



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

Luiz Alexandre Simões de Castro

**Hydryphantoidea Piersig, 1896 (Acari: Parasitengonina:
Hydrachnidiae) from South America, with an emphasis in
Rhynchohydracaridae:**

description of new species, homologies of idiosomal structures and a
catalog with geographic distribution, a key for species and molecular
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Tese apresentada como parte dos requisitos para
obtenção do título de Doutor em Biologia Animal,
junto ao Programa de Pós-Graduação em Biologia
Animal, do Instituto de Biociências, Letras e
Ciências Exatas da Universidade Estadual
Paulista “Júlio de Mesquita Filho”, Câmpus de São
José do Rio Preto.

Financiadora: CAPES
Processo (88887.342428/2019-00)

Orientador: Prof. Dr. Antonio C. Lofego
Coorientadora: Prof^a. Dr^a. Heather C. Proctor

São José do Rio Preto
2022

C355h Castro, Luiz Alexandre Simões de
Hydryphantoidea Piersig, 1896 (Acari: Parasitengonina: Hydrachnidae) from South America, with an emphasis in Rhynchohydracaridae: description of new species, homologues of idiosomal structures and a catalog with geographic distribution, a key for species and molecular data / Luiz Alexandre Simões de Castro. -- São José do Rio Preto, 2022
179 f. : il., tabs., fotos, mapas

Tese (doutorado) - Universidade Estadual Paulista (Unesp), Instituto de Biociências Letras e Ciências Exatas, São José do Rio Preto
Orientador: Antonio Carlos Lofego
Coorientador: Heather Coreen Proctor

1. Taxonomia Animal. 2. Invertebrados de água doce. 3. Ácaro. I. Título.

Sistema de geração automática de fichas catalográficas da Unesp. Biblioteca do Instituto de Biociências Letras e Ciências Exatas, São José do Rio Preto. Dados fornecidos pelo autor(a).

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02 de junho de 2022

For Miriam and Marina

ACKNOWLEDGEMENTS

I would like to thank Dr. Antonio C. Lofego, supervisor of this work for introducing me to the field of Acarology, more than 20 years ago. I am thankful to him for all things that were necessary for this thesis to be concluded. I wish to express my gratitude not only for his guidance but also for his friendship. Obrigado por tudo, Tonhão!

Thanks to Dr. Heather C. Proctor (University of Alberta, Canada) for the co-supervision of this work. For sparking my interest in water mites for the first time since I got in contact with her thoughtful and sagacious papers and books. For always responding promptly to all my questions, and for making possible the collecting trip to Ecuador.

I thank Dr. Gilberto J. de Moraes, for providing full access to all facilities and equipment at the zoology sector of the Escola Superior de Agricultura “Luiz de Queiroz”, University of São Paulo (ESALQ-USP) where most of this work was carried out. I am very indebted to his guidance since I was an undergraduate student and for his encouragement during all these years.

I am particularly grateful to Dr. Alberto S. Corrêa, for providing access to the Laboratory of Molecular Ecology of Arthropods (EntoMol), Department of Entomology and Acarology of the Escola Superior de Agricultura “Luiz de Queiroz”, University of São Paulo (ESALQ-USP) where all the steps of extraction, amplification, and purification of genetic samples were conducted and also for reviewing the qualities of DNA contigs.

I thank Dr. Raphael de C. Castilho, for providing access to the Laboratory of Microscopy, zoology sector of the Escola Superior de Agricultura “Luiz de Queiroz”, University of São Paulo (ESALQ-USP) where taxonomic work was carried out.

Drs. Bruce Halliday, Carlos H. W. Flechtmann, Harry Smit, Tom Goldschmidt and Vladimir Pešić sent to me very important and rare references. Thus, I would like to thank them for all this support and incentive.

Dr. David R. Cook (*in memoriam*) has been an incredible source of inspiration and information due to his colossal water mite works. I am very indebted to him, especially for sending an edition of his “Studies on Neotropical water mites” with a dedicatory.

MSc. Rosely S. Pereira and MSc. Cristina J. V. Marquesine introduced me to molecular techniques. Thanks for all their support and patience! MSc. Frederico Hickmann offered his assistance with the use of QGIS software. MSc. Frederico N. S. Sato, managed and uploaded genetic sequences to BOLD. Thank you all!

I thank my friend Dr. Douglas de Araújo, from the Federal University of Mato Grosso do Sul (UFMS), for hosting me in his residence in Campo Grande, for providing access to the Laboratory of Arachnology, and for the transport and assistance in the fieldwork in Aquidauana-MS.

Thanks to Dr. José Marcos Rezende, for making possible the collecting trip to Goiás. Deydre B.J. de Oliveira and Marina L. Pessôa, undergraduate students of IBILCE-UNESP helped with fieldwork in Pirenópolis-GO. I also would like to thank the

agronomist Antonio A. Müller de Oliveira (*in memoriam*). As chief of State Park of Pireneus (PEP), Mr. Müller promptly provided access, technical support, and all information about this conservation unit and its environs.

Many thanks to my friend, Dr. Carlos Alberto Ortega-Ojeda, from Universidad Central del Ecuador, to his wife, Dr. Elsa Liliana M. Molina and especially to his mother, Mrs. Marta Ortega-Ojeda (“Dona Martita”) for being excellent and lovable hosts during my collecting trip to Ecuador. I also thank all their relatives, who made my visit to Ecuador unforgettable. ¡Muchas gracias, amigos! Saludos desde Brasil.

I express my gratitude to all colleagues of Setor de Acarologia, “Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ-USP) for sharing good moments for more than four years in the lab routine. Special thanks to biologist Lásaro V. F. da Silva (*in memoriam*) for his daily assistance and for giving me special tips on how to prepare a good Hoyer’s medium. I miss his good mood and joy every day when I was in the lab.

Thanks to my friends, MSc. Vinícius da S. Borges and Msc. Lina M. G. Cano for the support during the collecting trips in the Atlantic rainforest. I also thank MSc. Elias S. de Figueiredo, Dr. Sofía Jiménez Jorge, Dr. Jorge L. Muñoz Marticorena and Dr. João Boavida da Cruz for sharing cultural and mite topics during our endless conversations in confraternizations and weekend barbecues.

I thank the Natural Sciences and Engineering Research Council of Canada (NSERC), Project/Grant ID: RES0046033 (Budget owner: H. C. Proctor), for the financial support for collecting trip to Ecuador.

This work was carried out with one year support of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brazil (CAPES) – Financing code 88887.342428/2019-00001, which I thank.

Special thanks to biologists Dr. Jônatas B. do Amaral, Dr. Leandro Yokota and Dr. Michel D. Gianeti, simply for always being my friends, in all moments, since 1999!

Finally, I would like to thank my wife, Miriam G. de Chaves and my daughter, Marina Chaves S. de Castro for their patience and care during every day of our lives, in good times and hard times. I love you!

What, no myths?

“[...] the fascinating world of the very small never came to the notice of primitive peoples. If you think about this for a minute, it is not really surprising. They had no way of even knowing it was there, and so of course they didn't invent any myths to explain it! It wasn't until the microscope was invented in the sixteenth century that people discovered that ponds and lakes, soil and dust, even our body, teem with tiny living creatures, too small to see, yet too complicated and, in their own way, beautiful – or perhaps frightening, depending on how you think about them.”

Richard Dawkins (2011, p. 95-96)

RESUMO

Ácaros aquáticos, também conhecidos como Hydrachnidia, Hydrachnidiae, Hydrachnellae ou Hydracarina, podem ser encontrados em todos os ambientes de água doce e pertencem à coorte Parasitengonina, caracterizada por um tipo de desenvolvimento único dentro dos Acariformes, em que as larvas ocupam um nicho diferente dos outros estágios: após emergir dos ovos, são hexápodes e procuram um hospedeiro adequado, tornando-se ectoparasitas. O tempo de vida desta fase, assim como o tipo de hospedeiro e os locais de fixação são diversos. Após ingurgitadas, as larvas entram em um estágio quiescente chamado protoninfa, e então passam por uma muda e desenvolvem um quarto par de pernas, atingindo as condições de deutoninfa ativa, tritoninfa inativa e adulto ativo. Por essa razão, adultos e ninfas podem ser encontrados no mesmo ambiente, como predadores. Os Hydrachnidiae são compostos por 7 superfamílias e o monofiletismo deste grupo foi recentemente recuperado por meio de análises moleculares, com exceção de Hydryphantoidea, considerada parafilética. Na América do Sul, esta superfamília é representada por 4 famílias: Hydryphantidae, Hydrodromidae, Rhynchohydracaridae e Thermacaridae. Dentre os Hydryphantoidea, Rhynchohydracaridae apresenta origem sul-americana, com as subfamílias Clathrosperchontinae e Rhynchohydracarinae vivendo em águas correntes límpidas. Nesse contexto, o objetivo deste trabalho foi estudar os Hydryphantoidea da América do Sul com ênfase em Rhynchohydracaridae. Novas espécies dos gêneros *Clathrosperchonella* (fêmea, macho e larva) e *Rhynchohydracarus* (fêmea e macho) do Brasil foram descritas. DNA barcodes foram obtidos pela primeira vez para esta família, com sequências do gene COI para *Clathrosperchon minor*, *C. punctatus*, *Clathrosperchonella olovi* sp. nov. e *Rhynchohydracarus armiger* sp. nov. Uma proposta de homologia para estruturas do idiossoma *dorsalia*, *ventralia*, *lateralia* e *glandularia* em Rhynchohydracaridae é apresentada, padronizando futuros estudos morfológicos e novas descrições. Novas ocorrências de Hydryphntoidea são relatadas para o Brasil e Equador. Um catálogo de espécies de Hydryphantoidea descritas até o momento para a América do Sul é apresentado, com mapas de distribuição e uma chave ilustrada para famílias, subfamílias, gêneros e subgêneros.

Palavras-chave: Ácaros aquáticos. Riachos. Morfologia. Taxonomia integrativa. COI.

ABSTRACT

The water mites, also known as Hydrachnidia, Hydrachnidae, Hydrachnellae or Hydracarina, can be found in all freshwater environments and belong to the cohort Parasitengonina, characterized by a unique type of development within Acariformes, in which the larvae occupy a different niche from the other stages: after emerging from the eggs, hexapod larvae search for a suitable host and become ectoparasites. The life span of this stage, as well as the type of host and the places of attachment, are diverse. After engorged, larvae enter into a quiescent stage called protonymph, and then undergo a molt and develop a fourth pair of legs, reaching the conditions of active deutonymph, inactive tritonymph and active adult. For this reason, adults and nymphs can be found in the same environment, as predators. Hydrachnidae is composed of 7 superfamilies and the monophyly of this group has been recently recovered by means of molecular analysis, except for Hydryphantoidea, considered paraphyletic. In South America, this superfamily is represented by four families: Hydryphantidae, Hydrodromidae, Rhynchohydracaridae and Thermacaridae. Among hydryphantoids, Rhynchohydracaridae presents a South American origin, with the subfamilies Clathrosperchontinae and Rhynchohydracarinae living in pristine running waters. In this context, the aims of this work were study the Hydryphantoidea of South America with an emphasis in Rhynchohydracaridae. New species of the genera *Clathrosperchonella* (female, male and larva) and *Rhynchohydracarus* (female and male) from Brazil are described. DNA barcodes were obtained for the first time for this family, with sequences of the gene COI for *Clathrosperchon minor*, *C. punctatus*, *Clathrosperchonella olovi* sp. nov. and *Rhynchohydracarus armiger* sp. nov. A proposal for the homologies of dorsalia, ventralia, lateralialia and glandularia in Rhynchohydracaridae is presented and should help to facilitate and standardize future morphological studies and descriptions of new species in this family. New reports are presented for Brazil and Ecuador. A catalog of all described species of Hydryphantoidea until the moment for South America is presented, with maps of distribution and an illustrated key for the families, subfamilies, genera and subgenera.

Keywords: Water mites. Streams. Morphology. Integrative taxonomy. COI.

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LIST OF ABBREVIATIONS AND INITIALS

BNHM	British Natural History Museum, London, England
DCB	Departamento de Ciências Biológicas, São José do Rio Preto, Brazil
FMNH	Field Museum of Natural History, Chicago, USA
GNHM	Göteborgs Naturhistoriska Museum, Gothenburg, Sweden
IFML	Instituto Fundación Miguel Lillo, Tucumán, Argentina
MBR	Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires, Argentina
MNH	Museum of Natural History, Podgorica, Montenegro
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MNHU	Museum für Naturkunde der Humboldt Universität, Berlin, Germany
NRM	Naturhistoriska Riksmuseet, Stockholm, Sweden
RMNH	Naturalis Biodiversity Center, Leiden, The Netherlands
SMF	Senckenberg Museum, Frankfurt, Germany
SMNH	Swedish Museum of Natural History, Stockholm, Sweden

LIST OF SIMBOLS

M	moles
µl	microliter
mg	miligram
ml	millilitre
s	seconds
RPM	revolutions per minute
mQ	milli Quality
PCR	Polymerase Chain Reaction
dNTPs	deoxynucleotide triphosphates
Taq	thermostable DNA polymerase I
COI	cytochrom oxydase subunit 1
mtCOI	mitochondrial cytochrom oxydase subunit 1

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1 GENERAL INTRODUCTION

1.1 Characterization and biology of water mites (Hydrachnidiae)

There are approximately 7500 species of water mites *sensu stricto* (Acariformes: Hydrachnidiae), also known as Hydrachnidia, Hydrachnellae or Hydracarina, distributed among 56 families, 485 genera and 214 subgenera (WALTER *et al.* 2009; ZHANG *et al.* 2011; DABERT *et al.* 2016; SMIT, 2020b). Water mites can be found in all freshwater environments, both lentic and lotic, from phytotelmata (plants that accumulate water), e.g. bromeliads (ROSSO DE FERRADÁS & FERNÁNDEZ, 2001; PEŠIĆ *et al.* 2015a, 2015b), water-filled treeholes and leaf axils (SMITH & HARVEY, 1989; WALTER & PROCTOR, 2013), lakes, temporary ponds, rivers (PROCTOR, 2015), the hyporheic interstitial zone of streams (GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020), springs and seepage areas (COOK, 1974), near-freezing glacial meltwater (WALTER & PROCTOR, 2013) and even in hot springs (COOK, 1980, 1988; MARTIN & SCHWOERBEL, 2002). Just one family (Pontarachnidae) has secondarily invaded brackish waters and the coastal region of the oceans (PROCTOR *et al.* 2015; CHATTERJEE *et al.* 2019).

Water mites belong to the cohort Parasitengonina (WALTER *et al.* 2009). This cohort is characterized by a unique type of development within Acariformes, in which the larvae occupy a different niche from the other stages: after emerging from the eggs, hexapod larvae search for a suitable host and become ectoparasites (SMITH *et al.* 2010; SMITH & COOK, 2016). The duration of this stage, the type of host and the places of attachment on the host, are diverse (LANCIANI, 1971; PRASAD & COOK, 1972; SMITH, 1984; SMITH & OLIVER, 1986). In most taxa, larvae parasitize insects of many orders, such as Odonata, Plecoptera, Hemiptera, Diptera and Trichoptera (PROCTOR *et al.* 2015). In some more derived groups, larvae live as commensals in sponges or as parasites of mussels, snails or amphibians (GOLDSCHMIDT *et al.* 2002, 2020, 2021a, 2021b; GOLDSCHMIDT & KOEHLER, 2007; GOLDSCHMIDT & FU, 2011; MARTIN & SCHWOERBEL, 2002; SMITH & COOK, 2016). After becoming fully engorged, larvae enter into a quiescent stage called protonymph, and then they undergo a molt and develop the fourth pair of legs, reaching the conditions of active predatory deutonymph, inactive tritonymph and finally, active predatory adult.

Depending on the species, adults and nymphs feed on eggs and larvae of insects, cladocerans, ostracods and copepods. Less frequently, some species prey on other mites and also rotifers, nematodes, oligochaetes and isopods (WALTER & PROCTOR, 2013; PROCTOR *et al.* 2015).

1.2 Phylogeny of Hydrachnidiae

The current classification of the cohort Parasitengonina (WALTER *et al.* 2009) includes Hydrachnidiae and three other lineages: Erythraiae, Trombidiae and Stygothrombiae. The first two lineages are terrestrial and known as “velvet mites”, with approximately 3000 described species (VARMA, 1993; MAKOL & WOHLTMANN, 2012). Members of the third lineage, the Stygothrombiae, are elongate-bodied mites found in the interstitial region of aquatic environments and classified into a single superfamily (Stygothrombidoidea), which share the same lifestyle as the Hydrachnidiae. However, its phylogenetic relationship with water mites is still not well understood (DABERT *et al.* 2016). Hydrachnidiae is composed of seven superfamilies: Hydrovolzioidea, Eylaoidea, Hydryphantoidea, Lebertioidea, Hydrachnoidea, Hygrobatoidae and Arrenuroidea (COOK, 1974). The monophyly of the Hydrachnidiae has long been controversial. According to reviews in BARR, (1972) and ABÉ (2000), until the 1970s, many authors did not consider water mites as a natural group, and that they instead consisted of lineages that independently invaded freshwater habitats. Hydrovolzioidea has been thought potentially unrelated to the rest of the Hydrachnidiae due to their very different morphology of the male ejaculatory complex (BARR, 1972) and also to the apparent absence of osmoregulatory structures called genital acetabula or genital papillae (which were later determined to be present by ALBERTI & BADER, 1990). Regarding the Stygothrombidoidea, opinions vary, with no consensus. KETHLEY (1982), HARVEY (1998) and JIN (2000) consider them to be water mites, while WALTER *et al.* (2009) and SMITH *et al.* (2010) classify them separately from Hydrachnidiae. For testing the position of Hydrovolzioidea and Stygothrombidoidea among Hydrachnidiae at a higher level, DABERT *et al.* (2016) inferred a phylogeny for representatives of all water mite superfamilies and potentially related Parasitengonina using multiple molecular markers. Among the results, they reached a hypothesis of monophyletic clades Parasitengonina and Hydrachnidiae with great support, including

the Hydrovolzioidea within the Hydrachnidae. The enigmatic Stygothrombiae was recovered as a potential sister group to the water mites, but with weak support. All superfamilies within the Hydrachnidae had strong support as being monophyletic, except for Hydryphantoidea, which was paraphyletic. Only two hydryphantoid families were included in the study: Hydrodromidae was recovered as a monophyletic clade, whereas the much larger family Hydryphantidae was clearly paraphyletic. The six other hydryphantoid families (Ctenothyadidae, Malgasacaridae, Rynchohydracaridae, Teratothyadidae, Thermacaridae and Zelandothyadidae) were not included in that work due to the lack of available molecular data or fresh specimens at that time. All these families (except Rynchohydracaridae) are very rare, with few representatives found at remote places.

1.3 Integrative taxonomy in Hydrachnidae

The concept “cybertaxonomy”, according to FISHER & DOWLING (2010), consists of integrating traditional and modern methods for doing classical taxonomy, including the use of hyperlinks along with descriptions of new species of mites, incorporating genetic sequences in available databases on the internet, such as GenBank and, more recently, Barcode of Life Data System (BOLD). Thus, several current studies have successfully proven the use of an integrative approach based on both morphological and genetic data for describing new species of water mites (MARTIN *et al.* 2010; PEŠIĆ *et al.* 2012, 2020a, 2021b; 2021c; STÅLSTEDT *et al.* 2013; PEŠIĆ & SMIT, 2014, 2017, 2018, 2020, 2022a); FISHER *et al.* 2015, 2017; HERON & SHEFFIELD, 2016; O'NEILL *et al.* 2016; DING *et al.* 2017; GARCÍA-JIMÉNEZ *et al.* 2017; BLATTNER *et al.* 2019; ZHANG *et al.* 2019; DING *et al.* 2020; MONTES-ORTIZ *et al.* 2021; GU *et al.* 2022; PEŠIĆ, 2022; PEŠIĆ & GOLDSCHMIDT, 2022), unraveling species-complex (PEŠIĆ *et al.* 2020b) and also for species redescrptions (ZHANG *et al.* 2020). Integrative taxonomy has also been useful for the resolution of taxonomic uncertainties in Hydrachnidae, such as species delimitation (FISHER *et al.* 2015; GARCÍA-JIMÉNEZ *et al.* 2017; WIĘCEK *et al.* 2020), cryptic diversity (PEŠIĆ & SMIT, 2016; PEŠIĆ *et al.* 2017, 2021a) and molecular correlation between immature and adult stages (ALARCÓN-ELBAL *et al.* 2020; LEWISCH *et al.* 2021). Other powerful molecular approaches include construction of DNA barcode

libraries (VASQUEZ *et al.* 2017, 2020; BLATTNER *et al.* 2019; MONTES-ORTIZ & ELÍAS-GUTIÉRREZ, 2020; PEŠIĆ *et al.* 2021d) and, by the use of next-generation sequencing, molecular determination of water mite prey (VASQUEZ *et al.* 2021) and obtaining complete mitochondrial genome sequences (HIRUTA *et al.* 2020).

1.4 State of knowledge of Hydrachnidae in South America

The first studies related to Hydrachnidae in South America date from the end of the 19th century, with the descriptions of *Eylais protendens* Müller, var. *protendens* and *Hydrachna globosa* de Geer, var. *miliaria*, from Argentina (BERLESE, 1888), followed by several descriptions of new species from Brazil (KOENIKE, 1890a; 1890b; 1891; 1894; 1905), one from Paraguay (DADAY, 1905) and one from Venezuela (THOR, 1897). During the first three decades of the 20th century, increasing knowledge of South American water mite fauna continued at a slow pace, with some works for Colombia (WALTER, 1914), Brazil and Peru (WALTER, 1919a), Surinam (WALTER, 1919b) and Argentina (WALTER, 1925).

Major efforts for covering a wider range of collecting, with more detailed descriptions and ecological data were possible due to efforts made by several local and foreign researchers, who sent material to two European water mite taxonomists: Karl H. Viets, from Germany and Olov Lundblad, from Sweden. Even without traveling to South America, these water mite specialists received hundreds of samples, mainly from Brazil and Paraguay. VIETS (1927; 1933, 1935, 1936a, 1936b, 1937, 1938, 1954a, 1954b, 1959) described 31 new species from north, northeast and south of Brazil, whereas LUNDBLAD (1930, 1936a, 1936b, 1936c, 1937a, 1937b, 1938a, 1938b, 1941a, 1941b, 1941c, 1941d, 1942, 1943a, 1943b, 1944a) studied samples collected from 120 different locations, from which 75 of them came from south and southeast Brazil and 45 from Paraguay, with the discovery and description of 82 new species.

Other countries also had their water mite fauna investigated in the same way as discussed above, though on a minor scale, with studies for Argentina (LUNDBLAD, 1944b), Ecuador (LUNDBLAD, 1944b), Peru (LUNDBLAD, 1924; 1944b; VIETS, 1953), Colombia (LUNDBLAD, 1953; VIETS, 1956) and Venezuela (VIETS, 1956). In the 1960s, new contributions were made by Wulf Besch from Germany, with works for

Chile (BESCH, 1962, 1964, 1963b), Argentina (BESCH, 1963a, 1963b, 1964) and Brazil (BESCH, 1965, 1969). Only in the 1970s did South American researchers begin to get directly involved within the systematics of Hydrachnidiae, with great contributions of two Argentinean researchers: Beatriz Rosso de Ferradás and, lately, Hugo R. Fernández, who developed several taxonomic and ecological studies of water mites, from 1973 to 2011, mainly from Argentina (ROSSO DE FERRADÁS, 1973a, 1973b, 1973c, 1974, 1975a, 1975b, 1977, 1978, 1980, 1981a, 1981b, 1981c, 1982, 1983, 1984a, 1984b, 1987, 1989, 1991, 1993, 1995, 1996, 2000, 2006a, 2006b; ROSSO DE FERRADÁS *et al.* 1987; ROSSO DE FERRADÁS & SMIT, 1998; ROSSO DE FERRADÁS & MATTONI, 1999; ROSSO DE FERRADÁS & FERNÁNDEZ, 2004, 2005, 2007; 2009; FERNÁNDEZ, 1987a, 1987b, 1992, 1993, 1994a, 1994b, 1995, 2001, 2002, 2003, 2004; FERNÁNDEZ & PALACIOS, 1989; FERNÁNDEZ & GROSSO, 1991; FERNÁNDEZ & ROSSO DE FERRADÁS, 2008; FERNÁNDEZ *et al.* 2009; FERNÁNDEZ & FOSSATI-GASCHIGNARD, 2011) and, eventually, from other South American countries, such as Bolivia (ROSSO DE FERRADÁS *et al.* 2004), Paraguay (ROSSO DE FERRADÁS & BÖTTGER, 1997) and Venezuela (ROSSO DE FERRADÁS & FERNÁNDEZ, 2001). Also very important and remarkable were the studies made by the North American researcher David R. Cook during the 1980s, who traveled to northern and austral Argentina and Chile, collecting and describing a total of 154 new species (COOK, 1980, 1988). Some other efforts to sample new localities and describe new species from Brazil near the end of the 20th century were conducted by VIETS (1977) for the Atlantic Rainforest and VIDRINE (1985), for the Amazonian Rainforest.

Compared to the majority of voluminous works of the last century, current knowledge of South American Hydrachnidiae has accumulated at a slower pace during the last two decades, both in terms of sampling locations and the number of new described species. GOLDSCHMIDT (2002) counted only 1360 species described for the Neotropical region up to that year, just 892 from South America, with several regions and many probable new species still remaining unknown with an estimation of about 5500 neotropical species. Since then, there have been new and current efforts for sampling new localities, where water mite fauna is still unknown or poorly studied, with studies for Argentina (SMIT, 2002, 2018, 2020a; PEŠIĆ & SMIT, 2022b), Bolivia (VALDECASAS, 2019; SMIT, 2020a), Brazil (SMIT, 2007; PEŠIĆ *et al.* 2015a, 2015b,

2016; CASTRO *et al.* 2017, 2020, 2022), Chile (TUZOVSKIJ, 2016; TUZOVSKIJ & STOLBOV, 2016a, 2016b; TUZOVSKIJ & GERECKE, 2020; SMIT, 2021), Colombia (PEŠIĆ *et al.* 2010; GOLDSCHMIDT *et al.* 2021c), Ecuador (GOLDSCHMIDT & GERECKE, 2003; TUZOVSKIJ, 2008; TUZOVSKIJ & GERECKE, 2020; VALDECASAS & GARCÍA-JÍMENEZ, 2021), French Guiana (SMIT & CLAVIER, 2019) and Surinam (MAKHAN, 2005; SMIT, 2020a).

