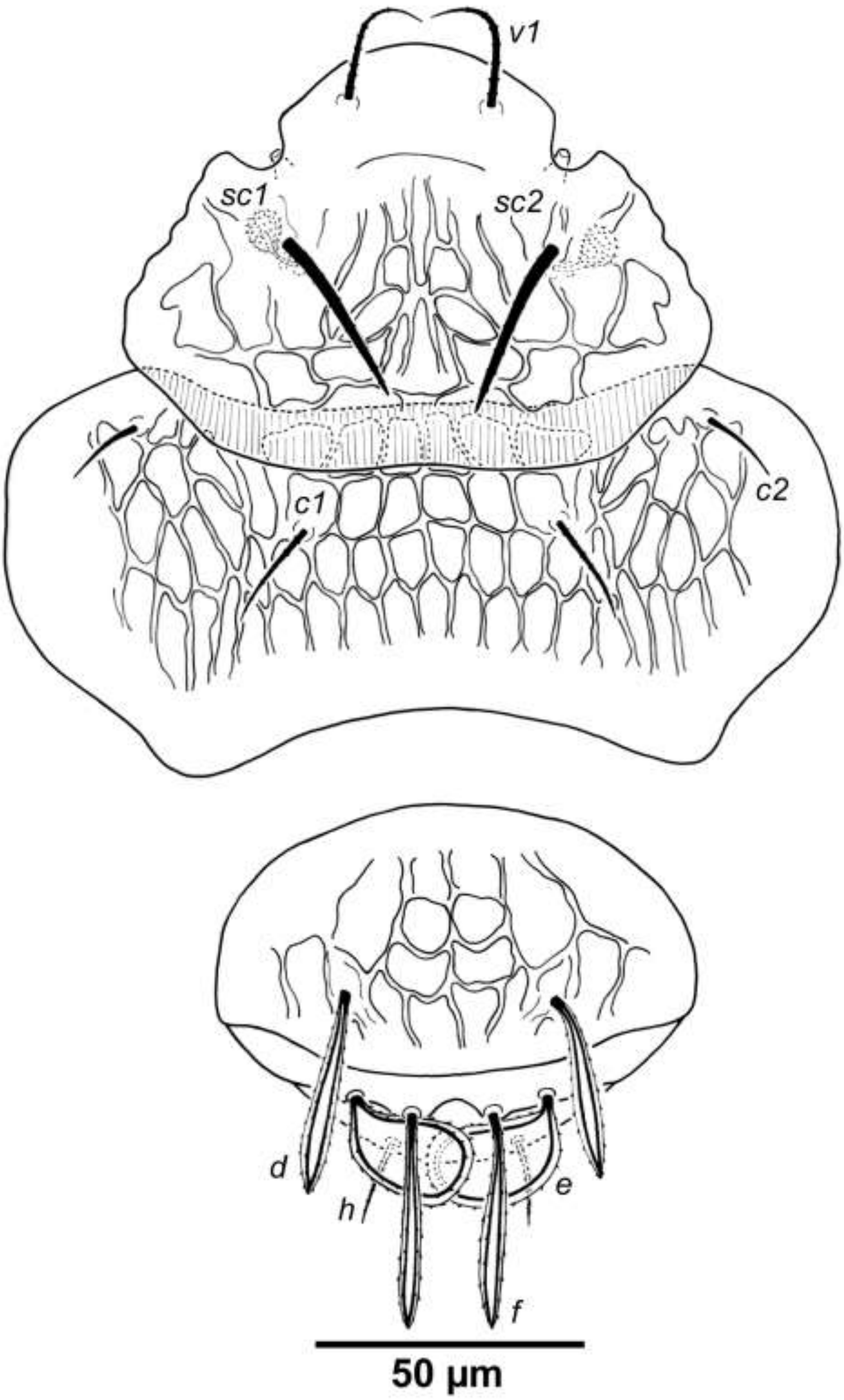

Figure 43. *Daidalotarsonemus somalatus* Attiah (female). Dorsal surface of the idiosoma.

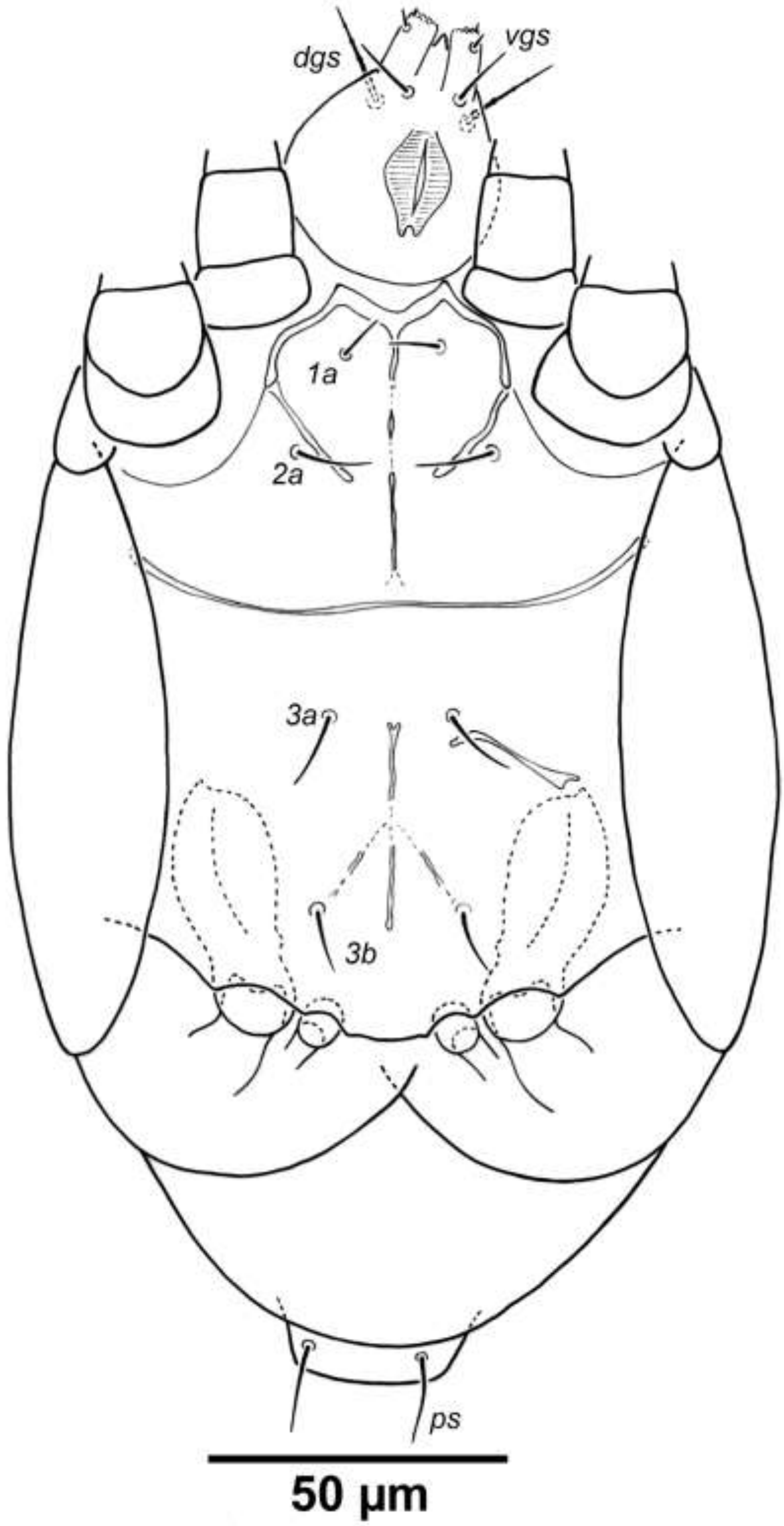

Figure 44. *Daidalotarsonemus somalatus* Attiah (female). Ventral surface of the idiosoma.

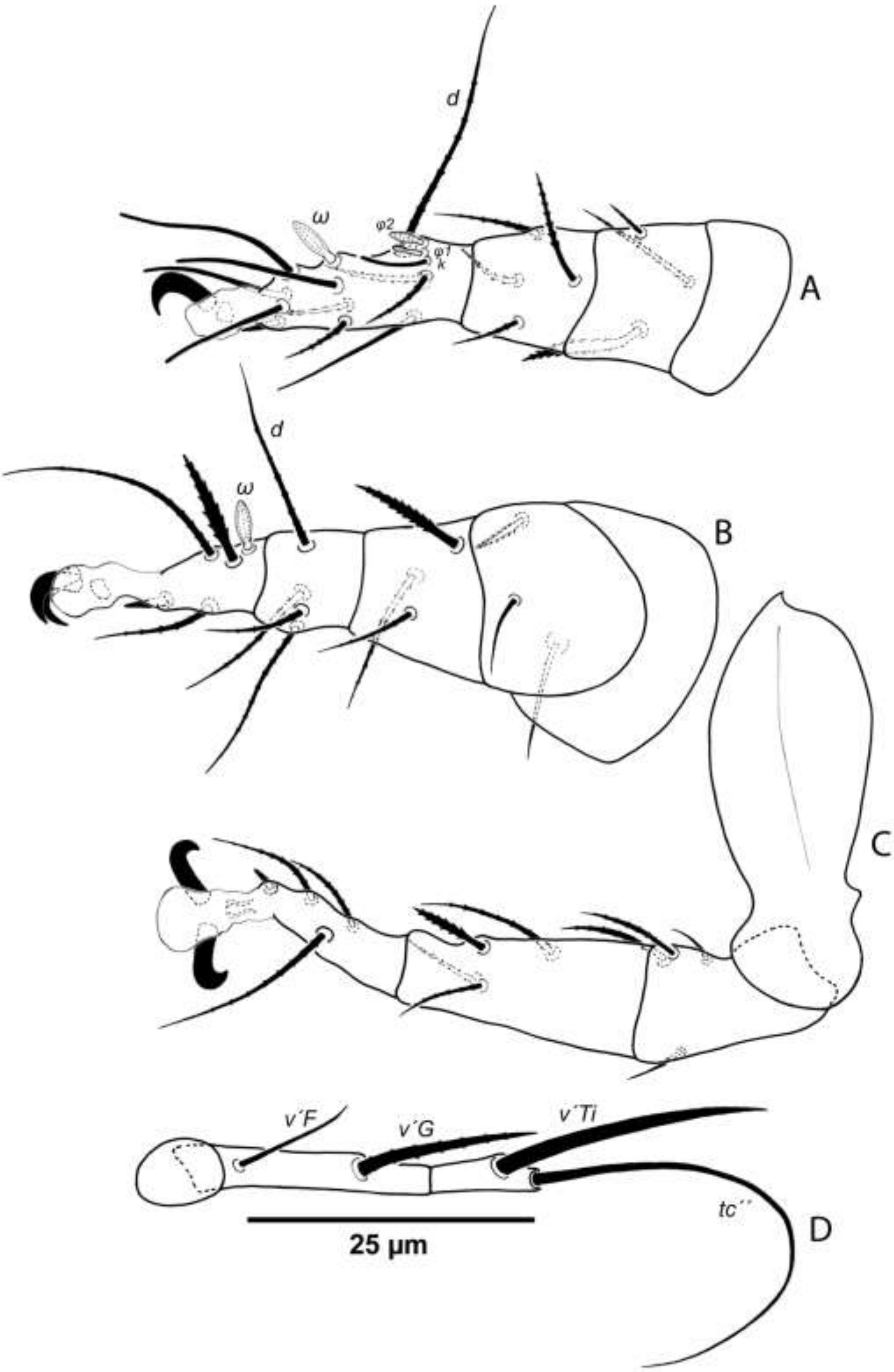

Figure 45. *Daidalotarsonemus somalatus* Attiah (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

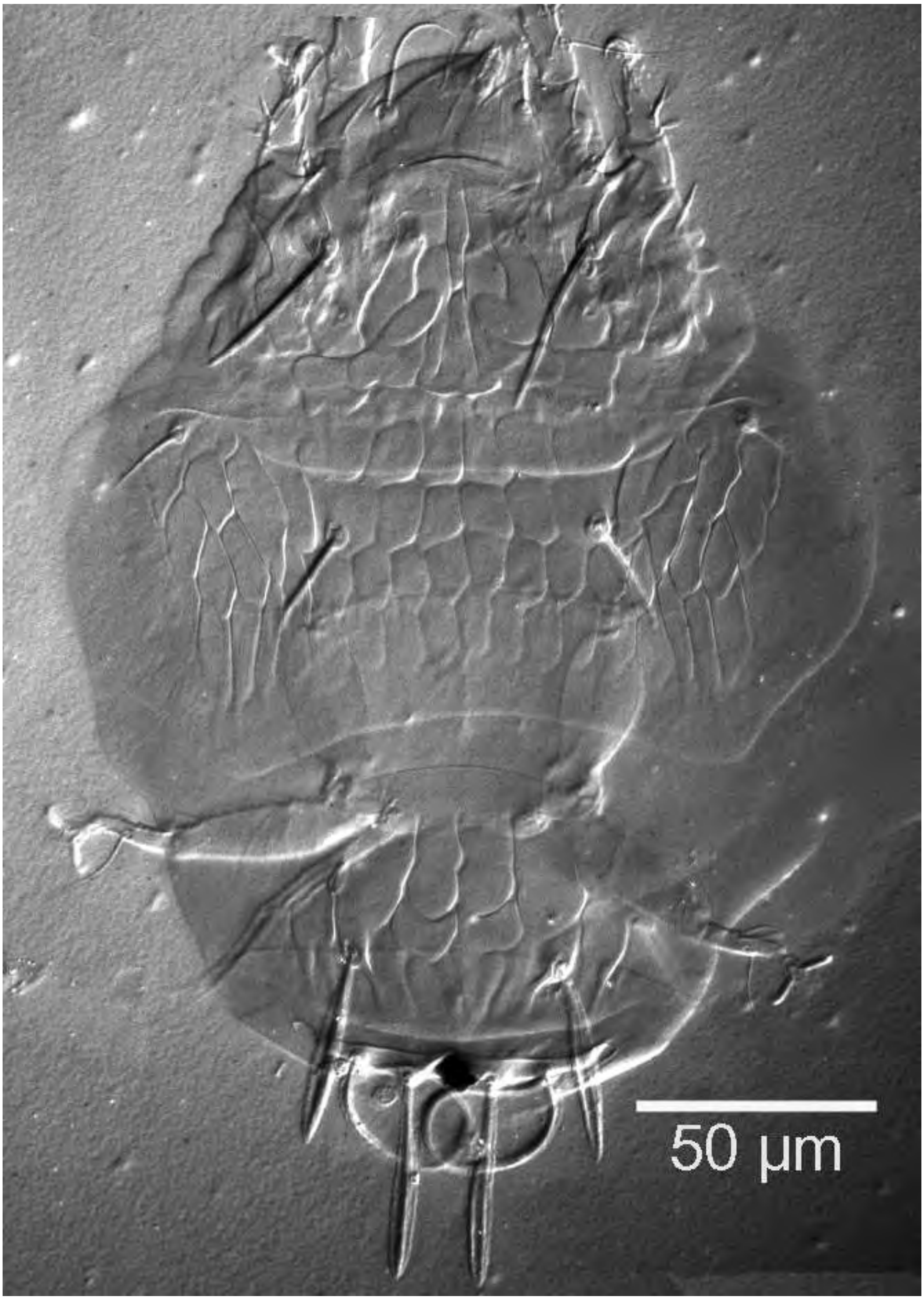

Figure 46. *Daidalotarsonemus somalatus* Attiah (female). Dorsal DIC micrograph of the idiosoma.

Figure 47. *Daidalotarsonemus somalatus* Attiah (female). Dorsal LT-SEM micrograph of the idiosoma.

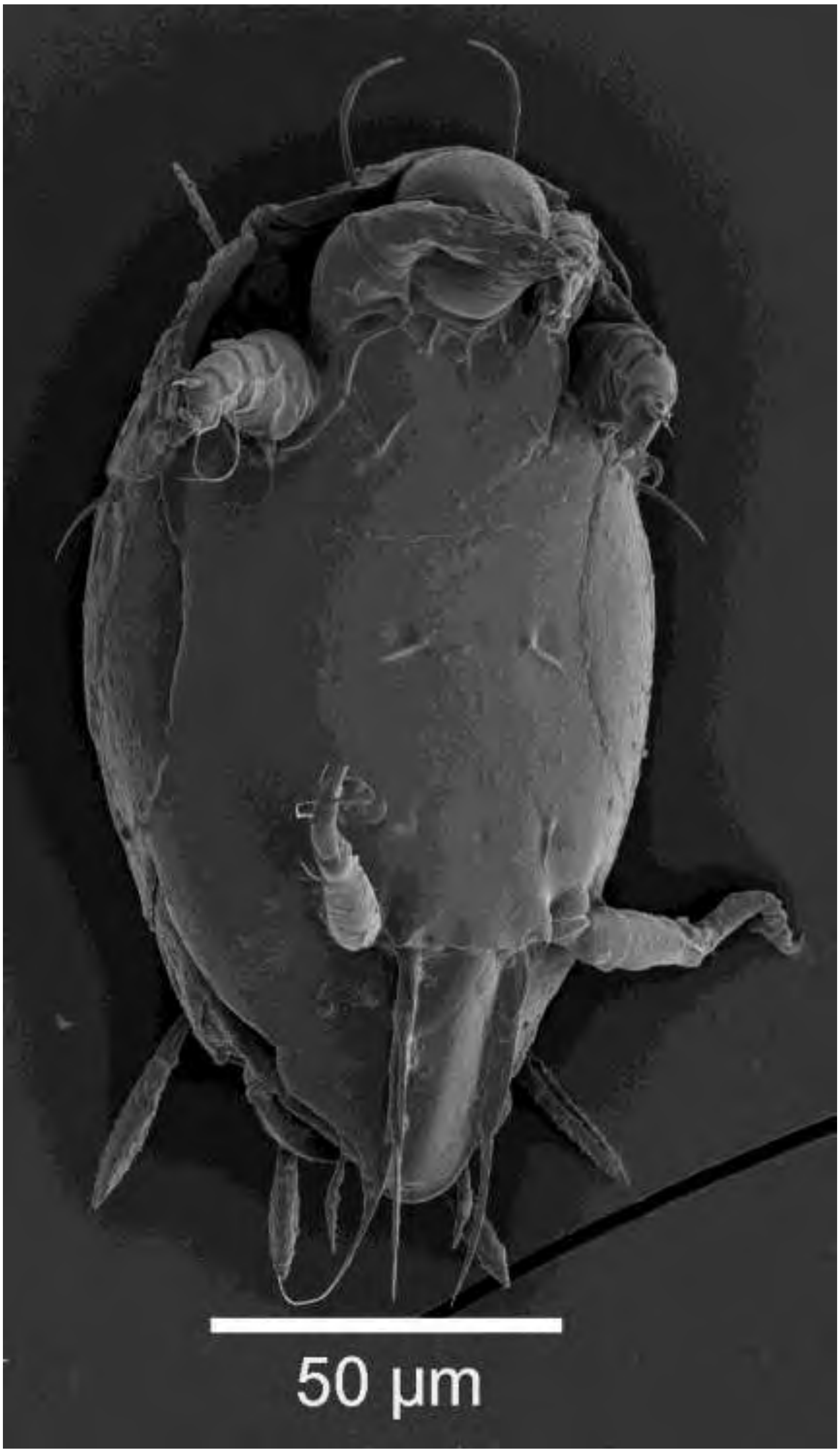

Figure 48. *Daidalotarsonemus somalatus* Attiah (female). Ventral LT-SEM micrograph of the idiosoma.

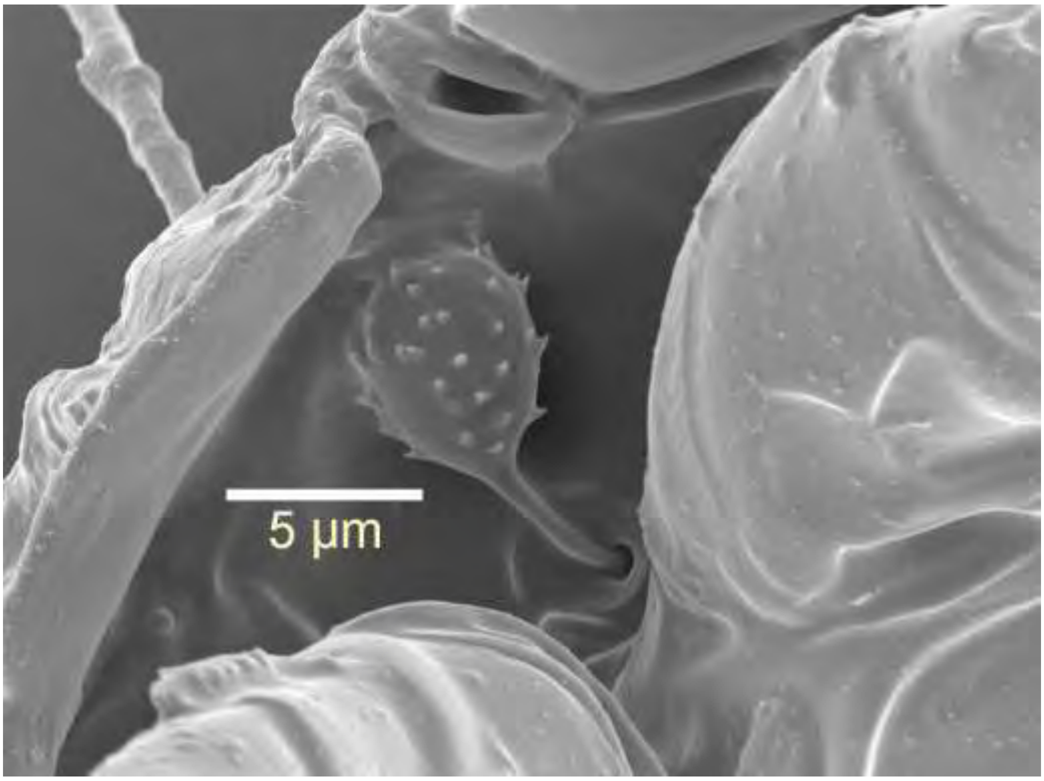

Figure 49. *Daidalotarsonemus somalatus* Attiah (female). LT-SEM micrograph of the setae *sc1* and stigmata oppening.

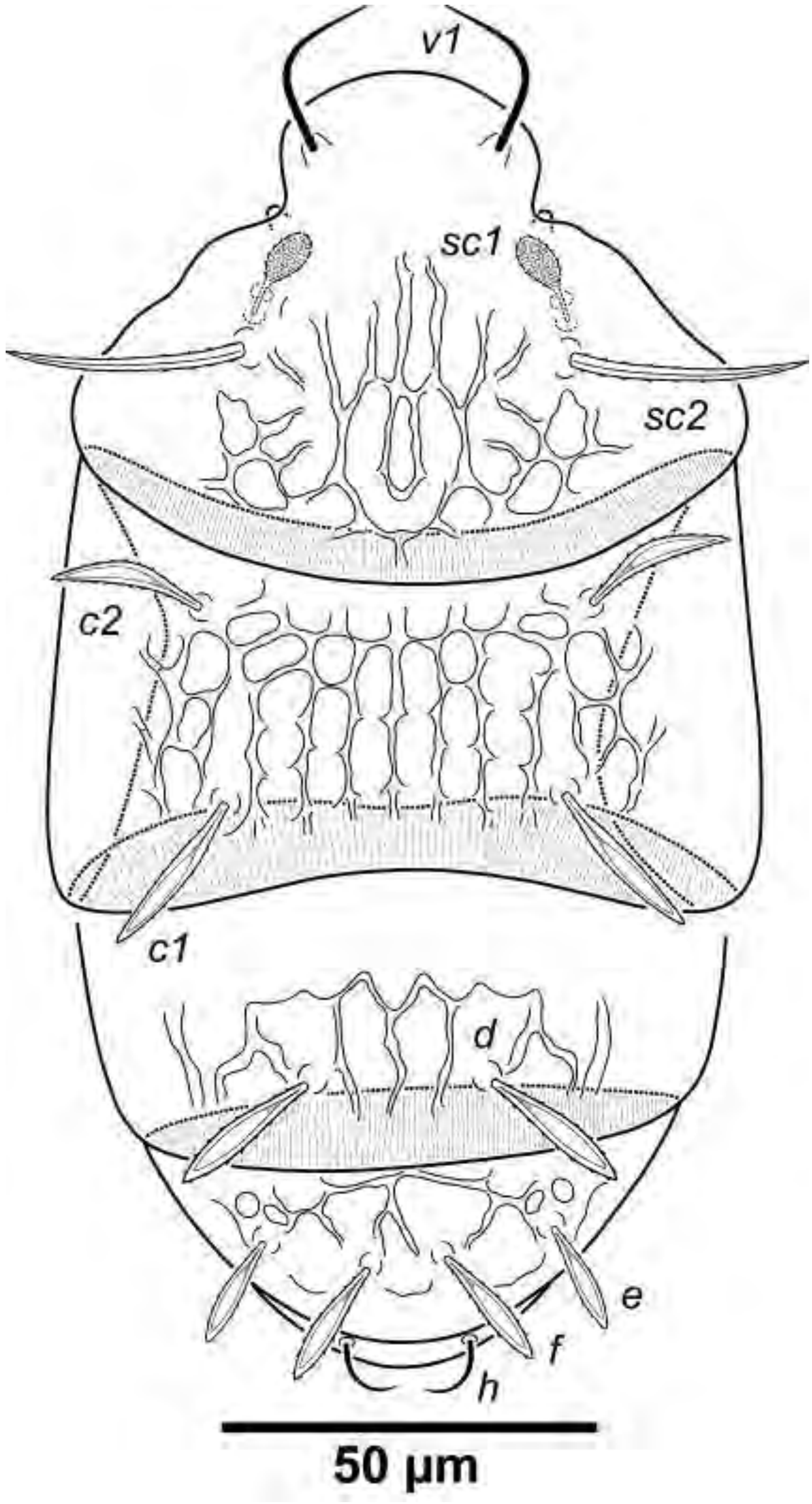

Figure 50. *Daidalotarsonemus* sp. n. 1 (female). Dorsal surface of the idiosoma.