1.5 Hydryphantoidea from South America

Members of the superfamily Hydryphantoidea Piersig, 1896 are found in all types of freshwater environments in all continents, except Antarctica. It includes 8 families (ZHANG *et al.* 2011). More recently, SMIT (2020), considered Malgasacaridae and Zelandothyadidae as synonyms and hence, there are currently 7 families, four of which occur in South America: Hydryphantidae, Rhynchohydracaridae, Hydrodromidae and Thermacaridae (ROSSO DE FERRADÁS & FERNÁNDEZ, 2005; GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020). In this continent, until now, the families with the highest degree of diversity are Hydryphantidae (8 subfamilies, 10 genera and 36 species) and Rhynchohydracaridae (2 subfamilies, 3 genera and 10 species). The Hydrodromidae (monotypic, with 9 species) and Thermacaridae (monotypic, with just 1 species found in thermal waters) are less diverse. The high diversification observed in the first two families was most likely due to the presence of ancestral clades present in Gondwana, reflecting a basic pattern of vicariance, e.g. in the endemic subfamily Rhynchohydracarinae (DI SABATINO *et al.* 2008). Regarding Hydryphantidae, a relevant work conducted by GOLDSCHMIDT & GERECKE (2003) for Central America and the Andean region of South America discussed 17 species, proposing a new genus, 10 new species and 3 new synonyms. However, almost all works so far made dealing with South American hydryphantoids have not included descriptions of larvae, PRASAD & COOK (1972) and SMITH (1976) have published detailed studies on the larval morphology and taxonomy of the Nearctic region. The only three exceptions for South America are the works of MARTIN & SCHWOERBEL (2002) and CASTRO *et al.* (2017, 2020) with larval descriptions of *Thermacarus andinus* Martin & Schwoerbel, 2002, *Hydryphantes ramosus* Daday, 1905 and *Clathrosperchonella olovi* Castro, Proctor & Lofego, 2020, respectively. For further

understanding of the phylogeny of this family, studies on the life cycle (larval stages, hosts and preys) need to be urgently performed. In this sense, PROCTOR *et al.* (2015) emphasized the importance of obtaining the larval stage, when possible, for more accurate identification of species, due to their plesiomorphic morphology, which follows the standards of terminology and chaetotaxy found in Acariformes, as opposed to what is used for adults. Furthermore, the identification of insects parasitized by larvae and preyed by deutonymphs and adults can help to unravel the co-evolution mechanisms between aquatic mites and their insect hosts and prey. Therefore, taking into account that Hydryphantoidea is definitively considered paraphyletic, with an expectation of great diversity in the Neotropics, still widely unknown, it can be assumed that further studies will certainly contribute with a more profound comprehension of taxonomy, morphology and phylogenetic relationships within this group, with special attention to South American fauna. In this sense, the aims of this work were: (1) to describe a new species of the South American endemic genus *Clathrosperschonella* (Rhynchohydracaridae), including a description of female, male and, for the first time, a larva for this family (Chapter I); (2) to describe male and female of a new species of *Rhynchohydracarus* (Rhynchohydracaridae) including DNA barcodes and a proposal of idiosomal homologies in this family (Chapter II); (3) to present a catalog of Hydryphantoidea from South America, including new data on the geographical distribution, an identification key for all species and molecular data for 3 genera and 4 species of Rhynchohydracaridae.

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**CHAPTER I. A NEW SPECIES OF *Clathrosperchonella* Lundblad 1937
(ACARIFORMES: HYDRACHNIDIAE: HYDRYPHANTOIDEA:
RHYNCHOHYDRACARIDAE) FROM BRAZIL, WITH DESCRIPTIONS OF THE
FEMALE, MALE AND LARVA**

2. A new species of *Clathrosperchonella* Lundblad 1937 (Acariformes: Hydrachnidiae: Hydryphantoidea: Rhynchohydracaridae) from Brazil, with descriptions of the female, male and larva

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2.1 Abstract

We describe a new species of the genus *Clathrosperchonella*, *C. olovi* **sp. nov.** from Brazil, including complete information for female, male and larva. This brings the number of named species in the Rhynchohydracaridae to thirteen. In addition, we provide a key to named species of *Clathrosperchonella*.

Key words: water mites, *C. olovi*, streams, morphology, taxonomy

2.2 Introduction

The water mite family Rhynchohydracaridae includes five genera and, up to now, twelve named species (ZHANG *et al.* 2011). These mites inhabit lotic habitats such as the surface and interstitial waters of streams (COOK, 1974; SMITH *et al.* 2010), as well as springs. They are often found on algae, moss and root mats associated with rocks (COOK, 1980). Ecological characteristics related to their larval hosts, prey during deutonymphal and adult stages, and mode of sperm transfer still remain unknown (PROCTOR *et al.* 2015). Regarding their distribution and taxonomy, rhynchohydracarids appear to be restricted to the New World and are currently arranged into three subfamilies (WALTER *et al.* 2009): Clathrosperchontinae, distributed through North, Central and South America (COOK, 1974, 1980);

Rhynchohydracarinae, which is restricted to the Neotropical region (DI SABATINO *et al.* 2008) and Santiagocarinae, known only from Central America (VALDECASAS, 2001) (Table 1). Here we increase knowledge of Rhynchohydracaridae from Brazil and Neotropical region by describing a third species of *Clathrosperchonella*, including complete morphological descriptions of female, male and larva, plus a discussion about its distinctive morphological features and distribution. It is the first time that a rhynchohydracarid larva is described. We also provide a key to known *Clathrosperchonella* species.

Table 1. Subfamilies, genera and species of Rhynchohydracaridae

Subfamily, Genera	Species	Type locality	Distribution
Clathrosperchontinae			
<i>Clathrosperchon</i>	<i>americanus</i> Habeeb, 1953	USA ¹	USA ¹
	<i>crassipalpis</i> Lundblad, 1936	Brazil ²	Brazil ³ Colombia ⁴
	<i>minor</i> Lundblad, 1937	Brazil ⁵	Brazil ³ Colombia ⁴ Guatemala ⁶ Paraguay ³
	<i>ornatus</i> Cook, 1974	USA ⁷	USA ⁷
	<i>punctatus</i> Cook, 1980	Argentina ⁸	Argentina ^{8,9,10,11} Costa Rica ⁸ México ⁸ Panama ¹² Paraguay ¹³
	<i>transversus</i> Viets, 1977	Guatemala ¹⁴	Guatemala ^{6, 14, 15} Panama ¹² Venezuela ¹⁶
<i>Clathrosperchonella</i>	<i>asterifera</i> Lundblad, 1937	Brazil ¹⁷	Brazil ³ Paraguay ³
	<i>olovi</i> sp. nov.	Brazil	Brazil
	<i>rutae</i> Lundblad, 1938	Brazil ¹⁸	Brazil ³
Rhynchohydracarinae			
<i>Rhynchohydracarus</i>	<i>carmenae</i> Valdecasas, 2001	Panama ¹²	Panama ¹²
	<i>dividuus</i> Lundblad, 1941	Paraguay ³	Paraguay ³
	<i>testudo</i> Lundblad, 1936	Brazil ²	Brazil ³
Santiagocarinae			
<i>Gledhillia</i>	<i>coibensis</i> Valdecasas, 2001	Panama ¹²	Panama ¹²
<i>Santiagocarus</i>	<i>robustus</i> Valdecasas, 2001	Panama ¹²	Panama ¹²

¹HABEEB, 1953; ²LUNDBLAD, 1936; ³LUNDBLAD, 1941; ⁴LUNDBLAD, 1953; ⁵LUNDBLAD, 1937b; ⁶BÖTTGER, 1984; ⁷COOK, 1974; ⁸COOK, 1980; ⁹ROSSO DE FERRADÁS, 1984; ¹⁰ROSSO DE FERRADÁS, 2000; ¹¹FERNÁNDEZ, 2003; ¹²VALDECASAS, 2001; ¹³VIETS & BÖTTGER, 1986; ¹⁴VIETS, 1977a; ¹⁵VIETS, 1977b; ¹⁶GRUIA, 1988; ¹⁷LUNDBLAD, 1937a; ¹⁸LUNDBLAD, 1938.

2.3 Material and methods

Water mites were collected by the first author, removing mosses with a spatula from submerged rocks in a shallow, unnamed rainforest stream that flows in “Poço das Antas” in Cardoso Island State Park, Cananéia, São Paulo, Brazil (Fig. 1A). Moss mats were transferred with water to plastic vials and taken to a laboratory at University of São Paulo, where mites were separated from the substrate under a stereomicroscope. Males were immediately preserved in GAW solution (PROCTOR *et al.* 2015) whereas females were kept in small glass containers filled with water and kept in the laboratory at room temperature, between 20–25°C, for oviposition. A single female laid a small clutch of three eggs on the bottom of the plastic vial. Embryonic development in the laboratory took 20 days, in a temperature ranging between 20–25°C, from oviposition to hatching. After hatching, larvae were directly slide-mounted in PVA (BioQuip, CA, USA) and females were also preserved in GAW solution for subsequent dissection, slide-mounting in Hoyer’s medium and taxonomical study, using differential interference contrast microscopy.

Adult idiosomal structures are named according to the terminology used in LUNDBLAD (1927). Dorsal region: *dgl*–dorsoglandularia, *lgl*–lateroglandularia, *pr*–preocularia, *po*–postocularia. Ventral region: *cxgl*–coxoglandularia, *vgl*–ventroglandularia. Gnathosoma: P-1 to P-5–palp segments from proximal to distal. For larval idiosomal and leg setae, we employed the terminology used by SMITH *et al.* (2010) and PROCTOR *et al.* (2015). Dorsal region: *vi*–internal vertical, *si*–internal scapular; *ve*–external vertical, *se*–external scapular; *c1*, *c2*, *d1*, *d2*, *e1*, *e2*–hysterosomal setae. Ventral region: *1a*, *1b*, *3a*–coxal plate setae; *ps1*, *ps2*–setae associated with the excretory pore; *f1*, *h1*, *h2*, *h3*, *h4*–hysterosomal setae. Gnathosoma: P-1 to P-5–palp segments from proximal to distal; *Hy1*, *Hy2*–hypostomal setae. Legs: I, II or III–Leg-1 to 5 free leg segments from proximal to distal (trochanter, femur, genu, tibia and tarsus); (σ) for solenidion on each genu of leg I to III; (ϕ) for solenidion on each tibia of leg I to III; (ω) for solenidion on each tarsus of legs I to II; (“2”) for eupathidium on each tarsus of leg I to II; L–length; W–width; n–number of specimens measured. All measurements are given in μm . The holotype and paratypes of the new species are deposited in the Acari collection of Department of Zoology and Botany (DZSJRP), São Paulo State University, São José do Rio Preto, Brazil.

2.4 Results

Family Rhynchohydracaridae Lundblad, 1936

Genus *Clathrosperchonella* Lundblad, 1937

***Clathrosperchonella olovi* sp. nov.**

(Figs. 1B–F, 2–5)

Type series. Holotype female (DZSJRP-06048), dissected and slide mounted in Hoyer's fluid, Brazil, São Paulo, Cananéia, State Park of Cardoso Island, 13/I/2012, 25°05'18"S 47°55'27"W, in submerged mosses. Paratypes, same data as holotype: one female (DZSJRP-06049), two males (DZSJRP-06050–06051) and three larvae (DZSJRP-06052–06054) obtained from holotype female; collector: Luiz A. S. de Castro.

2.4.1 Description

Female. Dorsal. Colour in life yellowish-brown (Fig. 1B); integument bearing acutely pointed papillae on the margins of idiosoma (Fig. 1E); idiosoma partially covered by 16 dorsal and 5 ventral platelets that have radiating reticulations (Fig. 2A); *po* associated with a pair of elongated anteromedial platelets (Fig. 2A); *dgl*-2–4 and *lgl*-2 lying on irregular sclerites; opisthosoma with a horizontal sclerite, between *dgl*-5, with lateral pointed tips (Fig. 1C, 2A). **Ventral.** Coxal plates I and II fused medially; coxal plate II bearing a lateral rounded tip; coxal plate III shorter than IV; genital flaps bearing three distinct and clearly separated groups of 3, 5–6 and 6–8 genital acetabula; *cxgl*-4, *vgl*-1, *vgl*-3 and a pair of simple setae (located between three stellate sclerites and the excretory plate) lying on irregular platelets (Fig. 2B); *vgl*-2 absent; legs without swimming hairs; claws bearing a secondary ventral tooth (Fig. 2F). **Gnathosoma.** Capitulum short and rounded, not protrusible, bearing two postero-medial tips, the superior one longer than the inferior (Fig. 2D); palp slender and bearing a single long ventro-distal seta on P-4 (Fig. 2C); number of setae on P-1–5: 0, 5, 4, 1, 3; chelicera with a dorso-medial hump (Fig. 2E).

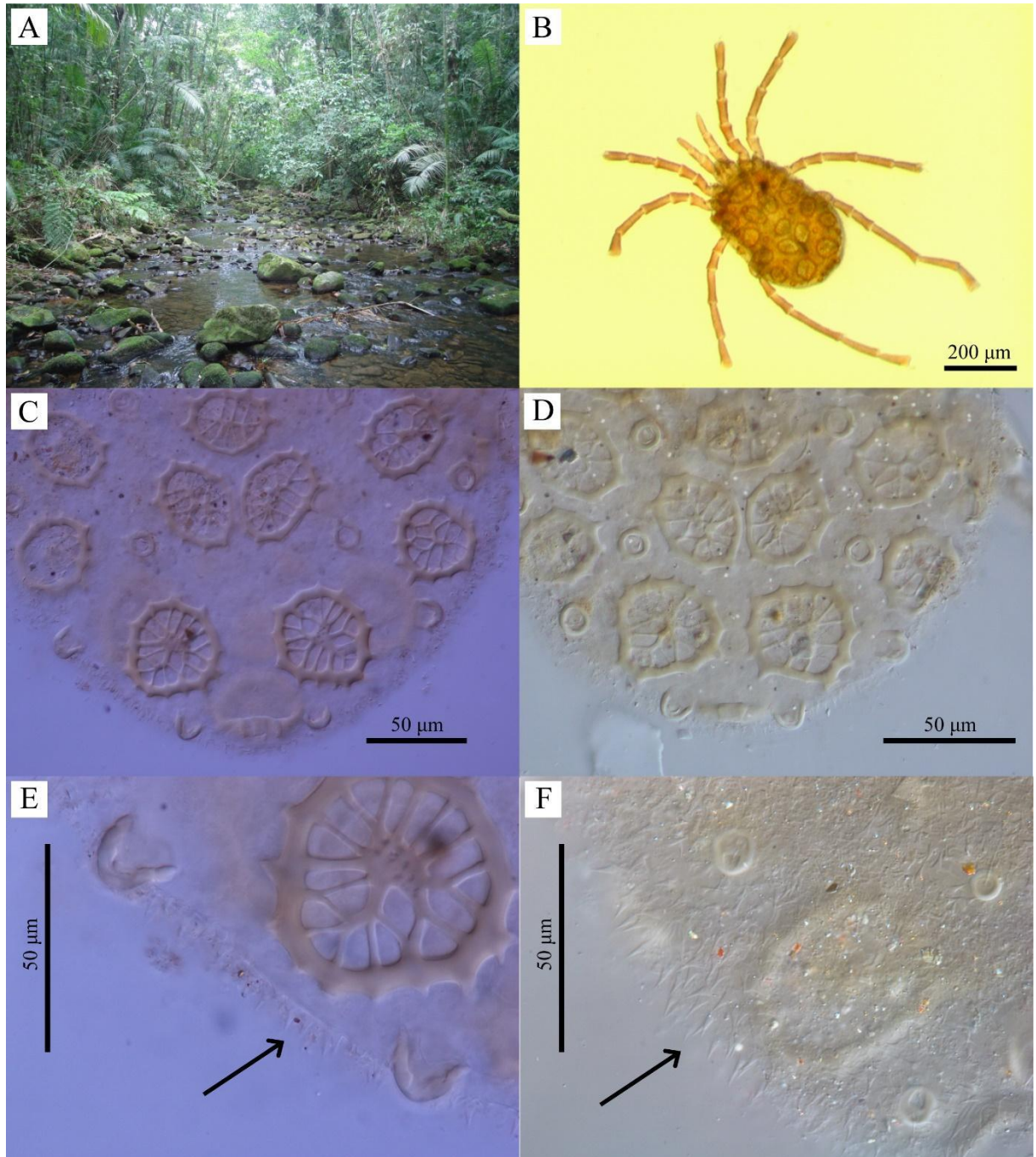


Figure 1. A, the new species was collected from this shallow stream in the Atlantic rainforest at Cardoso Island State Park, Cananéia, São Paulo, Brazil; B, *Clathrosperchonella olovi* **sp. nov.**, adult female, dorsal habitus; C, female, opisthosoma; D, male, opisthosoma; E, female, detail of opisthosoma, dorsal surface; F, male, detail of opisthosoma, ventral surface (arrows indicating acutely pointed papillae).

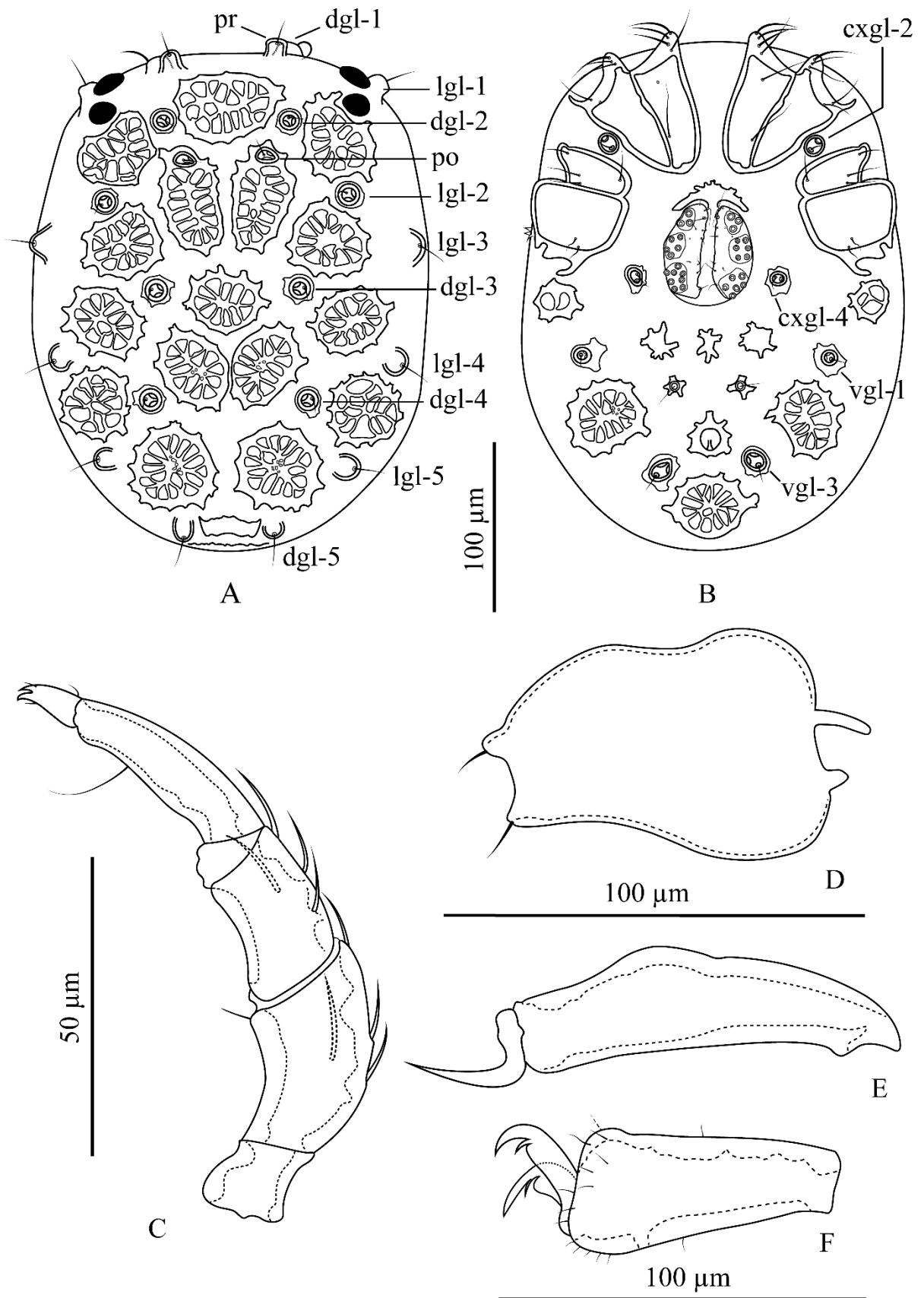


Figure 2. *Clathrosperchonella olovi* sp. nov., female. A, dorsal view; B, ventral view; C, palp, lateral view; D, capitulum, lateral view; E, chelicera, lateral view; F, I-Leg-6.

Measurements, holotype (single paratype in parentheses). Idiosoma L 360 (358), W–285 (268); genital flap L 87–89, maximum W 35 (39); capitulum L 87 (85); rostrum L 50 (48); chelicera: basal segment L 86 (82), H 23 (21), chela L 33 (31); palp segments (P-1–5) L: 22 (21), 38 (34), 41 (40), 52 (55), 18 (21); leg segments L: I-Leg-1–6: 32 (30), 51 (50), 41 (42), 63 (64), 71 (69), 76 (74); II-Leg-1–6: 28 (32), 52 (57), 45 (47), 76 (77), 85 (86), 83 (80); III-Leg-1–6: 29 (31), 52 (50), 44 (42), 86 (85), 90 (91), 82 (83); IV-Leg-1–6: 42 (45), 60 (62), 58 (60), 137 (135), 102 (100), 80 (77).

Male. Dorsal. Similar to female, except that the sclerite located between *dgl*-5 on the opisthosoma is shorter than that of the female and is trapezoidal in its shape (Figs. 1D, 3A). **Ventral.** Coxal plates III and IV fused and stouter than on female (Fig. 3B); genital flaps proportionally larger compared to female and also bearing three clearly separated and regular groups of 3, 4 and 8 genital acetabula. **Gnathosoma.** Capitulum and chelicera similar to female (Figs. 3D–E); palp slender, similar to female (Fig. 3C); number of setae on P-1–5: 0, 4, 4, 1, 3.

Measurements, n=2. Idiosoma L 283–360, W 236–295; genital flap L 77–80, W 33–38; chelicera: basal segment L 88–91, H 14–16; chela L 27–30; palp segments (P-1–5) L: 19–20, 38–44, 32–37, 52–54, 18–20; leg segments L: I-Leg-1–6: 31–32, 52–54, 39–44, 58–64, 67–74, 66–71; II-Leg-1–6: 30–31, 54–58, 45–48, 72–74, 78–86, 77–83; III-Leg-1–6: 22–30, 42–52, 43–46, 84–85, 82–86, 76–81; IV-Leg-1–6: 35–40, 55–62, 56–58, 138–140, 93–104, 76–85.

Larva. Dorsal. Colour in life yellowish; idiosoma longer than wide, oval and slightly sclerotized; dorsum bears a great number of irregular platelets distributed along almost the whole extent of the idiosoma, from *vi* to *d1* and between eye lenses; four pairs of propodosomal setae (*vi*, *ve*, *se*, *si*), a pair of humeral setae (*c3*) and seven pairs of hysterosomal setae (*c1*, *c2*, *d1*, *d2*, *e1*, *e2*, *f1*); propodosomal and humeral setae thin and moderately long; hysterosomal setae thin, with variable length (*c1*, *d1*, *e1*, long; *c2*, *d2*, *e2*, short); anterior eye lenses located lateral to *se*; posterior eye lenses located anterolateral to *si* (Fig. 4A); there are a pair of lateral shields full of platelets that extend along almost the whole idiosoma. **Ventral.** Coxal plates I–III enlarged, covering almost whole extent of the ventral surface of the idiosoma; coxal plate I longer than wide, with *1b* long and *1a* short; coxal plate II trapezoidal, without

setae and bearing a pair of urstigmata protruding forward from its antero-lateral border; coxal plate III trapezoidal, with $3a$ thin and shorter than $1b$ and $1a$; two pairs of hysterosomal setae, thin, short and aligned; $f2$ slightly longer than hysterosomal setae

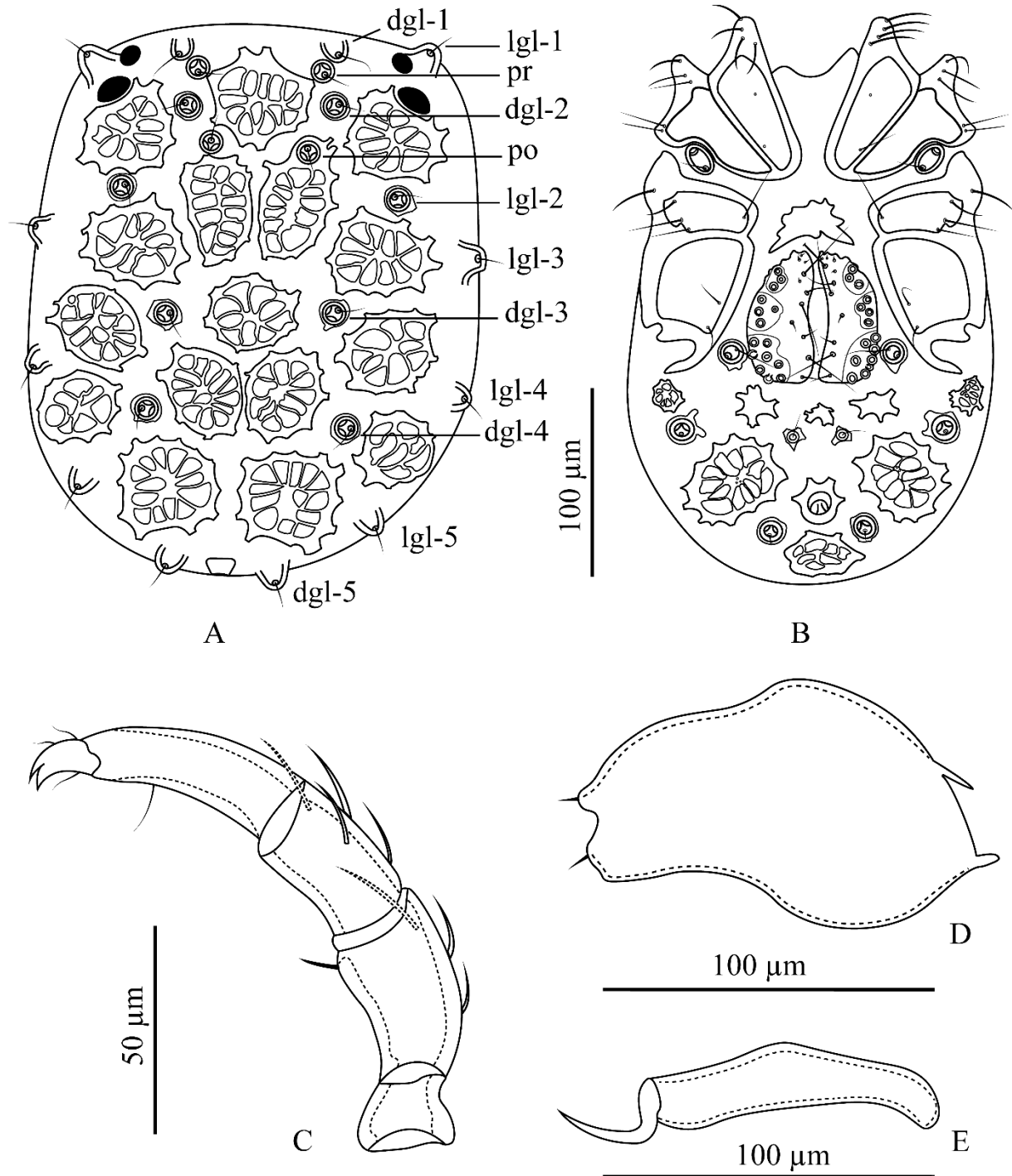


Figure 3. *Clathrosperchonella olovi* sp. nov., male. A, dorsal view; B, ventral view; C, palp, lateral view; D, capitulum, lateral view; E, chelicera.

and located below them; *h2* absent; excretory pore oval (Fig. 4D), lying free on the integument, with *ps1* absent and *ps2* very short (Fig. 4B); legs I and II with distal famulus and euphathidium on each tarsus; number of setae on legs I-III: I-Leg-1–5: 1, 6, 5 (σ), 9 (ϕ 1, ϕ 2), 9 (ω , "2"); II-Leg-1–5: 1, 6, 5 (σ), 9 (ϕ 1, ϕ 2), 9 (ω , "2"); III-Leg-1–5: 1, 6, 5 (σ), 8 (ϕ 1), 8. **Gnathosoma.** Capitulum rounded posteriorly (Fig. 4B); *Hy1* very reduced, *Hy2* absent; chelicera with basal segment smooth; chela with three distal denticles (Fig. 4C); palps stocky, extending beyond the distal end of the capitulum; P-4 bearing three short setae and a thin and long solenidion; palp tarsus with a claw (Fig. 4E); number of setae from P-1–P-5: 0, 1, 2, 4(ϕ), 0.

Measurements, $n=3$. Idiosoma L 166–181, W 149–152; dorsal setae: *ve* L 17–18, *vi* L 16–19, *se* L 17–20, *si* L 13–16, distance between setae: *se–se* 42–45, *si–si* 44–47; ventral setae: *ps1* absent, *ps2* vestigial; excretory pore plate L 5–7, W 2–4; capitulum L 52–56; chelicera: basal segment L 40–45, chela L 8–10; palpal segments (P-1–5) L: 12–14, 22–23, 7–8, 5–6, 7–8; leg segments L: I-Leg-1–5: 24–29, 40–46, 30–33, 41–42, 47–52; II-Leg-1–5: 20–22, 35–42, 30–32, 40–42, 46–51; III-Leg-1–5: 30–31, 42–45, 32–36, 44–48, 51–56. **Etymology.** Named after Olov Lundblad (1890–1970), in honour of his studies on Brazilian water mites and also to form a pair with *Clathrosperchonella rutae* Lundblad, named by him in remembrance of his wife, Rut.

2.4.2 Remarks and differential diagnosis

This paper presents the first description of a *Clathrosperchonella* species based on female as holotype; Lundblad did not completely illustrate this sex in his descriptions of *C. asterifera* and *C. rutae*. *Clathrosperchonella olovi* **sp. nov.** is very similar to *C. asterifera*, except for the following features. Dorsally, both sexes of *C. olovi* bears both *dgl-2–4* and *lgl-2* lying on irregular sclerites, whereas in *C. asterifera* these structures are not present surrounding glandularia. LUNDBLAD (1941) depicted the pair of *dgl-5* in *C. asterifera* as linked by a semicircular platelet, while in *C. olovi* **sp. nov.** this structure is shorter and horizontal, differs slightly in shape between female and male, and is located between *dgl-5* instead of linking them.

Ventrally, *C. olovi* **sp. nov.** also bears *cxgl-4*, *vgl-1* and *vgl-3* on irregular sclerites. In this new species, differently from *C. asterifera* and *C. rutae*, a reticulated platelet is found in both sexes, below the excretory pore. However, it not can be

assumed for certain that this structure is not present on the previously described species, as on figures of LUNDBLAD (1941) the opisthosoma was drawn as if it were folded and, possibly, the platelet may have not been visible.

Furthermore, acutely pointed integumental papillae are present both on the margins of idiosoma and on ventral surface of opisthosoma of *C. olovi*, whereas these structures were neither described nor illustrated by Lundblad for *C. asterifera* and *C. rutae*, casting a doubt as to whether they are present or not. With the finding of this new species, we can extend the known distribution of the genus *Clathrosperchonella* from the Chaco region of Paraguay and west of Santa Catarina State in Brazil to the coastal Atlantic rainforest of São Paulo State on southeast Brazil. Future expeditions to the original collecting sites of *C. asterifera* and *C. rutae* may allow us to collect more males, find females, obtain their larvae and describe their characters.

Although the larva of *C. olovi* **sp. nov.** retains the plesiotypic complement of setae on the segments of the legs, as is found in all known Hydryphantoidea (PROCTOR *et al.* 2015), the number of movable leg segments is five, instead of six. After hatching, the larvae were observed in the laboratory swimming awkwardly below the water surface and thus can be considered aquatic rather than 'aerial' (active on the surface of the water), as is common among hydryphantoid larvae (PROCTOR *et al.* 2015). Moreover, the coxal plates are enlarged, covering almost the whole ventral surface; an unusual doubled urstigma is found between coxal plates I and II and the excretory plate is absent. These features are typical to more derived superfamilies. The occurrence of both plesiotypic and more derived characteristics in *C. olovi* **sp. nov.** likely reflects the paraphyletic nature of Hydryphantoidea (DABERT *et al.* 2016) and also suggests that the Rhynchohydracaridae may be more closely related to Neohydrachnidia than to other hydryphantoid families. Molecular phylogenetic analysis plus examination of more species of this family are needed in order to test this hypothesis.

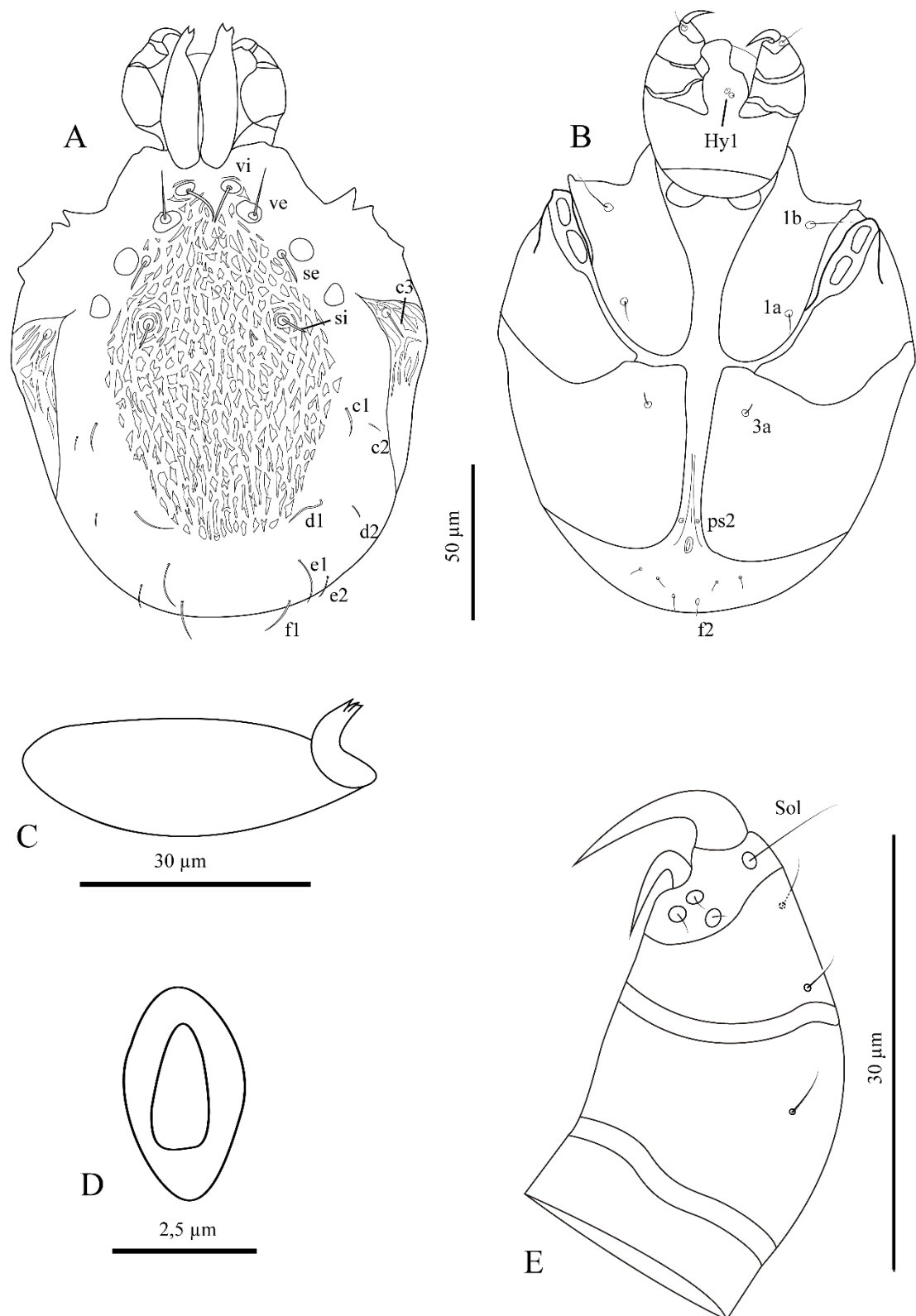


Figure 4. *Clathrosperchonella glovi* sp. nov., larva. A, dorsal view; B, ventral view; C, chelicera, lateral view; D, excretory pore; E, palp, ventral view. (Sol: solenidion).

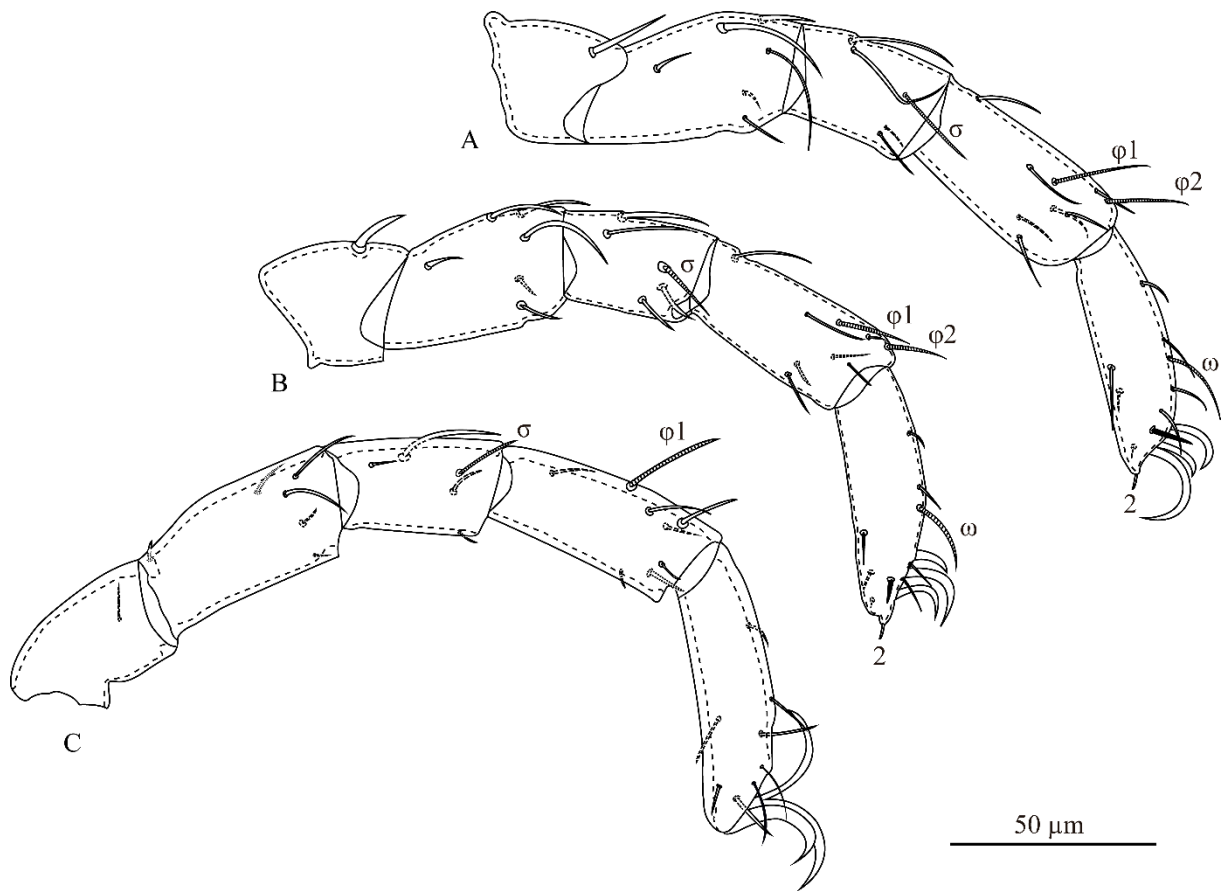


Figure 5. *Clathrosperchonella olovi* **sp. nov.**, larva. A, I-Leg-1 to 5; B, II-Leg-1 to 5; C, III-Leg-1 to 5.

Distribution. Brazil, São Paulo State, Cananéia. Known only from the collection site.

2.4.3 Key to *Clathrosperchonella* species based on adults

- 1a. Dorsal and ventral plates with radiating reticulations; palp slender..... 2
- 1b. Dorsal and ventral plates without radiating reticulations; palp stout..... *C. rutae*

- 2a. Dgl-2–4, lgl-2, cxgl-4 and vgl-1,3 lying free on the integument; genital flaps bearing two distinct and clearly separated groups of genital acetabula; P-4 bearing two long ventro-distal setae..... *C. asterifera*
- 2b. Dgl-2–4, lgl-2, cxgl-4 and vgl-1,3 lying on irregular sclerites; genital flaps bearing three distinct and clearly separated groups of genital acetabula; P-4 bearing a single long ventro-distal seta..... *C. olovi* **sp. nov.**

Acknowledgements

LASDC thanks CAPES (Process 88887.342428/2019-00) for the financial support, Ilso Carlos Neves for sea transportation to Cardoso Island State Park and also Bruce Halliday of CSIRO Division of Entomology, Canberra, Australia and Harry Smit, of Naturalis Biodiversity Center, Leiden, Netherlands, for sending references.

Note: *Clathrosperschonella olovi* **sp. nov.** and its larva were mistakenly identified and described as being *Clathrosperschon minor* Lundblad, 1937 in CASTRO (2013). Thus, here this mistake is corrected.

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Submitted: 17 Feb. 2020; accepted by Zhi-Qiang Zhang: 1 Aug. 2020; published: 1 Oct. 2020

**CHAPTER II. A NEW SPECIES OF *Rhynchohydracarus* Lundblad 1936
(ACARIFORMES: HYDRACHNIDIAE: HYDRYPHANTOIDEA:
RHYNCHOHYDRACARIDAE) FROM CENTRAL BRAZIL, WITH DNA BARCODES,
A KEY FOR KNOWN SPECIES AND A PROPOSAL FOR THE HOMOLOGIES OF
DORSALIA, VENTRALIA, LATERALIA AND GLANDULARIA FOR THE FAMILY**



3. A new species of *Rhynchohydracarus* Lundblad 1936 (Acariformes: Hydrachnidiae: Hydryphantoidea: Rhynchohydracaridae) from central Brazil, with DNA barcodes, a key for known species and a proposal for the homologies of dorsalia, ventralia, lateralialia and glandularia for the family

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Received 05 December 2021

Accepted 01 February 2022

Published 03 February 2022

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Academic editor
Małgorzata Joanna

[https://doi.org/
10.24349/0lg5-xg0l](https://doi.org/10.24349/0lg5-xg0l)

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



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Original research

3.1 Abstract

We describe a new species of the genus *Rhynchohydracarus*, *R. armiger* **n. sp.**, from central Brazil, including complete information for female and male, accompanied by DNA barcode sequences. It is the first record of water mites for the running waters of the Cerrado biome. We present a proposal for the homologies of dorsalia, ventralia, and glandularia in Rhynchohydracaridae and also provide an identification key for the known species of the genus.

Key-words

water mites; streams; integrative taxonomy; COI

Zoobank <http://zoobank.org/2B893E42-84B8-412E-B23F-A4EE014788EC>

How to cite this article Castro L. A. S. D. *et al.* (2022), A new species of *Rhynchohydracarus* Lundblad 1936 (Acariformes: Hydrachnidiae: Hydryphantoidea: Rhynchohydracaridae) from central Brazil, with DNA barcodes, a key for known species and a proposal for the homologies of dorsalia, ventralia, lateralialia and glandularia for the family. **Acarologia** 62(1): 161-173. <https://doi.org/10.24349/0lg5-xg0l>

3.2 Introduction

The Rhynchohydracaridae is a water mite family that inhabits riffles, springs, and streams in the New World (COOK, 1974; GOLDSCHMIDT, 2004, 2006, 2009; GOLDSCHMIDT *et al.* 2016; PROCTOR *et al.* 2015; GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020) and is composed of three subfamilies: Rhynchohydracarinae Lundblad, 1936, Clathrosperchontinae Lundblad, 1936, and Santiagocarinae Valdecasas, 2001 (WALTER *et al.* 2009; GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020; SMIT, 2020). For a brief checklist of all genera, species, type localities, and known distribution see CASTRO *et al.* (2020). The monogeneric subfamily Rhynchohydracarinae is considered endemic to the Neotropical region (DI SABATINO *et al.* 2008) and, until now, has included only three species in the genus *Rhynchohydracarus*, with sparse and distant localities of occurrence (Fig. 1). In South America, *Rhynchohydracarus testudo* Lundblad, 1936 was described from Brazil (LUNDBLAD 1936, 1941) and *Rhynchohydracarus dividuus* Lundblad, 1941 from Paraguay (LUNDBLAD 1941), whereas in Central America, *Rhynchohydracarus carmenae* Valdecasas, 2001 is known only from Panama (VALDECASAS, 2001). Some other records of unidentified or undescribed *Rhynchohydracarus* species are mentioned for Costa Rica (GOLDSCHMIDT, 2004, 2006, 2009), Panama (GOLDSCHMIDT *et al.* 2016) and Ecuador (GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020). *Rhynchohydracarus* species are often found associated with substrate such as sand and small pebbles collected from hyporheic habitats (L.A.S.D.C., personal observation). The reduction of ocular pigments, the dorso-ventrally flattened body and strong sclerotization suggest that they are adapted for living in the interstitial zone. Concerning habitat preferences, FERNÁNDEZ & FOSSATI-GASCHIGNARD (2011) classified the preferences of two *Rhynchohydracarus* species as “unknown” (based on the lack of ecological information in Lundblad’s descriptions, these two species are probably *R. testudo* and *R. dividuus*) and *R. carmenae* as “benthic” given that this species was collected by kick-sampling the substrate (VALDECASAS, 2001). Here we increase the knowledge of Rhynchohydracaridae by describing a fourth species of *Rhynchohydracarus* from central Brazil using integrative taxonomy, including complete morphological descriptions of adult female and male together with their barcodes, which represent the first genetic information for the family Rhynchohydracaridae. A

proposal for the homologies of dorsalia, ventralia, and glandularia in Rhynchohydracarinae is also provided, followed by an identification key for the known species of *Rhynchohydracarus*.

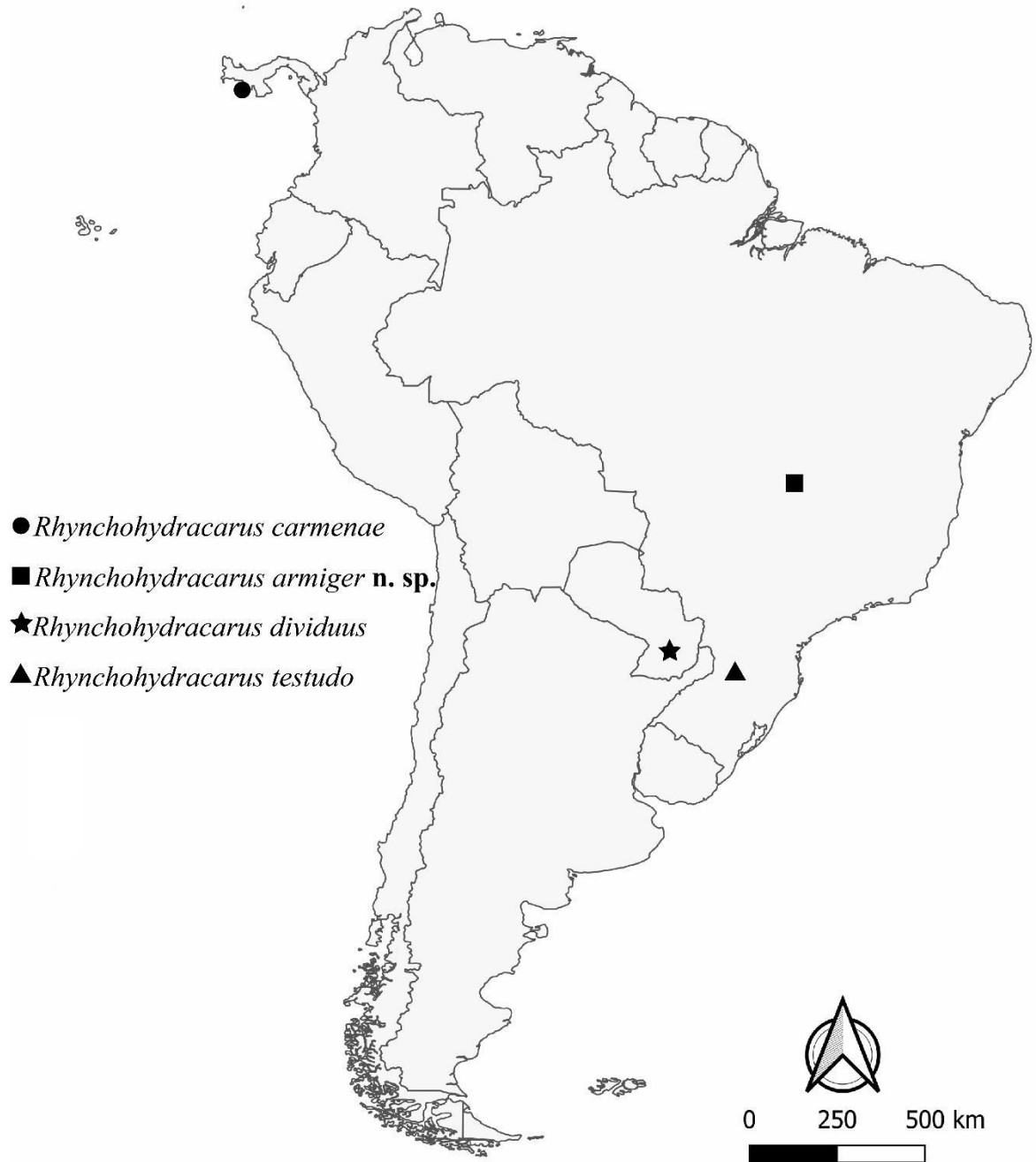


Figure 1. Distribution of the known species of *Rhynchohydracarus* (Rhynchohydracarinae), including *R. armiger* n. sp. from central Brazil.

3.3 Material and methods

3.3.1 Sampling

Water mites were collected by digging, stirring, and removing substrate with a small shovel, followed by washing detritus and dislodged organisms into a plankton dip net (250 µm mesh) from a shallow and sandy stream, “Córrego da Santa”, 15.788083°S, 48.872194°W, located in the Cerrado biome, Pirenópolis, Goiás State, central Brazil. After collecting, the substrate was transferred with water to plastic vials and taken to a laboratory at State University of São Paulo, where living mites were separated from the fine gravel under a stereomicroscope using forceps and a pipette and preserved in 96% ethanol. Vouchers, including holotype and paratypes of the new species, are deposited in the Acari collection of the Department of Biological Sciences (DCBSJRP), State University of São Paulo (UNESP), São José do Rio Preto, Brazil.

3.3.2 Molecular analysis

3.3.2.1 DNA extraction

Non-destructive DNA extraction was carried out individually on four collected *Rhynchohydracarus* specimens, applying an adapted and modified protocol from GILBERT *et al.* (2007). The digestion buffer consisted of 1M CaCl₂ (3 µl), 2% sodium dodecyl sulfate (SDS) in powder (20 mg), dithiothreitol (DTT) (40 µl), Tris buffer pH 8 (100 µl), NaCl (20 µl). Water was added to bring the volume to 1 ml. Then each water mite was transferred from 96% ethanol to individual 1.5 ml Eppendorf® tubes containing 250 µl of digestion buffer and 5 µl of proteinase K (20 mg/ml), and incubated overnight (12–14 hours) at 65°C. After incubating, mite specimens were removed from the buffer and placed in new 1.5 ml tubes with absolute ethanol to stop further digestion and for subsequent morphological studies of the exoskeletons.

3.3.2.2 DNA purification

From the total volume of each tube (255 µl) of the products of extraction, 200 µl were transferred to new 1.5 ml tubes and the same volume of Phenol:Chloroform:Isoamyl Alcohol (25:24:1) was added. Then the tubes were closed

and vortexed for 2 s and finally centrifuged at 13000 RPM for 10 minutes at room temperature. After centrifugation, two phases were obtained with the supernatant being transferred to new 1.5 ml tubes with the addition of 1 µl of glycogen (5 mg/mL), 20 µl of 3M pH 5.2 sodium acetate, and 154.7 µl (0.7 volume of the supernatant) of 100% ice-cold isopropanol. The mixture was gently inverted and immediately stored at -20°C for two hours, followed by centrifugation at 4°C and 13000 RPM for 30 minutes to pellet the nucleic acids. The liquid was then discarded and the pellet obtained was washed twice in 500 µl of ice-cold 70% and 95% ethanol, allowed to air-dry in a fume hood, and eluted in 30 µl of mQ water.

3.3.2.3 PCR parameters and sequencing

The standard COI barcoding fragment (HEBERT *et al.* 2003) was amplified using primers LCO1490 and HCO2198 (FOLMER *et al.* 1994). PCR reactions were conducted in a final volume of 25 µl, containing 12.4 µl of mQ water, 2.5 µl 10x PCR Buffer, 1 µl of MgCl₂ (50 mM) (Sinapse®), 1.0 µl of each primer, 2.0 µl of dNTPs (Sinapse®), 0.1 µl of Taq polymerase Platinum (Sinapse®) and 5.0 µl of template DNA. PCR was performed using an initial denaturation step at 94°C for 120 s, followed by 35 cycles of denaturation at 94°C for 30 s, annealing at 50°C for 45 s, elongation at 72°C for 60 s, and finishing with a final extension at 72°C for 600 s, followed by a pause at 4°C. The purification process was performed using 2.5 µl of Exonuclease I (EXO1) (Thermo Fisher Scientific®) and 5.0 µl of FastAP® Thermosensitive Alkaline Phosphatase (Thermo Fisher Scientific®). The forward and reverse sequences obtained were manually edited and aligned using the software Sequencher 4.1.4 (Gene Codes Corporation, Ann Arbor, MI, USA). COI sequences have been deposited in the Barcode of Life Data System (BOLD: <http://www.barcodinglife.org/>) and GenBank (<https://www.ncbi.nlm.nih.gov/>). All steps of molecular analysis were conducted in the Laboratory of Arthropod Molecular Ecology, and bidirectional sequencing was performed by Sanger method in the Agricultural Biotechnology Center (CEBTEC), both located at “Escola Superior de Agricultura Luiz de Queiroz” (ESALQ), University of São Paulo (USP), Piracicaba, Brazil.