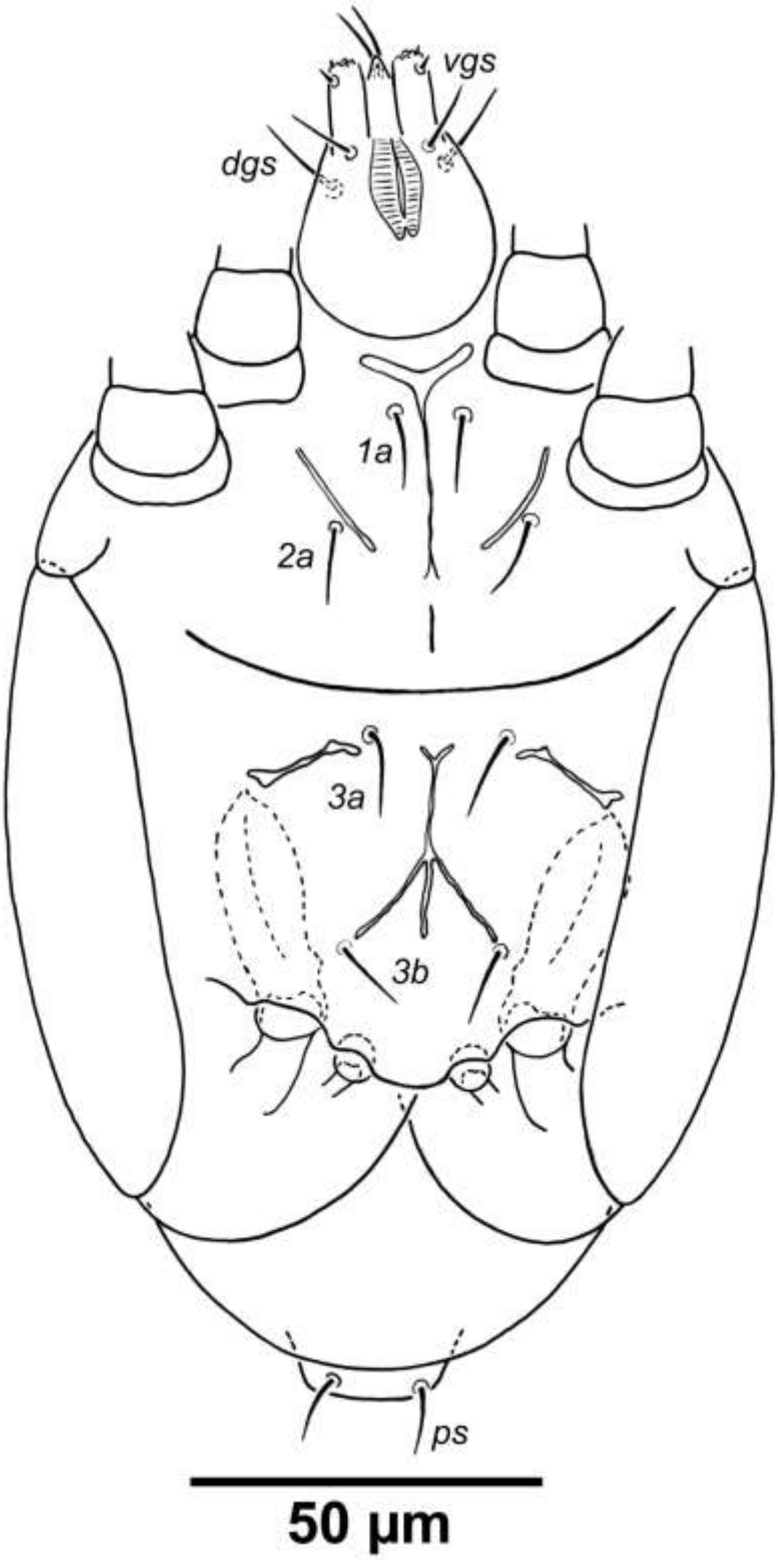

Figure 51. *Daidalotarsonemus* sp. n. 1 (female). Ventral surface of the idiosoma.

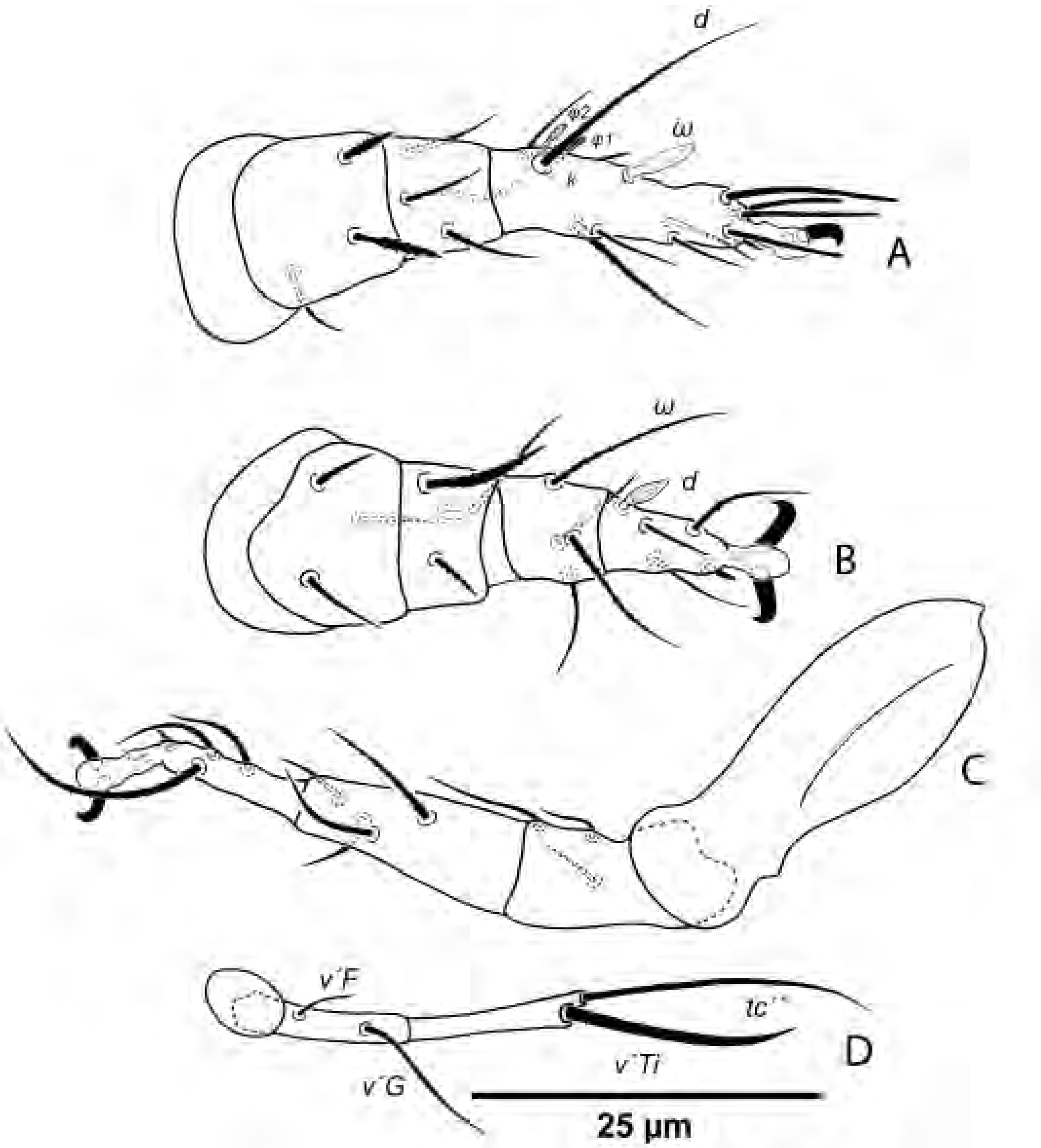

Figure 52. *Daidalotarsonemus* sp. n. 1 (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

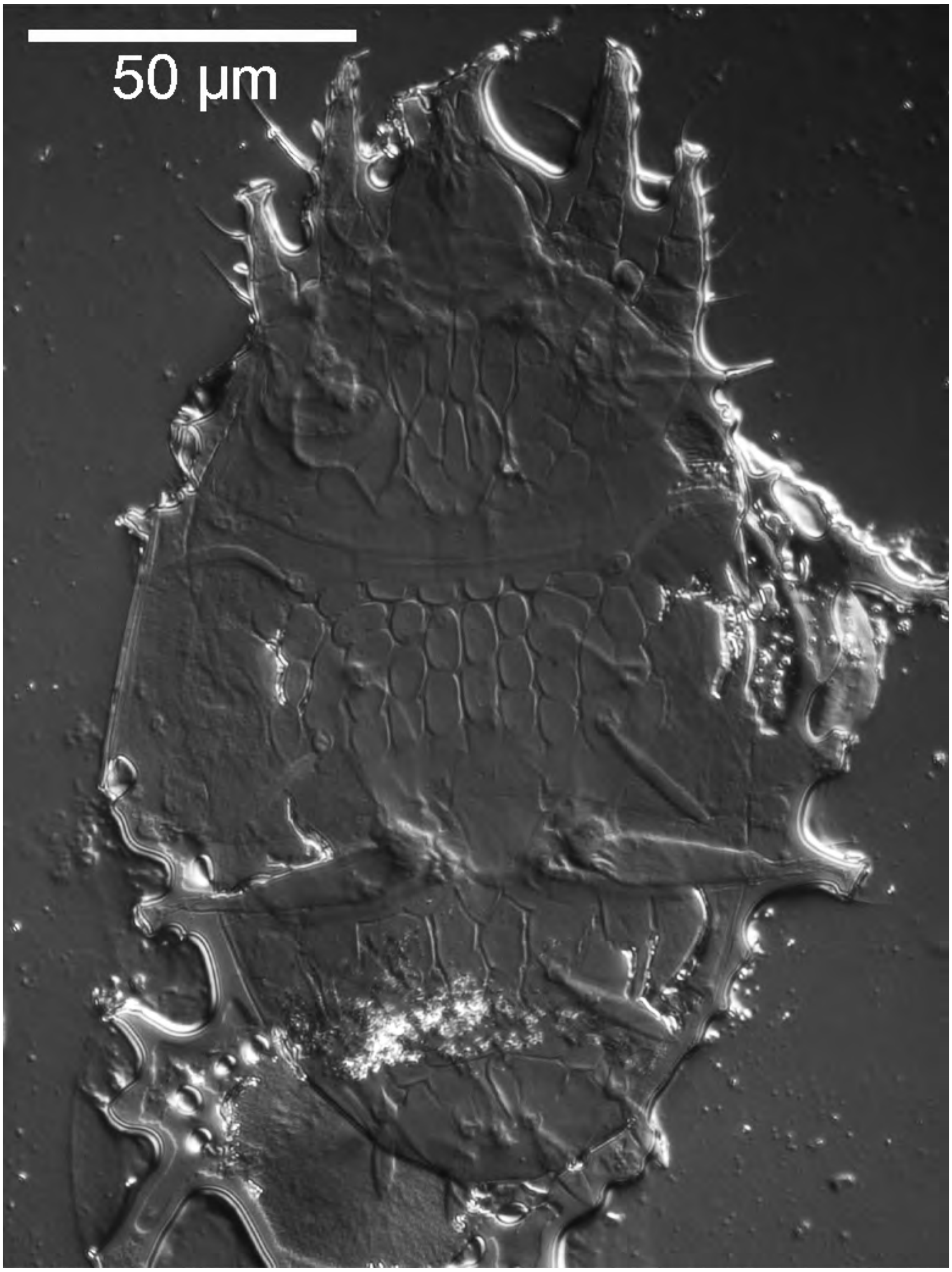

Figure 53. *Daidalotarsonemus* sp. n. 1 (female). Dorsal DIC micrograph of the idiosoma.

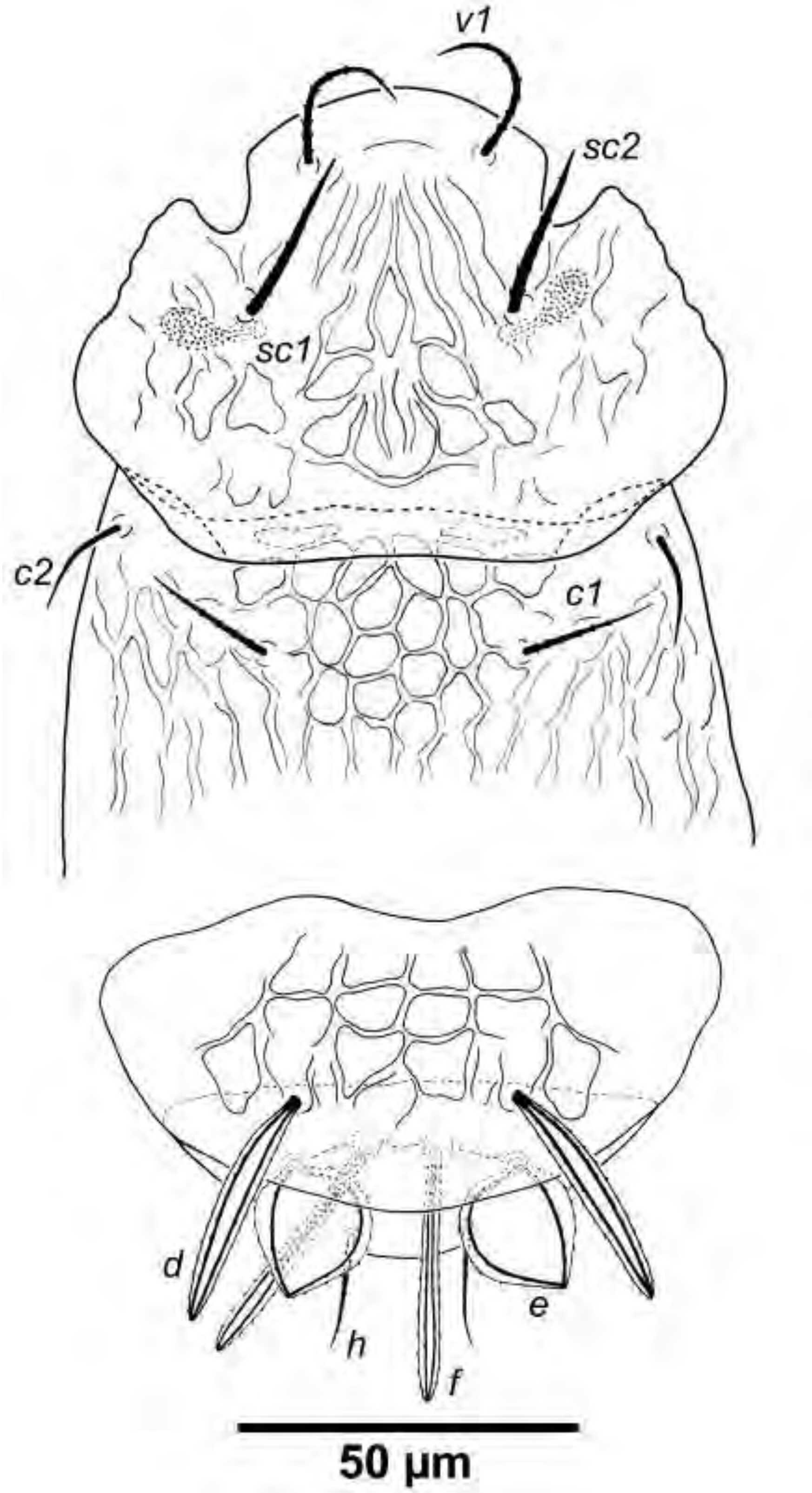

Figure 54. *Daidalotarsonemus* sp. n. 2 (female). Dorsal surface of the idiosoma.

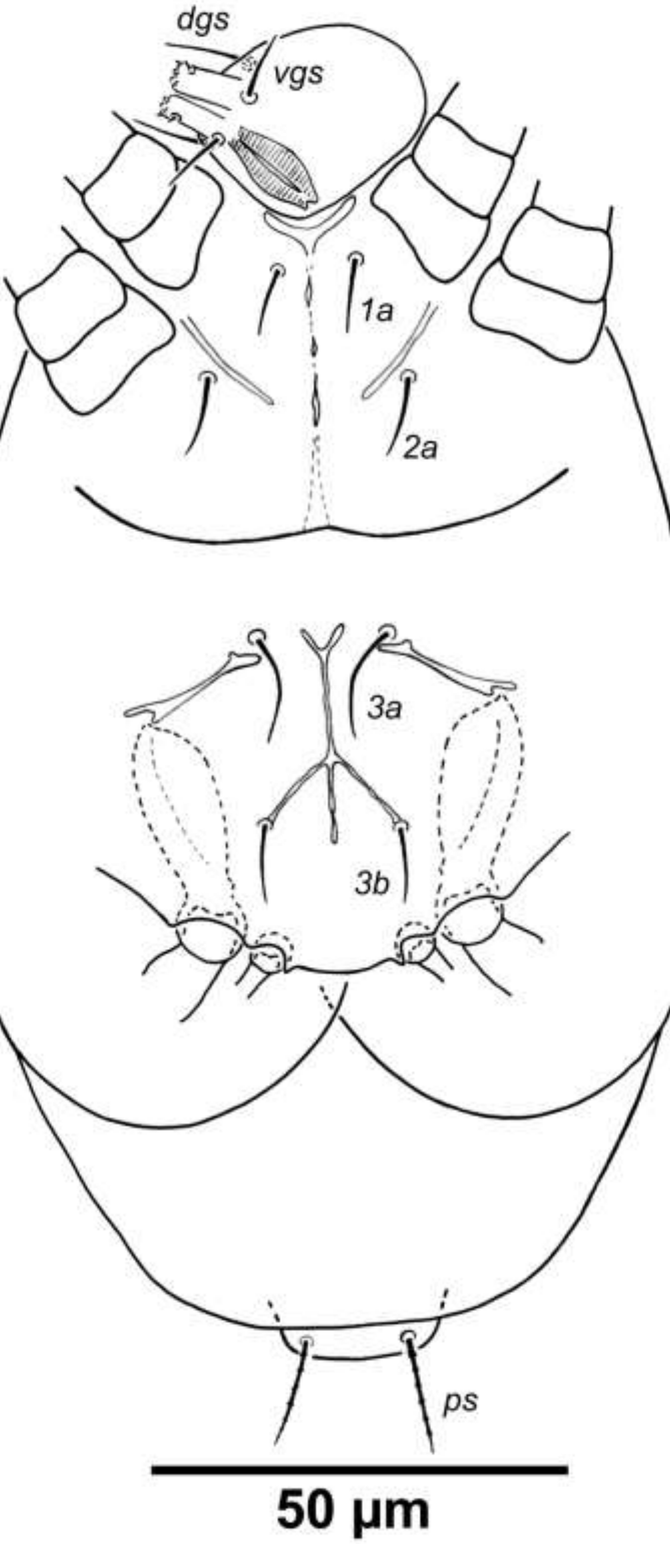

Figure 55. *Daidalotarsonemus* sp. n. 2 (female). Ventral surface of the idiosoma.

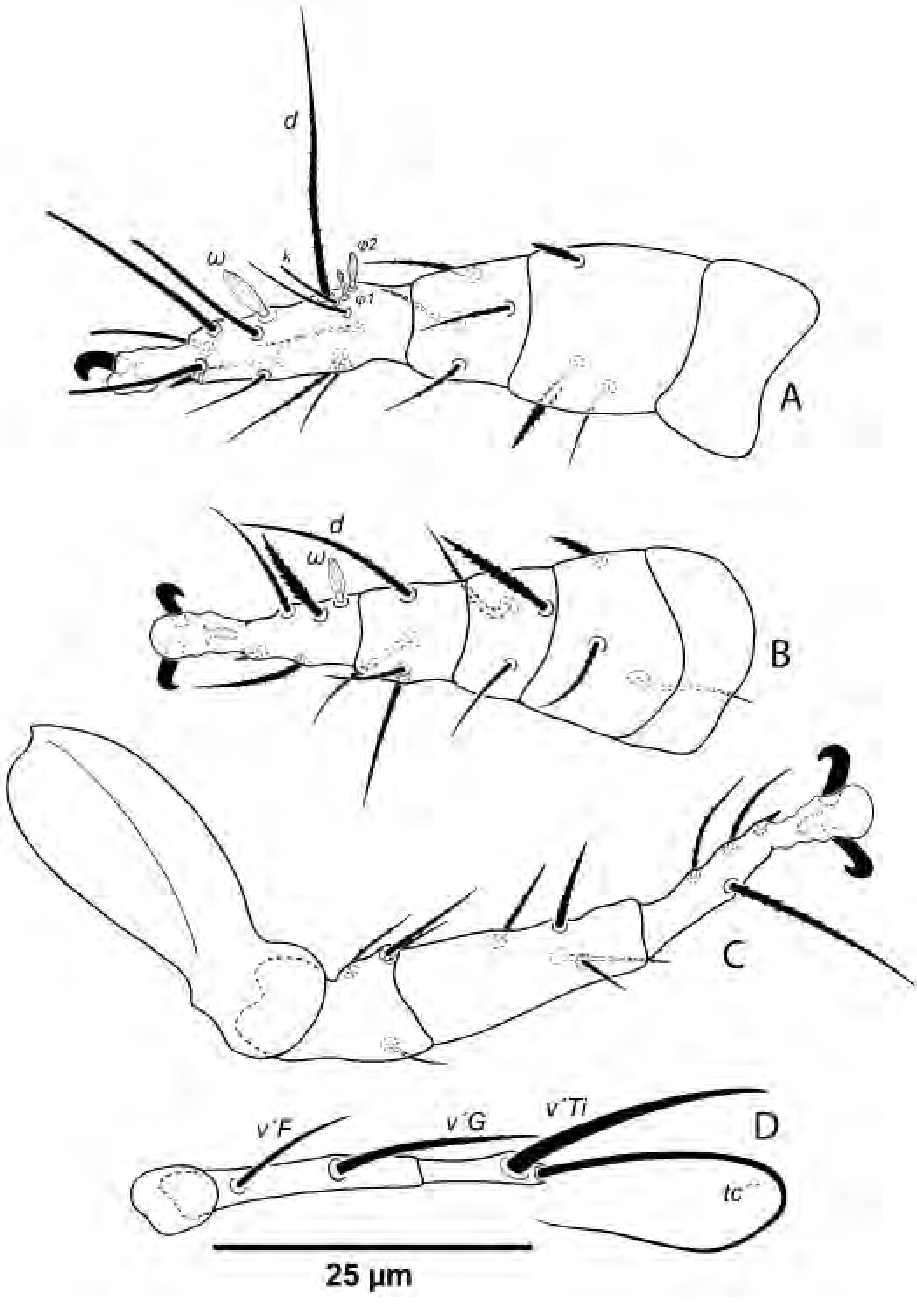

Figure 56. *Daidalotarsonemus* sp. n. 2 (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

the idiosoma.

Figure 57. *Daidalotarsonemus* sp. n. 2 (female). Dorsal DIC micrograph of the idiosoma.