3.3.3 Morphological analysis

After DNA extraction, all four mite exoskeletons preserved in 100% ethanol were transferred to 85% lactic acid overnight to clear them as suggested in Proctor *et al.* (2015), and then slide-mounted in PVA medium (BioQuip, CA, USA) as vouchers. All specimens have been deposited in the mite collection of DCBSJRP-UNESP. Morphological analysis and photography were conducted at the Laboratory of Acarology of ESALQ-USP, using a Nikon® Eclipse 80i microscope, with differential interference contrast (DIC) lighting and equipped with a Nikon® digital camera. Microphotographs were processed with the imaging software Nikon® NISElements. Line drawings were made using the software Adobe Illustrator® CC 2018. Idiosomal structures are named according to the terminology used in LUNDBLAD (1927; 1941), except for coxoglandularia (called epimeroglandularia by Lundblad 1941), which are named *cxgl-1* and *cxgl-2* according to PROCTOR *et al.* (2015), SMITH & COOK (2016) and GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ (2020). These same structures are named in European literature as *cxgl-2* and *cxgl-4*, respectively (BARTSCH, 2007). Dorsal region: *dc*—dorsocentralia, *dl*—dorsolateralia, *dgl*—dorsoglandularia, *lgl*—lateroglandularia, *prefr*—prefrontalia, *postfr*—postfrontalia, *pr*—preocularia, *po*—postocularia. Ventral region: *cxgl*—coxoglandularia, *pregen*—pregenital plate, *postgen*—postgenital plate; *vgl*—ventroglandularia, *v*—ventralia. We also propose a new term for the side of the idiosoma, the “lateral region”, and designate its sclerites as *lat*—lateralia. Gnathosoma: P-1 to P-5—palp segments from proximal to distal. The following additional abbreviations are used: *alt*—altitude; *m*—meters; *asl*—above sea level; *H*—height; *L*—length; *W*—width; *I*, *II*, *III* or *IV*—Leg-1 to 6 segments from proximal to distal; *n*—number of specimens measured. All measurements are given in μm .

3.4 Results

Systematics

Family Rhynchohydracaridae Lundblad, 1936

Genus *Rhynchohydracarus* Lundblad, 1936

***Rhynchohydracarus armiger* n. sp.**

Zoobank: E8F2D15C-5CC9-4EAF-981F-63EA83531D46

(Figures 2–4)

Type series. Holotype female (DCBSJRP-1741), dissected and slide-mounted in PVA, Brazil, Goiás, Pirenópolis, 18 Jul. 2019; 15.788083 S, 48.872194 E, 1123 m asl. Paratypes: one female (DCBSJRP-1742 and two males (DCBSJRP-1743–1744); collector: Luiz A. S. de Castro.

3.4.1 Description

Female. Body slightly flattened dorsoventrally; colour in life yellowish-brown.

Dorsal — Integument lineated, almost completely covered by three unpaired dorsocentralia (*dc*-1, *dc*-2+3, *dc*-4), one paired dorsocentralia (*dc*-5) and four pairs of dorsolateralia (*dl*-1–4); these sclerites ranging from densely to scarcely punctate (Fig. 2A). Two pairs of anterior platelets on the dorsum: *prefr* bearing *dgl*-1 and *pr*; *postfr* bearing two eye lenses and *lgl*-1; *lgl*-2, *dgl*-3 and *dgl*-4 each lying on individual platelets lateral to the large *dc*-2+3 and *dc*-4. Median eye absent. Camerostome margin wrinkled, medially separated, and bearing protuberances on the tips (Fig. 2A).

Lateral — Six pairs of lateralia (*lat*-1–6): *lat*-1 bearing *lgl*-3; *lat*-3 bearing *lgl*-4, *lat*-5 bearing *vgl*-3, and *lat*-6 bearing *dgl*-5; *lat*-2 and *lat*-4 without glandularia (Fig. 2A).

Ventral — Three coxal groups; coxae I and II fused medially, forming an anterior plate, bearing *cxgl*-1; coxae III and IV on each side forming two lateral plates, longer than wide; all coxae densely reticulate (Fig. 2B, 4C). *Pregen* long, slightly tapering on the anterior margin, with long and thin postero-lateral margins embracing the genital field (Fig. 2B, 4C). Genital flaps with several rounded acetabula and four pairs of setae along the inner margin of flaps (three pairs were lost during slide mounting); *cxgl*-2 located lateral to genital flaps, lying on trapezoidal plates, with concave anterior margins; *postgen* well-developed (Fig. 2B, 4C). Four pairs of ventralia (*v*-1–4), with *v*-4 bearing *vgl*-3; *vgl*-1 without gland openings, lying on small platelets, located between *postgen* and *v*-4; *vgl*-2 absent; excretory plate hexagonal, followed by an additional smaller hexagonal post-excretory platelet (Fig. 2B); legs without swimming setae; I–Leg-1-5 with slender setae; II–IV–Leg-4-5 with stocky setae.

Gnathosoma — Capitulum long and attached to a protrusible trunk-like tube of flexible integument (Fig. 2C); palp stout, number of setae on P-1–5: 0, 1, 1, 5, 2; P-5 with three claws (Figs. 2D–E); chelicera slender, claw stylet-like (Fig. 2C).

Measurements — Holotype (single female paratype in parentheses). Idiosoma, L 551 (556), from tips of dorsal face of camerostome to posterior margin of *dc-4*, W 250 (246); genital flaps (both sides) L 118 (120), W 130 (127); capitulum L 160 (156), H 40 (43); chelicera: basal segment L 140 (137), H 13 (12), claw L 29 (33); palp segments (P-1–5) L: 9 (8), 36 (40), 40 (42), 29 (34), 19 (17), H: 22 (20), 26 (29), 20 (22), 14 (16), 8 (7), L/H: 0.40 (0.40), 1.38 (1.37), 2.0 (1.9), 2.07 (2.12), 2.37 (2.42); leg segments L: I–Leg-1–6: 35 (37), 72 (73), 61 (56), 79 (70), 97 (84), 90 (80); II–Leg-1–6: 38 (36), 75 (67), 69 (65), 77 (71), 89 (87), 90 (85); III–Leg-1–6: 25 (26), 43 (45), 69 (57), 71 (65), 82 (74), 80 (73); IV–Leg-1–6: 58 (55), 62 (60), 60 (52), 122 (124), 94 (96), 81 (76).

Male.

n = 2 paratypes

Dorsal — Similar to female (Fig. 3A, 4A).

Ventral — Similar to female, except that the plates bearing *cxgl-2* are fused with *pregen* and almost surround the genital field (Fig. 3B, 4B).

Gnathosoma — Capitulum (Fig. 3C), palps (Figs. 3D–E) and chelicera (Fig. 3C) similar to female.

Measurements — n=2. Idiosoma L 520, 550, from tips of dorsal face of camerostome to posterior margin of *dc-4*, W 240, 252; genital flaps (both sides) L 98, 102; W 112, 118; capitulum L 145, 162; rostrum L 39, 47; chelicera: basal segment L 126, 142; H 11, 12; claw L 29, 36; palp segments (P-1–5) L: 8, 10; 38, 39; 34, 39; 25, 30; 16, 17; leg segments L: I–Leg-1–6: 31, 36; 69, 72; 50, 52; 74, 76; 75, 85; 80, 90; II–Leg-1–6: 32, 35; 64, 68; 50, 52; 74, 76; 80, 87; 83, 93; III–Leg-1–6: 24, 28; 41, 47; 40, 42; 64, 71; 78, 86; 72, 75; IV–Leg-1–6: 49, 54; 56, 65; 48, 52; 122, 124; 88, 94; 77, 86.

Etymology. From the Latin *armiger*, meaning “arms-bearer” in reference to the idiosoma, fully armoured by plates.

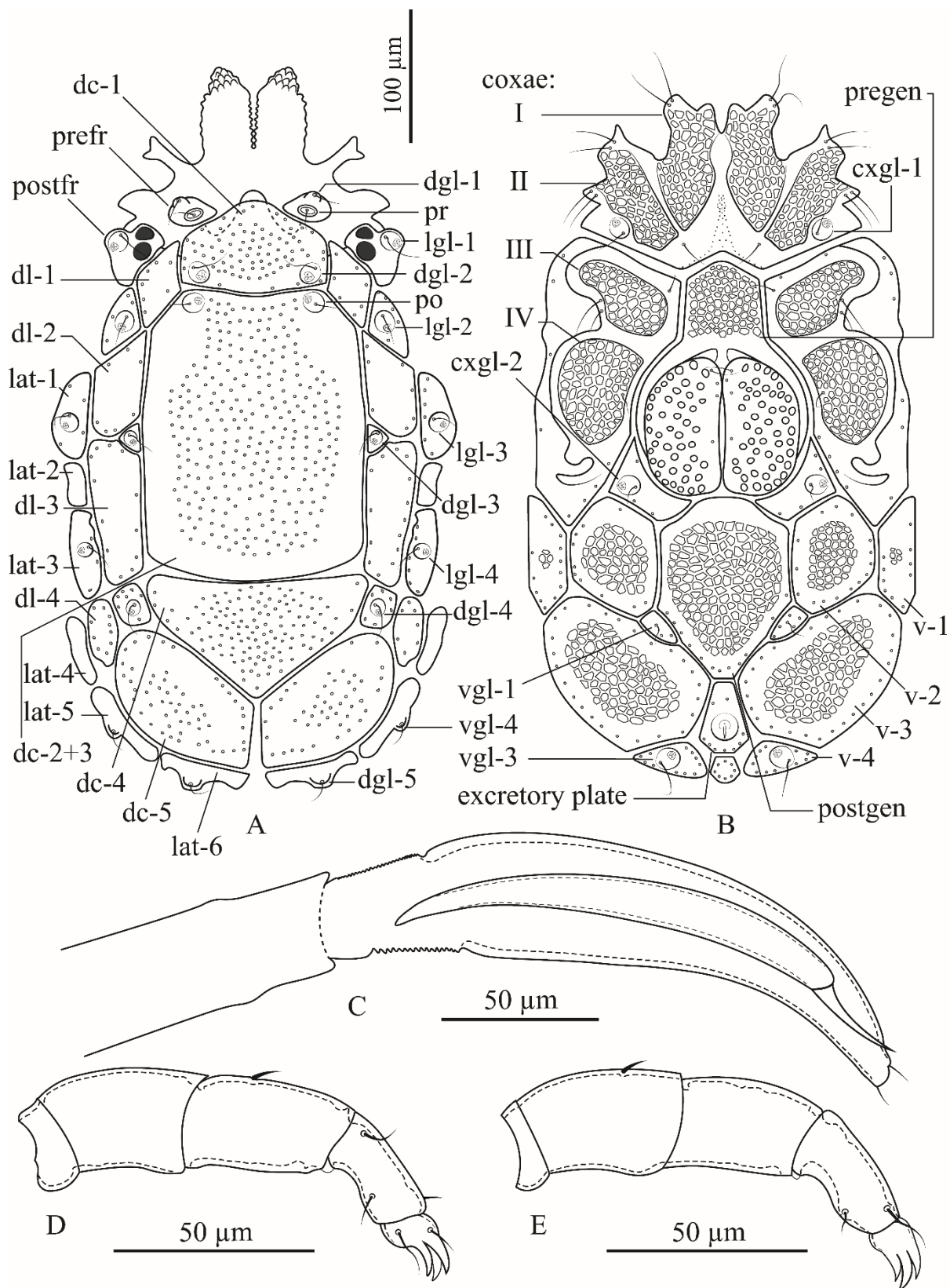


Figure 2. *Rhynchohydracarus armiger* n. sp., female holotype. A – Dorsal view, including lateralia; B – Ventral view; C – Capitulum and right chelicera, lateral view; D – Palp, lateral view; E – Palp, medial view.

3.4.2 Differential diagnosis

Rhynchohydracarus armiger n. sp. differs from the three already described species in the following three diagnostic characters: 1) anterior margin of the prodorsum (i.e., roof of camerostome) wrinkled, medially separated, and bearing protuberances on the tips; 2) excretory plate hexagonal, accompanied by a similar and smaller post-excretory platelet; 3) in males, the plates that bear *cxgl*-2 are fused with *pregen*, almost surrounding the genital field. In other named species of *Rhynchohydracarus*, prodorsum is smooth, having a median split in *R. dividuus* shorter than that of *R. armiger*. Excretory plate is pentagonal in *R. testudo* and oval in both *R. dividuus* and *R. carmenae*. *Pregen* and *postgen* fused in males of *R. dividuus* and *R. testudo*, forming a unique plate surrounding genital flaps as well as *cxgl*-2. In *R. carmenae* these structures are separated, both in male and female.

3.4.3 DNA Barcoding

DNA was successfully amplified and mitochondrial cytochrome C oxidase subunit I gene (COI) sequenced from two of the four *R. armiger* specimens; sequence data have been deposited in BOLD Systems (<https://www.boldsystems.org/>) and GenBank (<https://www.ncbi.nlm.nih.gov/>), with the following accession codes: holotype female, 679 base pairs (BOLD: ENBRA012-21, GenBank: MZ444663) and paratype male, 679 base pairs (BOLD: ENBRA011-21, GenBank: MZ444679).

3.4.4 Remarks

Based on the plesiotypical idiosoma organization of Hydrachnidae discussed in DAVIDS *et al.* (2006) (Fig. 5A, 6A), we propose the following homologies for dorsalia (Fig. 5B) and ventralia (Fig. 6B) in Rhynchohydracaridae, including their respective glandularia and the new term “lateralia”. This proposal should help to facilitate and standardize future morphological studies and descriptions of new species in this family.

Dorsalia. In *Rhynchohydracarus* the dorsocentralia 1-4 may have fused and expanded in the following way: paired *dc*-1 fused and involved *dgl*-2, becoming a single

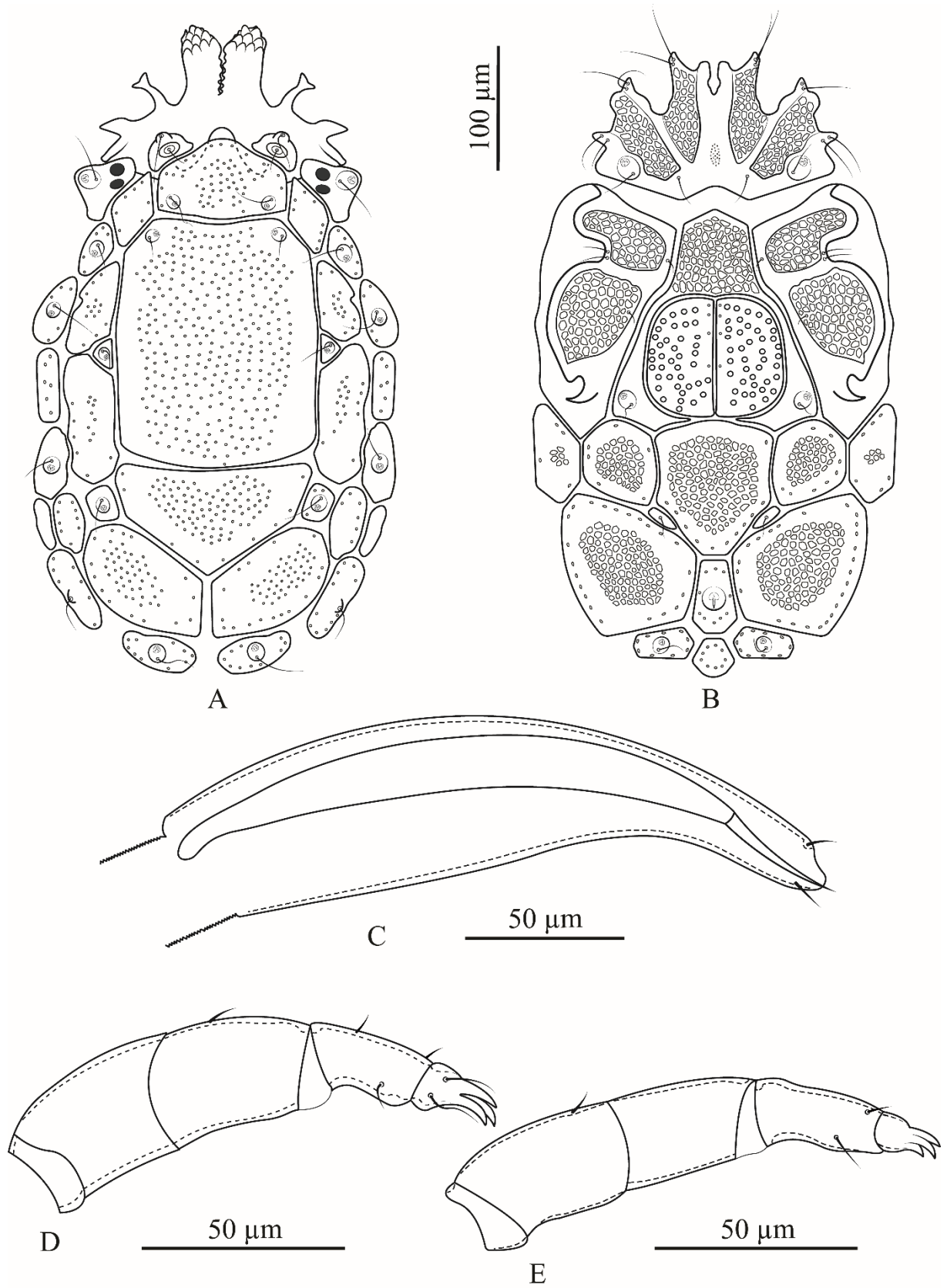


Figure 3. *Rhynchohydracarus armiger* n. sp., male paratype. A – Dorsal view, including lateral plates; B – Ventral view; C – Capitulum with left chelicera, lateral view; D – Palp, lateral view; E – Palp, medial view.

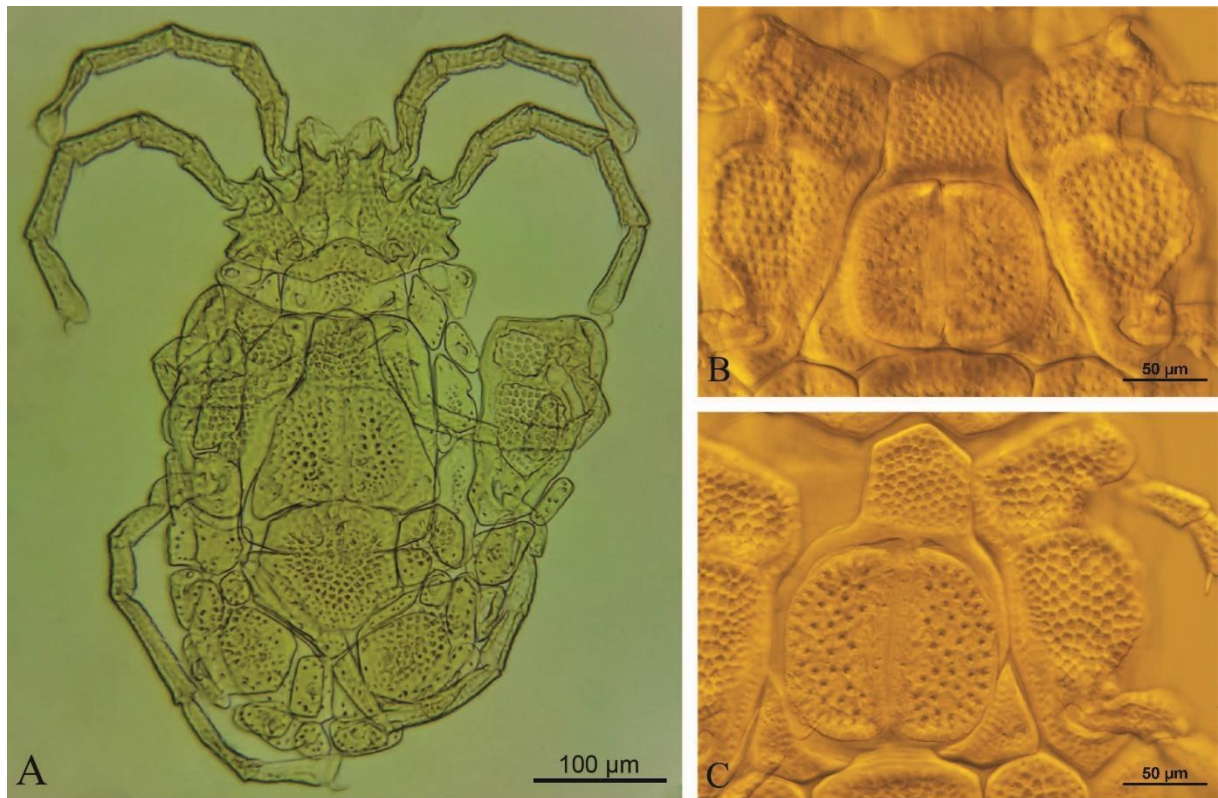


Figure 4. *Rhynchohydracarus armiger* n. sp.. A – Male paratype, habitus (ventral, left posterior coxae broken apart from idiosoma); B – Male paratype, detail of the coxae III-IV and genital field; C – Female holotype, coxae III-IV and genital field.

anterior plate; paired *dc*-2 fused, expanded and involved postocularia (as in *Clathrosperchon* Lundblad, 1936 and *Clathrosperchonella* Lundblad, 1937, though in those genera they remained as a separated pair), and also fused with both paired *dc*-3 (in *R. dividuus*, *R. carmenae*, and *R. armiger* n. sp.) and paired *dc*-3+4 (in *R. testudo*) forming, in consequence, 1 or 2 central plate(s), respectively (if not mentioned otherwise, data taken from original descriptions). In *Clathrosperchon* and *Clathrosperchonella*, paired *dc*-3 also fused, becoming a single plate, right below paired *dc*-2. Therefore, the 13 smaller lateral plates mentioned by LUNDBLAD (1941) for *Rhynchohydracarus* are: a single *dc*-1 + paired *dl*-1 + paired *dl*-2 + paired *dl*-3 + paired *dl*-4 + a pair of plates that bear *lgl*-2 + paired *dc*-5. Moreover, *dgl*-3 and *dgl*-4 lay on small plates that were not considered in Lundblad's account. Thus, these plates may have been originated by sclerotization of their respective glandularia (Fig. 5B). In *Gledhillia* Valdecasas, 2001 and *Santiagoocarus* Valdecasas, 2001 (VALDECASAS, 2001) the fusion of *dc*-1–4 was complete, giving origin to a unique central plate, whilst

paired *dc*-5 and the *dl*-1–4 remained separated. The plesiotypic *prefr* and *postfr* also may have fused with paired *dc*-1 and frontale (Fig. 5A), giving rise in all genera of Rhynchohydracaridae to a single *dc*-1 (Fig. 5B), also known as frontal plate, as discussed in DAVIDS *et al.* (2006). *Dgl*-6 (Fig. 5A) are not present in rhynchohydracarids and, therefore, may have been lost in all genera of this family.

Lateralialia. Laterally, there are 6 pairs of lateralialia in *Rhynchohydracarus*: *lat*-1 bearing *lgl*-3, *lat*-2, *lat*-3 bearing *lgl*-4, *lat*-4, *lat*-5 bearing *vgl*-4 (*lgl*-5 *sensu* LUNDBLAD 1941), and *lat*-6 bearing *dgl*-5 (Fig. 5B). In the description of *R. testudo*, LUNDBLAD (1941) mentions that although *lgl*-2 are dorsal, they shifted slightly to the side and all other lateroglandularia are in fact on the side of the body, enclosed in plates. However, Lundblad neither counted those sclerites nor illustrated them. When mounting water mites on slides without dissection, i.e., with no separation of dorsal and ventral body surfaces of the mite, lateral plates remain better preserved in their natural orientation, tending to fold up and thus can be clearly seen laterally to dorsolateralialia (Figs, 2A, 3A, 4A, 5B). None of these lateralialia is present in *Clathrosperchon* and *Clathrosperchonella* (LUNDBLAD, 1941); however, two small plates can be noticed in *Gledhillia* and *Santiagocarus* (VALDECASAS, 2001), located right below posterior margins of paired *dc*-5 and bearing *vgl*-4 and *dgl*-5, similarly to *Rhynchohydracarus*. Thus, we can assume that these sclerites can also be homologized with *lat*-5 and -6.

Ventralialia. Ventrally, in *Rhynchohydracarus testudo* and *R. dividiuus*, the pre- and postgenital plates also got greatly expanded and fused, surrounding completely *cxgl*-2 and the genital field. In contrast, these genital plates remained separated in *R. carmenae* and *R. armiger* **n. sp.** with *cxgl*-2 lying on individual plates in females of both species, and fused with the pregenital plate in males of *R. armiger* (Fig. 6B). In all other genera of Rhynchohydracaridae, these plates are not well-developed, except in Santiagocarinae, where they are fused with the ventral shield. Regarding the ventroglandularia, we noted that in all described species of Rhynchohydracaridae *vgl*-1 are always present, located medially right below *postgen* and deprived of glands (Fig. 6B), as discussed in WILES (1997). The *vgl*-2 are also present in the family, located laterally and slightly above *vgl*-1, but without setae in *Gledhillia* and *Santiagocarus*, as it was depicted in VALDECASAS (2001, Figs. 2 and 5), yet not discussed. However,

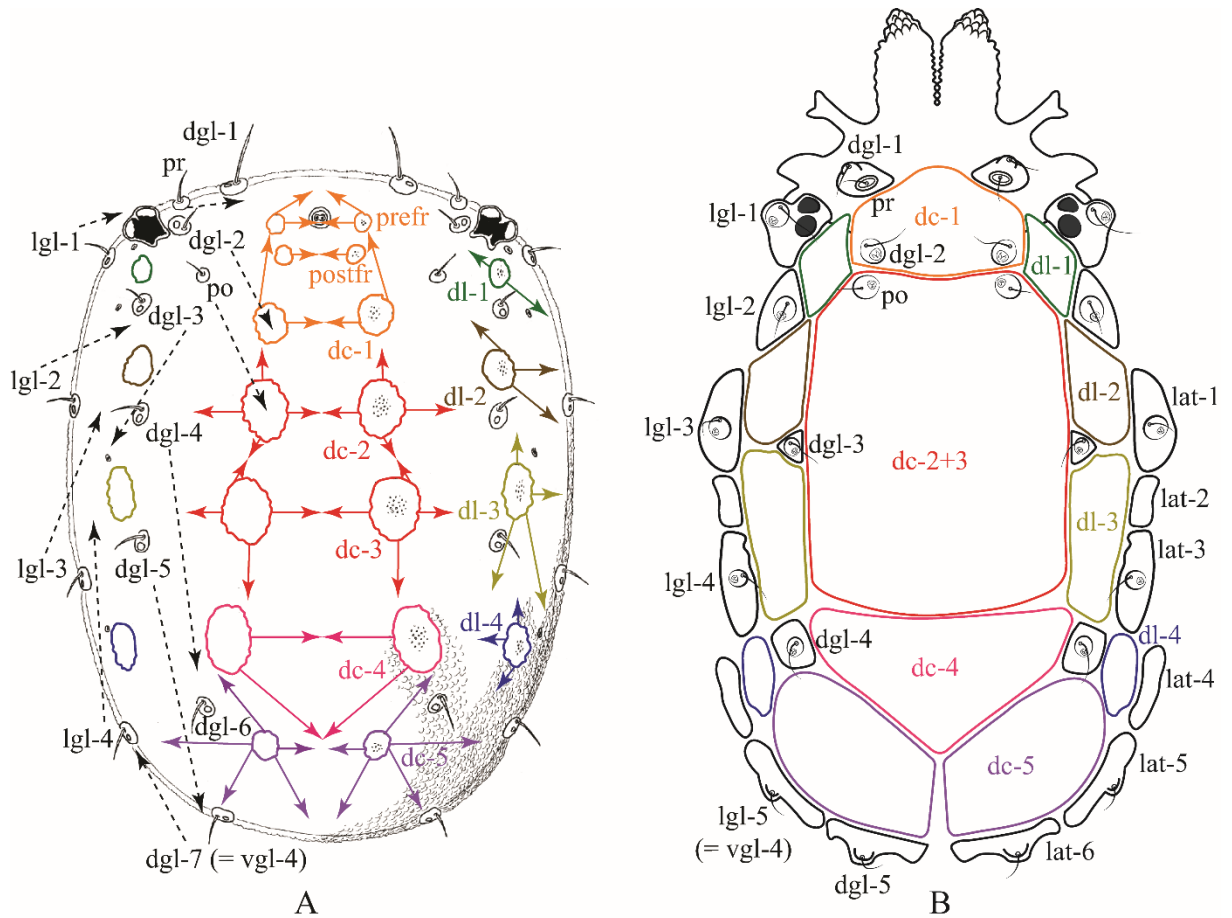


Figure 5. Homologies between the hypothetical plesiotypical arrangement of dorsal features of Hydrachnidiae and those of the Rhynchohydracarinae. A – Plesiotypical idiosoma organization of dorsalia (after Davids *et al.* 2006, modified); dashed arrows indicating movements of dorsoglandularia (*dgl*) and lateroglandularia (*lgl*); solid arrows indicate movements of prefrontalia (*pr*), postfrontalia (*postfr*), dorsocentralia (*dc*) and dorsolateralia (*dl*); B – *Rhynchohydracarus armiger* n. sp. (female); colloured lines in *dc* and *dl* indicating their respective homologies with plesiotypical idiosoma organization in Hydrachnidiae. Terminology used follows Lundblad (1927).

in all species of *Rhynchohydracarus* *vgl-2* are absent and may have been lost, being considered an autapomorphy of this genus. As illustrated in DAVIDS *et al.* (2006) and according to LUNDBLAD's nomenclature (1927), *vgl-1* and *vgl-3* are located medially, while *vgl-2*, and *vgl-4* are located laterally. Therefore, we conclude that *lgl-5* (*sensu* LUNDBLAD, 1941) are, in fact, 'migratory' *vgl-4* (Fig. 6A) in all genera of the Rhynchohydracarinae. Similar to *vgl-1*, *vgl-3* are ventral and positioned posterior to the excretory pore and on the paired *v-4* (Fig. 6B); however, Lundblad (1941) described the latter as just "*vgl*" for *Clathrosperchon crassipalpis* Lundblad, 1936 and only "*v*" for

Rhynchohydracarus testudo, and CASTRO *et al.* (2020) described *vgl-2* as being *vgl-1* for *Clathrosperchonella olovi* Castro, Proctor & Lofego, 2020. Here we correct these mistakes. In Clathrosperchontinae and Rhynchohydracarinae, *v-1–3* are found in pairs, with the position of *v-1* varying from immediately posterior to coxa IV to almost lateral to coxa IV, as in *Clathrosperchon crassipalpis*, *C. punctatus*, and *Rhynchohydracarus testudo*. Paired *v-4* got fused in Clathrosperchontinae whereas in Rhynchohydracarinae remained separate as small plates, bearing *vgl-3*. Conversely, in Santiagocarinae there was a complete fusion of ventralia, *pregen* and *postgen*, giving rise to a single heavily sclerotized ventral shield as described by VALDECASAS (2001).

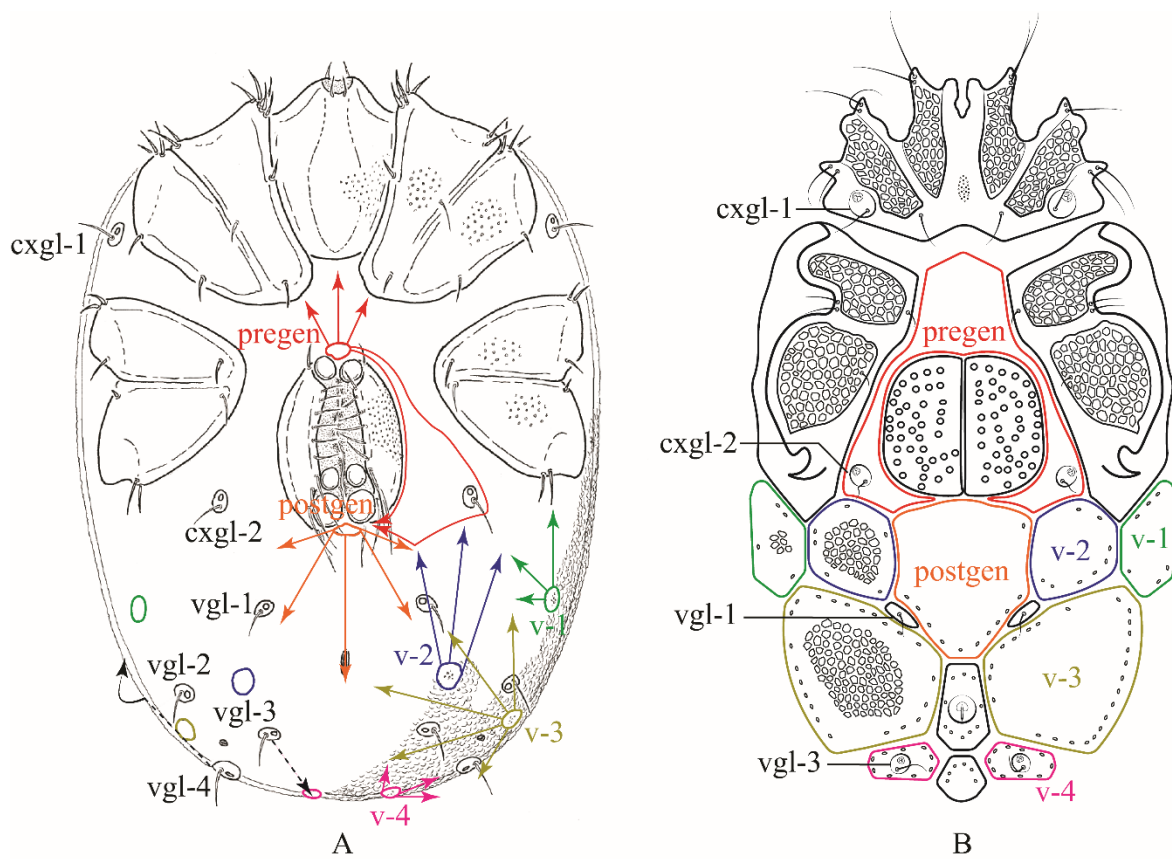


Figure 6. Ventral homologies between a plesiotypic Hydrachnidiae and Rhynchohydracaridae. A – Plesiotypical idiosoma organization of ventralia (after Davids *et al.* 2006, modified); dashed arrows indicating movements of ventroglandularia (*vgl*); solid arrows indicating movements of pregenital plate (*pregen*), postgenital plate (*postgen*) and ventralia (*v*); B – *Rhynchohydracarus armiger* n. sp. (male); colloured lines in *pregen*, *postgen* and *v-1-4* indicating their respective homologies with plesiotypical idiosoma organization in Hydrachnidiae. Terminology used follows Lundblad (1927).

3.4.5 Key to *Rhynchohydracarus* species based on known adults

- 1 Excretory plate penta- or hexagonal..... 2
— Excretory plate oval..... 3
- 2 Excretory plate pentagonal; *dc*-2–4 fused, forming a single dorsal plate; prodorsum integrate and smooth..... *R. testudo* Lundblad (only male known)
— Excretory plate hexagonal; *dc*-2–3 fused, separated from *dc*-4, forming two dorsal plates; prodorsum medially divided and wrinkled..... *R. armiger* **n. sp.** male and female
- 3 Dorsal and ventral plates covering almost all the body surfaces but leaving narrow gaps of striated integument; *pre* and *postgen* plates fused to form a complete ventral plate, surrounding the genital field; *dl*-4 present.....
..... *R. dividuus* Lundblad (only male known)
— Dorsal and ventral plates covering almost all body surfaces but leaving wide gaps of striated integument; *pre* and *postgen* plates neither fused nor forming a ventral plate surrounding the genital field; *dl*-4 absent... *R. carmenae* Valdecasas (male and female)

3.5 Conclusions

The description of *Rhynchohydracarus armiger* **n. sp.** from central Brazil brings new data for the known distribution of the endemic Rhynchohydracarinae in the Neotropical region, establishing a connection between the single record of Central American *R. carmenae* and South American *R. dividuus* and *R. testudo* (Fig. 1). It also fills a knowledge gap in a Brazilian area hitherto considered without any information regarding water mite fauna (GOLDSCHMIDT, 2002). This area covers, in part, an important Brazilian biome - the Cerrado - a central plateau where abundant pristine running-water habitats still await exploration in terms of invertebrate fauna. Prospective work focusing on sampling wider varieties of freshwater biotopes will certainly increase our knowledge of this family, including new information about larvae, nymphs, and host associations. Phylogenetic analysis based on both morphological and molecular characters will clarify relationships within the Rhynchohydracaridae and of this family within Hydryphantoidea.

Acknowledgements

LASDC thanks CAPES (Process 88887.342428/2019-00) for the financial support. Alberto S. Corrêa and Gilberto J. de Moraes, of Department of Entomology and Acarology, ESALQ-USP, kindly provided access to their laboratories and facilities. We thank Tom Goldschmidt and Vladimir Pešić for their careful revision and valuable comments for improving the quality of the MS.

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**CHAPTER III. A CATALOG OF HYDRYPHANTOIDEA FROM SOUTH AMERICA,
WITH GEOGRAPHIC DISTRIBUTION, A KEY FOR FAMILIES, SUBFAMILIES,
GENERA, SUBGENERA AND SPECIES, WITH MOLECULAR DATA FOR
RHYNCHOHYDRACARIDAE**

4.1 Abstract

A catalog of nominal taxa of Hydryphantoidea is provided, assigned to the four families that are present in South America: Hydryphantidae, Hydrodromidae, Rhynchohydracaridae and Thermacaridae. So far 56 species are known from this region, by far most exclusively as adults, just in three species the larvae are known as well. The data on the type localities and the hitherto known distribution in maps of the species are included, plus molecular data of barcodes for all three representative genera of Rhynchohydracaridae of this continent, including the following species: *Clathrosperchon punctatus* Cook, 1980, *C. minor* Lundblad, 1937, *Clathrosperchonella olovi* Castro, Proctor & Lofego, 2020 and *Rhynchohydracarus armiger* Castro, Proctor & Lofego 2022.

Key words: Hydryphantidae, Hydrodromidae, Rhynchohydracaridae, Thermacaridae, taxonomy, nomenclature, barcodes, mtCOI.

4.2 Introduction

Works concerning major efforts for cataloging the diversity of Hydrachnidiae in South America, providing detailed occurrences and geographic distribution, started with check-lists of water mites from the Córdoba Province, Argentina (ACOSTA & ROSSO DE FERRADÁS, 1996) and São Paulo State, Brazil (FORNERIS, 1999). In a detailed study analyzing the biodiversity of Neotropical water mites, GOLDSCHMIDT (2002) suggested a richness of species fourfold higher than it was known until that moment, with a high degree of endemism and possible hotspots of biodiversity, especially in South America. In this sense, ROSSO DE FERRADÁS & FERNÁNDEZ (2005) presented a checklist of South American Hydrachnidiae, including biogeographic information of 916 species, included in 6 superfamilies, 23 families and 118 genera. Later on, the same authors published an updated list of water mites from Argentina (FERNÁNDEZ & ROSSO DE FERRADÁS, 2008) and a book chapter with general information, methods for collecting and an illustrated key for identification of South American families and genera (ROSSO DE FERRADÁS & FERNÁNDEZ, 2009). Finally, (QUIROGA *et al.* 2010) in a broader approach, provided ecological data,

concerning genera diversity and distribution of water mite assemblages along a river sub-basin in San Luis Province, Argentina. Since then, no more lists have been made. Among all seven currently recognized superfamilies of Hydrachnidae, Hydryphantoidea is the only one considered paraphyletic (DABERT *et al.* 2016). Although many genera of hydryphantoids show a high degree of similarity to terrestrial parasitengonine mites, which have obligate terrestrial larvae, there is a great variety of distinct morphological adaptations in some representatives, such as an aquatic lifestyle in the larvae of the genera *Wandesia* (GERECKE, 2010) and *Clathrosperchonella* (CASTRO *et al.* 2020), suggesting that these lineages can be more related to derivative groups. The latter belongs to the family Rhynchohydracaridae, only found in the New World, with South American origin (PROCTOR *et al.* 2015). Therefore, a catalog of Hydryphantoidea will contribute to a better comprehension of this group and will stimulate prospective works with several purposes, such as zoogeographic, ecological and conservationists. Molecular data, available by accession numbers and an identification key for all species will be useful for further integrative studies in taxonomy and also for new phylogenetic analysis.

4.3 Material and methods

This catalog is organized in 56 species, listed alphabetically and considering the following sequence of the four currently known families of Hydryphantoidea in South America: Hydryphantidae, Hydrodromidae, Rynchohydracaridae and Thermacaridae. Subfamilies, genera, and subgenera were also included, with all taxa accompanied by their respective authority name(s) and year. Information on each species is presented as follows: species, author(s) and year of publication for each numbered item. In sequence, all references related to the species are mentioned, beginning with the author reference and each new citation in subsequent publications. The number of the page where the species are first mentioned follows the references. Synonyms are also mentioned and discussed in remarks. Abbreviations of the institutions and respective collections where all types are deposited are as follows:

BNHM British Natural History Museum, London, England

DCB Departamento de Ciências Biológicas, São José do Rio Preto, Brazil

FMNH	Field Museum of Natural History, Chicago, USA
GNHM	Göteborgs Naturhistoriska Museum, Gothenburg, Sweden
IFML	Instituto Fundación Miguel Lillo, Tucumán, Argentina
MBR	Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires, Argentina
MNH	Museum of Natural History, Podgorica, Montenegro
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MNHU	Museum für Naturkunde der Humboldt Universität, Berlin, Germany
NRM	Naturhistoriska Riksmuseet, Stockholm, Sweden
RMNH	Naturalis Biodiversity Center, Leiden, The Netherlands
SMF	Senckenberg Museum, Frankfurt, Germany
SMNH	Swedish Museum of Natural History, Stockholm, Sweden

All compiled information here presented was taken from the available literature. New species occurrences were obtained from new collecting points (Table 1), using material and methods described with details in chapters I and II of this thesis. Maps of species distribution were elaborated for each genus and species distribution, also based on previous publications, using the software QGIS 3.16. Geographic coordinates, when available in original description works, were used for plotting latitude and longitudes on maps. For works where just the locations (e.g. municipalities, roads, rivers) of collecting were provided, coordinates were obtained using Google Earth. Methods for collecting, slide preparation and taxonomic studies are described in Chapters I and II, while molecular techniques are described in Chapter II of the present work. Specimens whose mtCOI gene were successfully amplified are listed in Table 2. The list of Brazilian conservation units are as follows: PECD: Caverna do Diabo State Park; ECB: Carlos Botelho State Park; PEIC: Ilha do Cardoso State Park.

Table 1. Localities of new collecting points of Hydryphantoidea in South America.

Locality	Municipality, country	Geographic coordinates	Biome type	Habitat type
PECD	Eldorado, Brazil	24.636944 S 48.401111 W	Atlantic rainforest	stream
PEIC	Cananéia, Brazil	25.088333 S 47.924166 W	Atlantic rainforest	stream
PECB	Sete Barras, Brazil	24.107411 S 47.984667 W	Atlantic rainforest	stream
Fazenda São Bento	Aquidauana, Brazil	20.474245 S 55.668624 W	Pantanal	swamp
Fazenda Estância Crioula	Dois Irmãos do Buriti, Brazil	20.441944 S 55.428333 W	Cerrado	temporary lake
Rio das Almas	Pirenópolis, Brazil	15.847500 S 48.956111 W	Cerrado	spring
Campus USP	Pirassununga, Brazil	21.944347 S 47.467449 W	Cerrado	lake
Granja Integral El Éden de Mindo	Mindo, Ecuador	0.084806 S 78.747944 W	Yunga	stream

Table 2. Details of specimens with mtCOI fragment successfully amplified.

Species and locality	Geographic coordinates	voucher code	GenBank/BOLD accession numbers
<i>Cathrosperchon minor</i>			
Corujas River, Tapiraí, São Paulo State, Brazil; stream	24.030277 S 47.576666 W	CSP001	OK624821 ENBRA017-21
<i>Clathrosperchon punctatus</i>			
Sete Barras, São Paulo State, Brazil; stream	24.107411 S 47.984667 W	CSP002	ON303304 ENBRA014-21
Ostras River, Eldorado, São Paulo State; stream	24.613272 S 48.389488 W	CSP009	ON303468 ENBRA016-21
	24.613272 S 48.389488 W	CSP010	ON303309 ENBRA015-21
<i>Clathrosperchonella olovi</i>			
Cananeia, São Paulo State, Brazil; stream	25.088333 S 47.924166 W	CIC002	ON260956 ENBRA013-21
<i>Rhynchohydracarus armiger</i>			
Córrego da Santa, Pirenópolis, Goiás State, Brazil; stream	15.788083 S 48.872194 W	RG0001	MZ444679 ENBRA011-21
	15.788083 S 48.872194 W	RG0002	MZ444663 ENBRA017-21

4.4 Results

4.4.1 List of taxa and genera distribution maps

Superfamily **Hydryphantoidea** Piersig, 1896

Family **Hydryphantidae** Piersig, 1896

Subfamily **Hydryphantinae** Piersig, 1896

Genus **Hydryphantes** Koch, 1841

Subgenus **Hydryphantes** Koch, 1841

1. *Hydryphantes (Hydryphantes) jujuyensis* Nordenskiöld, 1904

NORDENSKIÖLD, 1904: 395; BESCH, 1964: 84; COOK, 1980: 16; K.O. VIETS, 1987: 354; ROSSO DE FERRADÁS, 1987: 26; ROSSO DE FERRADÁS *et al.* 1987: 119; COOK, 1988: 7; SMIT, 2002: 2; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 185. GOLDSCHMIDT & GERECKE, 2003: 109.

Type locality: Saladillo, Jujuy Province, Argentina

Distribution: Argentina and Chile

Remarks: type locality unknown, except that it was collected in Jujuy Province, Argentina (COOK, 1980).

Type deposition: unknown; 7 undesignated types from Chile and 3 undesignated types from Argentina, both deposited in SMF.

2. *Hydryphantes (Hydryphantes) pumilus* (K. Viets, 1954)

K. VIETS, 1954a: 26; K.O. VIETS, 1987: 356; GOLDSCHMIDT & GERECKE, 2003: 84; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Paramaribo, Suriname

Distribution: Colombia and Suriname

Remarks: synonymized with *Hydryphantes ramosus pumilus* Viets, 1954 (GOLDSCHMIDT & GERECKE, 2003).

Type deposition: SMF

3. *Hydryphantes (Hydryphantes) ramosus* Daday, 1905

DADAY, 1905: 279; LUNDBLAD, 1941: 56; K. VIETS, 1959: 130; ROSSO DE FERRADÁS, 1981: 84; K.O. VIETS & BÖTTGER, 1986: 109; K.O. VIETS, 1987: 356; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186; CASTRO *et al.* 2017: 1689.

Type locality: Tebicuary, Guairá Department, Paraguay

Distribution: Argentina, Brazil and Paraguay

Remarks: synonymized with *Hydryphantes (Hydryphantes) schadei* Lundblad, 1938 (GOLDSCHMIDT & GERECKE, 2003). Larval description in CASTRO *et al.* (2017).

Type deposition: unknown; one undesignated type specimen from Brazil, deposited in SMF.

4. *Hydryphantes (Hydryphantes) thermalis* Cook, 1988

COOK, 1988: 6; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Chillán, Ñuble Province, Chile

Distribution: Chile

Type deposition: FMNH

5. *Hydryphantes (Hydryphantes) undulatifrons* (K. Viets, 1954)

K. VIETS, 1954b: 93; K.O. VIETS, 1987: 356; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Fordlândia, Amazonas State, Brazil

Distribution: Brasil

Remarks: elevated by GOLDSCHMIDT & GERECKE (2003) as a separated species of *Hydryphantes ramosus undulatifrons* K. Viets, 1954.

Type deposition: SMF

Subgenus ***Papilloporus*** Walter, 1935

6. *Hydryphantes (Papilloporus) papillosus* Lundblad, 1936

LUNDBLAD, 1936b: 208; LUNDBLAD, 1941: 58; K. VIETS, 1954a: 28, 1954b: 94; ROSSO DE FERRADÁS, 1983: 14; K.O. VIETS, 1987: 361; GOLDSCHMIDT & GERECKE, 2003: 87; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Argentina, Brazil, Paraguay and Suriname

Remarks: synonymized with *Hydryphantes (Papilloporus) papillosus stellaris* Lundblad, 1941 (GOLDSCHMIDT & GERECKE, 2003).

Type deposition: NRM

New records: 1. Fazenda São Bento, Aquidauana, Mato Grosso do Sul, Brazil, swamp – 01.IV.2019 (3 females and 1 male), coll. L.A.S. de Castro; 2. Fazenda Estância Crioula, Dois Irmãos do Buriti, Mato Grosso do Sul, Brazil, temporary lake – 23.V.2019 (1 female and 1 male), coll. L.A.S. de Castro.

Subgenus ***Polyhydriphantes*** Viets, 1926

7. *Hydriphantes (Polyhydriphantes) alienus* Lundblad, 1924

LUNDBLAD, 1924: 11; BESCH, 1964: 84; K.O. VIETS, 1987: 362; COOK, 1988: 8; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Junín, Junín Province, Peru

Distribution: Chile and Peru

Type deposition: GNHM

8. *Hydriphantes (Polyhydriphantes) coscaroni* Cook, 1980

COOK, 1980: 17; K.O. VIETS, 1987: 362; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Dina Huapi, Río Negro Province, Argentina

Distribution: Argentina

Type deposition: FMNH

9. *Hydriphantes (Polyhydriphantes) pinguipalpis* Viets, 1954

K. VIETS, 1954a: 28; ROSSO DE FERRADÁS, 1981:88; K.O. VIETS, 1987: 364; GOLDSCHMIDT & GERECKE, 2003: 109; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Santa Lucia, Canelones Department, Uruguay

Distribution: Argentina and Uruguay

Type deposition: SMF

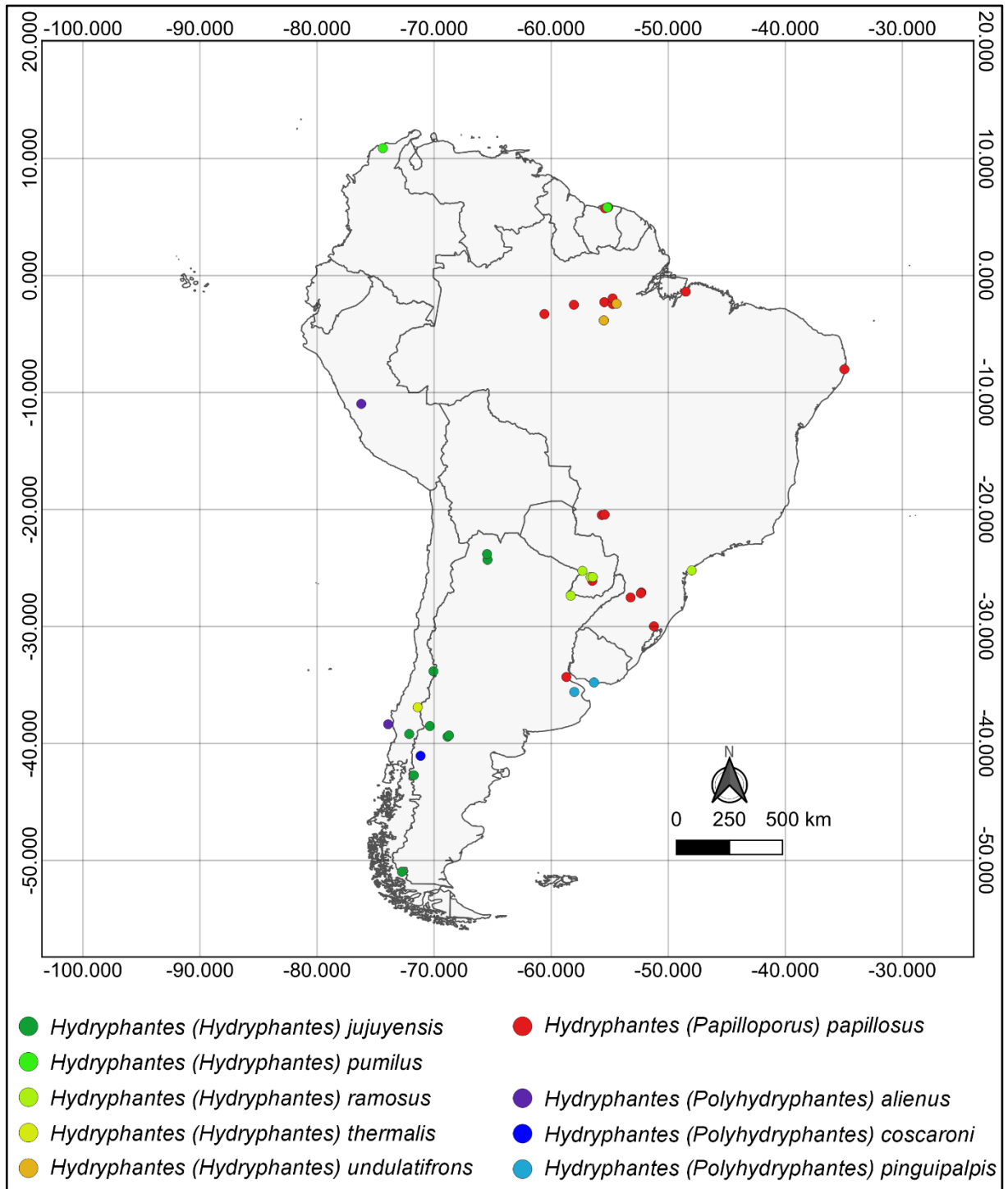


Figure 1. Distribution of the genus *Hydryphantes* in South America.

Subfamily **Pseudohydryphantinae** K.Viets, 1926

Genus *Pseudohydryphantes* K. Viets, 1907

10. *Pseudohydryphantes chilensis* Smit, 2021

SMIT, 2021: 275

Type locality: Pidpid, Chiloé Province, Chile

Distribution: Chile

Remarks: this is the first record of the genus for South America (SMIT, 2021).