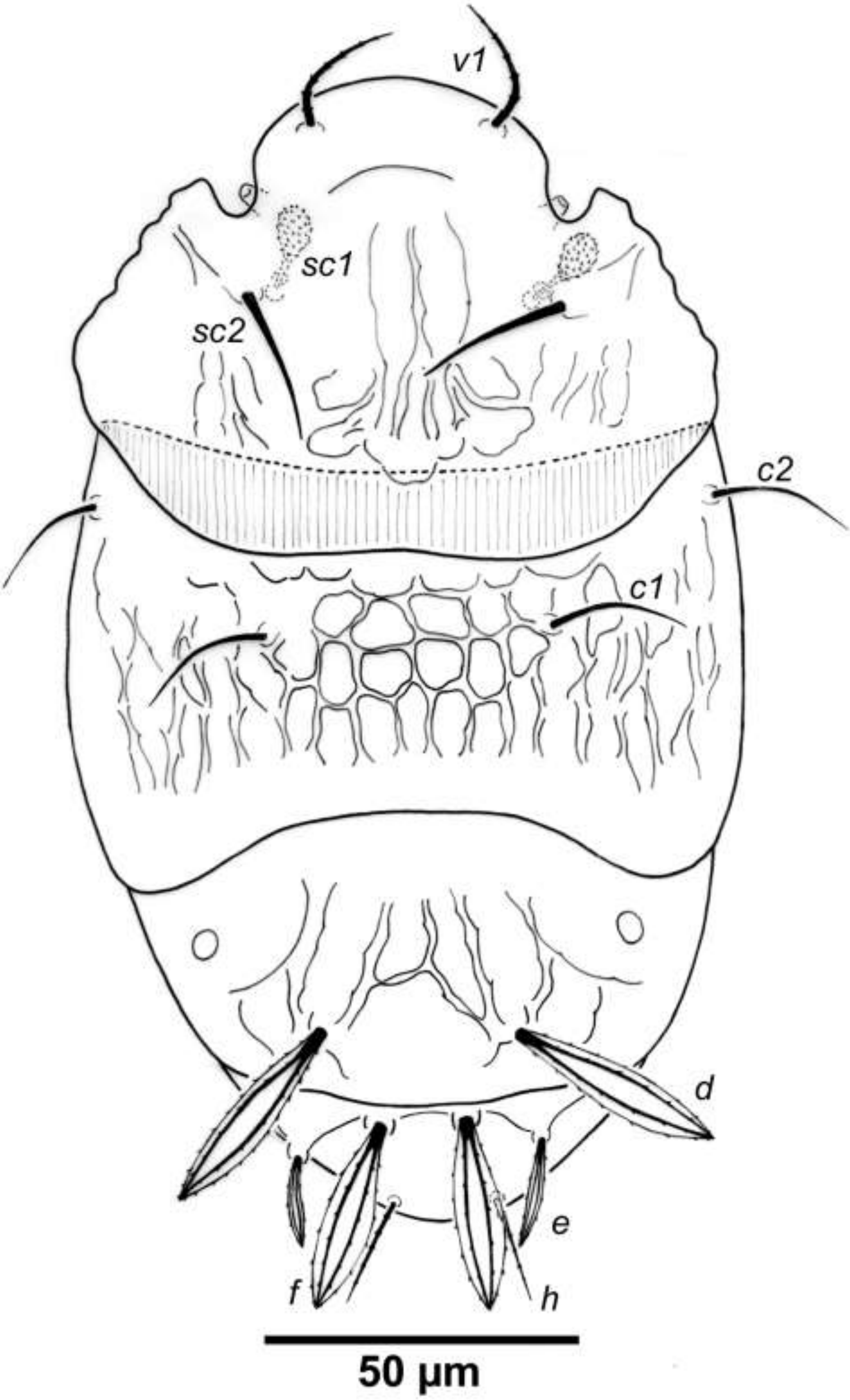

Figure 58. *Daidalotarsonemus* sp. n. 3 (female). Dorsal surface of the idiosoma.

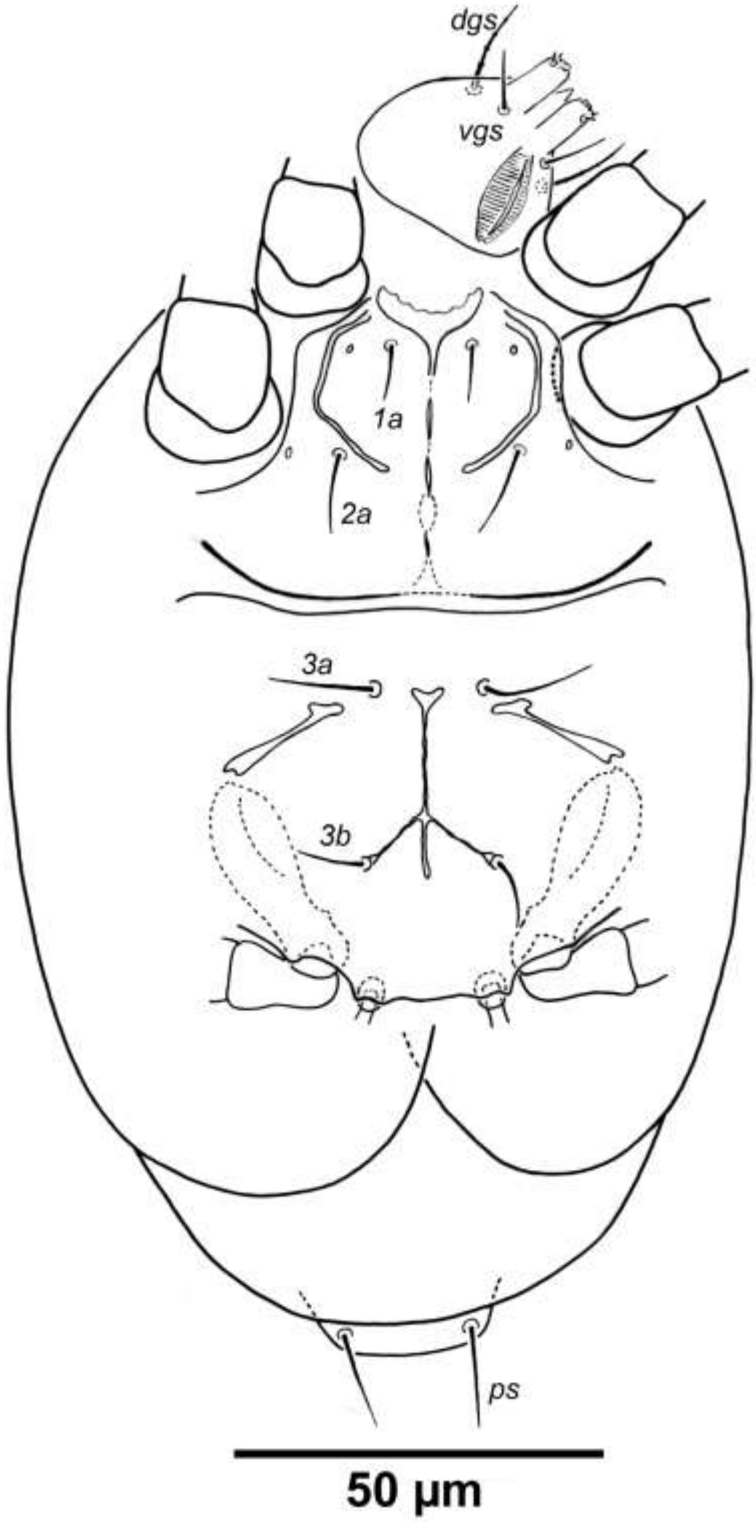

Figure 59. *Daidalotarsonemus* sp. n. 3 (female). Ventral surface of the idiosoma.

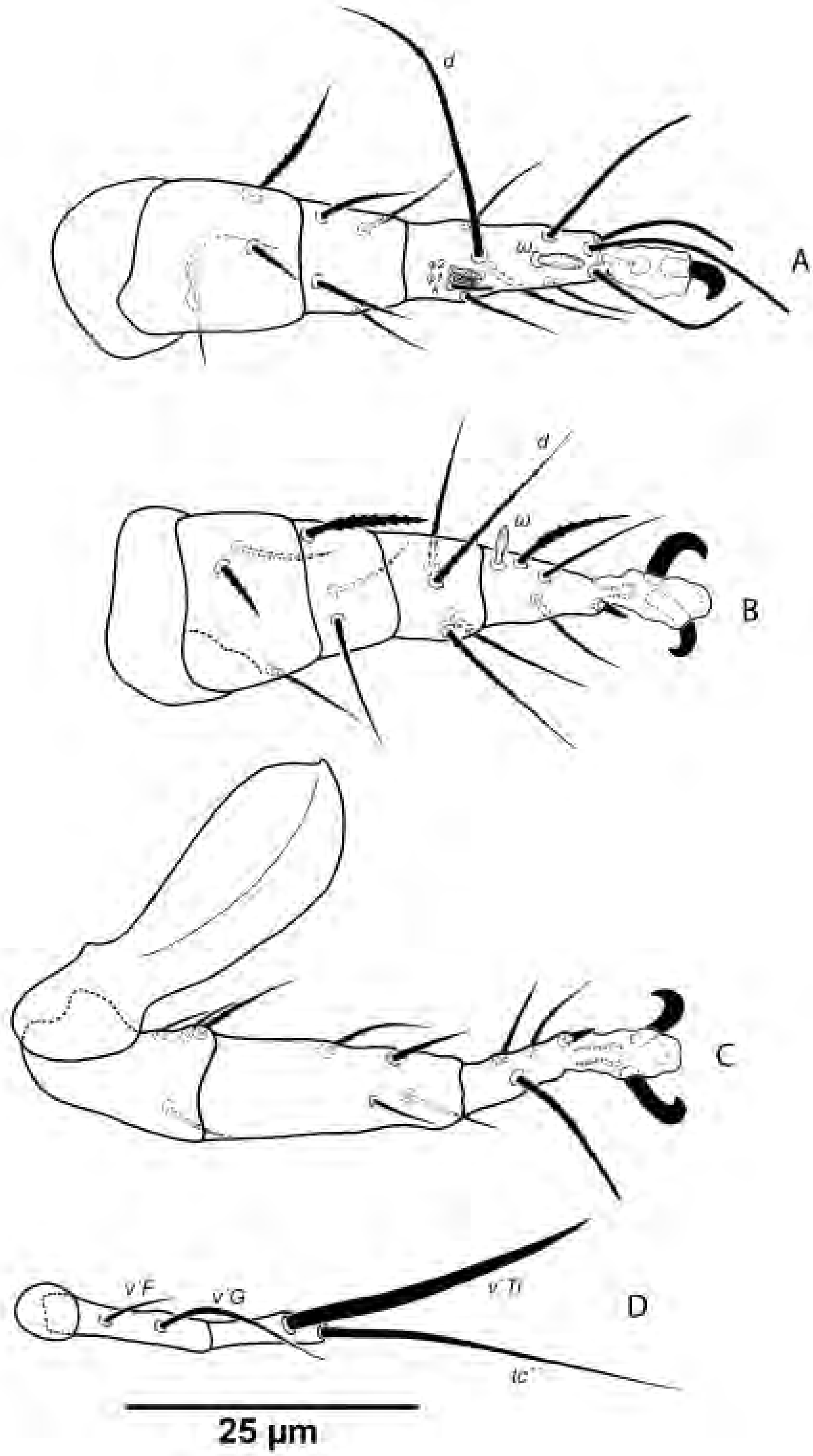

Figure 60. *Daidalotarsonemus* sp. n. 3 (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

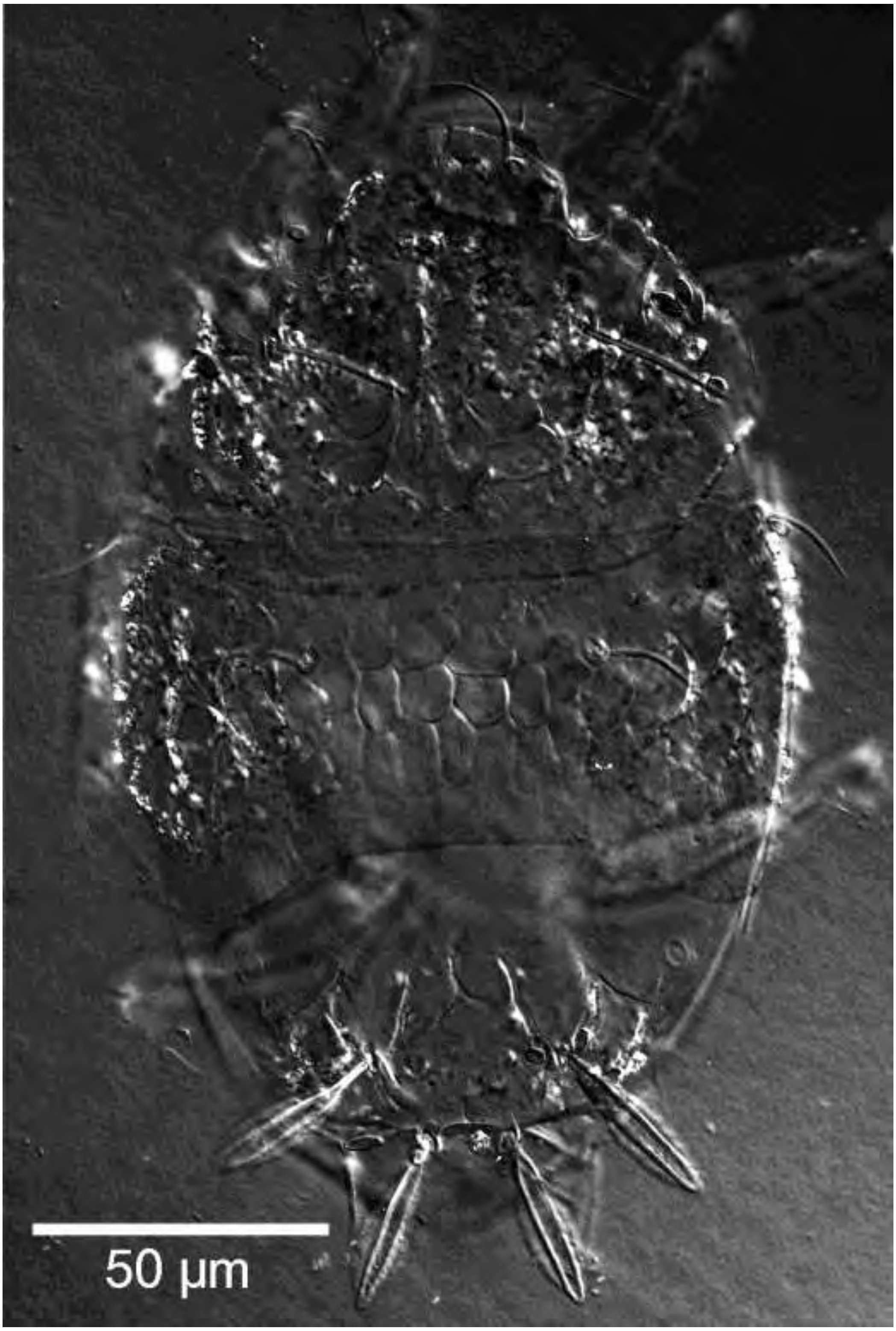

Figure 61. *Daidalotarsonemus* sp. n. 3 (female). Dorsal DIC micrograph of the idiosoma.

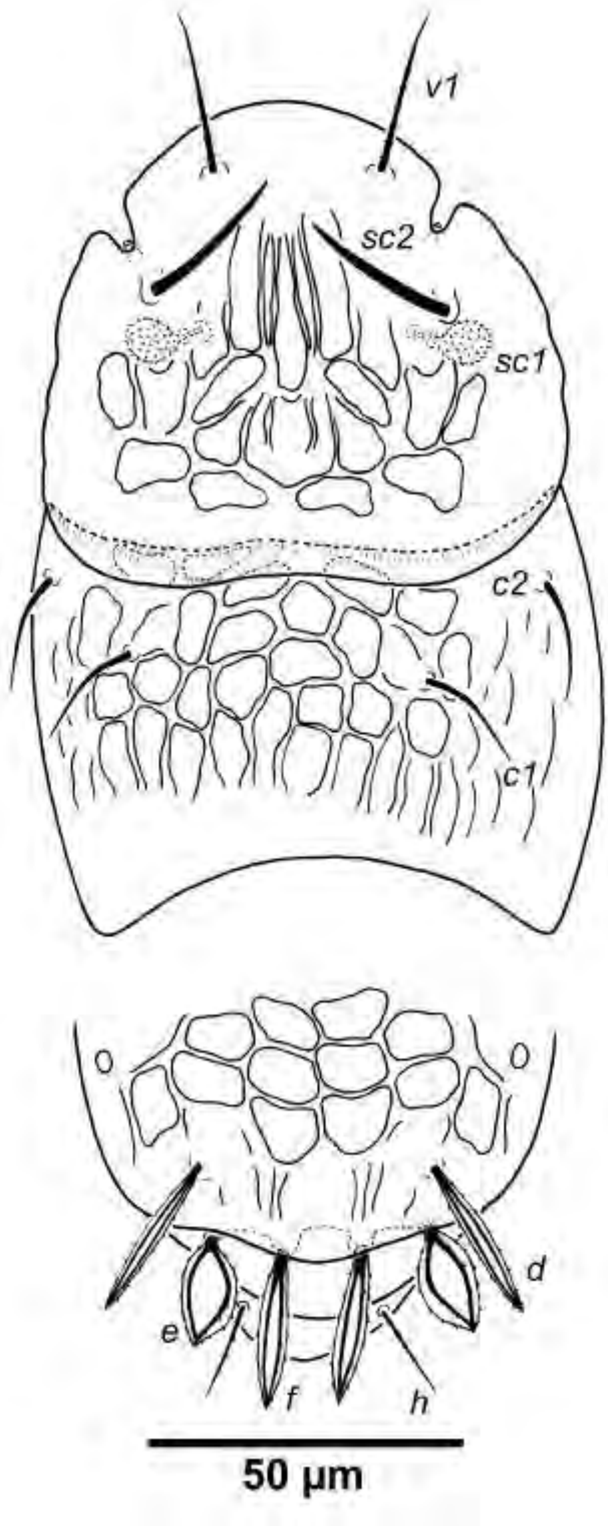

Figure 62. *Daidalotarsonemus* sp. n. 4 (female). Dorsal surface of the idiosoma.

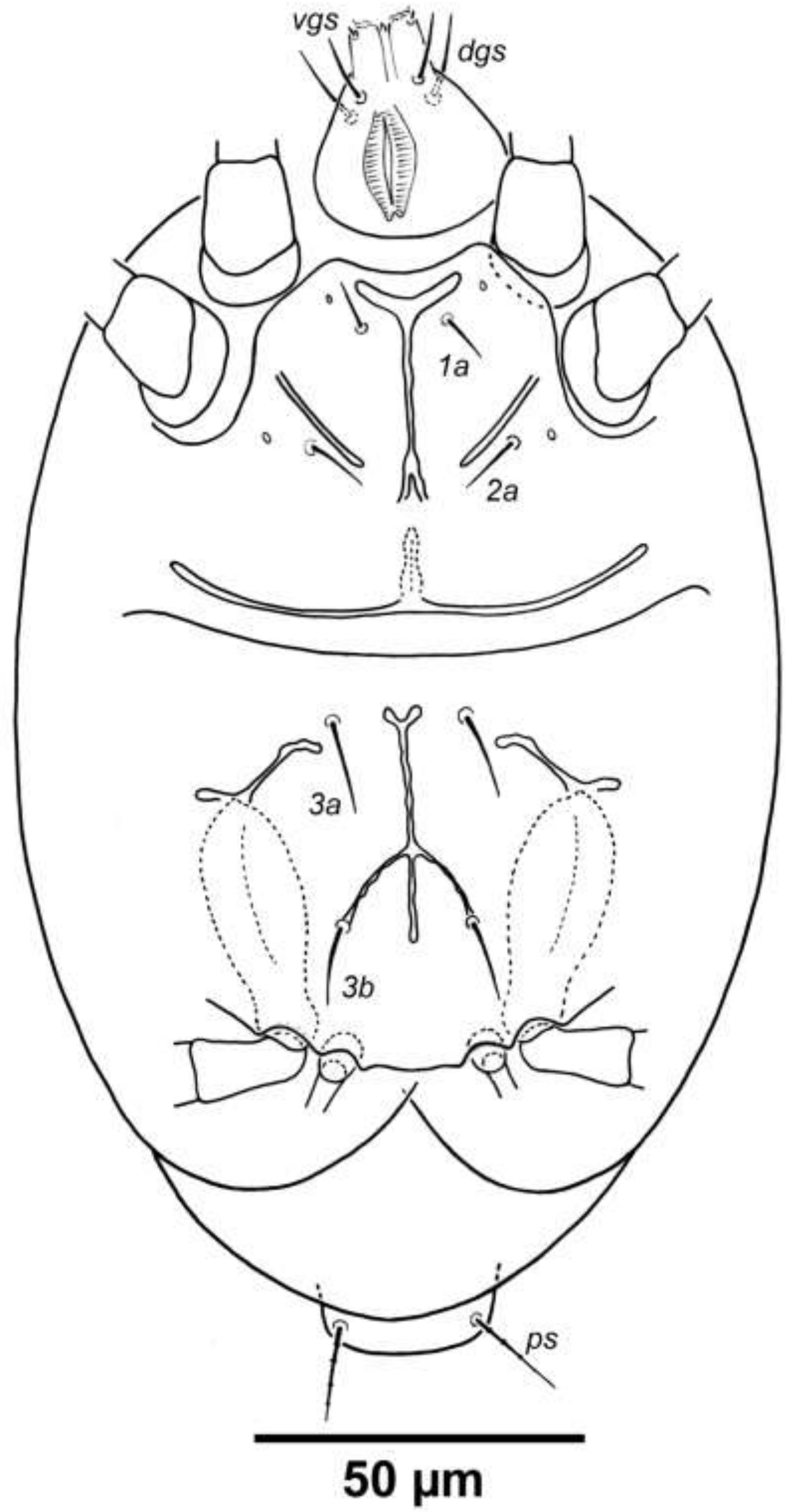

Figure 63. *Daidalotarsonemus* sp. n. 4 (female). Ventral surface of the idiosoma.