Type deposition: RMNH

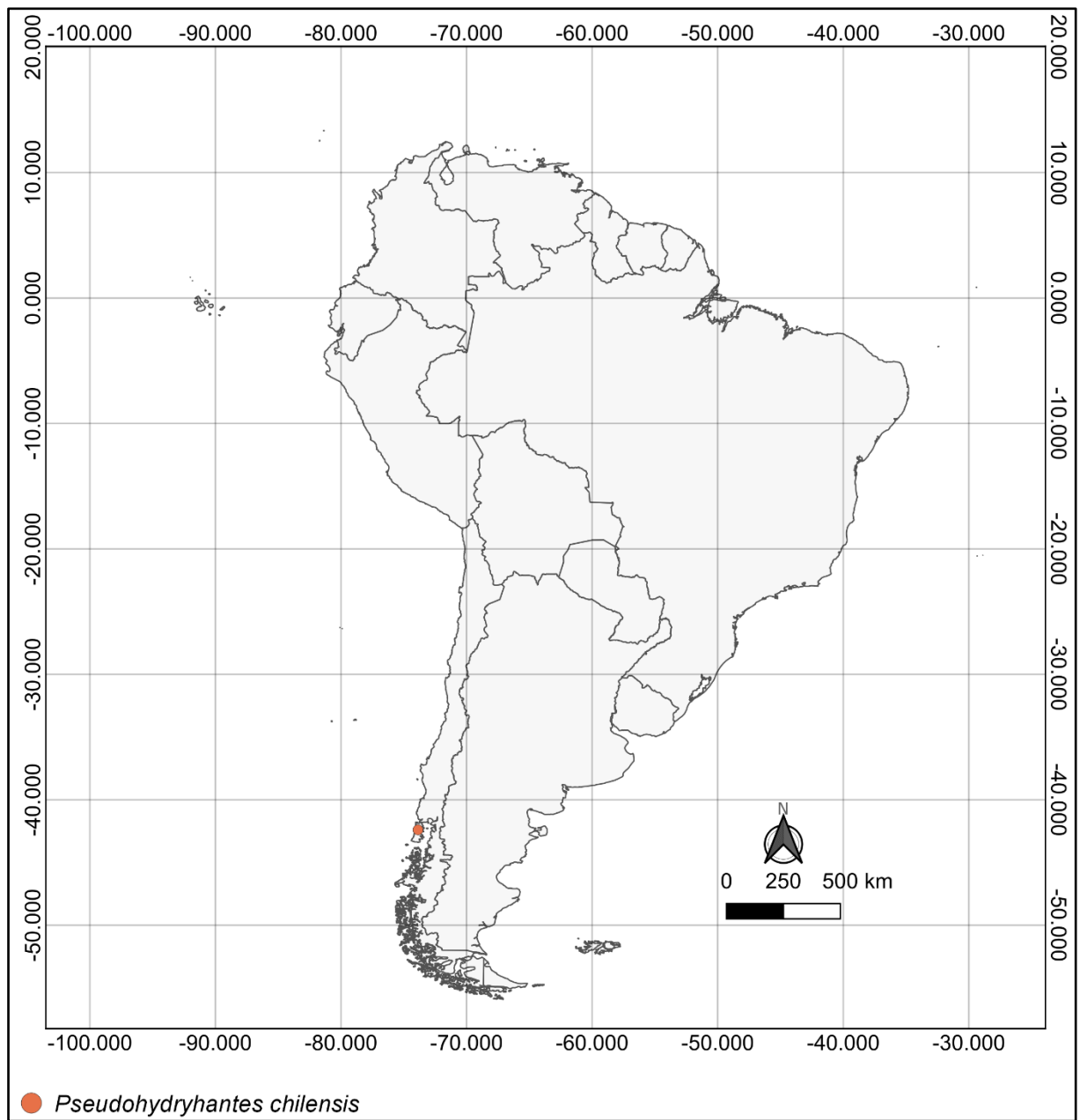


Figure 2. Distribution of the genus *Pseudohydryphantes* in South America.

Subfamily **Tartarothyadinae** K. Viets, 1934

Genus **Tartarothyas** K. Viets, 1934

11. *Tartarothyas xiua* Goldschmidt, Pimiento-Ortega & Herrera-Martínez, 2021

GOLDSCHMIDT *et al.* 2021: 246

Type locality: Mongua, Boyacá Department, Colombia

Distribution: Colombia

Remarks: this is the first record of the genus for South America (GOLDSCHMIDT *et al.* 2021).

Type deposition: waiting for deposition in some institution (T. Goldschmidt, person. comm.)

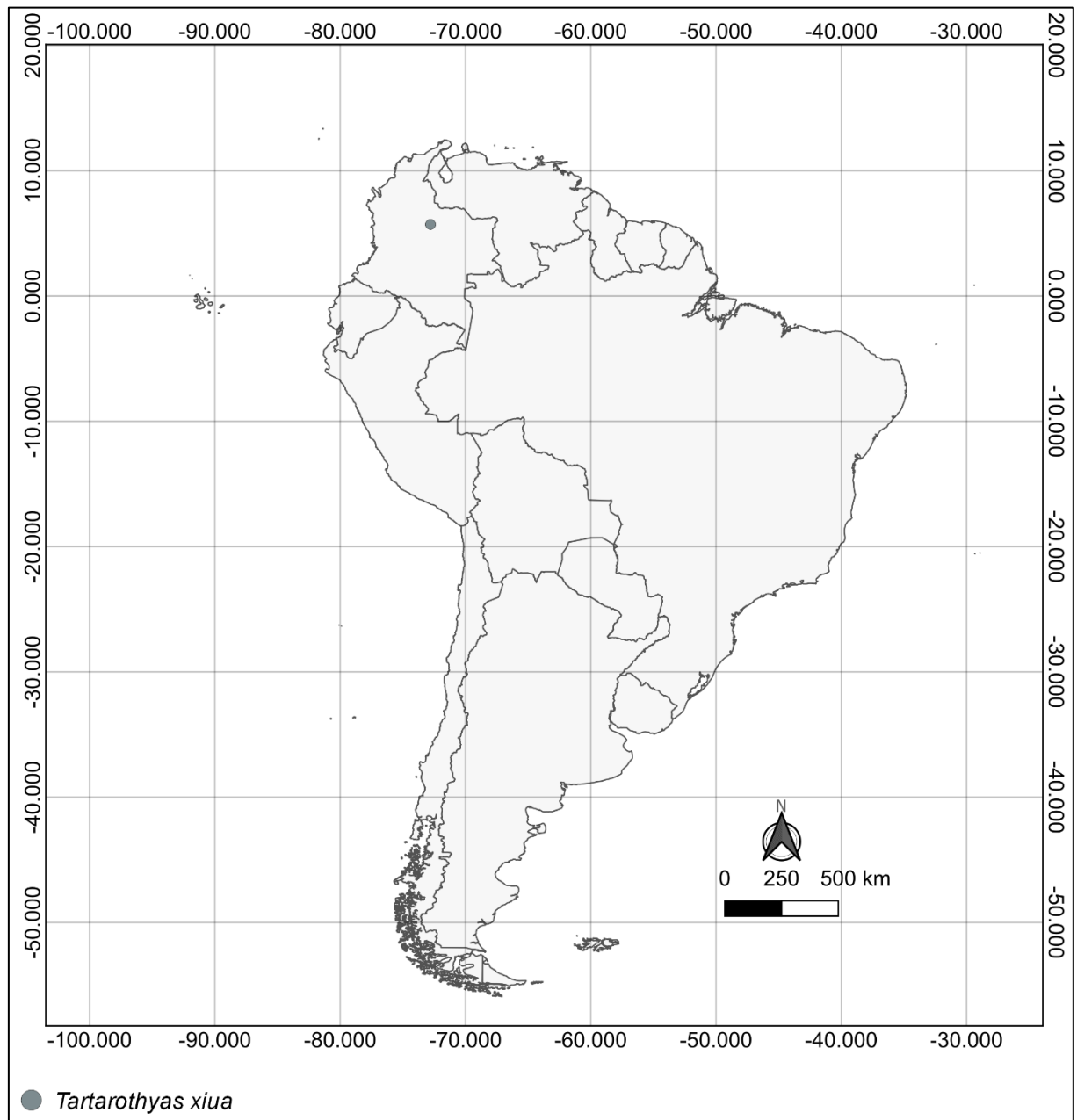


Figure 3. Distribution of the genus *Tartarothyas* in South America.

Subfamily **Euthyadinae** K. Viets, 1931

Genus ***Notopanisus*** Besch, 1964

12. *Notopanisus wetzeli* Besch, 1964

BESCH, 1964: 93; K.O. VIETS, 1987: 579; COOK, 1980: 17; COOK, 1988: 8; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Valdivia, Los Rios Province, Chile

Distribution: Argentina and Chile

Type deposition: SMF

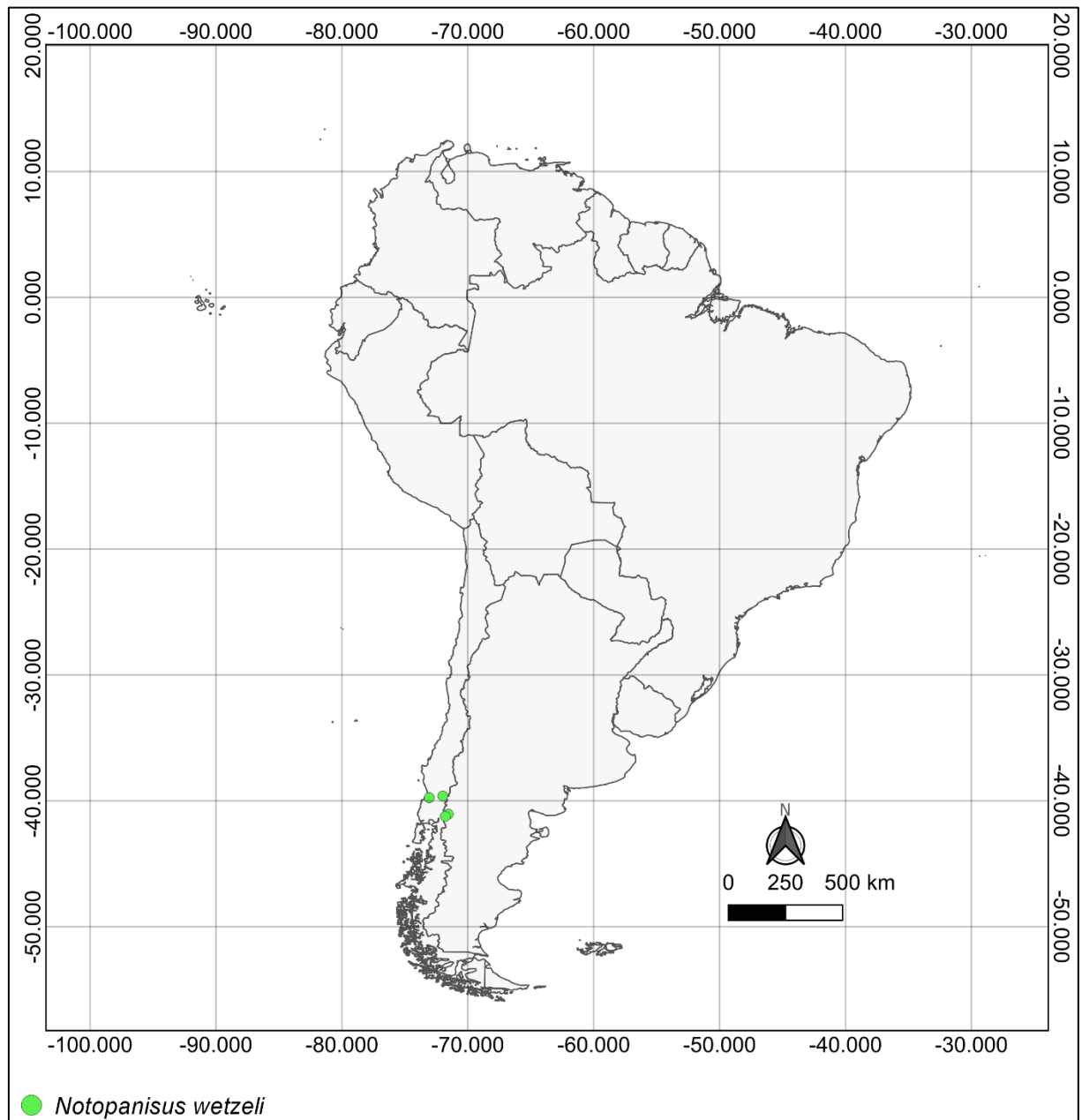


Figure 4. Distribution of the genus *Notopanisus* in South America.

Subfamily **Protziinae** Koenike, 1909

Genus ***Protzia*** Piersig, 1896

13. *Protzia salsa* Gerecke, 2003

GOLDSCHMIDT & GERECKE, 2003: 88; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Quebrada Jorco, Guanacaste Province, Costa Rica

Distribution: Ecuador

Remarks: this is the first record of the genus for South America (GOLDSCHMIDT & GERECKE, 2003).

Type deposition: SMF

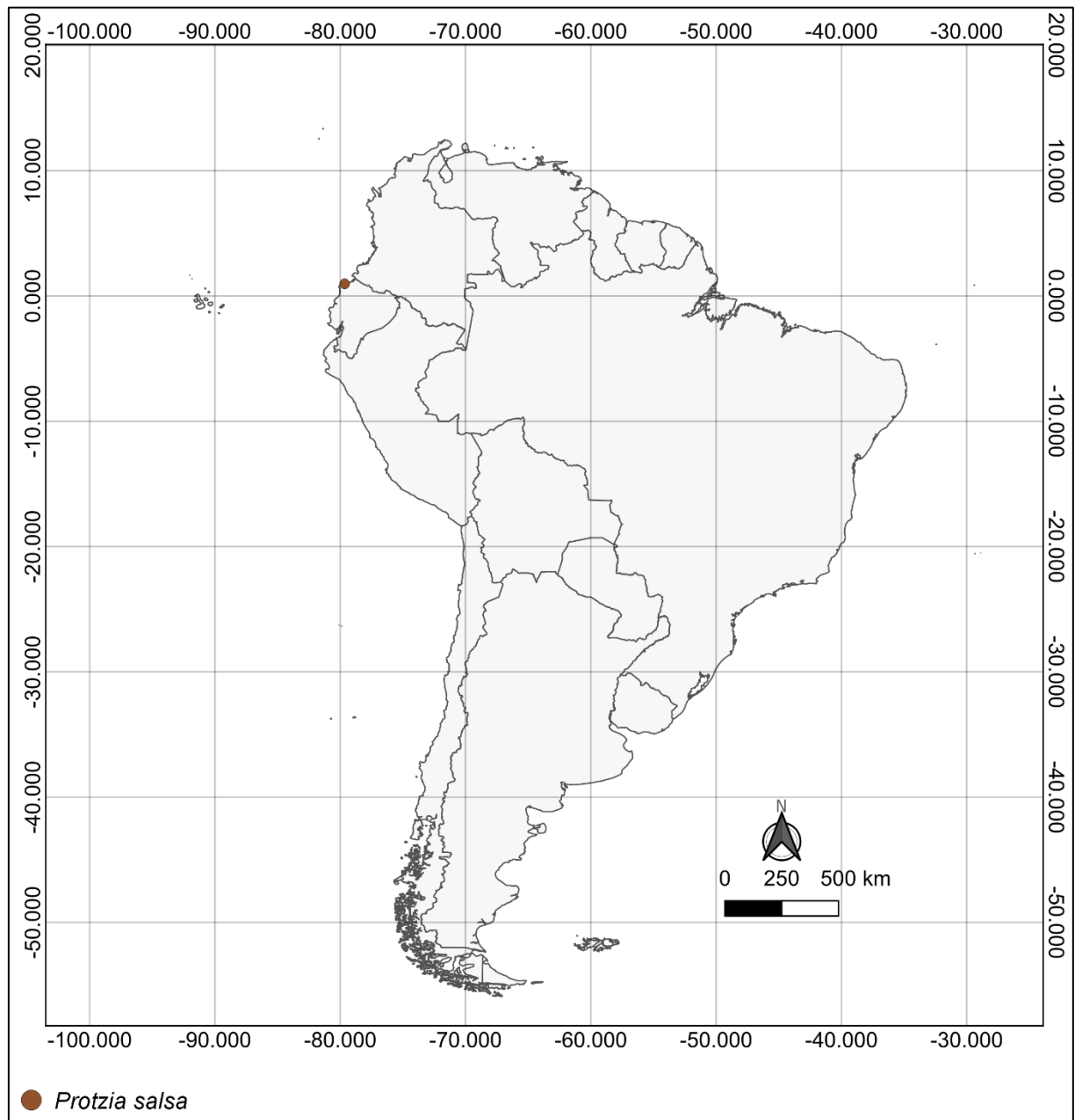


Figure 5. Distribution of the genus *Protzia* in South America.

Genus ***Neocalonyx*** Walter, 1919

Subgenus ***Neocalonyx*** Walter, 1919

14. *Neocalonyx (Neocalonyx) desajunos* Gerecke, 2003

GOLDSCHMIDT & GERECKE, 2003: 98; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: El Dorado, Esmeraldas Province, Ecuador

Distribution: Ecuador

Type deposition: SMF

15. *Neocalonyx (Neocalonyx) diaguita* Rosso de Ferradás & Fernández, 2007

ROSSO DE FERRADÁS & FERNÁNDEZ, 2007: 184

Type locality: General Belgrano, Jujuy Province, Argentina

Distribution: Argentina

Type deposition: IFML

16. *Neocalonyx (Neocalonyx) frijolito* Gerecke, 2003

GOLDSCHMIDT & GERECKE, 2003: 97; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Cayambe, Pichincha Province, Ecuador

Distribution: Ecuador

Type deposition: SMF

17. *Neocalonyx (Neocalonyx) godeti* Walter, 1919

WALTER, 1919: 28; K.O. VIETS, 1987: 542; GOLDSCHMIDT & GERECKE, 2003: 92; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Naticocha, Pasco Province, Peru

Distribution: Ecuador and Peru

Type deposition: unknown

New record: Quebrada Josefina, Granja Integral El Éden de Mindo, Mindo, Pichincha Province, Ecuador, spring – 02.XI.2019 (5 females, 1 male and 1 deutonymph), colls. L.A.S. de Castro, C.A. Ortega-Ojeda, E.L.M. Molina

18. *Neocalonyx (Neocalonyx) keldomus* Cook, 1988

COOK, 1988: 13; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Puente Colo, Malleco Province, Chile

Distribution: Chile

Type deposition: FMNH

19. *Neocalonyx (Neocalonyx) longimaxillaris* K. Viets, 1953

K. VIETS, 1953: 129, 1955: 253; BESCH, 1964: 87; K.O. VIETS, 1987: 542; COOK, 1988: 10; GOLDSCHMIDT & GERECKE, 2003: 96; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Lake Titicaca, Puno Province, Peru

Distribution: Chile, Ecuador and Peru

Type deposition: BNHM

20. *Neocalonyx (Neocalonyx) pectunguis* Lundblad, 1953

LUNDBLAD, 1953: 444; K.O. VIETS, 1987: 542; GOLDSCHMIDT & GERECKE, 2003: 93; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: El Tambo, Cauca Department, Colombia

Distribution: Colombia and Ecuador

Type deposition: NRM

21. *Neocalonyx (Neocalonyx) penai* Besch, 1964

BESCH, 1964: 88; K.O. VIETS, 1987: 543; COOK, 1988: 11; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186; SMIT, 2021: 275.

Type locality: Tecka River, Río Negro Province, Argentina

Distribution: Argentina and Chile

Remarks: BESCH (1964) described this species as belonging to the subgenera *Paracalonyx*. After reviewing the holotype, COOK (1988) reclassified it in the subgenus *Neocalonyx*.

Type deposition: SMF

22. *Neocalonyx (Neocalonyx) placophorus* Cook, 1988

COOK, 1988: 14; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Puente Colo, Malleco Province, Chile

Distribution: Chile

Type deposition: FMNH

23. *Neocalonyx (Neocalonyx) schindowskii* Besch, 1964

BESCH, 1964: 87; K.O. VIETS, 1987: 543; COOK, 1988: 12; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Coñaripe, Los Ríos Province, Chile

Distribution: Chile

Type deposition: SMF

24. *Neocalonyx (Neocalonyx) tenuirostris* Lundblad, 1941

LUNDBLAD, 1941a: 108, 1944: 135; K.O. VIETS, 1987: 543; GOLDSCHMIDT & GERECKE, 2003: 95; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186; ROSSO DE FERRADÁS & FERNÁNDEZ, 2007: 182.

Type locality: Baños, Tungurahua Province, Ecuador

Distribution: Bolivia and Ecuador

Type deposition: NRM

Subgenus ***Paracalonyx*** Lundblad, 1944

25. *Neocalonyx (Paracalonyx) longipalpis* Lundblad, 1941

LUNDBLAD, 1941: 156, 1944: 137; K.O. VIETS, 1987: 543; ROSSO DE FERRADÁS, 1987: 27; COOK, 1988: 14; GOLDSCHMIDT & GERECKE, 2003: 110; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Lagunita, Mendoza Province, Argentina

Distribution: Argentina, Chile and Ecuador

Type deposition: NRM

Subgenus ***Otongacarus*** Goldschmidt & Gerecke, 2003

26. *Neocalonyx (Otongacarus) pina* Gerecke, 2003

GOLDSCHMIDT & GERECKE, 2003: 99; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: El Dorado, Esmeraldas Province, Ecuador

Distribution: Ecuador

Type deposition: SMF

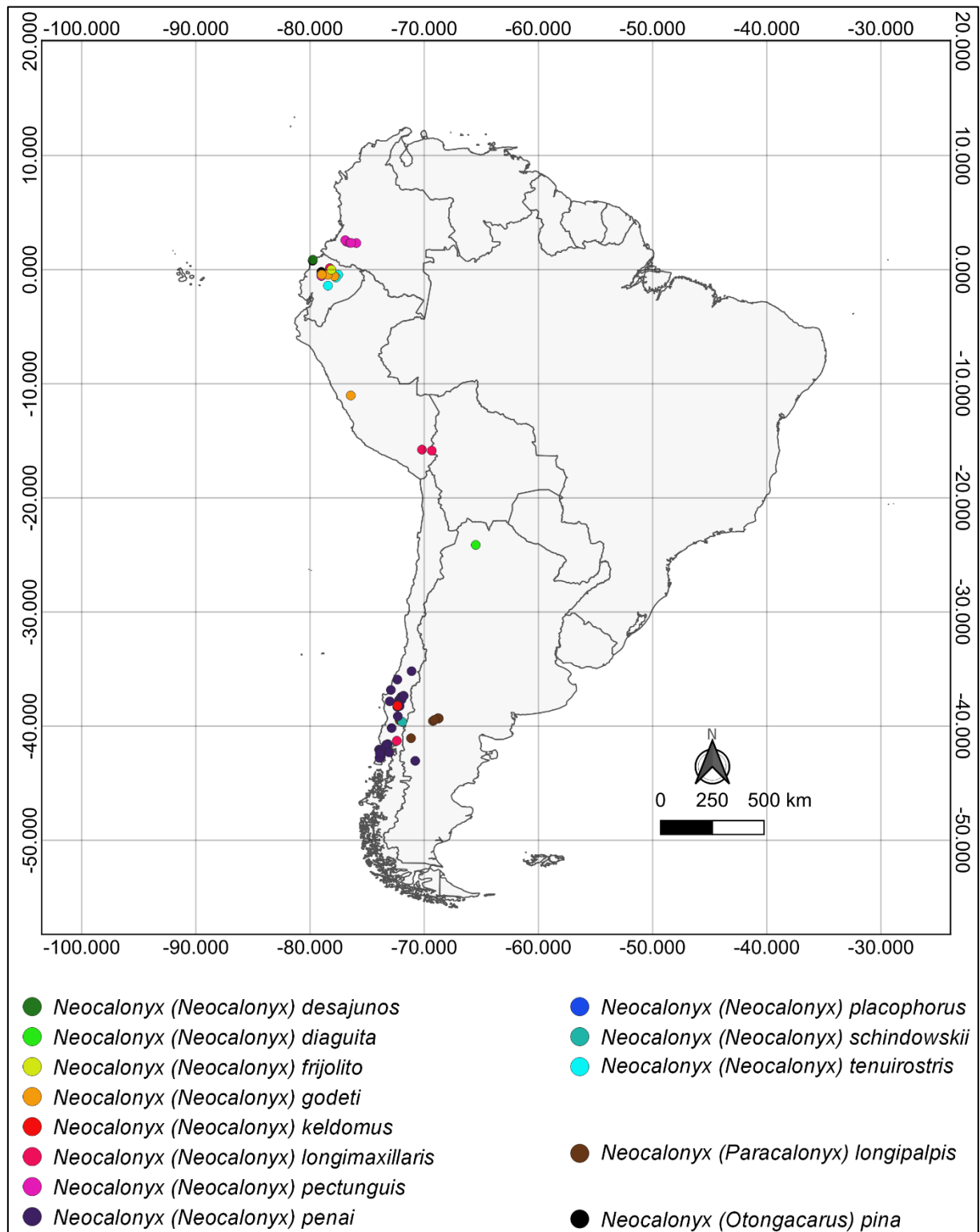


Figure 6. Distribution of the genus *Neocalonyx* in South America.

Subfamily **Eupatrellinae** K. Viets, 1935

Genus ***Eupatrella*** Walter, 1935

27. *Eupatrella platano* Gerecke, 2003

GOLDSCHMIDT & GERECKE, 2003: 105; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: El Dorado, Esmeraldas Province, Ecuador

Distribution: Ecuador

Type deposition: SMF

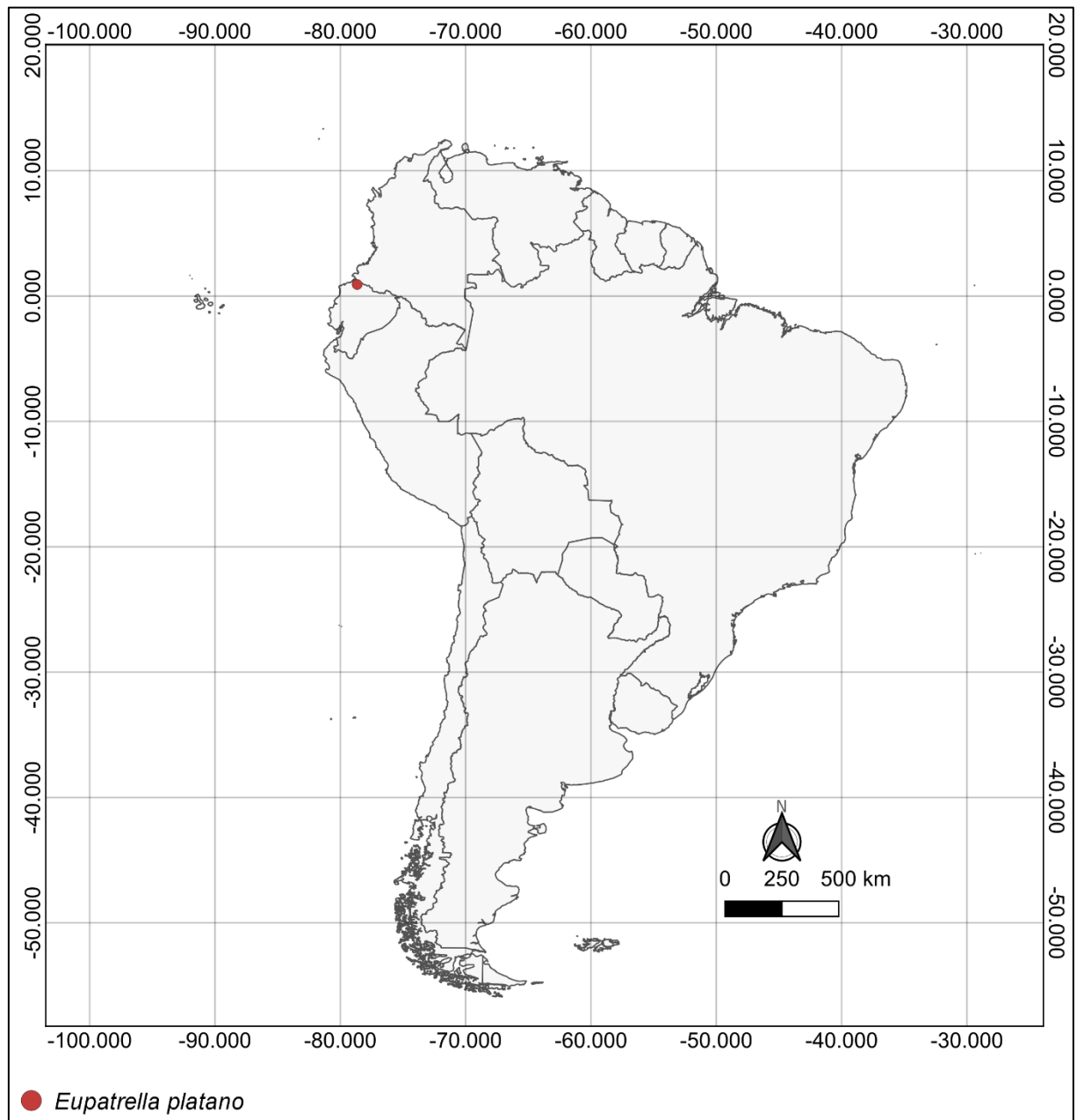


Figure 7. Distribution of the genus *Eupatrella* in South America.