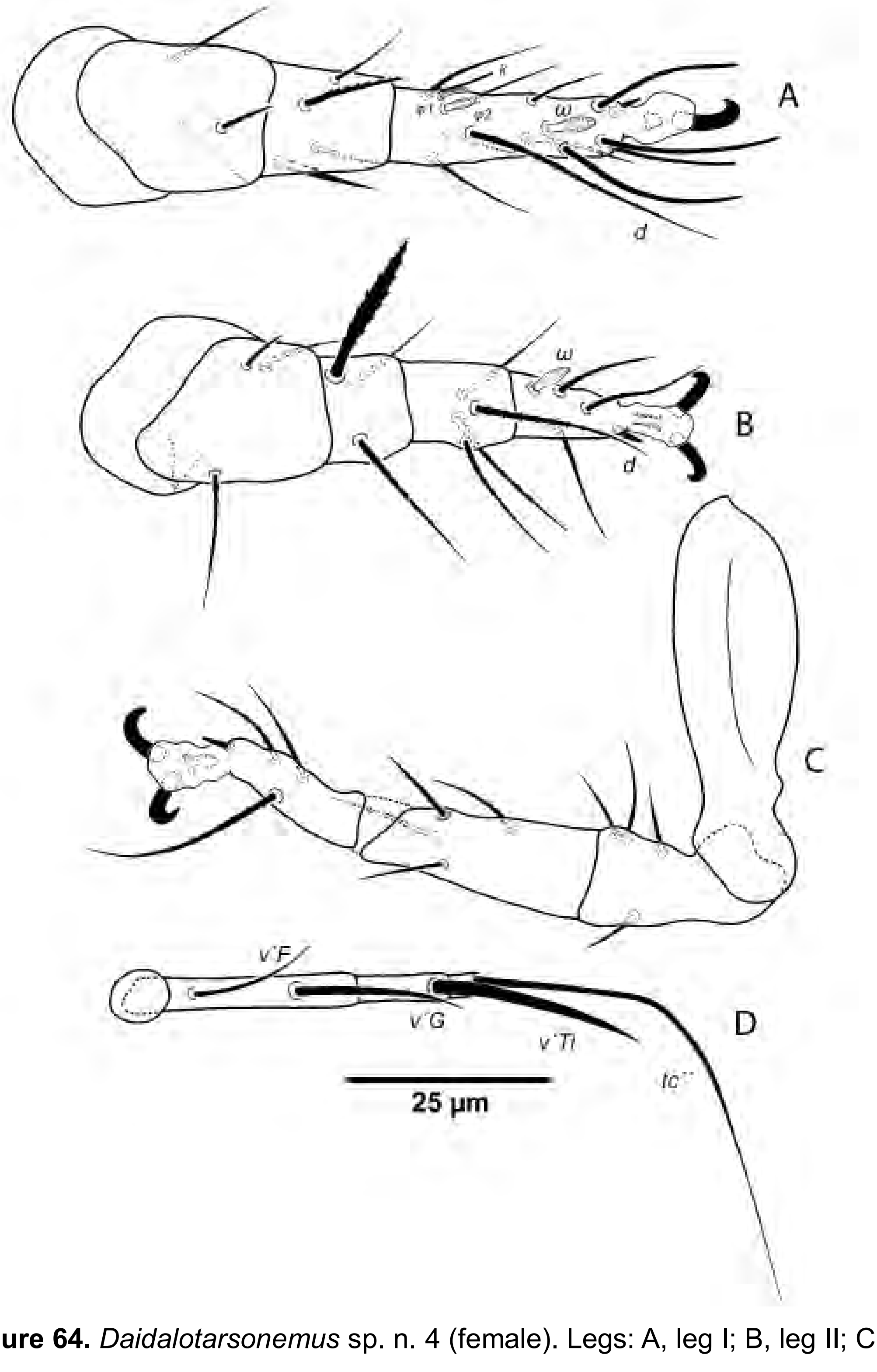

Figure 64. *Daidalotarsonemus* sp. n. 4 (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

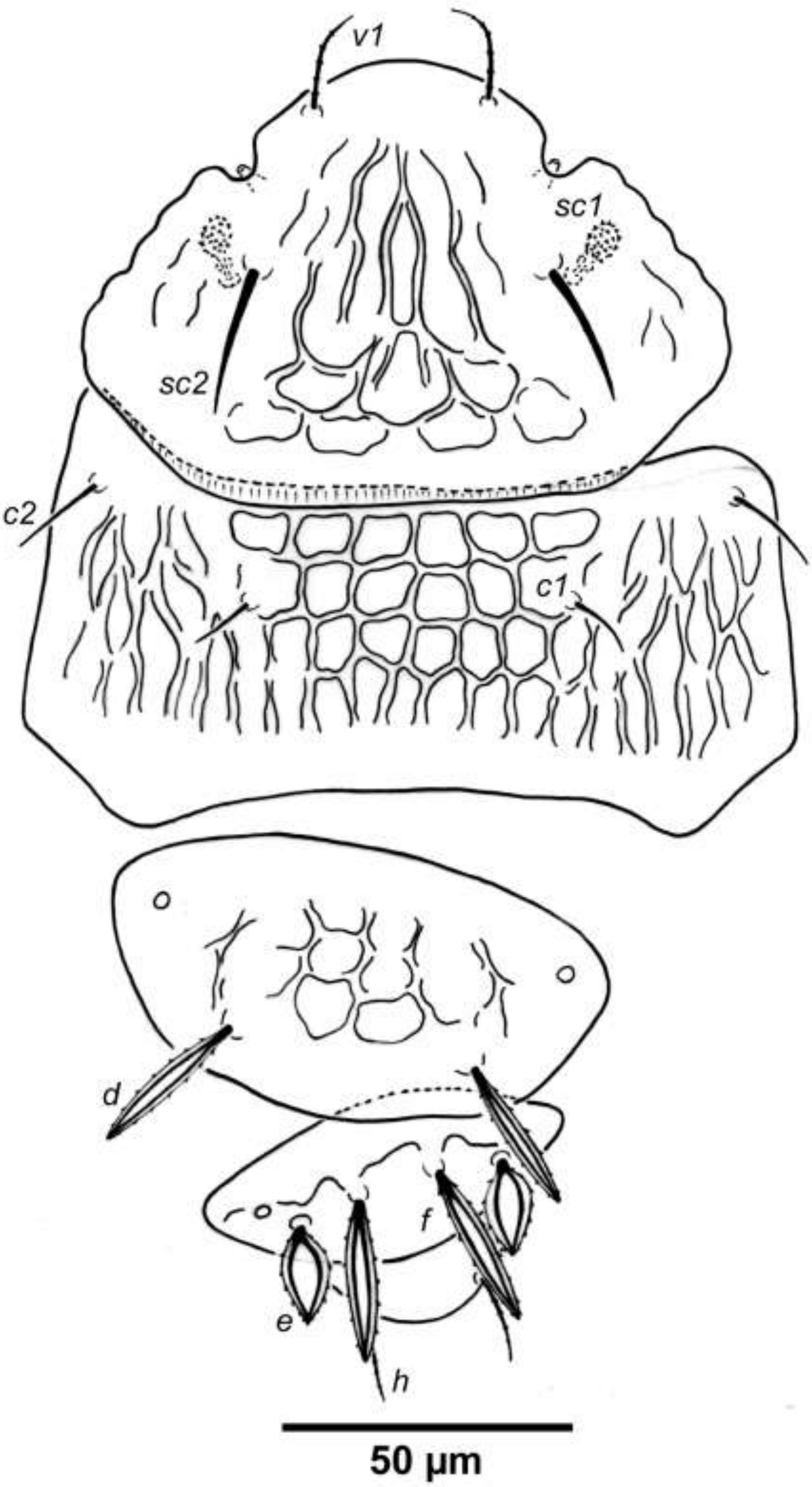

Figure 65. *Daidalotarsonemus* sp. n. 5 (female). Dorsal surface of the idiosoma.

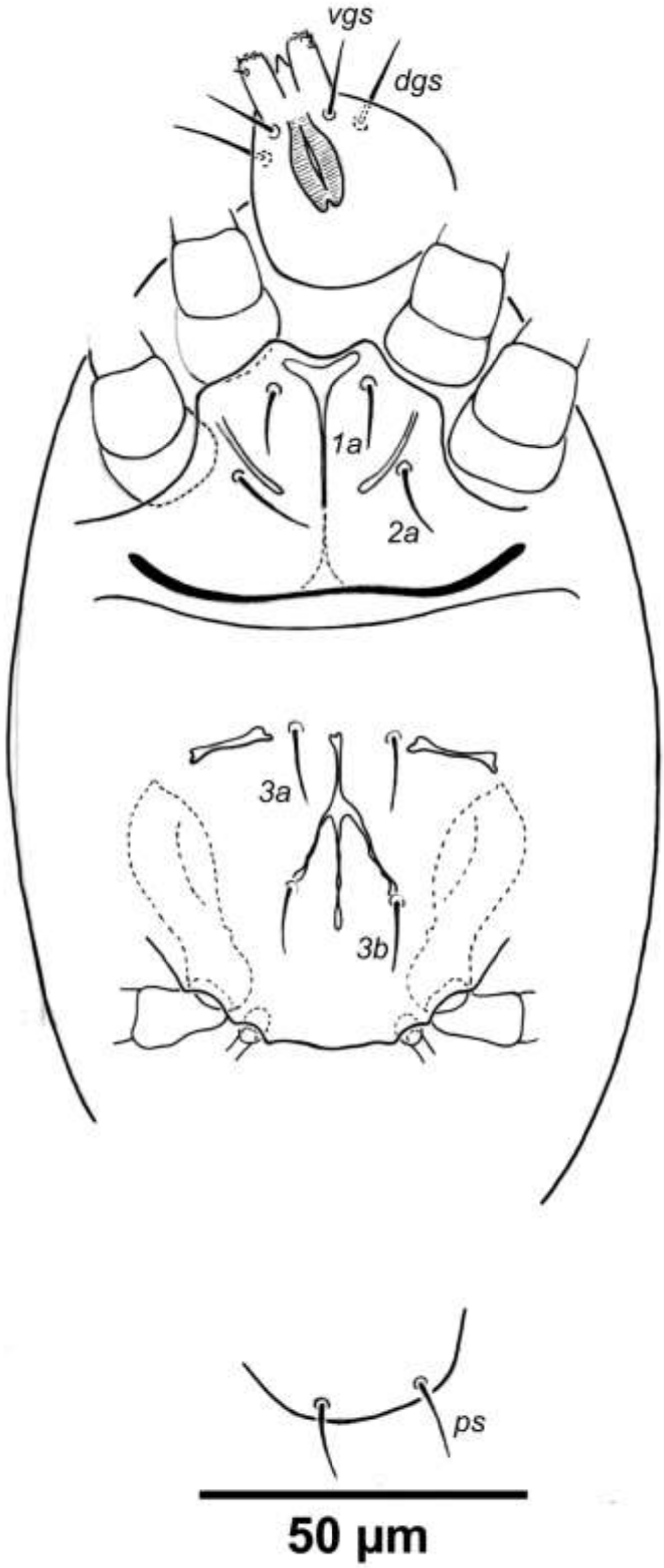

Figure 66. *Daidalotarsonemus* sp. n. 5 (female). Ventral surface of the idiosoma.

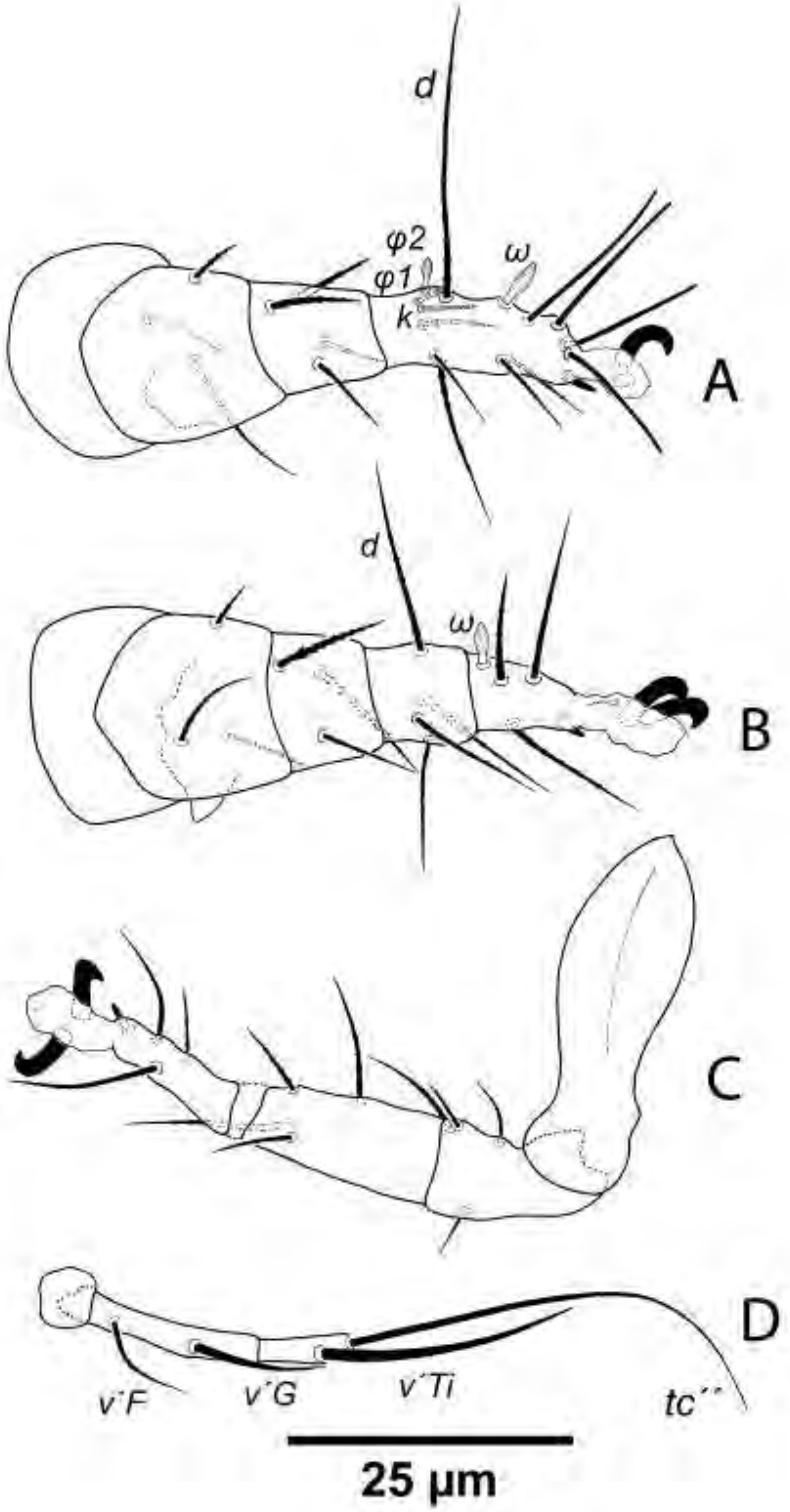

Figure 67. *Daidalotarsonemus* sp. n. 5 (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 68. *Daidalotarsonemus* sp. n. 5 (female). Dorsal PC micrograph of the idiosoma.

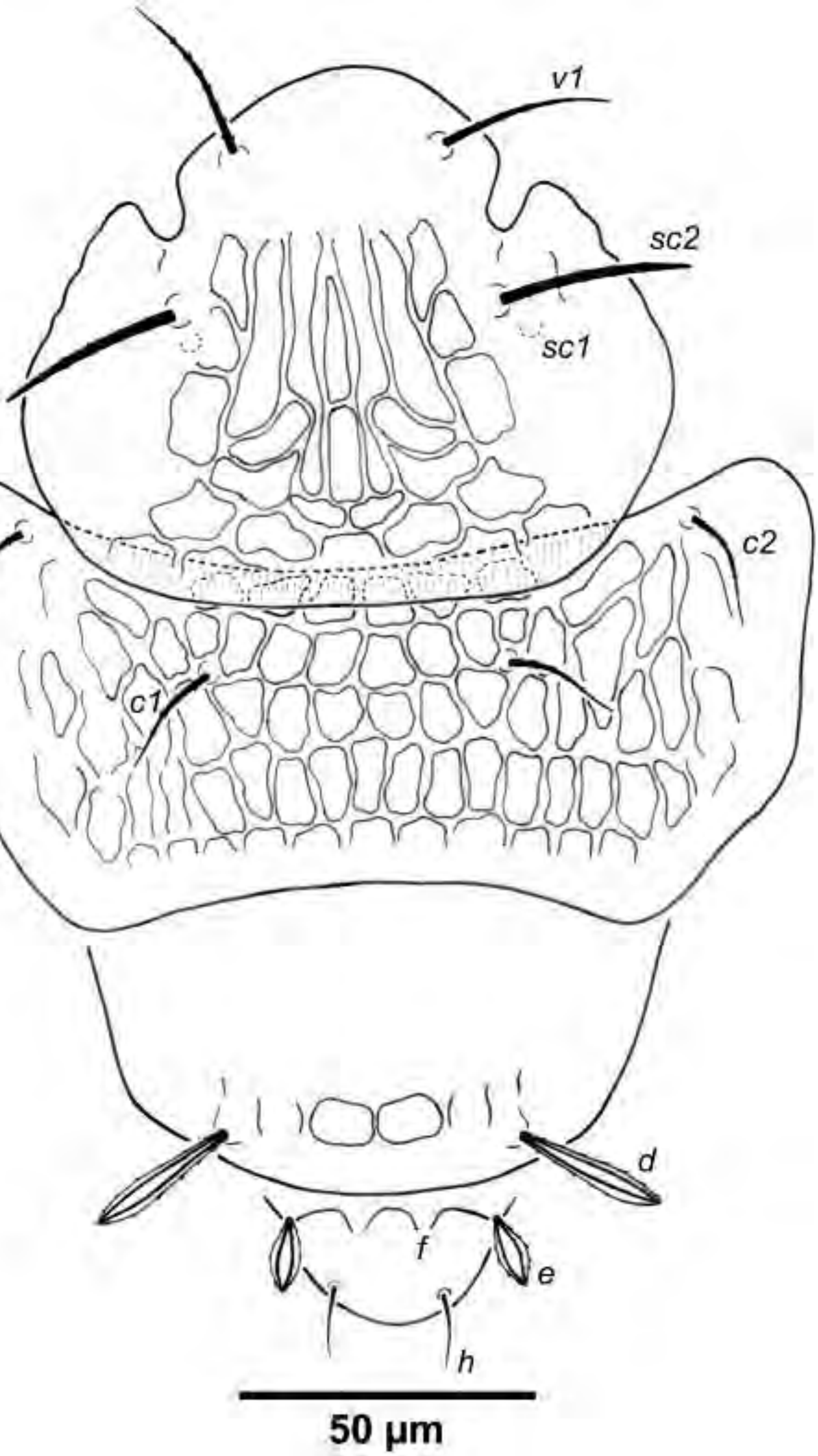

Figure 69. *Daidalotarsonemus tessellatus* De Leon (female). Dorsal surface of the idiosoma.

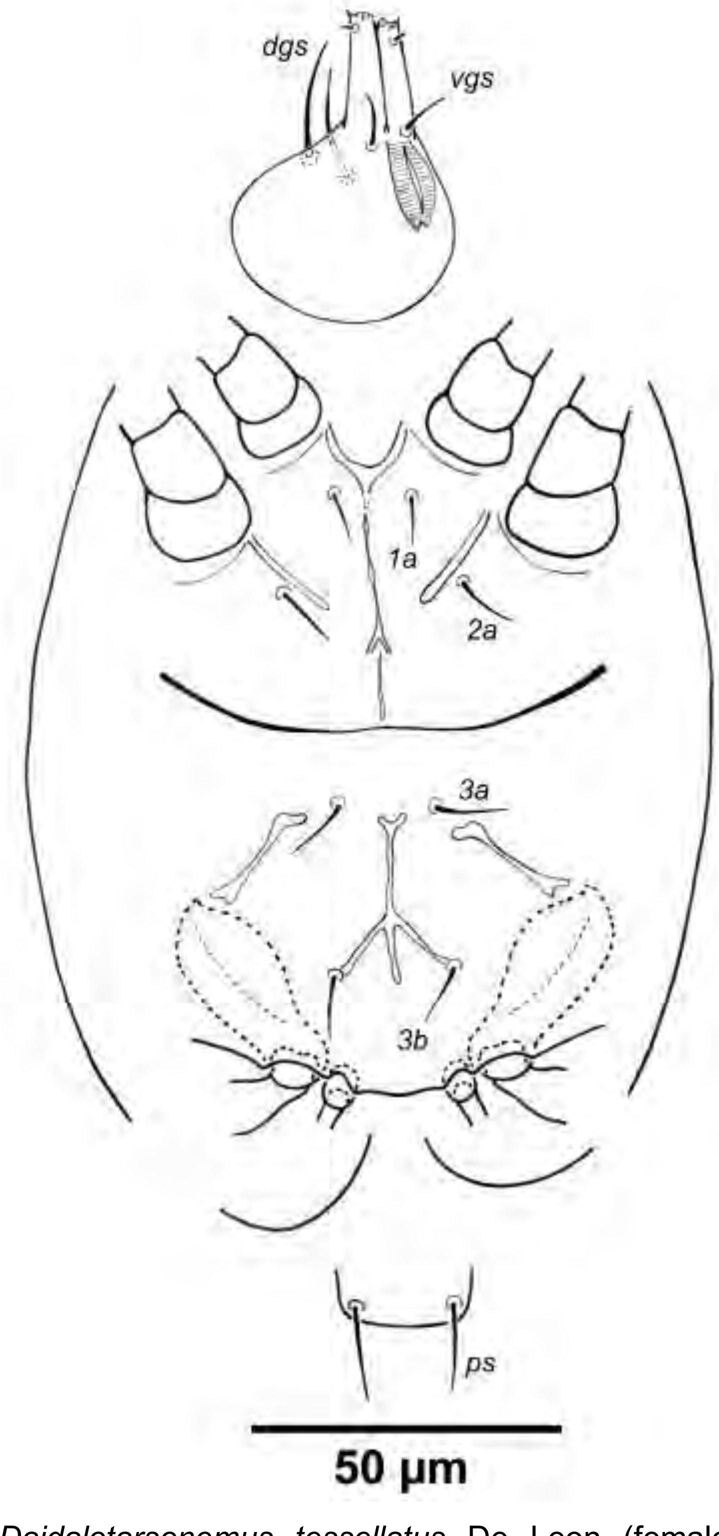

Figure 70. *Daidalotarsonemus tessellatus* De Leon (female). Ventral surface of the idiosoma.

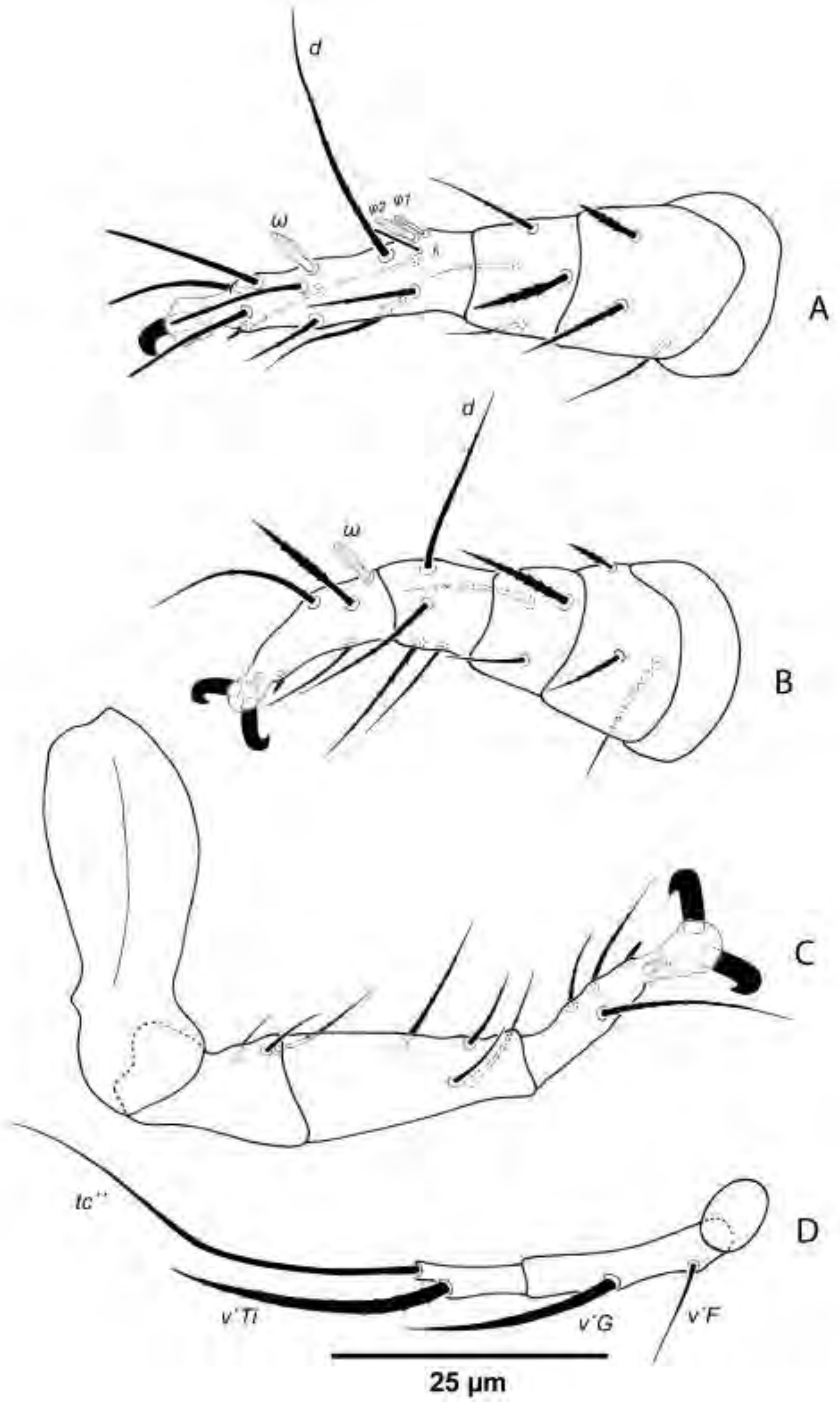

Figure 71. *Daidalotarsonemus tessellatus* De Leon (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

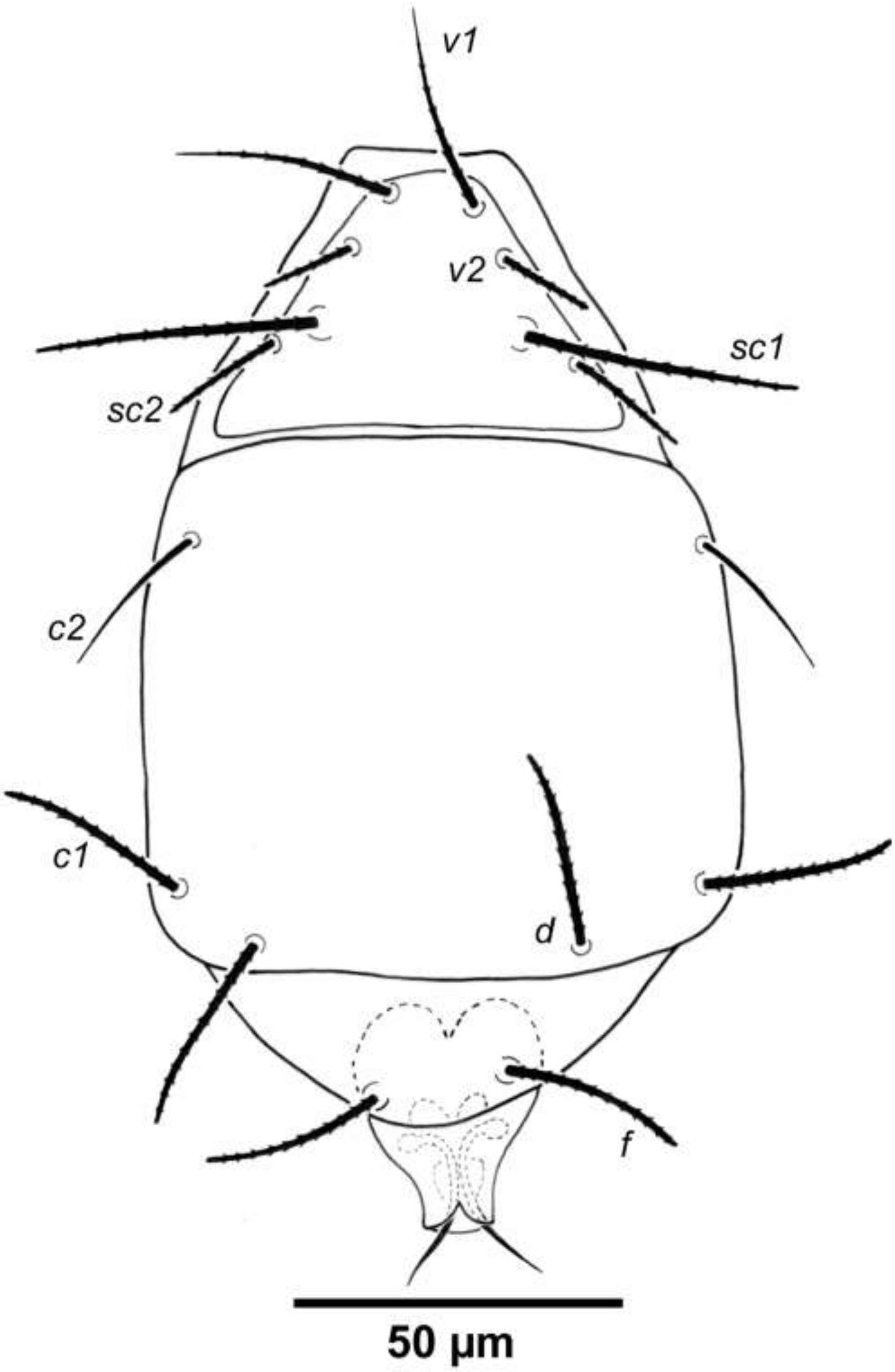

Figure 72. *Daidalotarsonemus tessellatus* De Leon (male). Dorsal surface of the idiosoma.

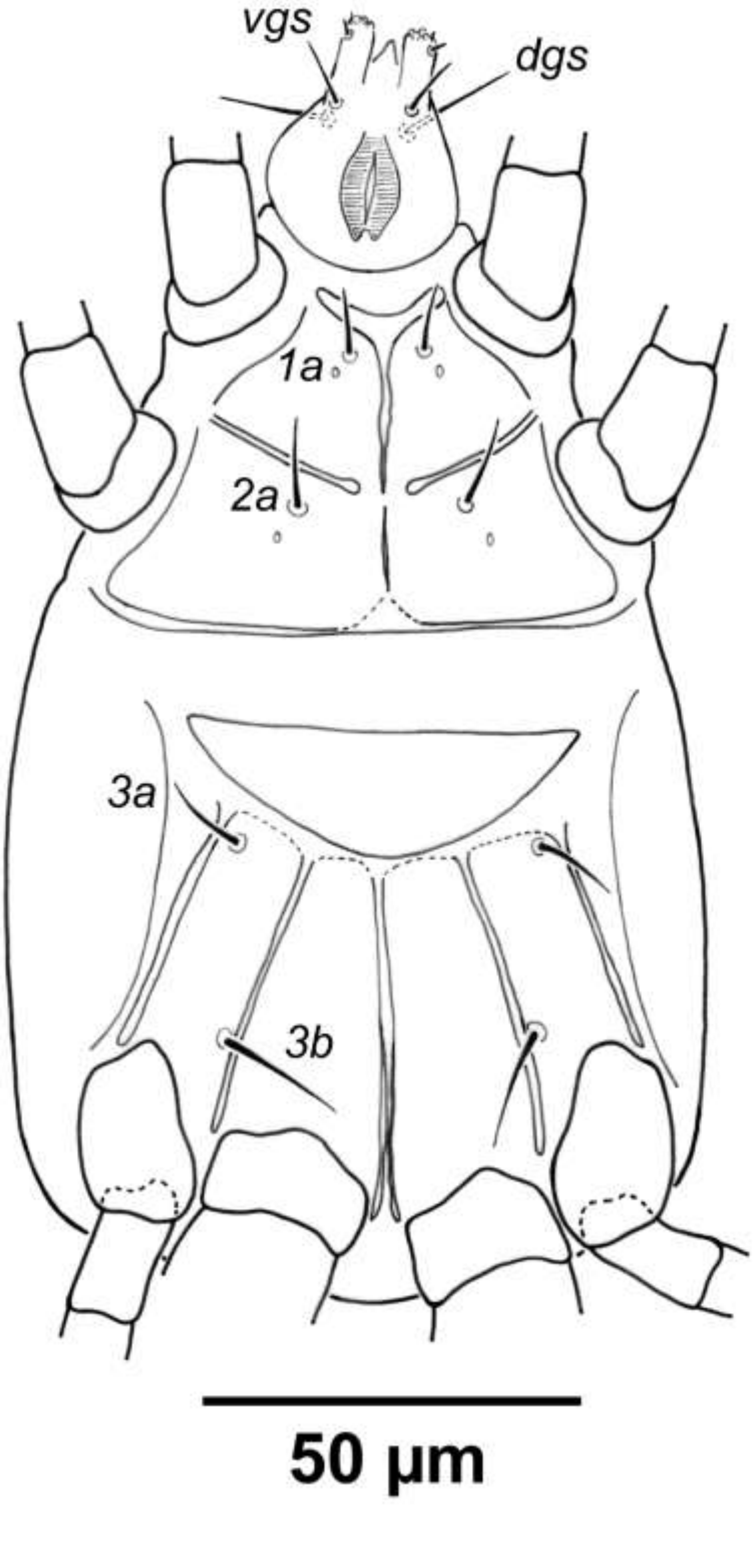

Figure 73. *Daidalotarsonemus tessellatus* De Leon (male). Ventral surface of the idiosoma.

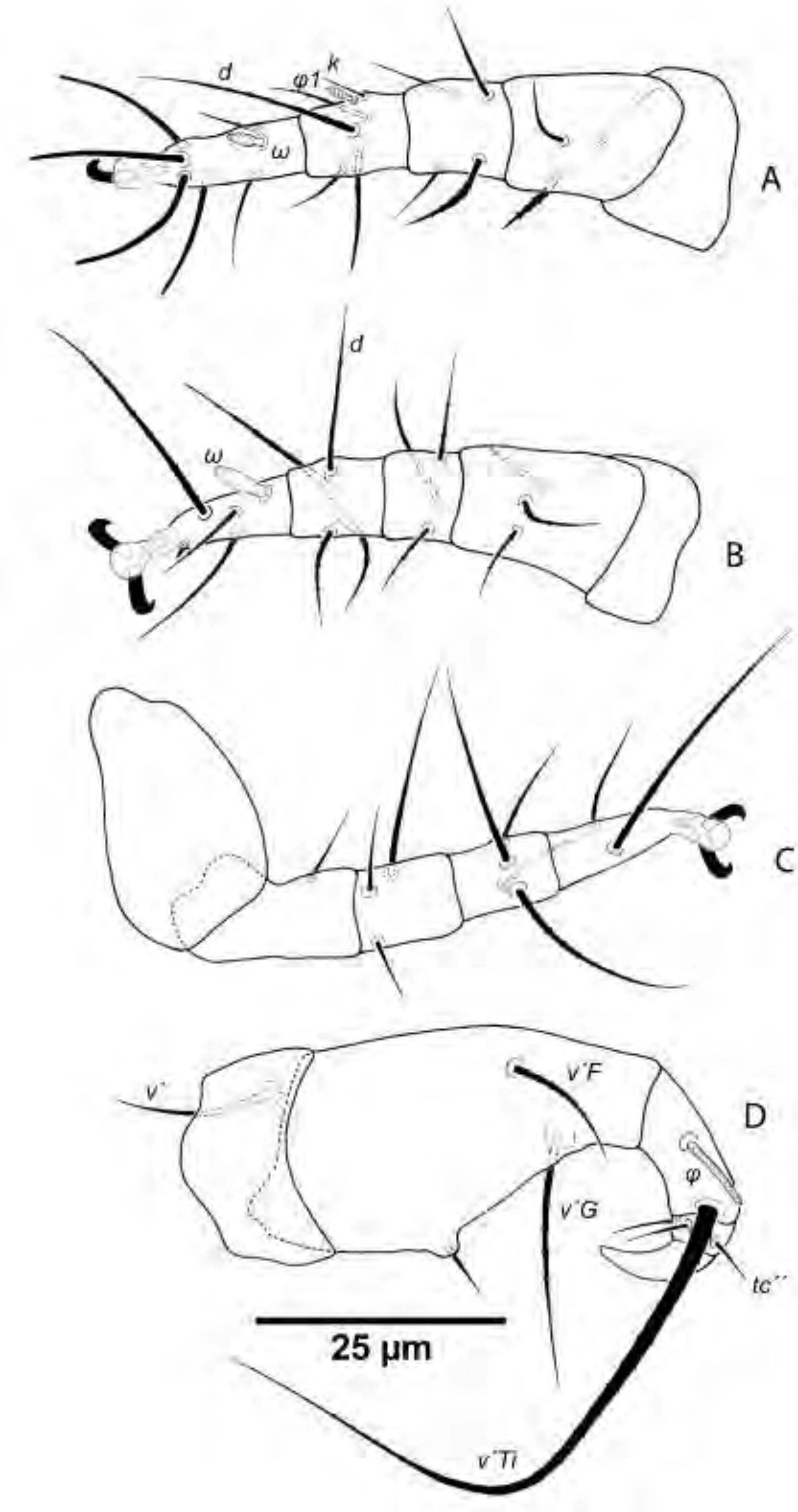

Figure 74. *Daidalotarsonemus tessellatus* De Leon (male). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

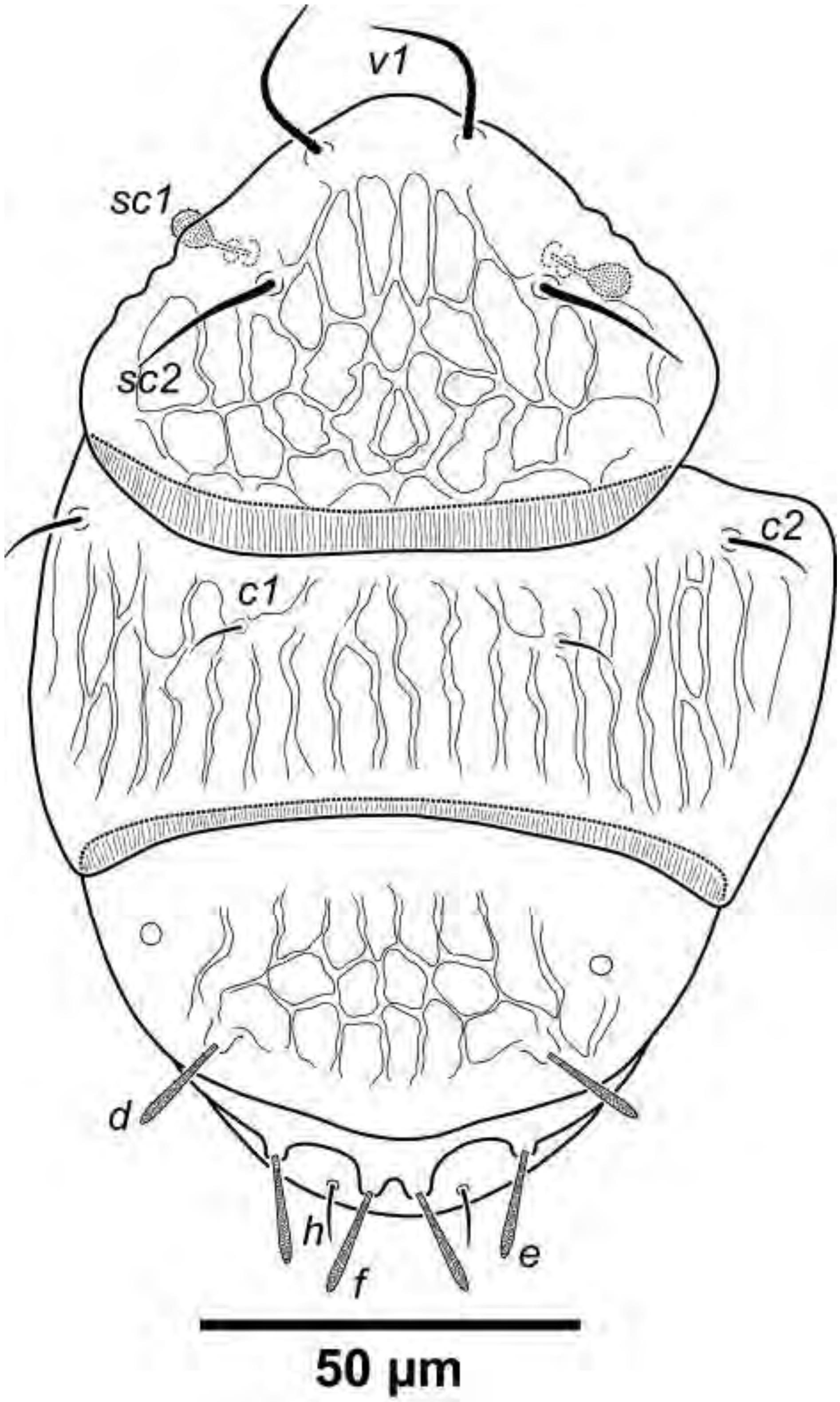

Figure 75. *Daidalotarsonemus vandevriei* Suski (female). Dorsal surface of the idiosoma.

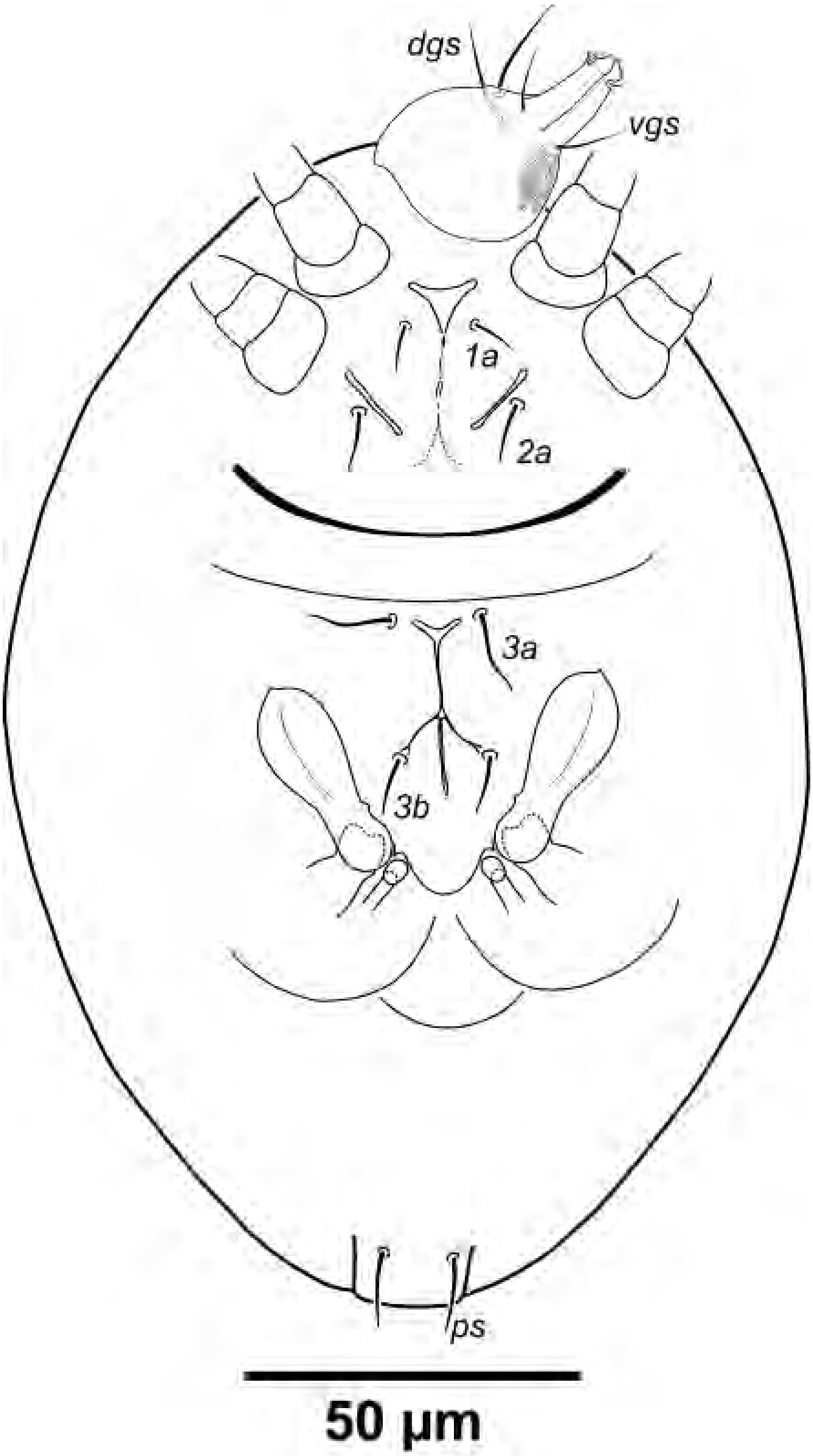

Figure 76. *Daidalotarsonemus vandevriei* Suski (female). Ventral surface of the idiosoma.

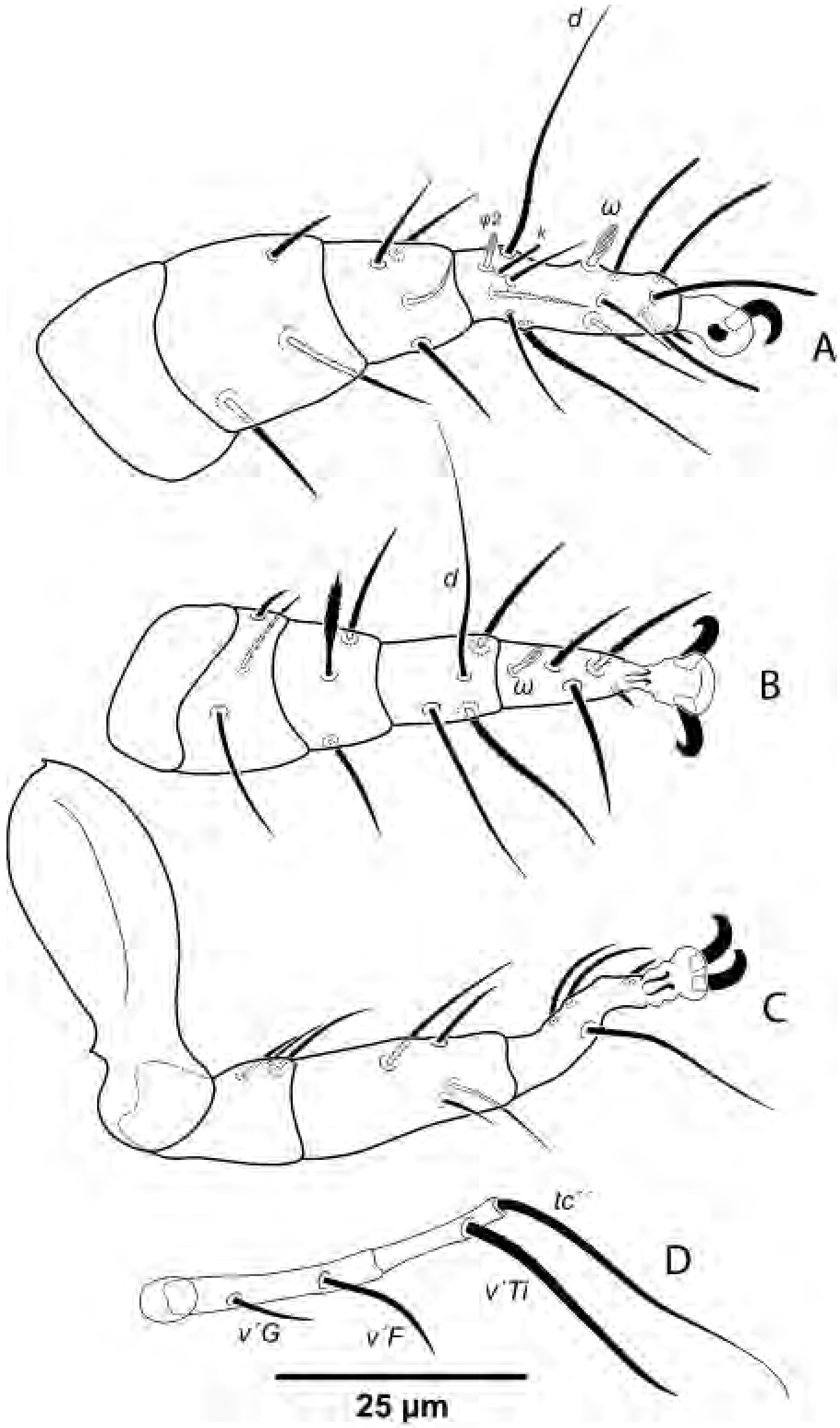

Figure 77. *Daidalotarsonemus vandevriei* Suski (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

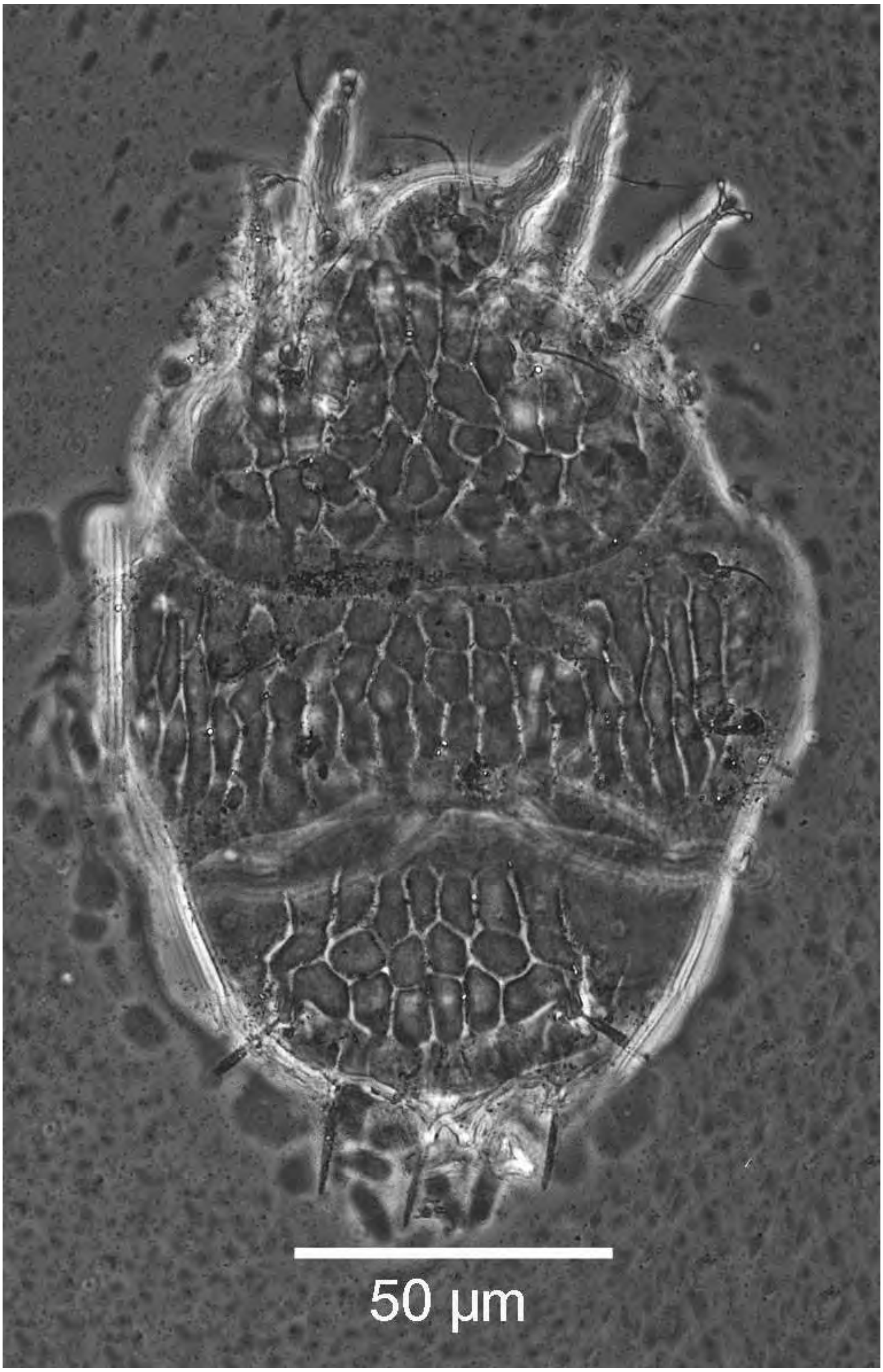

Figure 78. *Daidalotarsonemus vandevriei* Suski (female). Dorsal PC micrograph of the idiosoma.