Subfamily **Wandesiinae** Schwoerbel, 1961

Genus **Wandesia** Schechtel, 1912

Subgenus **Partnuniella** K. Viets, 1938

28. *Wandesia (Partnuniella) chechoi* Cook, 1988

COOK, 1988: 15; *W. (Pseudowandesia) chechoi* Goldschmidt & Gerecke, 2003: 111;
ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: Chillán, Ñuble Province, Chile

Distribution: Chile

Type deposition: FNMH

29. *Wandesia (Partnuniella) lehmanni* Pešić et al. 2010

PEŠIĆ et al. 2010: 54.

Type locality: Duitama, Boyacá Department, Colombia

Distribution: Colombia

Type deposition: MNHP

30. *Wandesia (Partnuniella) stalagmophila* Lundblad, 1941

LUNDBLAD, 1941b: 54; K.O. VIETS, 1987: 820; GOLDSCHMIDT & GERECKE, 2003:
111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil

Type deposition: NRM

31. *Wandesia (Partnuniella) thermalis* (K. Viets, 1938)

K. VIETS, 1938: 215; K.O. VIETS, 1987: 821; SCHWOERBEL, 1987: 401; MARTIN & SCHWOERBEL, 2002: 68; GOLDSCHMIDT & GERECKE, 2003: 111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Yellowstone National Park, Wyoming State, USA

Distribution: Chile

Type deposition: SMF

32. *Wandesia (Partnuniella) walteri* Lundblad, 1937

LUNDBLAD, 1937b: 281, 1941b: 51; K.O. VIETS, 1987: 821; GOLDSCHMIDT & GERECKE, 2003: 111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil and Paraguay

Type deposition: NRM

Subgenus ***Pseudowandesia*** Habeeb, 1958

33. *Wandesia (Pseudowandesia) andiana* Cook, 1980

COOK, 1980: 19; K.O. VIETS, 1987: 821; *Wandesia andina* GOLDSCHMIDT & GERECKE, 2003: 111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Cachi, Salta Province, Argentina

Distribution: Argentina

Type deposition: FMNH

34. *Wandesia (Pseudowandesia) lethaea* (Besch, 1964)

BESCH, 1964: 91; K.O. VIETS, 1987: 821; GOLDSCHMIDT & GERECKE, 2003: 111;
ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 186.

Type locality: San Luis, Mendoza Province, Argentina

Distribution: Argentina

Type deposition: SMF

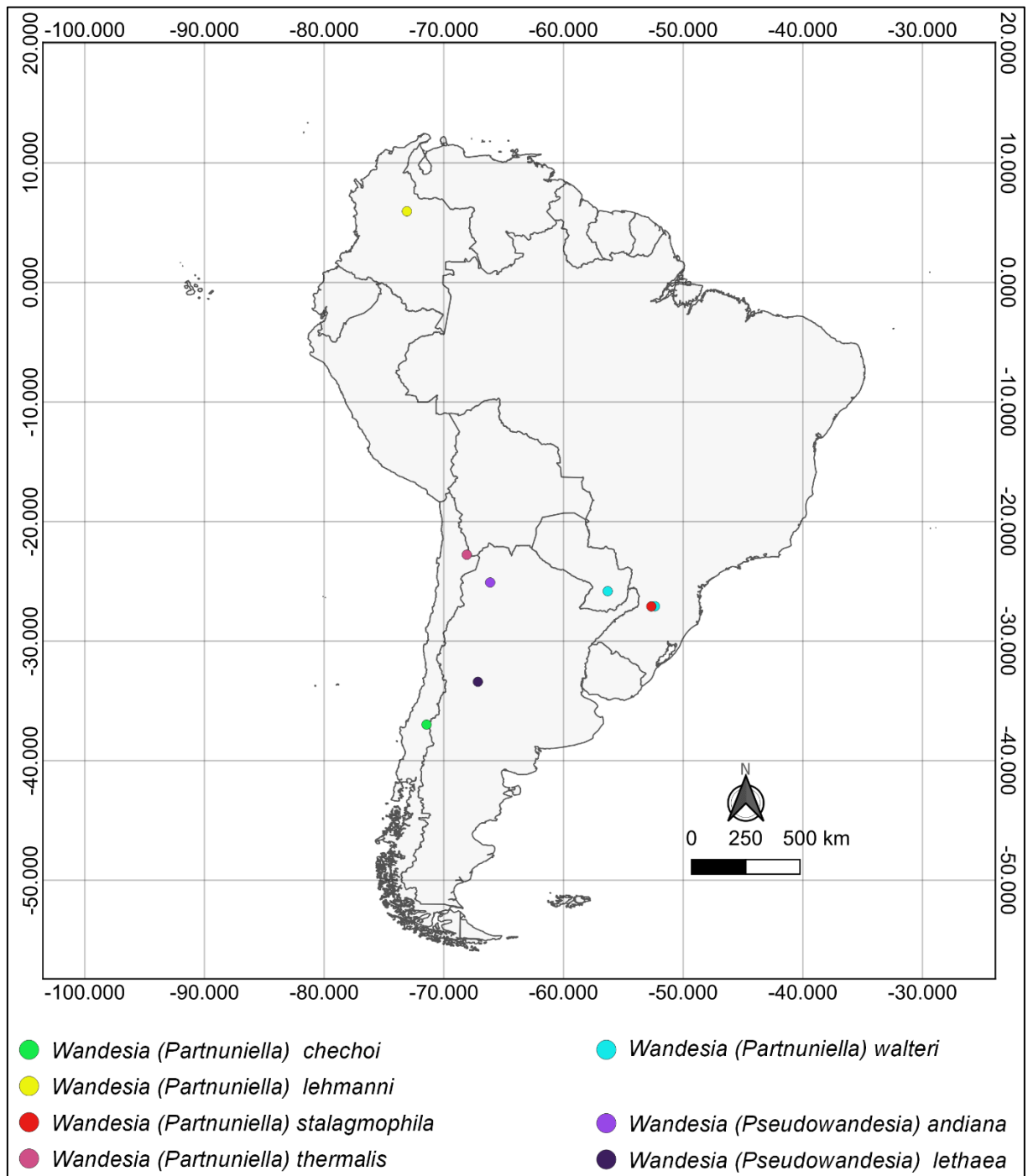


Figure 8. Distribution of the genus *Wandesia* in South America.

Genus ***Euwandesia*** André & Naudó, 1962

35. *Euwandesia sensitiva* André & Naudó, 1962

Synonymy: *Euwandesia vietsiella* Besch, 1964

ANDRÉ & NAUDO, 1962: 598, 1963: 99; BESCH, 1964: 99; K.O. VIETS, 1987: 235; COOK, 1988: 17; GOLDSCHMIDT & GERECKE, 2003: 111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Lago Puelo, Chubut Province, Argentina

Distribution: Argentina and Chile

Remarks: After examining Besch's type specimen (BESCH, 1964), which were described as *Euwandesia vietsiella*, COOK (1988) placed this species in synonymy with *E. sensitiva*.

Type deposition: MNHN

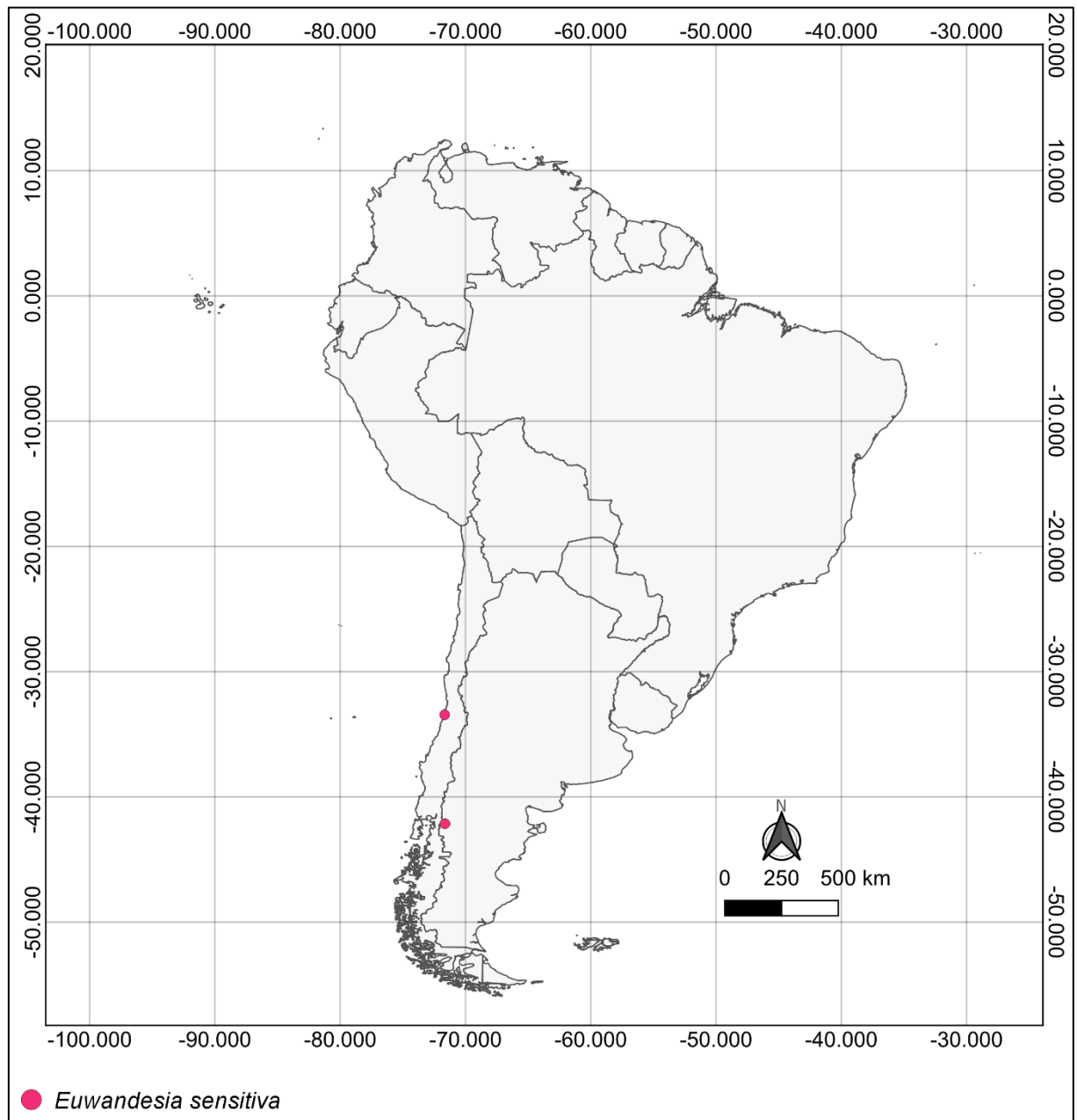


Figure 9. Distribution of the genus *Euwandesia* in South America.

Subfamily **Ankelothyadinae** Besch, 1964

Genus ***Ankelothyas*** Besch, 1964

36. *Ankelothyas emydoides* Besch, 1964

BESCH, 1964: 96; COOK, 1974: 91; K.O. VIETS, 1987: 28; COOK, 1988: 17; GOLDSCHMIDT & GERECKE, 2003: 111; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Huellehue, Los Rios Province, Chile

Distribution: Chile

Type deposition: SMF

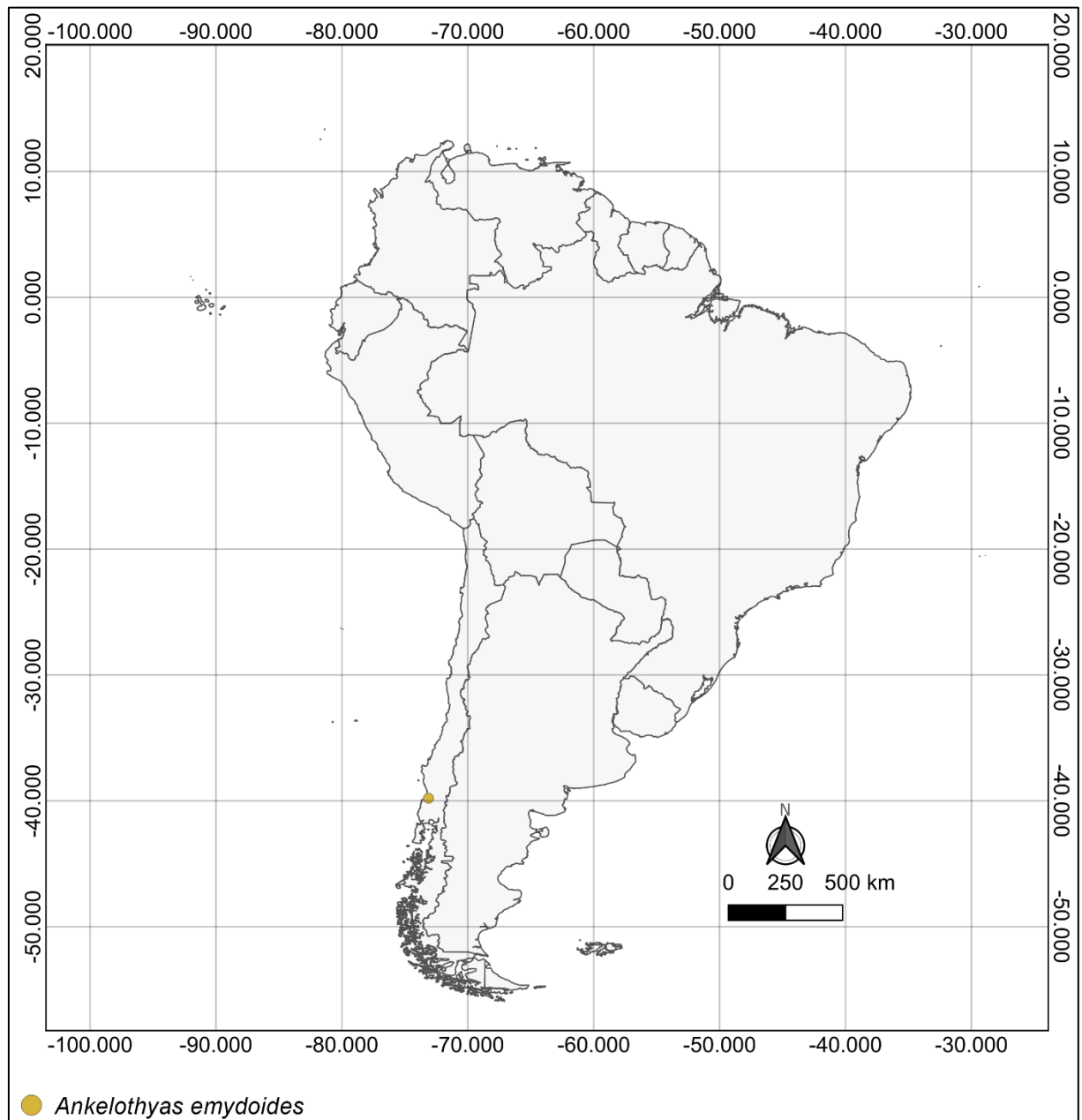


Figure 10. Distribution of the genus *Ankelothyas* in South America.

Family **Hydrodromidae** K. Viets, 1936

Genus **Hydrodroma** Koch, 1837

37. *Hydrodroma argentinensis* Pešić & Smit, 2022

PEŠIĆ & SMIT, 2022: 72.

Type locality: Nahuel Huapi, Río Negro Province, Argentina

Distribution: Argentina

Type deposition: MBR

38. *Hydrodroma clavipes* (Lundblad, 1953)

LUNDBLAD, 1953: 449; COOK, 1980: 23; PEŠIĆ & SMIT, 2022: 71.

Type locality: El Tambo, Cauca Province, Colombia

Distribution: Colombia

Remarks: previously described as *Hydrodroma despiciens clavipes* Lundblad, 1953 collected in Colombia (LUNDBLAD, 1953) and later on elevated by COOK (1980) as a different species, based on material collected from Mexico (PEŠIĆ & SMIT, 2022).

Type deposition: NRM

39. *Hydrodroma despiciens* (Müller, 1776)

MÜLLER, 1776: 190; LUNDBLAD, 1941b: 62, 1944: 139, 1953: 449; K. VIETS, 1954a: 29; K.O. VIETS, 1968: 209; COOK, 1980: 22; ROSSO DE FERRADÁS, 1984: 126; VIETS & BÖTTGER, 1986: 109; K.O. VIETS, 1987: 342; COOK, 1988: 17; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: *terra typica*, Denmark

Distribution: Argentina, Brazil, Chile, Paraguay and Peru

Remarks: this species was considered cosmopolitan until being redescribed by GERECKE (2017); therefore, the status of several South American *H. despiciens* needs revision.

Type deposition: holotype lost; SMNH (neotype, from the same country)

40. *Hydrodroma longiseta* (K. Viets, 1954)

K. VIETS, 1954a: 30; PEŠIĆ & SMIT, 2022: 72.

Type locality: Zárate, Entre Rios Province, Argentina

Distribution: Argentina, Brazil and Suriname

Remarks: Previously described as *Hydrodroma despiciens longiseta* K. Viets, 1954 collected in Brazil and Suriname (VIETS, 1954a) and later on elevated by PEŠIĆ & SMIT (2022) as a separated species, based on material collected from Argentina.

Type deposition: SMF

41. *Hydrodroma peregrina* (Koenike, 1905)

KOENIKE, 1905: 696; MARSHALL, 1940: 377; LUNDBLAD, 1941b: 60; K.H. VIETS, 1954a: 32; K.O. VIETS, 1987: 344; ROSSO DE FERRADÁS; 1983: 16; ROSSO DE FERRADÁS & BÖTTGER, 1997: 181; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Rio Grande do Sul State, Brazil

Distribution: Argentina, Brazil and Paraguay

Type deposition: MNHU

New record: University of São Paulo Campus, Pirassununga, São Paulo State, lake – 14.II.2019 (7 females, 4 males), coll. L.A.S. de Castro.

42. *Hydrodroma robusta* (K. Viets, 1954)

VIETS, 1954a: 32; LUNDBLAD, 1941b: 60; PEŠIĆ & SMIT, 2022: 71.

Type locality: Cabo de Santo Agostinho, Pernambuco State, Brazil

Distribution: Argentina, Brazil and Paraguay

Remarks: Previously described as *Hydrodroma peregrina robusta* K. Viets, 1954 collected in Brazil and later on elevated by PEŠIĆ & SMIT (2022) as a separated species.

Type deposition: SMF

43. *Hydrodroma stalagmophila* Lundblad, 1941

LUNDBLAD, 1941b: 66; K.O. VIETS, 1987: 344; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil

Type deposition: NRM

44. *Hydrodroma unguolata* Lundblad, 1941

LUNDBLAD, 1941b: 68; K.O. VIETS, 1987: 345; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Petrópolis, Rio de Janeiro State, Brazil

Distribution: Brazil

Type deposition: NRM

New records: 1. Corujas River, Tapiraí, São Paulo State, Brazil, stream – 20.X.2017 (2 males), 27.XII.2017 (1 female and 1 male), coll. L.A.S. de Castro. 2. Rio das Almas,

Pirenópolis, Goiás State, Brazil, stream – 01.VIII.2018 (1 female), coll. L.A.S. de Castro.

45. *Hydrodroma ventana* Pešić & Smit, 2022

PEŠIĆ & SMIT, 2022: 78.

Type locality: Sierra de la Ventana, Buenos Aires Province, Argentina

Distribution: Argentina

Type deposition: MBR

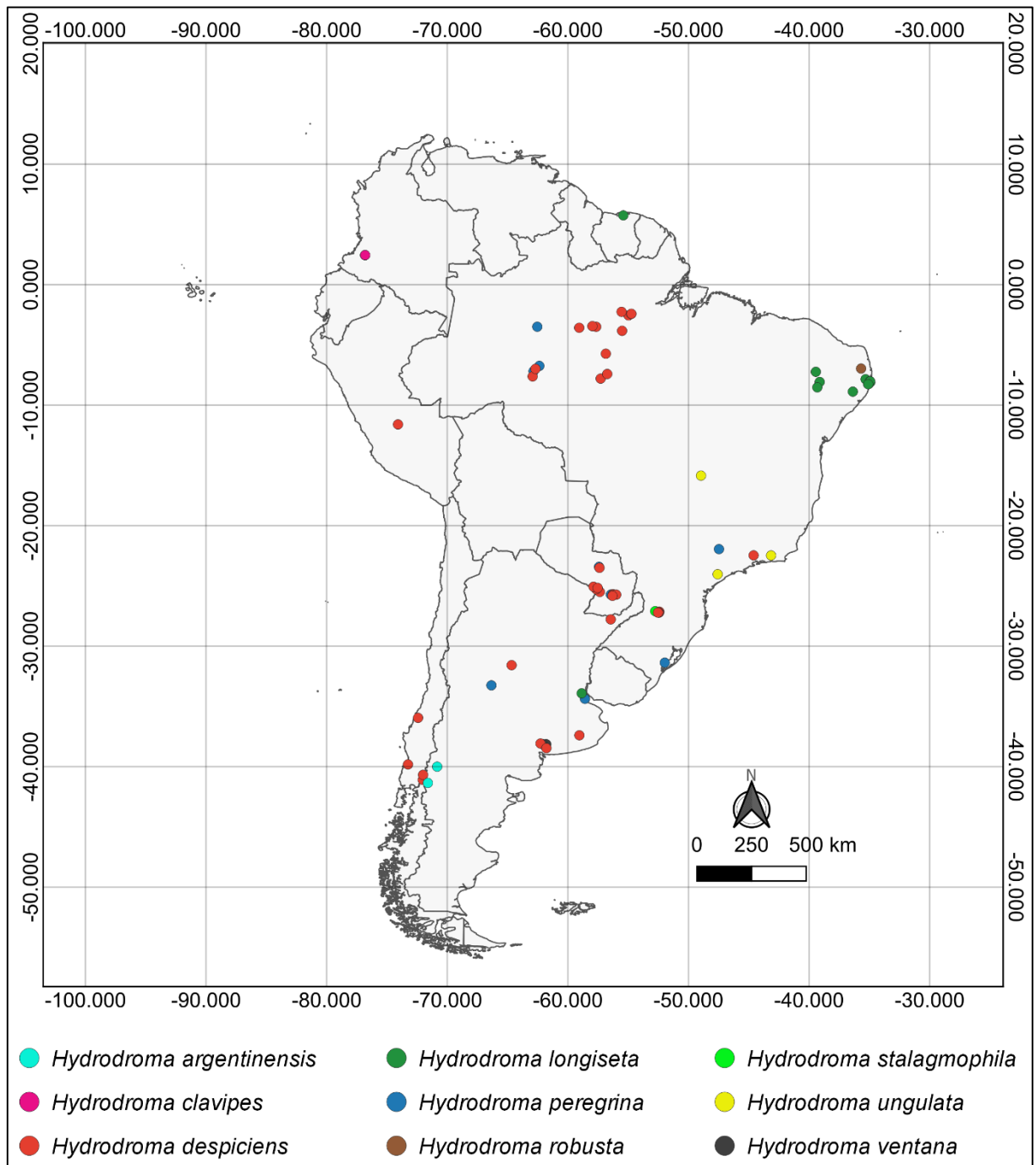


Figure 11. Distribution of the genus *Hydrodroma* in South America.

Family **Rhynchohydracaridae** Lundblad, 1936

Subfamily **Rhynchohydracarinae** Lundblad, 1936

Genus ***Rhynchohydracarus*** Lundblad, 1936

46. *Rhynchohydracarus armiger* Castro, Proctor & Lofego, 2022

CASTRO *et al.* 2022: 164.

Type locality: Pirenópolis, Goiás State, Brazil

Distribution: Brazil

Type deposition: DCBSJRP

Molecular data: voucher RGO002 (holotype), accession numbers: MZ444663 (GenBank), ENBRA017-21 (BOLD); voucher RGO001 (paratype), accession numbers: MZ444679 (GenBank:), ENBRA011-21 (BOLD)

47. *Rhynchohydracarus dividiuus* Lundblad, 1941

LUNDBLAD, 1941b: 84; K.O. VIETS, 1987: 679; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Villarica, Guairá Province, Paraguay

Distribution: Paraguay

Type deposition: NRM

48. *Rhynchohydracarus testudo* Lundblad, 1936

LUNDBLAD, 1936a: 29, 1941b: 82; BESCH, 1964: 123; K.O. VIETS, 1987: 679; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil

Type deposition: NRM

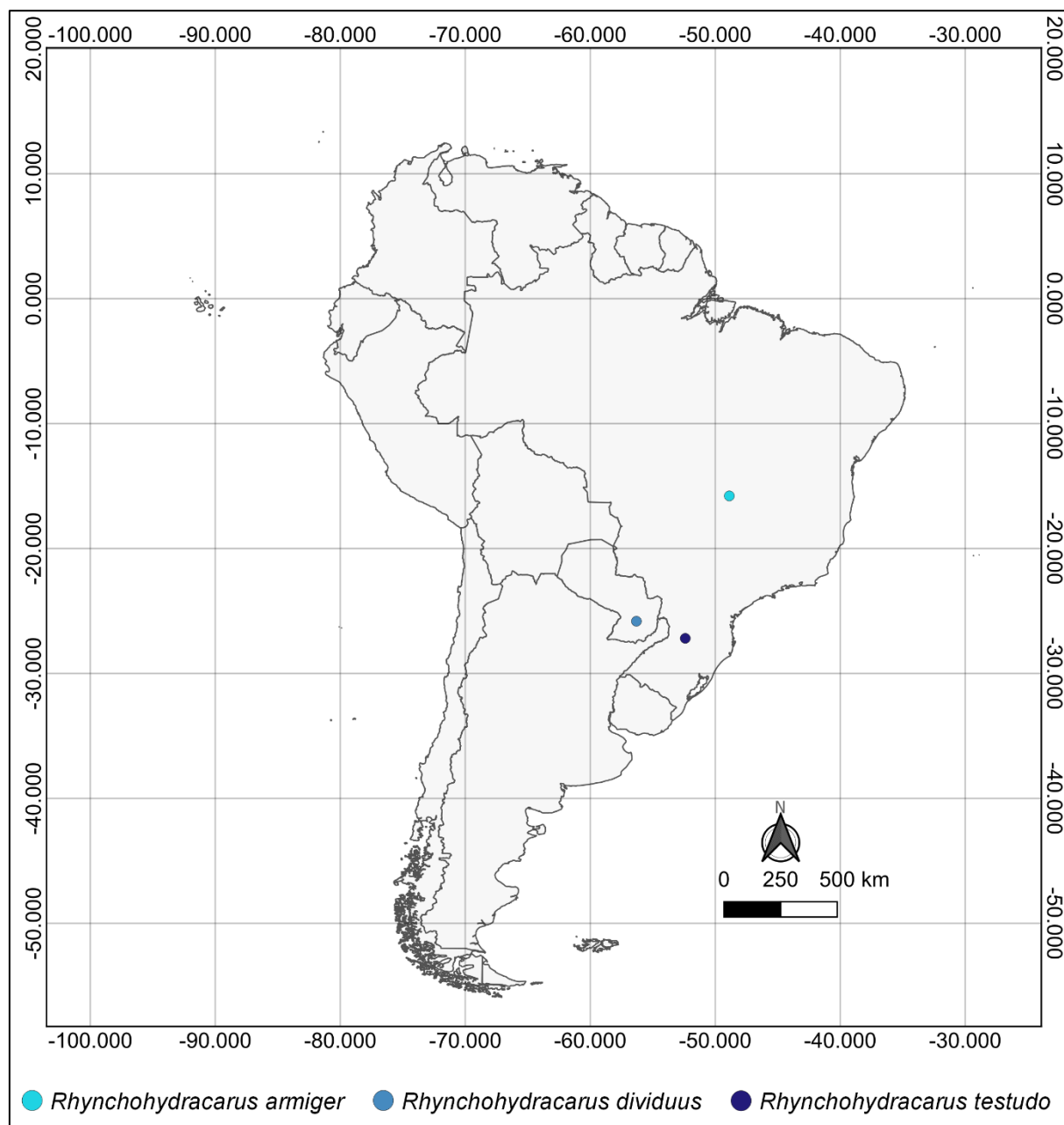


Figure 12. Distribution of the genus *Rhynchohydracarus* in South America.