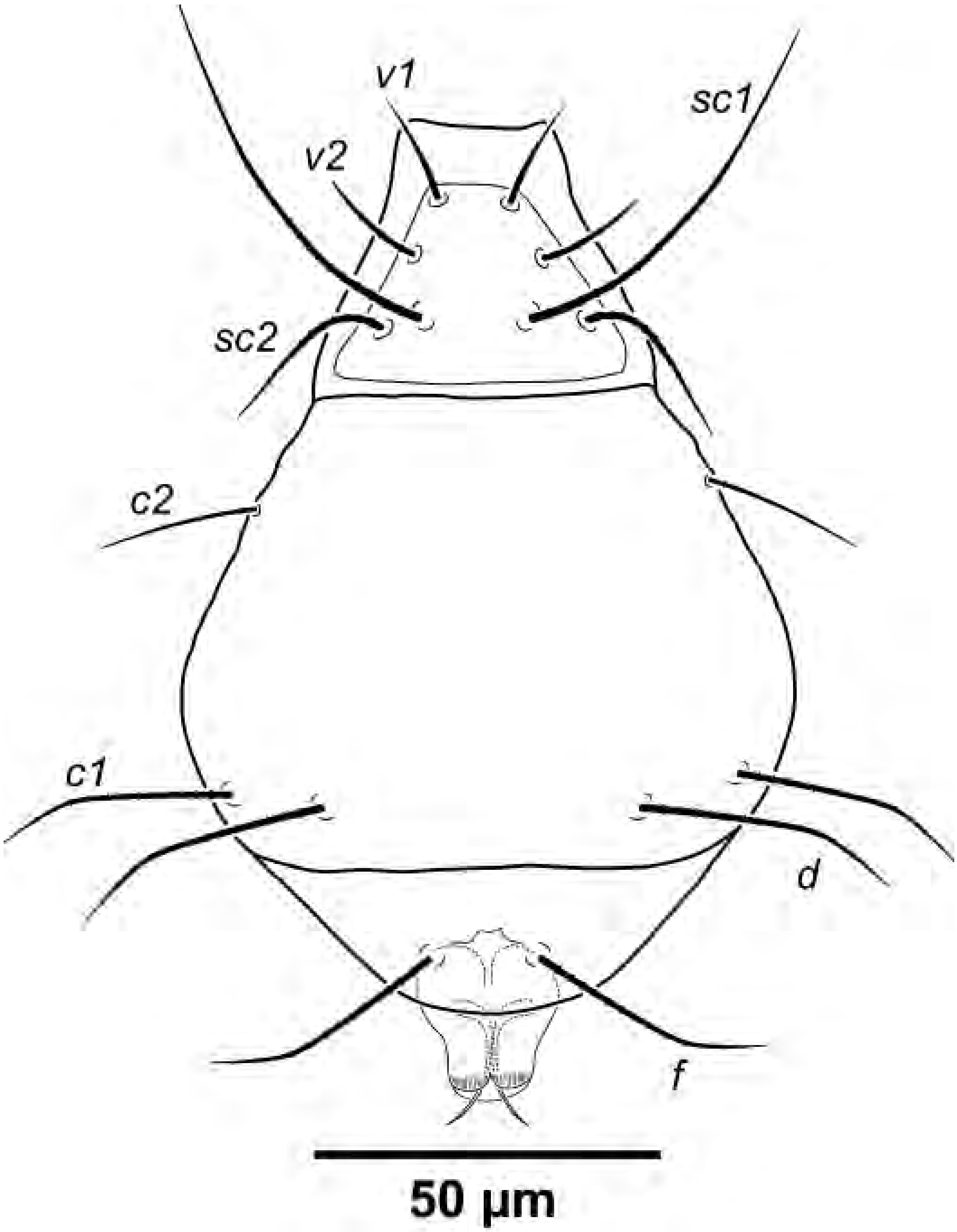

Figure 79. *Daidalotarsonemus vandevriei* Suski (male). Dorsal surface of the idiosoma.

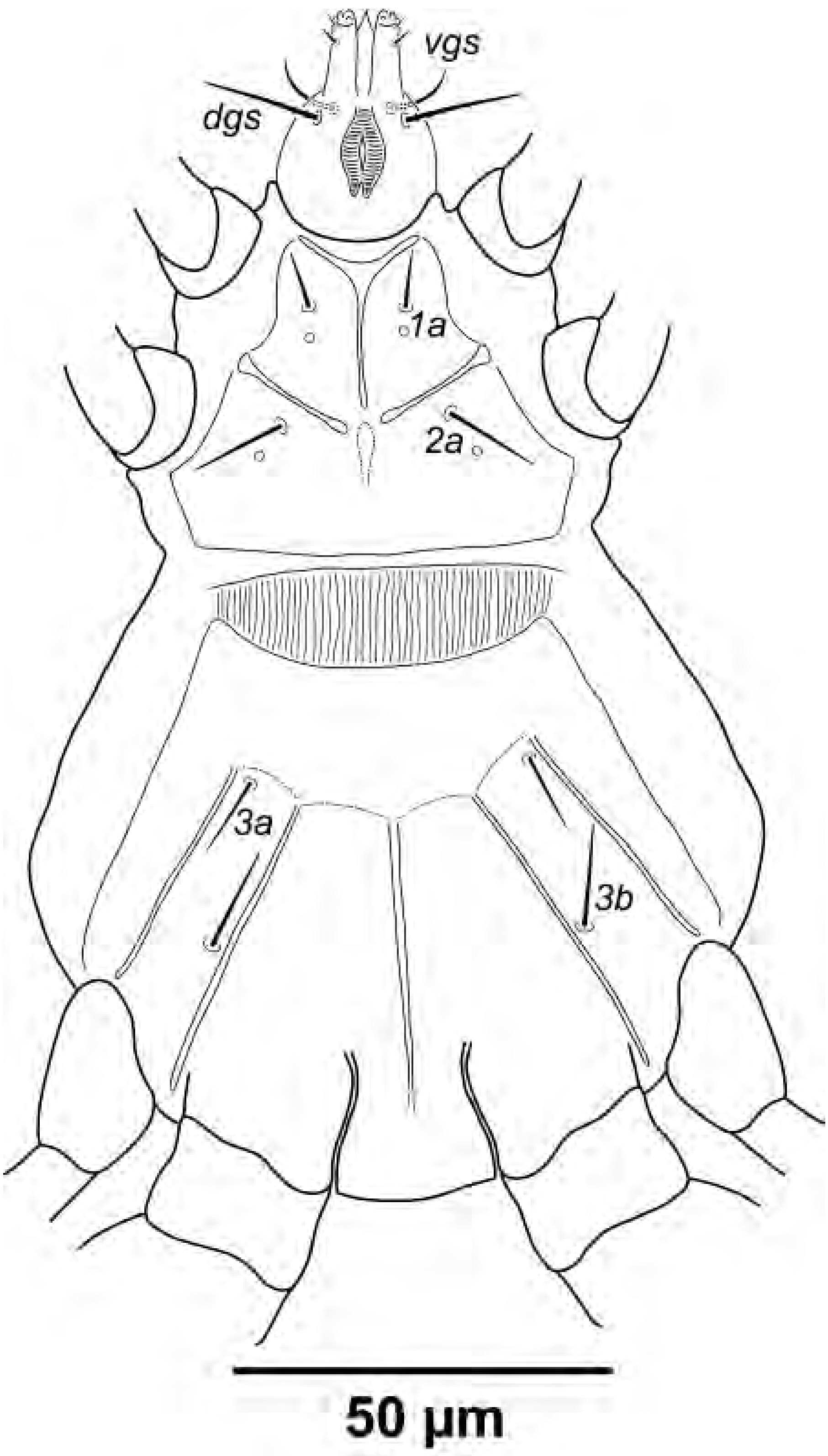

Figure 80. *Daidalotarsonemus vandevriei* Suski (male). Ventral surface of the idiosoma.

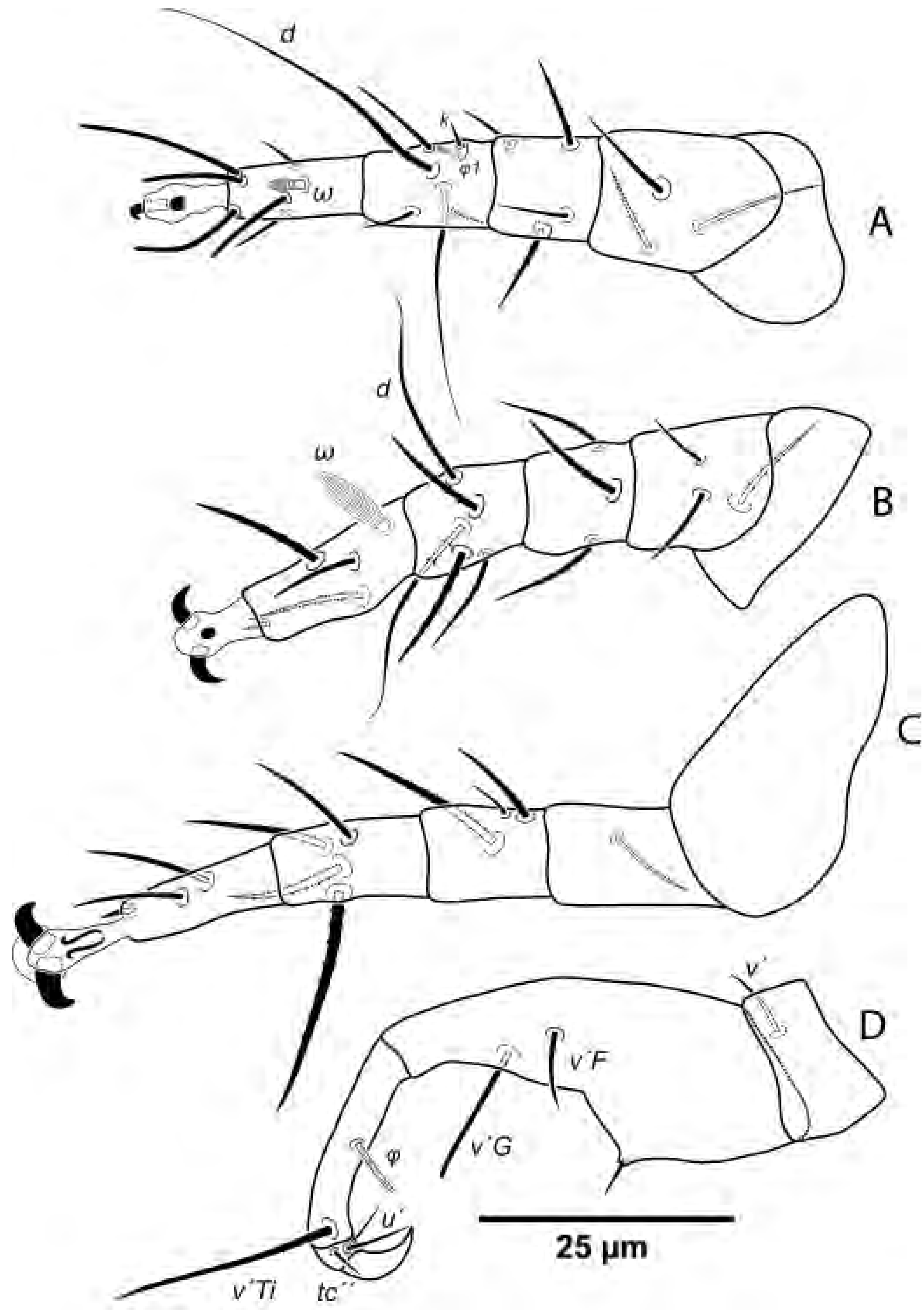

Figure 81. *Daidalotarsonemus vandevriei* Suski (male). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

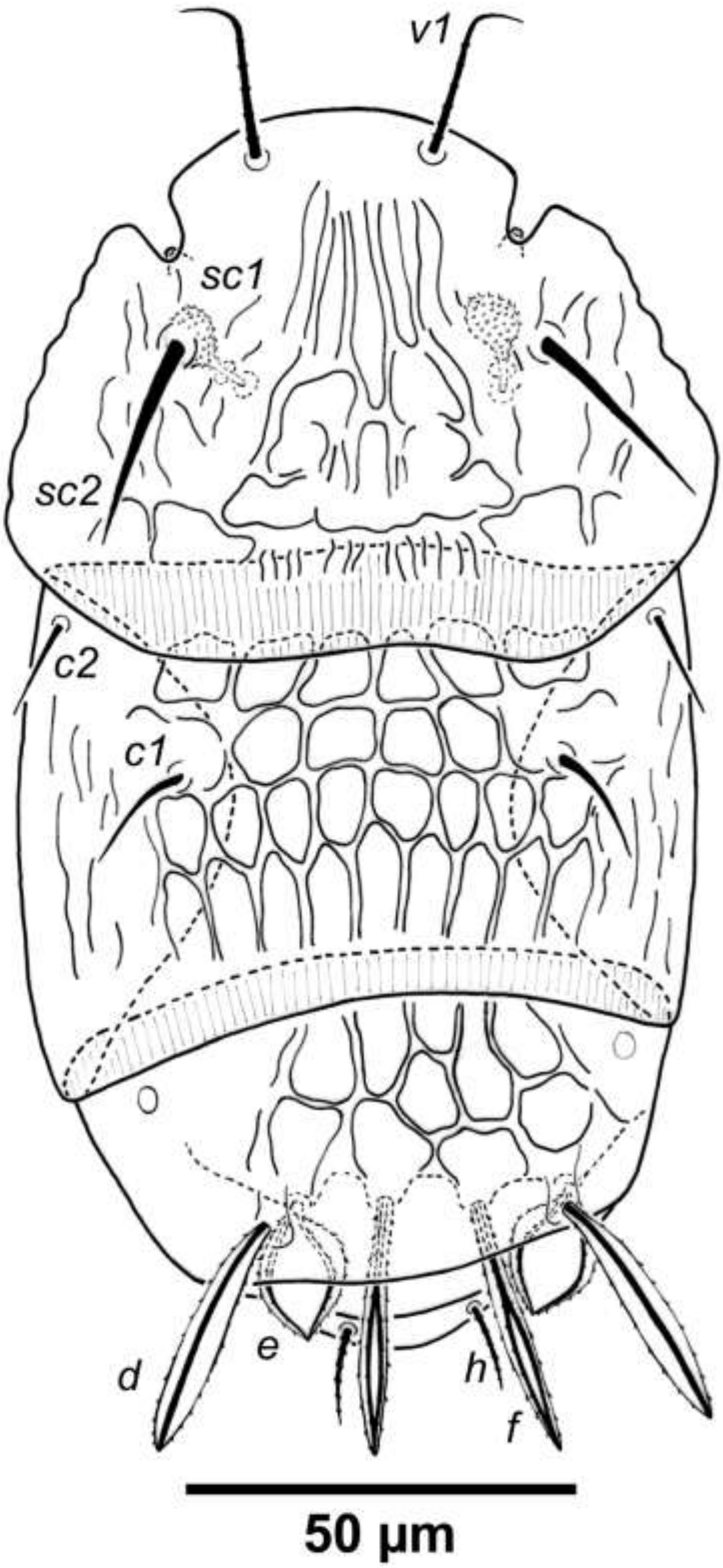

Figure 82. *Daidalotarsonemus venustus* Attiah (female). Dorsal surface of the idiosoma.

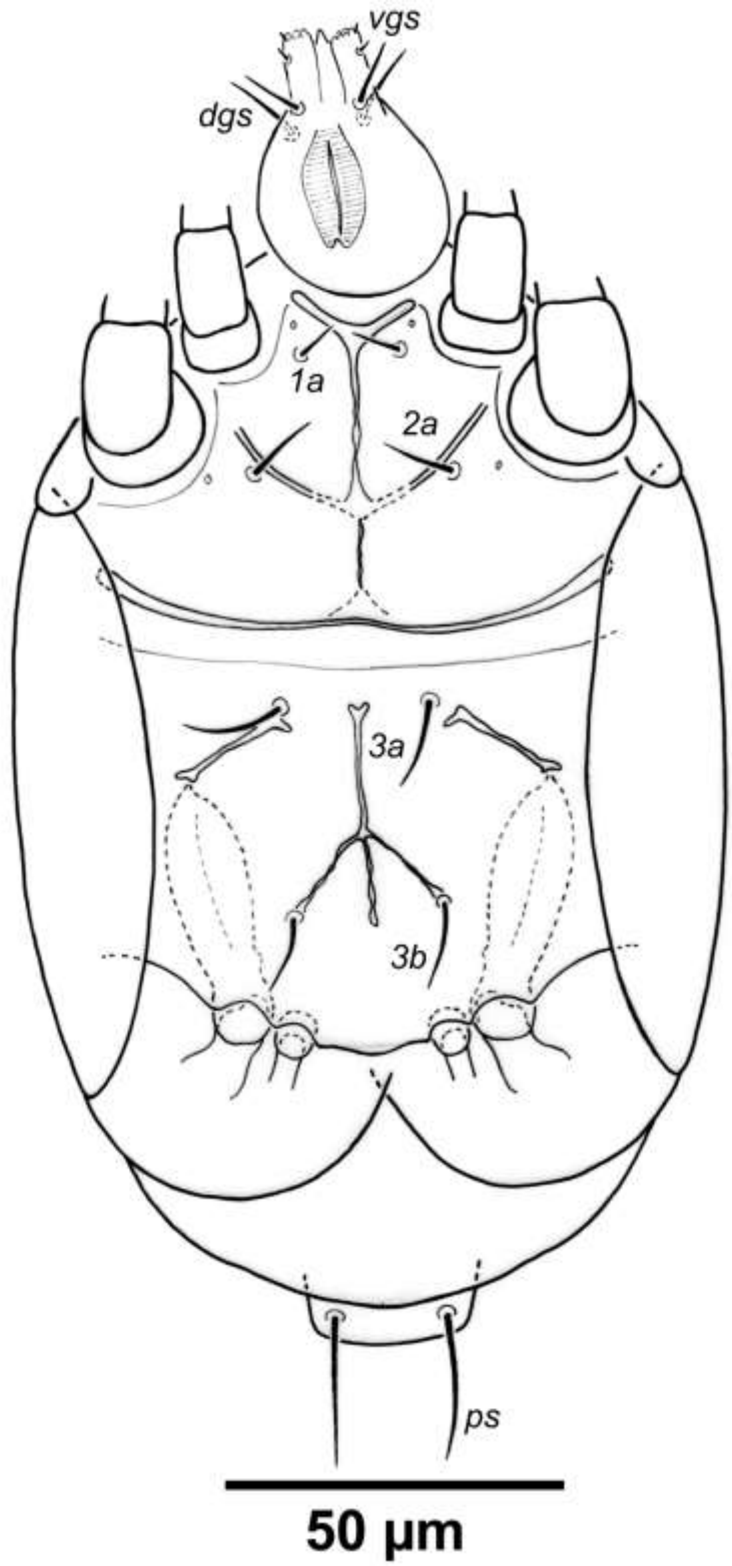

Figure 83. *Daidalotarsonemus venustus* Attiah (female). Ventral surface of the idiosoma.

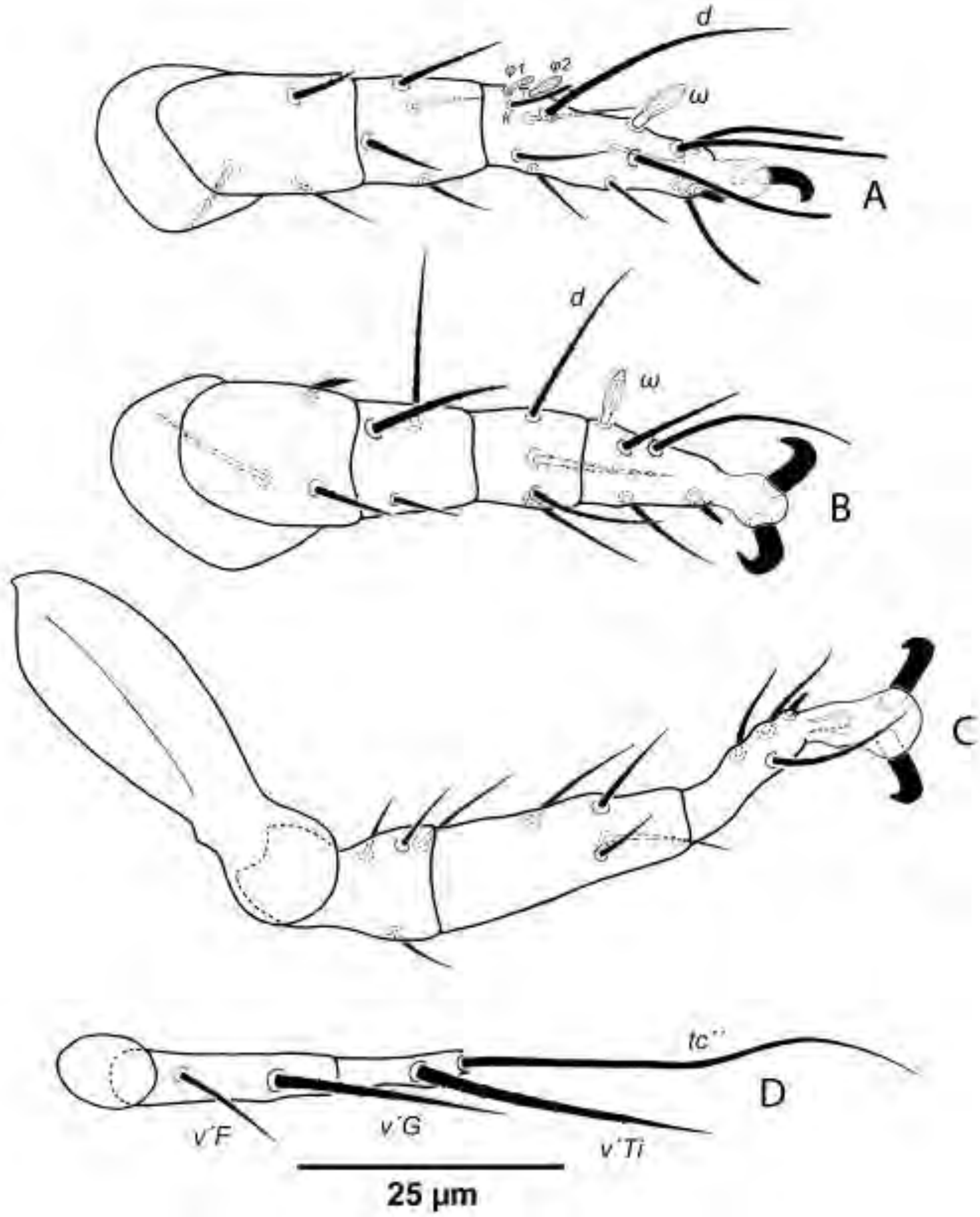

Figure 84. *Daidalotarsonemus venustus* Attiah (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

Figure 85. *Daidalotarsonemus venustus* Attiah (female). Dorsal DIC micrograph of the idiosoma.

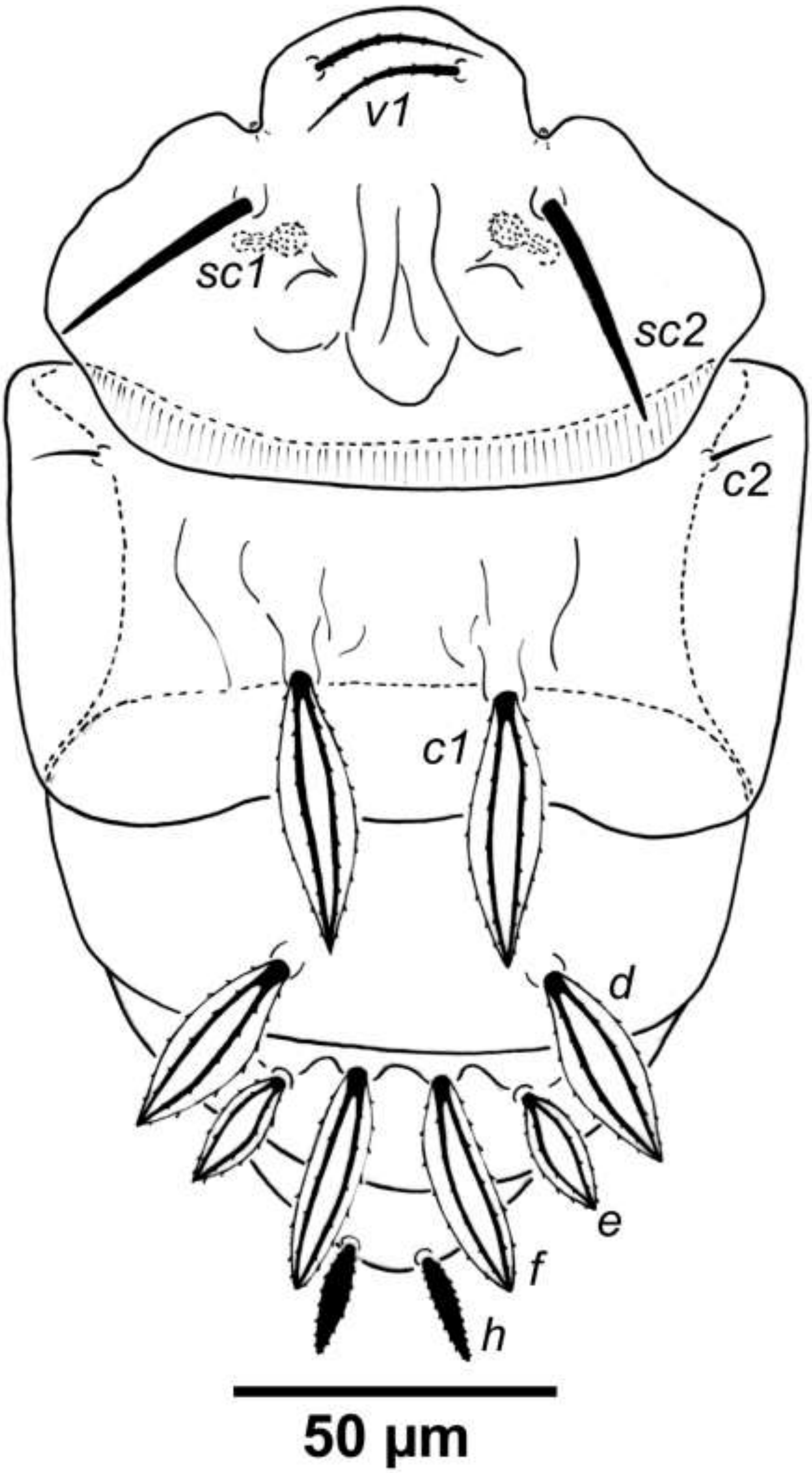

Figure 86. *Excelsotarsonemus* sp. n. (female). Dorsal surface of the idiosoma.

idiosoma.

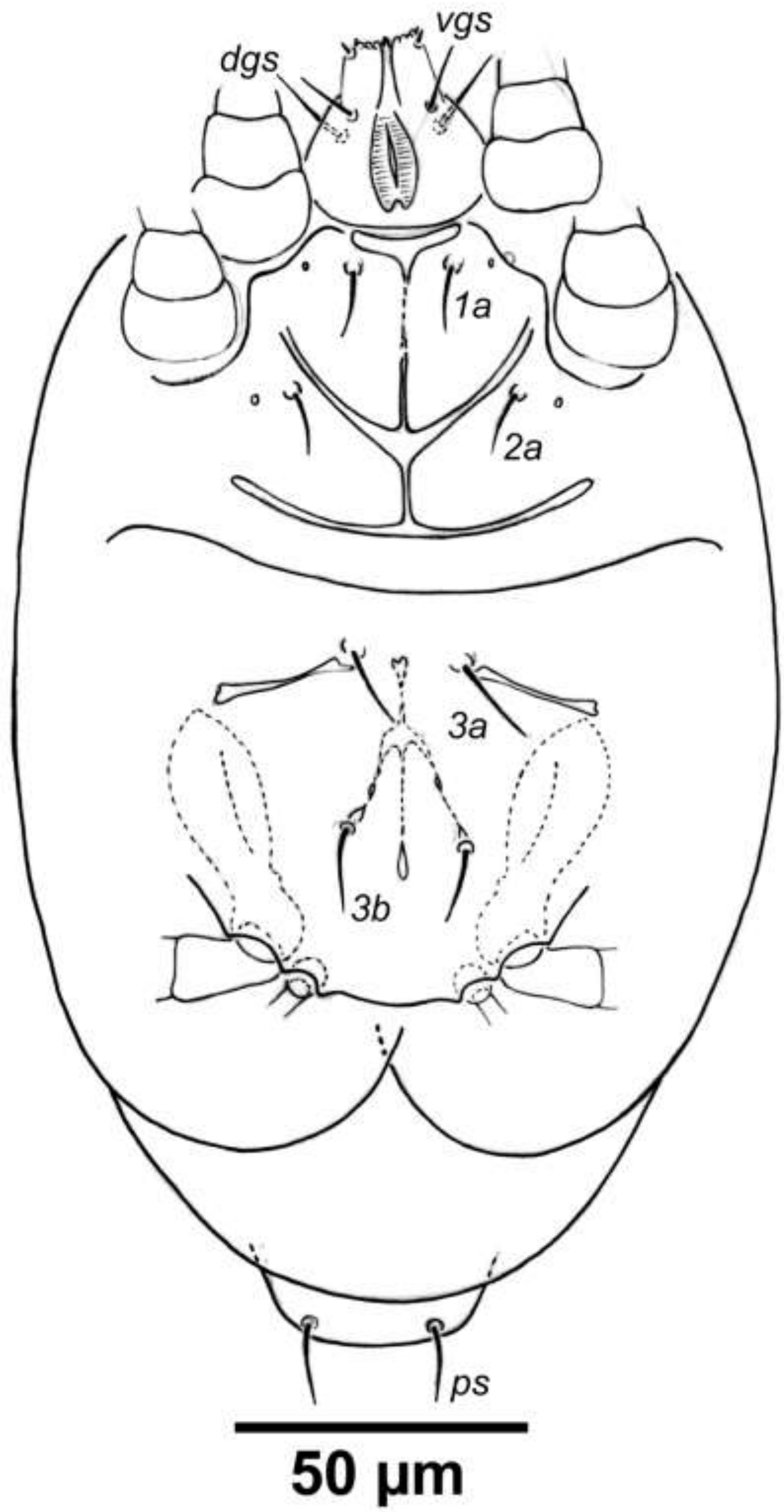

Figure 87. *Excelsotarsonemus* sp. n. (female). Ventral surface of the idiosoma.

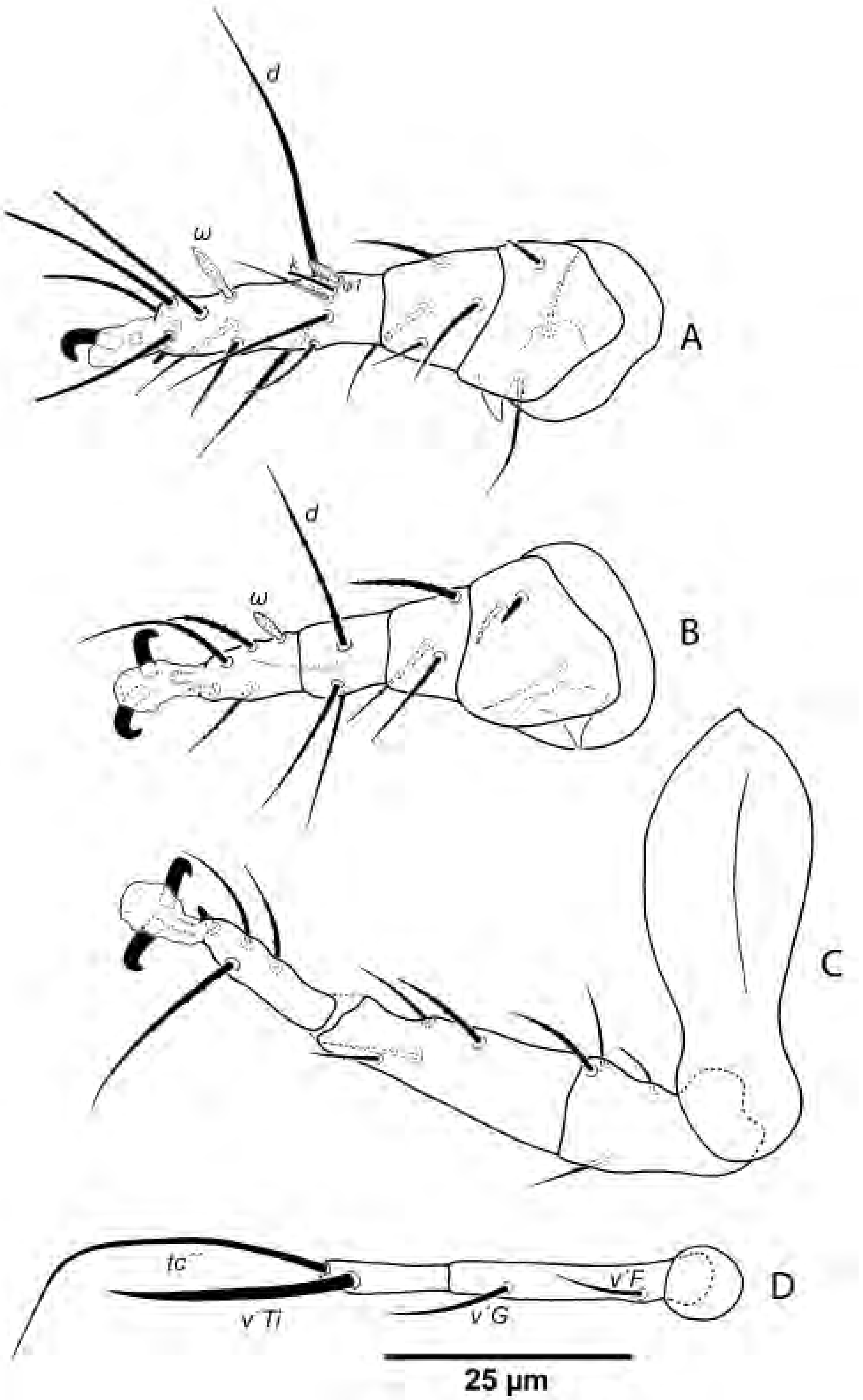

Figure 88. *Excelsotarsonemus* sp. n. (female). Legs: A, leg I; B, leg II; C, leg III; D, leg IV.

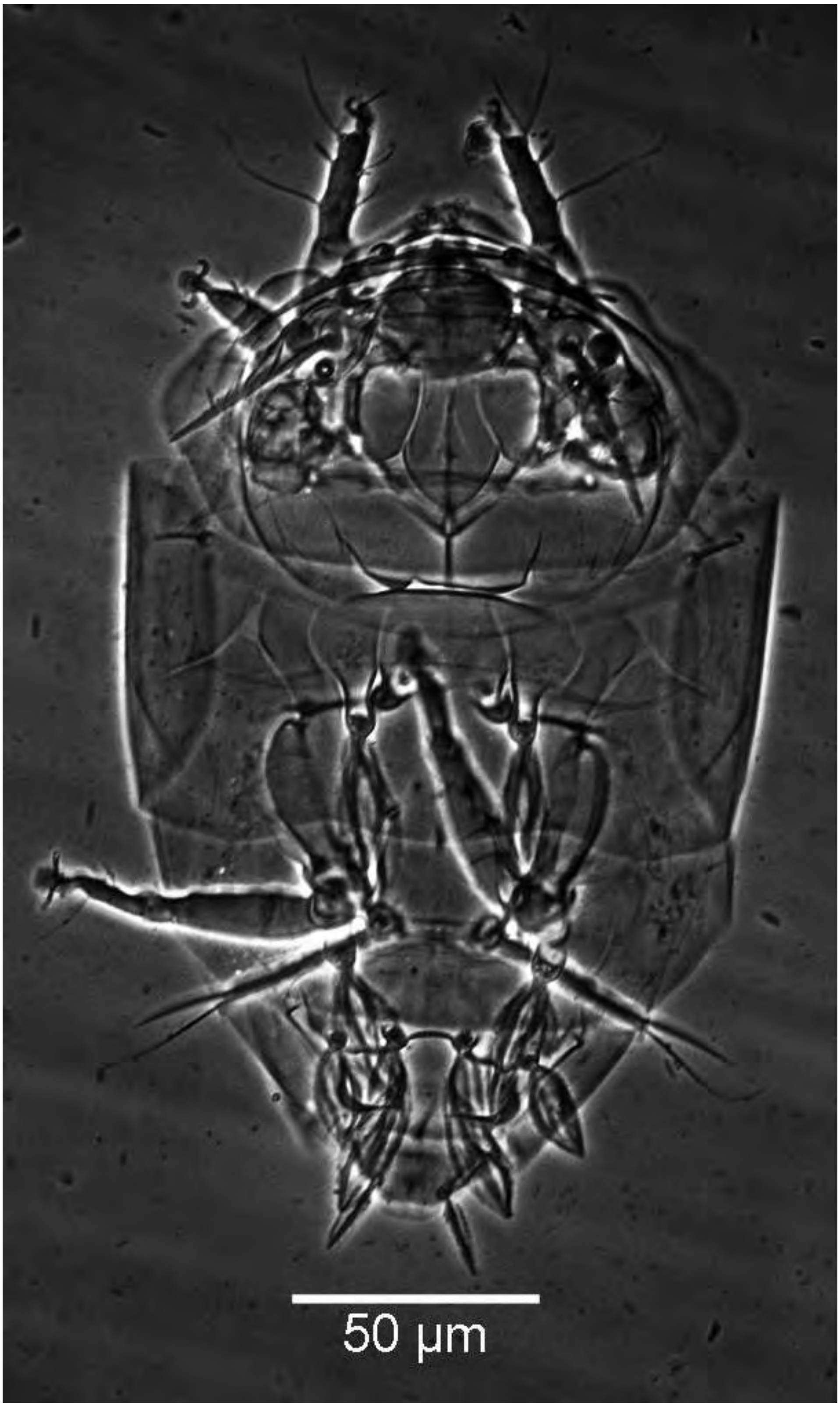

Figure 89. *Excelsotarsonemus* sp. n. (female). Dorsal PC micrograph of the idiosoma.

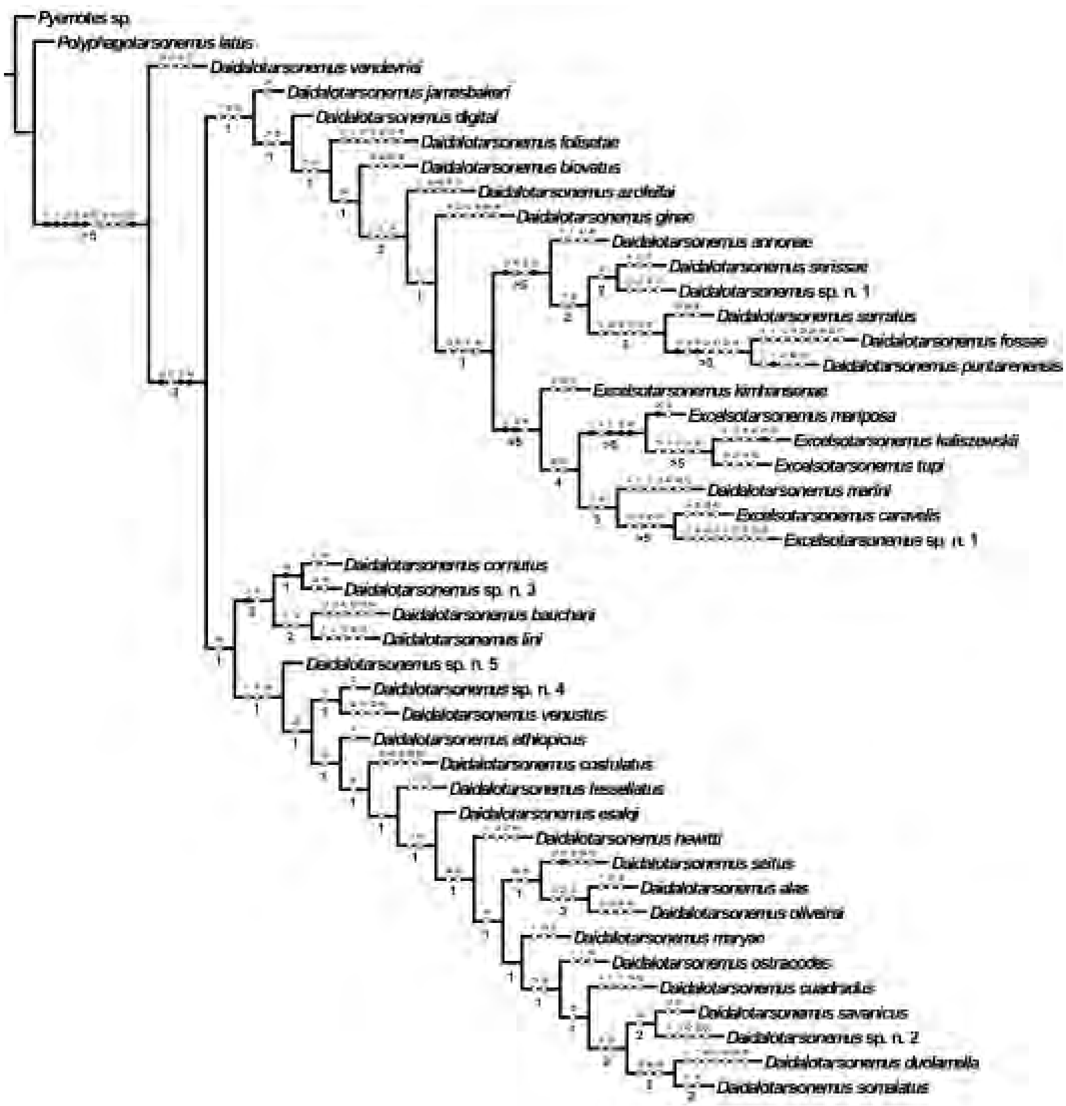

Figure 90. Strict consensus tree (L=241, CI=27, RI= 56). Numbers above circles are characters; below branches are Bremer branch support indexes; black circles are sinapomorphies; white circles are homoplasious characters

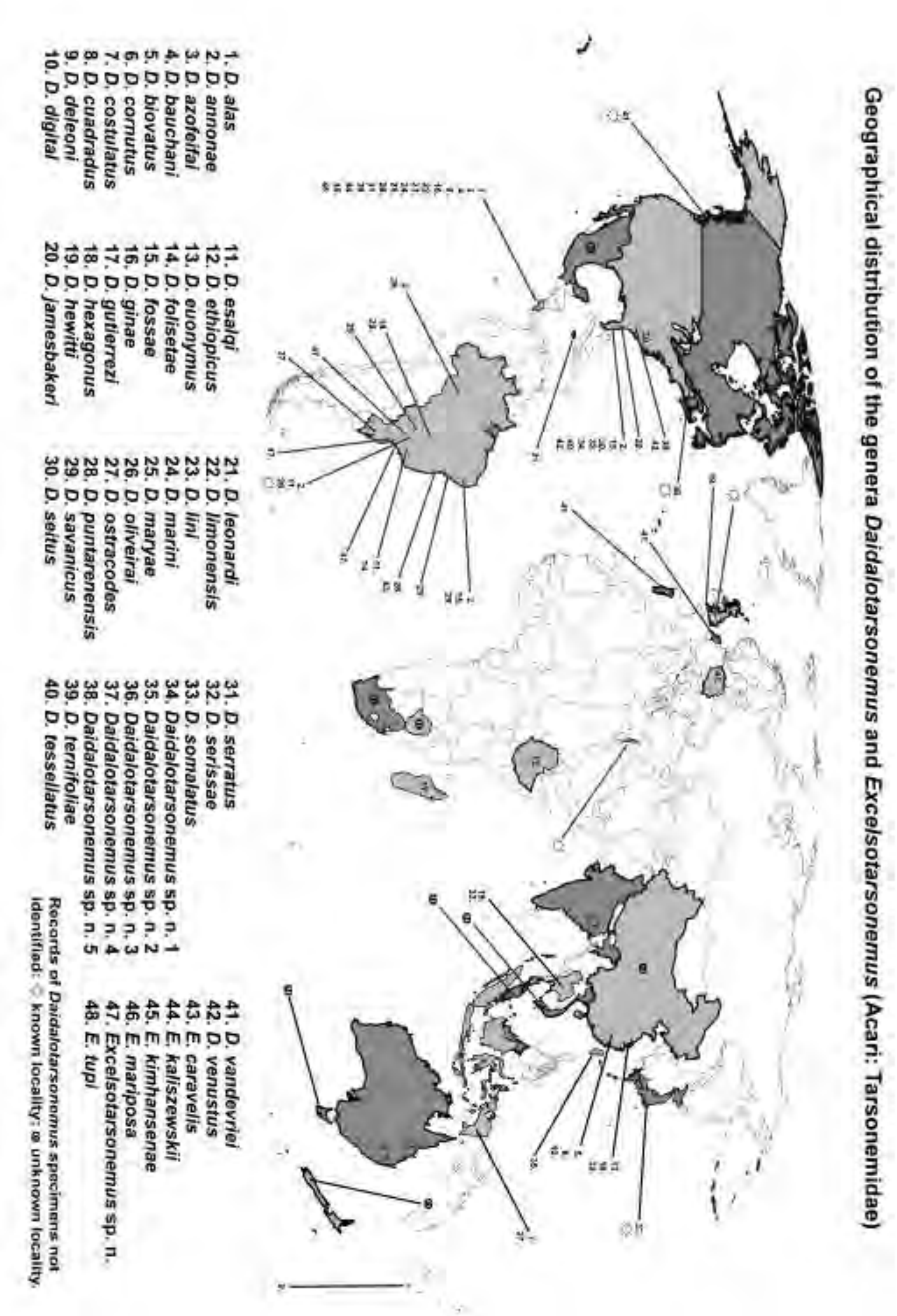

Figure 91. Map of geographical distribution for *Daidalotarsonemus* and *Excelsotarsonemus* (Acari: Tarsonemidae).

Table

Table 1. Records of *Daidalotarsonemus* (Acari: Tarsonemidae) not identified at the specific level.

Sex	Country	Locality	Host	Deposition
F	Australia	Nerang-	*Litchi chinensis* Sonn.	QM
F	Australia	Townsville-	*Elaeocarpus elliffii* Hyland &	QM
F	Australia	Mt.	-	QM
F	Brazil	Matão-SP	*Croton urucurana*	DZSJRP
F	Canada	Vancouver-	*Aesculus hippocastanum* L.	CNC
F	Canada	Ottawa-ON	House dust samples	CNC
M	China	-	*Pyracantha koidzumii*	USNM*
M	China	-	*Serissa* sp. (Rubiaceae)	USNM*
M	China	-	*Zelkova serrata* (Thunb.) Makino	USNM*
F	England	Wytham-BS	dead wood of *Quercus* sp.	CNC
F	England	Wytham-BS	*Crataegus* sp. (Rosaceae)	CNC
F	India	Kalyani-WB	*Ziziphus mauritiana*	BCKV**
M	Israel	Nahalal	*Citrus* sp. (Rutaceae)	ARC***
M	Israel	Kfar	*Citrus* sp. (Rutaceae)	ARC***
F	Japan	Tokyo	*Tetradium* sp. (Rutaceae)	NRIC****
F	Malasia	-	*Phalaenopsis* sp. (Orchideaceae)	USNM*
F	Mexico	-	*Murraya* sp. (Rutaceae)	USNM*
F	N.	-	*Passiflora edulis* Sims	QM
M	Singapore	-	*Dracaena* sp. (Ruscaceae)	USNM*
F	South	-	*Macadamia* sp. (Proteaceae)	ARC***
F	Vietnam	-	*Ochna integerrima* (Lour.) Merr.	USNM*
-	Zimbabwe	-	-	-*****

Remarks: *Individuals intercepted by the USDA quarantine system; ** Voucher material: BCKV - Acarology Laboratory, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India (photos of the specimen gently provided by Dr. K. Karmakar); *** Voucher material: ARC - Acarology Laboratory, Biosystematics Division, Agricultural Research Council, Pretoria, South Africa (material gently loaned by Dr. E. Ueckermann); **** Record made by Ito (1963). Voucher material: National Resources Inventory Center, Japan; ***** Record made by Meyer *et al.* (1973).

CONCLUSION

A considerable improvement about the knowledge of the morphology and phylogeny of *Daidalotarsonemus* and *Excelsotarsonemus* has been brought by all information presented. It represents an advance not only for these genera, but for the studies of all Tarsonemidae mites.

Some morphological characters are now clearly interpreted. There has been realized that most of dorsal setae on these genera has strong veins, probably for raising them up. They probably allow these mites to become airborne, gliding within the canopies. It was also noticed the production of cerotegument over the body; with fungi, lichens and bacteria accumulating on it. Microrganisms attached over the body of these mites, with such well elaborated mechanism for gliding, might be an important factor on the dispersion of pathogens over crops and natural areas.

Eighteen new *Daidalotarsonemus* and three new *Excelsotarsonemus* species have been described here, being most of them already published. Most are from Central and South Americas, where the biomes are still poorly sampled for tarsonemids. It suggests how diverse these unexplored areas may be. According to the results presented, *Daidalotarsonemus* has been recorded worldwide. Thus, the real number of species of this genus is probably much higher than what is currently known.

Some evidences point *Excelsotarsonemus* may not be syster group of *Daidalotarsonemus*. Instead, it would be junior synonym of it. However, it is decided to wait for more information before making changes on the taxonomic status of *Excelsotarsonemus*. Within *Daidalotarsonemus*, there is a species group well defined by its morphological characters, the *fossae* group. Their key characters are the position of setae *c1* near the tergite D border, and the heavily arched shape of tegula.

Morphological differences were found among all the types studied, reinforcing the hypothesis they are all valid species. It is clear that more new species of *Daidalotarsonemus* and *Excelsotarsonemus* are still to be found, given the great number of natural areas unexplored for tarsonemids around the world.

APPENDIX

Appendix A

Morphological characters used in the phylogenetic analysis

Dorsal chaetotaxy (characters 0 to 50):

0. Tubercles on setae *v1*: absent (0); present (1).

1. Shape of the setae *v1*: setiform (0); leaf-shaped (1); stout (2).

2. Serration on setae *v1*: absent (0); present (1).

3. Width of the median portion of the setae *v1*: about the same as their basis (0); larger than their basis (1).

4. Shape of the setae *sc2*: setiform (0); falcate (1); leaf-shaped (2).

5. External veins on the setae *sc2*: absent (0); present (1).

6. Width of the median portion of the setae *sc2*: about the same as their basis (0); larger than their basis (1).

7. Serration on setae *sc2*: absent (0); present (1).

8. Length of the setae *sc2*: about the same as setae *v1* (0); about two times longer than the setae *v1* (1).

9. Shape of the setae *c1*: setiform (0); not setiform (1).

10. Shape of the setae *c1* (when not setiform): stout (0); leaf-shaped (1).

11. Shape of the setae *c1* (when leaf-shaped): linear (0); elliptical (1).

12. Tip of the setae *c1*: pointed (0); rounded (1).

13. Serration on setae *c1*: absent (0); serrated (1).

14. External veins on the setae *c1*: absent (0); present (1).

15. Number of veins on the setae *c1*: one (0); two (1).

16. Position of the setae *c1*: near border of the tergite C (0); near border of the tergite D (1).

17. Shape of the setae *c2*: setiform (0); not setiform (1).

18. Shape of the setae *c2* (when not setiform): stout (0); leaf-shaped (1).

19. Tip of the setae *c2*: pointed (0); rounded (1).

20. Serration on setae *c2*: absent (0); present (1).

21. Shape of the setae *d*: setiform (0); not setiform (1).

22. Shape of the setae *d* (when not setiform): stout (0); leaf-shaped (1).

23. Shape of the setae *d* (when leaf-shaped): linear (0); elliptical (1).

24. Tip of the setae *d*: pointed (0); rounded (1).

25. Central veins on the setae *d*: absent (0); present (1).

26. Number of central veins on the setae *d*: one (0); two (1).

27. Width of the setae *d*: about the same width along the entire setae (0); about two times wider on the median portion than in its basis (1); at least three times wider on the median portion than in its basis (2).

28. Secondary veins on the setae *d*: absent (0); present (1).

29. Shape of the setae *e*: setiform (0); not setiform (1).

30. Shape of the setae *e* (when not setiform): stout (0); leaf-shaped (1).

31. Shape of the setae *e* (when leaf-shaped): linear (0); elliptical (1).

32. Tip of the setae *e*: pointed (0); rounded (1).

33. Central veins on the setae *e*: absent (0); present (1).

34. Number of central veins on the setae *e*: one (0); two (1).

35. Symmetry of the setae *e*: symmetric (0); asymmetrical (1).

36. Length of the setae *e*: 1/3 of the length of setae *f* (0); at least 1/2 of the length of setae *f* (1).

37. Width of the setae *e*: about the same width along the entire setae (0); about two times wider on the median portion than in its basis (1); at least three times wider on the median portion than in its basis (2).

38. Direction of the setae *e*: straight (0); heavily curve (1).

39. Secondary veins on the setae *e*: absent (0); present (1).

40. Shape of the setae *f*: setiform (0); not setiform (1).

41. Shape of the setae *f* (when not setiform): stout (0); leaf-shaped (1).

42. Shape of the setae *f* (when leaf-shaped): linear (0); elliptical (1).

43. Tip of the setae *f*: pointed (0); rounded (1).

44. Central veins on the setae *f*: absent (0); present (1).

45. Number of central veins on the setae *f*: one (0); two (1).

46. Symmetry of the setae *f*: symmetric (0); asymmetrical (1).

47. Length of the setae *f*: smaller than setae *d* (0); about the same length as setae *d* (1); longer than setae *d* (2).

48. Width of the setae *f*: narrower than setae *d* (0); about the same width as setae *d* (1); larger than setae *d* (2).

49. Aspect of the setae *f*: same as setae *d* (0); different than setae *d* (1).

50. Shape of the setae *h*: setiform (0); leaf-shaped (1).

Dorsal plates (characters 51 to 56):

51. Length of the prodorsal shield: longer than the length of the tergite C (0); about the same as the length of the tergite C (1).

52. Ornamentation on prodorsal shield: absent (0); irregular (1); reticulated (2).

53. Length of the tergite C: about the same as the tergite D (0); much shorter than the tergite D (1).

54. Ornamentation on tergite C: absent (0); irregular (1); reticulated (2).

55. Ornamentation on tergite D: absent (0); irregular (1); reticulated (2).

56. Ornamentation on tergite EF: absent (0); irregular (1); reticulated (2).

Gnathosoma (character 57):

57. Length of palps: about the same length as setae *vgs* (0); longer than the length of setae *vgs* (1).

Ventral chaetotaxy (characters 58 to 61):

58. Tubercles on setae *1a*: absent (0); present (1).

59. Tubercles on setae *2a*: absent (0); present (1).

60. Tubercles on setae *3a*: absent (0); present (1).

61. Tubercles on setae *3b*: absent (0); present (1).

Ventral plates (characters 62 to 67):

62. Prosternal apodeme: reaching the level of the sejugal apodeme (0); reaching the level of the apodemes 2 and becoming diffuse from this point to the sejugal apodeme (1).

63. Apodemes 2: reaching the prosternal apodeme (0); not reaching the prosternal apodeme (1).

64. Sejugal apodeme: uninterrupted without a median furrow in the middle (0); uninterrupted with a median furrow in the middle (1); inconspicuous in the middle (2).

65. Poststernal apodeme: bifurcated in the middle (0); not bifurcated in the middle (1).

66. Tegula: slightly arched (0); heavily arched (1).

67. Fissures around apodemes 4: absent (0); present (1).

Appendix B

Character matrix for the *Daidalotarsonemus* and *Excelsotarsonemus* species (Acari: Tarsonemidae).

Taxon	Char1	Char2	Char3	Char4	Char5	Char6	Char7	Char8	Char9	Char10	Char11	Char12	Char13	Char14	Char15	Char16	Char17	Char18	Char19	Char20
Pyemotes sp.	0	0	-	0	0	0	-	0	0	0	1	0	-	-	0	0	0	-	0	0
Polyphagotarsonemus latus	0	0	-	0	0	0	-	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus alas	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	1	0	-	0	0
Daidalotarsonemus annonae	0	0	-	1	0	1	0	1	0	0	1	1	1	0	0	1	1	0	1	0
Daidalotarsonemus azofeifai	1	0	-	1	0	1	0	0	0	0	1	1	1	0	0	1	1	0	0	0
Daidalotarsonemus bauchani	1	0	-	1	0	0	-	0	0	0	0	1	1	0	0	0	1	0	0	0
Daidalotarsonemus biovatus	1	0	-	?	0	?	?	0	0	?	0	0	-	-	0	?	0	-	0	0
Daidalotarsonemus cornutus	1	0	-	1	0	?	?	?	0	0	1	0	-	-	0	?	0	-	0	0
Daidalotarsonemus costulatus	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus cuadradus	1	0	-	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	0
Daidalotarsonemus digital	1	0	-	1	0	1	0	?	0	1	0	0	-	-	0	?	0	-	0	0
Daidalotarsonemus duolamella	1	0	-	1	0	?	?	1	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus esalqi	1	0	-	1	0	1	0	0	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus ethiopicus	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus folisetae	0	0	-	0	0	0	-	0	0	1	0	0	-	-	0	1	0	-	0	0
Daidalotarsonemus fossae	1	0	-	1	0	1	1	0	0	1	0	1	0	-	1	1	0	-	1	1
Daidalotarsonemus ginae	1	0	-	1	0	1	0	1	0	1	1	1	1	0	0	1	1	0	0	0
Daidalotarsonemus hewitti	1	0	-	1	0	0	-	0	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus jamesbakeri	1	0	-	1	0	0	-	0	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus lini	1	0	-	1	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	0
Daidalotarsonemus marini	1	0	-	1	0	0	-	0	0	1	1	1	1	1	1	1	1	1	0	0
Daidalotarsonemus maryae	1	0	-	1	0	1	0	1	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus oliveirai	1	0	-	1	0	1	0	0	0	1	0	0	-	-	1	1	0	-	0	0
Daidalotarsonemus ostracodes	?	0	-	0	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus puntarenensis	0	1	0	1	0	1	0	1	0	1	0	1	0	-	0	1	0	-	1	1
Daidalotarsonemus savanicus	1	0	-	1	0	1	0	0	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus seitus	1	0	-	1	0	1	0	0	0	1	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus serissae	1	0	-	1	0	1	1	0	0	?	1	1	1	0	0	?	1	0	1	1
Daidalotarsonemus serratus	1	0	-	1	0	1	0	1	0	1	0	1	1	0	0	1	1	0	1	1
Daidalotarsonemus somalatus	1	0	-	1	0	1	0	0	0	1	1	0	-	-	0	1	0	-	0	0
Daidalotarsonemus sp. n. 1	1	0	-	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1
Daidalotarsonemus sp. n. 2	1	0	-	1	0	1	0	0	0	1	0	0	-	-	0	1	0	-	0	0
Daidalotarsonemus sp. n. 3	1	0	-	1	0	0	-	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus sp. n. 4	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus sp. n. 5	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus tessellatus	1	0	-	1	0	1	0	0	0	1	0	0	-	-	0	1	0	-	0	0
Daidalotarsonemus vandevriei	1	0	-	1	0	0	-	0	0	0	0	0	-	-	0	0	0	-	0	0
Daidalotarsonemus venustus	1	0	-	1	0	1	0	0	0	0	0	0	-	-	0	0	0	-	0	0
Excelsotarsonemus caravelis	1	0	-	1	0	1	0	1	0	1	1	1	1	1	0	1	1	1	0	0
Excelsotarsonemus kaliszewskii	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	1	0	0	1
Excelsotarsonemus kimhansenae	1	1	1	1	0	1	0	1	0	1	1	1	1	1	0	1	1	1	0	0
Excelsotarsonemus mariposa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1
Excelsotarsonemus sp. n.	1	0	-	1	0	1	0	1	0	1	1	1	1	1	0	1	1	1	0	0
Excelsotarsonemus tupi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0

Continued

Taxon	Char21	Char22	Char23	Char24	Char25	Char26	Char27	Char28	Char29	Char30	Char31	Char32	Char33	Char34	Char35	Char36	Char37	Char38	Char39	Char40
Pyemotes sp.	-	0	0	0	-	-	0	0	0	0	-	0	0	-	-	0	0	-	0	0
Polyphagotarsonemus latus	-	0	0	0	-	-	0	0	0	0	-	0	0	-	-	0	0	-	0	1
Daidalotarsonemus alas	-	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1	0	0	1
Daidalotarsonemus annonae	-	0	1	1	1	1	0	1	0	1	1	0	1	1	1	0	1	0	0	1
Daidalotarsonemus azofeifai	-	0	0	1	1	0	0	1	0	0	-	0	1	1	1	0	1	1	0	1
Daidalotarsonemus bauchani	-	0	0	1	1	0	0	1	0	1	0	0	1	1	0	0	1	0	0	0
Daidalotarsonemus biovatus	-	0	?	1	1	0	0	1	0	0	-	0	1	1	1	0	1	1	0	0
Daidalotarsonemus cornutus	-	0	?	1	1	1	0	1	0	1	0	0	1	1	0	0	1	1	0	0
Daidalotarsonemus costulatus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus cuadradus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	1	1
Daidalotarsonemus digital	-	0	?	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus duolamella	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1
Daidalotarsonemus esalqi	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus ethiopicus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus folisetae	-	0	1	1	1	0	0	0	0	0	-	0	1	1	1	1	0	-	0	1
Daidalotarsonemus fossae	0	1	1	1	0	-	1	0	0	0	-	0	1	0	-	1	0	-	0	1
Daidalotarsonemus ginae	-	0	0	1	1	0	0	1	0	0	-	0	1	1	1	0	1	1	0	0
Daidalotarsonemus hewitti	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	0	-	0	1
Daidalotarsonemus jamesbakeri	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus lini	-	0	1	1	1	1	1	1	0	1	0	0	1	1	0	0	1	1	0	0
Daidalotarsonemus marini	-	0	1	1	1	0	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus maryae	-	0	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	1	0	1
Daidalotarsonemus oliveirai	-	0	0	1	1	0	0	0	0	0	-	0	1	1	1	0	1	0	0	1
Daidalotarsonemus ostracodes	-	0	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	1	1	1
Daidalotarsonemus puntarenensis	0	0	1	1	1	0	0	0	0	0	-	0	1	0	-	1	0	-	0	1
Daidalotarsonemus savanicus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	0	1	1
Daidalotarsonemus seitus	-	0	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	1	0	1
Daidalotarsonemus serissae	1	0	?	1	1	1	0	1	0	1	1	0	1	1	1	0	1	0	0	1
Daidalotarsonemus serratus	1	0	1	1	1	1	0	1	0	1	0	0	1	0	-	1	0	-	0	1
Daidalotarsonemus somalatus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	0
Daidalotarsonemus sp. n. 1	1	0	1	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus sp. n. 2	-	0	1	1	1	0	0	1	0	1	0	0	1	1	1	0	1	1	1	1
Daidalotarsonemus sp. n. 3	-	0	0	1	1	1	0	1	0	1	0	0	1	1	0	0	1	1	0	0
Daidalotarsonemus sp. n. 4	-	0	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus sp. n. 5	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus tessellatus	-	1	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Daidalotarsonemus vandevriei	-	0	0	1	0	-	1	0	0	0	-	0	1	0	-	1	0	-	0	1
Daidalotarsonemus venustus	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Excelsotarsonemus caravelis	-	0	0	1	1	1	0	1	0	1	1	0	1	1	1	0	1	0	1	1
Excelsotarsonemus kaliszewskii	1	0	1	1	1	1	0	1	0	1	1	1	1	1	0	0	1	0	0	1
Excelsotarsonemus kimhansenae	-	0	0	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	0	1
Excelsotarsonemus mariposa	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1
Excelsotarsonemus sp. n.	-	0	0	1	1	1	0	1	0	1	0	0	1	1	1	0	1	1	0	1
Excelsotarsonemus tupi	-	0	1	1	1	1	0	1	0	1	1	1	1	0	-	0	0	-	0	1

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Taxon	Char41	Char42	Char43	Char44	Char45	Char46	Char47	Char48	Char49	Char50	Char51	Char52	Char53	Char54	Char55	Char56	Char57	Char58	Char59	Char60
Pyemotes sp.	0	-	0	0	0	-	-	0	0	-	0	1	1	0	-	0	0	0	0	-
Polyphagotarsonemus latus	0	-	0	0	0	-	-	0	0	-	0	0	-	0	-	0	0	0	0	-
Daidalotarsonemus alas	1	0	0	0	1	1	1	0	1	1	0	0	-	0	-	0	0	0	1	0
Daidalotarsonemus annonae	0	-	0	0	1	1	1	0	1	0	0	1	1	0	-	1	0	0	1	0
Daidalotarsonemus azofeifai	1	0	0	0	1	1	1	0	1	1	0	1	0	1	1	1	0	0	1	0
Daidalotarsonemus bauchani	0	-	0	0	1	1	0	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus biovatus	1	0	0	0	1	1	0	0	1	1	0	1	0	1	0	0	0	0	1	0
Daidalotarsonemus cornutus	0	-	0	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus costulatus	1	0	0	0	1	1	1	0	1	0	0	0	-	0	-	1	1	0	1	0
Daidalotarsonemus cuadradus	1	1	1	0	1	1	1	0	1	1	0	0	-	0	-	0	0	0	1	1
Daidalotarsonemus digital	1	0	0	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	0
Daidalotarsonemus duolamella	1	1	1	0	1	1	0	0	1	1	0	1	0	1	0	0	0	1	1	1
Daidalotarsonemus esalqi	1	1	0	0	1	1	1	0	1	1	0	0	-	1	1	0	0	0	1	1
Daidalotarsonemus ethiopicus	1	0	0	0	1	1	1	0	1	1	0	1	0	1	1	1	0	0	1	1
Daidalotarsonemus folisetae	1	0	0	0	1	1	1	0	1	0	0	1	0	1	0	0	0	0	1	0
Daidalotarsonemus fossae	0	-	0	0	1	0	-	1	0	-	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus ginae	1	0	0	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus hewitti	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1	0	0	1	0
Daidalotarsonemus jamesbakeri	0	-	1	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus lini	0	-	0	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus marini	1	1	0	0	1	1	1	0	1	1	0	0	-	1	1	1	0	0	1	1
Daidalotarsonemus maryae	1	1	0	0	1	1	1	0	0	1	0	0	-	0	-	0	0	0	1	0
Daidalotarsonemus oliveirai	1	1	0	0	1	1	1	0	1	1	0	0	-	1	1	1	0	0	1	0
Daidalotarsonemus ostracodes	1	1	1	0	1	1	1	0	1	1	0	0	-	0	-	0	0	0	1	0
Daidalotarsonemus puntarenensis	0	-	0	0	1	0	-	1	0	-	0	1	1	1	1	1	0	0	1	0
Daidalotarsonemus savanicus	1	1	1	0	1	1	1	0	1	1	0	1	1	0	-	1	0	0	1	1
Daidalotarsonemus seitus	1	1	0	0	1	1	1	0	1	1	0	0	-	0	-	0	0	0	1	1
Daidalotarsonemus serissae	1	1	0	0	1	1	1	0	1	0	0	1	0	1	1	0	0	0	1	1
Daidalotarsonemus serratus	0	-	0	0	1	1	1	0	1	0	0	1	0	1	1	0	0	0	1	0
Daidalotarsonemus somalatus	1	1	1	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus sp. n. 1	0	-	0	0	1	1	1	0	1	1	0	0	-	0	-	0	0	0	1	1
Daidalotarsonemus sp. n. 2	1	1	1	0	1	1	0	0	1	1	0	1	0	0	-	1	0	0	1	0
Daidalotarsonemus sp. n. 3	0	-	0	0	1	1	1	0	1	1	0	1	0	1	0	0	0	0	1	0
Daidalotarsonemus sp. n. 4	1	1	0	0	1	1	1	0	1	1	0	1	0	1	1	1	0	0	1	1
Daidalotarsonemus sp. n. 5	1	0	0	0	1	1	1	0	1	1	0	1	0	1	1	0	0	0	1	1
Daidalotarsonemus tessellatus	1	0	0	1	?	?	?	?	?	?	?	?	?	?	?	?	0	0	1	1
Daidalotarsonemus vandevriei	0	-	0	0	1	0	-	1	0	-	0	1	0	1	0	0	0	0	1	1
Daidalotarsonemus venustus	1	1	0	0	1	1	0	0	1	1	0	1	0	1	0	1	0	0	1	0
Excelsotarsonemus caravelis	1	1	1	0	1	1	1	0	1	1	0	1	1	0	-	1	0	0	1	0
Excelsotarsonemus kaliszewskii	0	-	1	1	1	1	1	1	1	0	1	0	-	1	1	1	1	1	1	0
Excelsotarsonemus kimhansenae	0	-	0	0	1	1	1	0	1	1	0	1	0	0	-	0	1	1	1	0
Excelsotarsonemus mariposa	0	-	0	1	1	1	1	1	1	1	1	1	0	0	-	1	0	0	1	0
Excelsotarsonemus sp. n.	1	0	0	0	1	1	1	0	1	1	0	1	0	1	0	0	1	1	1	0
Excelsotarsonemus tupi	0	-	0	0	1	1	1	0	0	-	1	1	0	1	0	1	1	1	1	0

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Taxon	Char61	Char62	Char63	Char64	Char65	Char66	Char67
Pyemotes sp.	0	0	-	0	-	0	0
Polyphagotarsonemus latus	0	0	-	0	-	0	0
Daidalotarsonemus alas	0	1	0	1	0	0	0
Daidalotarsonemus annonae	0	1	1	1	1	0	0
Daidalotarsonemus azofeifai	0	1	1	1	1	0	0
Daidalotarsonemus bauchani	1	1	1	0	-	0	0
Daidalotarsonemus biovatus	0	1	1	0	-	0	0
Daidalotarsonemus cornutus	0	1	1	1	1	0	0
Daidalotarsonemus costulatus	0	1	1	1	1	0	0
Daidalotarsonemus cuadradus	0	1	1	1	0	0	0
Daidalotarsonemus digital	0	1	0	1	0	0	0
Daidalotarsonemus duolamella	1	1	0	0	-	0	0
Daidalotarsonemus esalqi	0	1	1	1	1	1	0
Daidalotarsonemus ethiopicus	0	1	1	1	1	0	0
Daidalotarsonemus folisetae	0	1	0	1	0	0	0
Daidalotarsonemus fossae	1	1	1	1	1	1	0
Daidalotarsonemus ginae	1	1	1	1	0	0	1
Daidalotarsonemus hewitti	0	1	1	1	0	0	0
Daidalotarsonemus jamesbakeri	0	1	0	1	0	0	0
Daidalotarsonemus lini	0	1	1	1	1	0	0
Daidalotarsonemus marini	1	1	0	1	0	0	0
Daidalotarsonemus maryae	0	1	1	1	0	0	0
Daidalotarsonemus oliveirai	0	1	0	1	0	0	0
Daidalotarsonemus ostracodes	0	1	1	1	0	0	0
Daidalotarsonemus puntarenensis	1	1	1	1	1	0	0
Daidalotarsonemus savanicus	0	1	1	1	1	0	0
Daidalotarsonemus seitus	0	1	0	1	0	0	1
Daidalotarsonemus serissae	0	1	1	1	1	0	0
Daidalotarsonemus serratus	1	1	1	1	1	0	1
Daidalotarsonemus somalatus	0	1	1	1	1	0	0
Daidalotarsonemus sp. n. 1	0	1	1	1	1	1	0
Daidalotarsonemus sp. n. 2	0	1	1	1	1	0	0
Daidalotarsonemus sp. n. 3	0	1	1	1	0	0	0
Daidalotarsonemus sp. n. 4	0	1	1	1	1	0	0
Daidalotarsonemus sp. n. 5	0	1	1	1	1	0	0
Daidalotarsonemus tessellatus	0	1	1	1	1	1	0
Daidalotarsonemus vandevriei	0	1	0	1	1	1	0
Daidalotarsonemus venustus	0	1	1	1	1	0	0
Excelsotarsonemus caravelis	1	0	-	1	0	0	1
Excelsotarsonemus kaliszewskii	1	0	-	1	0	0	1
Excelsotarsonemus kimhansenae	0	1	0	1	0	0	0
Excelsotarsonemus mariposa	1	1	0	0	-	0	0
Excelsotarsonemus sp. n.	0	0	-	0	-	0	1
Excelsotarsonemus tupi	1	0	-	0	-	0	1

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