Subfamily **Clathrosperchontinae** Lundblad, 1936

Genus **Clathrosperchon** Lundblad, 1936

49. *Clathrosperchon crassipalpis* Lundblad, 1936

LUNDBLAD, 1936a: 30; LUNDBLAD, 1941b: 70; LUNDBLAD, 1953: 437; K.O. VIETS, 1987: 211; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020: 1748.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil and Colombia

Type deposition: NRM

50. *Clathrosperchon minor* Lundblad, 1937

LUNDBLAD, 1937a: 282, 1941b: 74, 1953: 437; K.O. VIETS, 1987: 211; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020: 1748.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil, Colombia and Paraguay

Type deposition: NRM

Molecular data: voucher CSP001, accession numbers OK624821 (GenBank), ENBRA017-21 (BOLD)

New records: 1. Corujas River, Tapiraí, São Paulo State, Brazil, stream – 20.X.2017 (1 female), 27.XII.2017 (3 females, 7 males and 1 deutonymph), 14.I.2019 (2 females and 4 males), 16.VIII.2019 (5 females), coll. L.A.S. de Castro; 2. Almas River, Pirenópolis, Goiás State, Brazil, stream – 02.VIII.2018 (2 females), coll. L.A.S. de Castro.

51. *Clathrosperchon punctatus* Cook, 1980

COOK, 1980: 24; K.O. VIETS, 1987: 211; ROSSO DE FERRADÁS, 1984: 129; VIETS & BÖTTGER, 1986: 109; ROSSO DE FERRADÁS, 2000: 29; FERNÁNDEZ, 2003: 61; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020:1748.

Type locality: Tafi del Valle, Tucumán Province, Argentina

Distribution: Argentina, Brazil and Paraguay

Type deposition: FNMH

Molecular data: voucher CSP002, accession numbers ON303304 (GenBank), ENBRA014-21 (BOLD); voucher CSP009, accession numbers ON303468 (GenBank), ENBRA016-21 (BOLD); voucher CSP010, accession numbers ON303309 (GenBank), ENBRA015-21 (BOLD)

New records: 1. PECD, Ostras River, Eldorado, São Paulo State, Brazil, stream – 25.I.2012 (1 female and 1 male), 16.VIII.2019 (2 females), coll. L.A.S. de Castro; 2. Almas River, Pirenópolis, São Paulo State, Brazil, stream – 01.VIII.2018 (1 female and 1 deutonymph), coll. L.A.S. de Castro; 3. PECB, Sete Barras, São Paulo State, Brazil, stream – 19.VIII.2019 (1 female), coll. L.A.S. de Castro; 4. Corujas River, Tapiraí, São Paulo State, Brazil, stream – 11.VIII.2020 (1 female), coll. L.A.S. de Castro.

52. *Clathrosperchon transversus* K.O. Viets, 1977

K.O. VIETS, 1977: 520, 1987: 211; GRUIA, 1988: 21; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020: 1748.

Type locality: Cobán, Alta Verapaz Department, Guatemala

Distribution: Venezuela

Type deposition: SMF

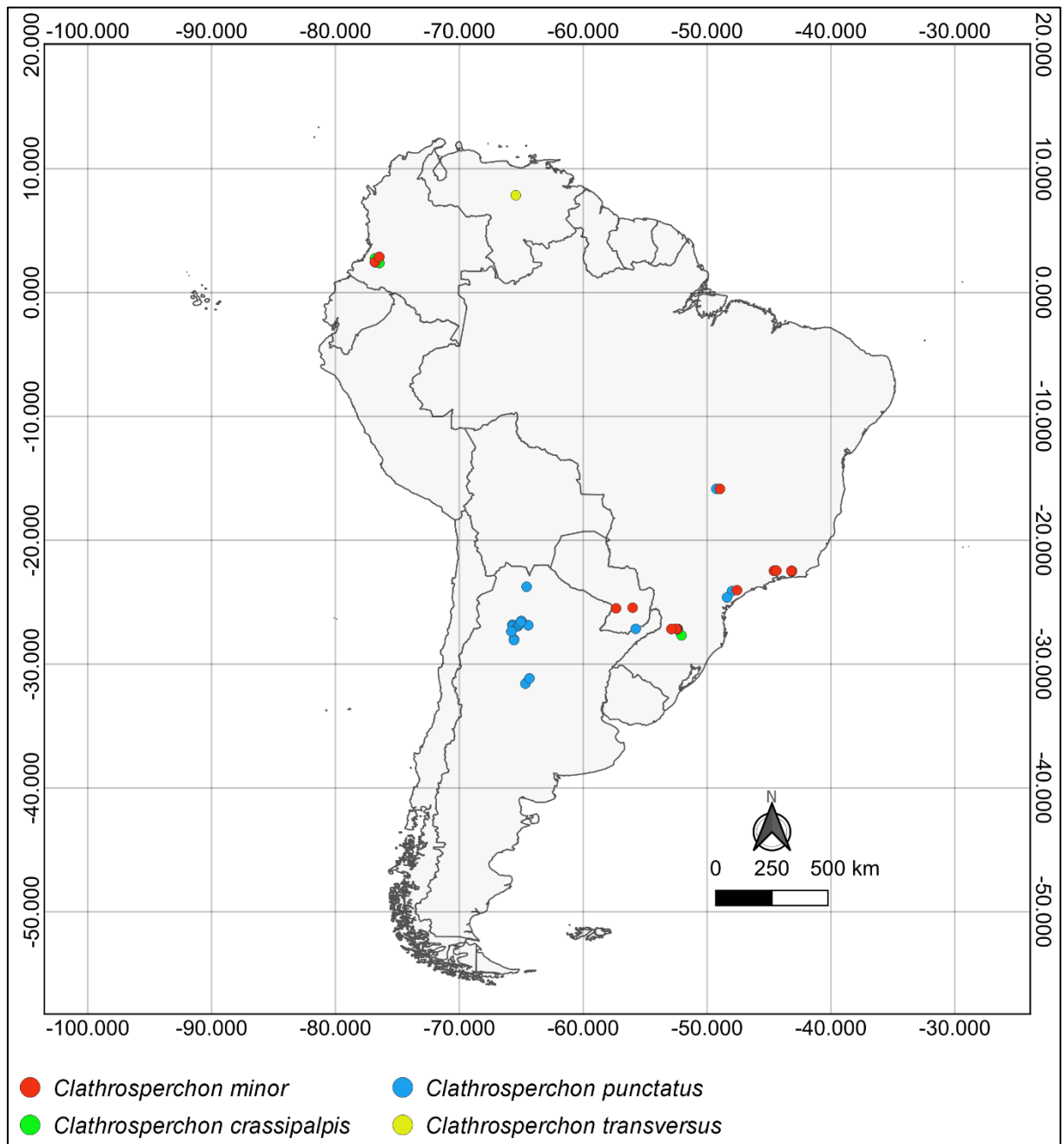


Figure 13. Distribution of the genus *Clathrosperchon* in South America.

Genus ***Clathrosperchonella*** Lundblad, 1937

53. *Clathrosperchonella asterifera* Lundblad, 1937

LUNDBLAD, 1937a: 249; LUNDBLAD, 1941b: 77; K.O. VIETS, 1987: 211; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020: 1748.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil and Paraguay

Type deposition: RNM

54. *Clathrosperchonella olovi* Castro, Proctor & Lofego, 2020

CASTRO *et al.* 2020: 1746.

Type locality: Cananéia, São Paulo State, Brazil

Distribution: Brazil

Remarks: larval description in CASTRO *et al.* (2020)

Type deposition: DCBSJRP

Molecular data: voucher CIC002, accession numbers: ON260956 (GenBank), ENBRA013-21 (BOLD)

New records: Cardoso Island State Park (PEIC), Cananéia, São Paulo State, Brazil, stream – 03.X.2019 (6 females and 2 males), coll. L.A.S. de Castro.

55. *Clathrosperchonella rutae* Lundblad, 1938

LUNDBLAD, 1938: 35; LUNDBLAD, 1941: 79; K.O. VIETS, 1987: 211; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 187; CASTRO *et al.* 2020: 1748.

Type locality: Seara, Santa Catarina State, Brazil

Distribution: Brazil

Type deposition: RNM

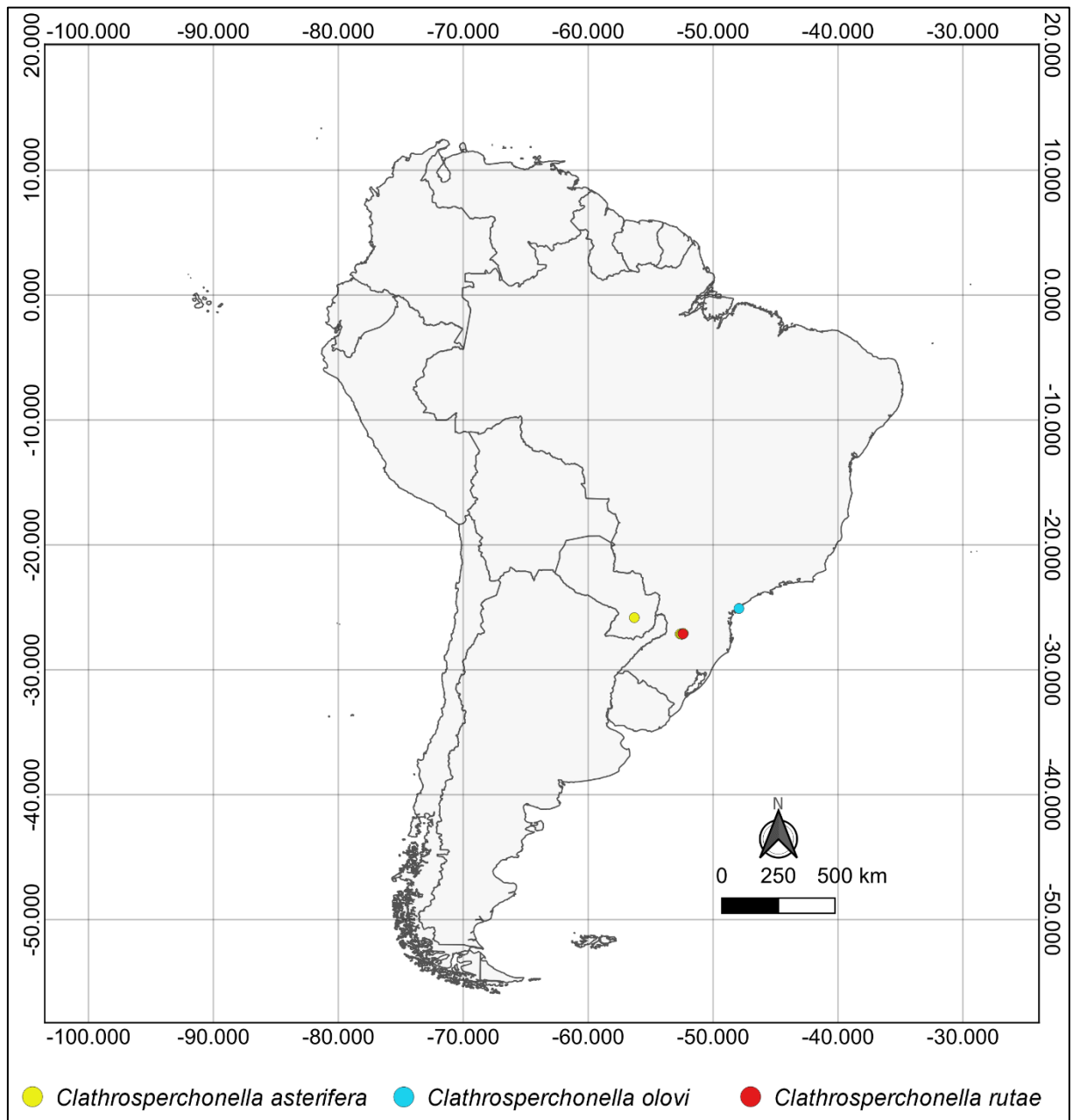


Figure 14. Distribution of the genus *Clathrosperchonella* in South America.

Family **Thermacaridae** Sokolow, 1927

Genus ***Thermacarus*** Sokolow, 1927

56. *Thermacarus andinus* Martin & Schwoerbel, 2002

MARTIN & SCHWOERBEL, 2002: 68; ROSSO DE FERRADÁS & FERNÁNDEZ, 2005: 188; HERON & SHEFFIELD, 2016: 3.

Type locality: Laguna Salada, Potosí Department, Bolívia

Distribution: Bolivia and Chile

Remarks: the North American species *Thermacarus nevadensis* Marshall, 1928 was reported from Chile (SCHWOERBEL, 1987), but was later correctly identified as *T. andinus* (MARTIN & SCHWOERBEL, 2002). Larval description in MARTIN & SCHWOERBEL (2002).

Type deposition: SMF

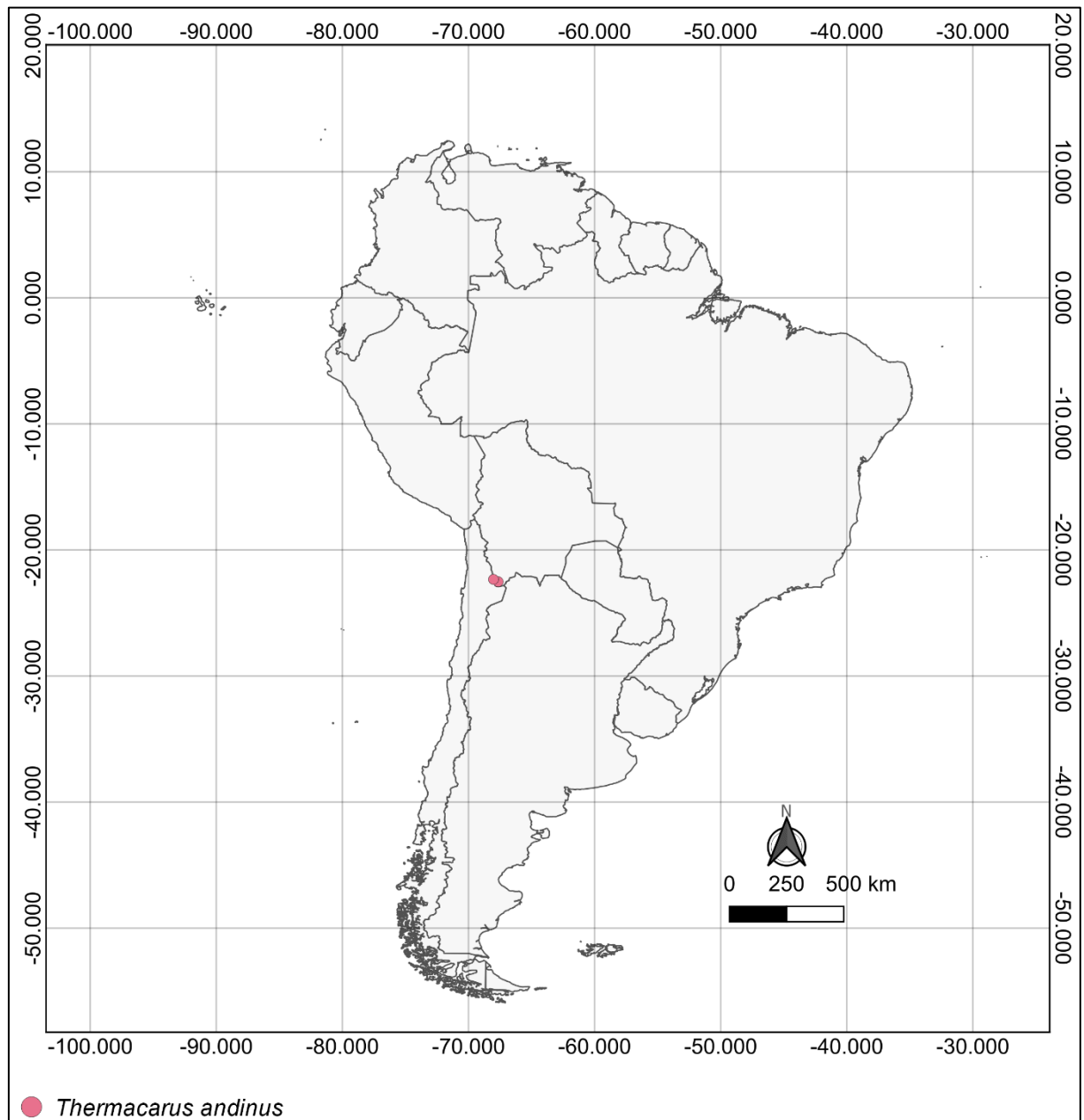


Figure 15. Distribution of the genus *Thermacarus* in South America.

4.4.2 Key to families, subfamilies, genera, subgenera and species of South American Hydraphantoidea Piersig, 1896

(Adapted and modified from: LUNDBLAD, 1924, 1941b, 1953; K. VIETS, 1954a, 1954b; COOK, 1974, 1980, 1988; K. O. VIETS, 1977; GOLDSCHMIDT & GERECKE, 2003; PEŠIĆ *et al.* 2010; SMITH *et al.* 2010; GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020; GOLDSCHMIDT *et al.* 2021; CASTRO *et al.* 2020, 2022; PEŠIĆ & SMIT, 2022)

- 1a. Palp chelate, P-4 dorso-distal protrusion reaching to P-5 apex (Fig. 16); genital flaps with many acetabula; coxae with many long setae (Fig. 18); lateral eyes separated on respective sides, bearing lenses but not in capsules..... **Hydrodromidae** K. Viets, ***Hydrodroma*** Koch 2
- 1b. Palp not chelate or, if chelate with P-4 dorso-distal protrusion extended only slightly beyond insertion of P-5 (Fig. 17); coxae not with many long setae (Fig. 19); lateral eyes variable, acetabula variable..... 10

- 2a. Legs with swimming setae (Fig. 20)..... 3
- 2b. Legs without swimming setae (Fig. 21)..... 9

- 3a. First coxae coming into contact with one another through a transversely short and broad process (Fig. 22)..... 4
- 3b. First coxae coming into contact with one another through a transversely long and narrow process (Fig. 23)..... 8

- 4a. II-Leg-5 with 1 swimming seta..... *despiciens* (Müller)
- 4b. II-Leg-5 without swimming seta..... 5

- 5a. IV-Leg-5 with 1 swimming seta (Fig. 24)..... *clavipes* (Lundblad)
- 5b. IV-Leg-5 with 3 or more swimming setae (Fig.25)..... 6

- 6a. Genital plates with 37-45 pairs of acetabula in at most 4 longitudinal rows (Fig. 26); integument papillae flattened..... *ventana* Pešić & Smit

- 6b. Genital plates with 58-81 pairs of acetabula in at most 5 longitudinal rows (Fig. 27); integument papillae not flattened..... 7
- 7a. Integument papillae apically rounded; enital plates with 62 pairs of acetabula (Fig. 28); P-3 with a dorsodistal hair-like seta, long and slender (Fig. 29)..... *longiseta* (K. Viets)
- 7b. Integument papillae longish; genital plates with 58–81 pairs of acetabula (Fig. 27); P-3 with a dorsodistal hair-like seta, not as long as above (Fig. 30).....
..... *argentinensis* Pešić & Smit
- 8a. II-Leg with swimming setae; P-2 with 3 pectinate distal setae on the medial surface (Fig. 31)..... *peregrina* (Koenike)
- 8b. II-Leg without swimming setae; P-2 with 4 long and slender hair-like mediodistal pectinate setae (Fig. 32)..... *robusta* (K. Viets)
- 9a. Claws small; distal portion of I-IV-Leg-6 slightly expanded (Fig. 33).....
.....*stalagmophila* Lundblad
- 9b. Claws large; distal portion I-IV-Leg-6 greatly expanded (Fig.34).....
..... *ungulata* Lundblad
- 10a. Palp chelate or P-4 with strong dorso-distal seta (Fig. 43) and often with idiosoma soft and elongated (Figs. 37, 48, 49), or several acetabula stalked (Fig. 59) (in some *Neocalonyx*, acetabula not stalked (Fig. 77), palp hardly visible as chelate)..... **Hydryphantidae** Piersig 11
- 10b. Palp not chelate, if P-4 with robust dorsodistal seta, then idiosoma not elongated, acetabula not stalked..... 46
- 11a. Idiosoma greatly elongated (Figs. 48, 49)..... 12
- 11b. Idiosoma not greatly elongated (Fig. 50)..... 20
- 12a. Lateral eyes reduced or small, below the integument, but not in capsules (Fig. 35)..... 13

- 12b. Lateral eyes present, clearly visible, in capsules or attached to frontal plates (Fig. 36)..... 15
- 13a. Body clearly elongated, coxal groups widely separated; 3 pairs to many acetabula (Figs. 38, 39, 44-47); with none or with small dorsal plates.....
..... **Wandesiinae** Schwoerbel 14
- 13b. Body not elongated (rectangular-oval), coxal groups rather close together (coxae I and II suture subparallel to longitudinal axis of idiosoma, coxae III and IV suture oblique to longitudinal axis; three pairs of acetabula (Fig. 41); no dorsal plates (Fig. 35).....**Tartarothyadinae** K. Viets, **Tartarothyas** K. Viets (one described species: *T. xiuva* Goldschmidt, Pimiento-Ortega & Herrera-Martínez, 2021).
- 14a. Genital flaps absent, 3 pairs (Figs. 37, 39, 40) to many (Fig. 38, 44-47) acetabula; dorsal plate absent..... **Wandesia** Schechtel 15
- 14b. Genital flaps present, partially covering 3 pairs of acetabula (Fig. 48); small medio-dorsal plate present (Fig. 49)..... **Euwandesia** André & Naudo (one described species: *E. sensitiva* André & Naudo, 1962).
- 15a. 3 or 4 pairs of genital acetabula (Figs. 37, 39, 40).....
..... subgenus **Pseudowandesia** Habeeb 16
- 15b. 5 or more pairs of genital acetabula (Figs. 38, 44-47).....
..... subgenus **Partnuniella** K. Viets 17
- 16a. Genital field with well-developed sclerites (Fig. 39); palps (Fig. 42) and legs stocky..... *lethaea* (Besch)
- 16b. Genital field without sclerites (Fig. 37, 40); palps (Fig. 43) and legs slender
..... *andiana* Cook
- 17a. Genital field with more than 70 stalked acetabula on each side (Fig. 44); P-4 long (L/H 3.3)..... *lehmanni* Pešić *et al.*
- 17b. Genital field with less than 30 acetabula on each side, variable in shape (Fig. 45); palp segments also variable..... 18

- 18a. Palp very robust; P-4 stocky (L/H about 1.9; calculated from LUNDBLAD, 1941);
8-9 acetabula on each side of genital field (Fig. 45).....
..... *stalagmophila* Lundblad
- 18b. Palp slender; 13 or more acetabula on each side of genital field..... 19
- 19a. The posterior setae-bearing sclerites of genital field not flanked laterally by
acetabula; anteromedial corners of the posterior coxal groups without apodemal
projection (Fig. 46)..... *chechoi* Cook
- 19b. The posterior setae-bearing sclerites of the genital field flanked laterally by
acetabula; anteromedial corners of posterior coxal groups with apodemal
projection (Fig. 47)..... *walteri* Lundblad
- 20a. Dorsum with frontal plate between lateral eyes bearing a pigmented medial eye
(Fig. 36)..... 21
- 20b. Dorsum without frontal platelet between lateral eyes, with a pigmented medial
eye lying on the integument (Fig. 50)..... **Pseudohydryphantinae** K. Viets,
Pseudohydryphantes K. Viets (one described species: *P. chilensis* Smit,
2021).
- 21a. Characteristically shaped frontal plate with indented caudal margin, bearing pre-
and postocular setae (Fig. 51), generally no further dorsalia; legs with swimming
setae..... **Hydryphantinae** Piersig 38
- 21b. If frontal plate present, without caudal protrusions; mostly without swimming
setae..... 22
- 22a. Many (mostly) stalked acetabula (Fig. 52); some species with very short stalks
(Fig. 53); dorsal platelets (if any) small (Fig. 54); with or without swimming
setae..... 23
- 22b. 3 pairs of acetabula not stalked (Fig. 55); often (one genus without) with regular
dorsal plates; no swimming setae..... 37

- 23a. Leg claws with many fan-like clawlets (Fig. 56); genital sclerites reduced to small individual platelets (Fig. 52); without swimming setae..... **Protziinae** Koenike, **Protzia** Piersig (one described species: *P. salsa* Goldschmidt, 2003).
- 23b. Leg claws with or without lateral clawlets, however not broad fan-like (Figs 57, 58), genital sclerites present (Fig. 59); with or without swimming setae.
..... 24
- 24a. Leg claws simple; 2 pairs of genital plates; acetabula on short stalks (Figs. 53, 60); large antero-lateral extensions at coxa-III (Fig. 61); no swimming setae..... **Eupatrellinae** K. Viets, **Eupatrella** Walter (one described species: *E. platano* Gerecke, 2003).
- 24b. Leg claws mostly with lateral clawlets (Figs. 56, 57); genital sclerite D-shaped (Fig. 59) or elongated (Fig. 62); with or without swimming setae
..... **Protziinae** Koenike, **Neocalonyx** Walter 25
- 25a. Coxal groups I-II long, with strongly developed posteromedial projection; posterior region of coxal group I slender, with parallel margins and rounded tips (Fig. 68)..... subgenus **Otongacarus** Goldschmidt & Gerecke (one described species: *N. pina* Gerecke, 2003)
- 25b. Coxal groups I-II long, with slightly developed posteromedial projection; posterior region of coxal group I stocky, without parallel margins and blunt tips (Fig. 69)..... 26
- 26a. Numerous swimming setae present (Fig. 70)..... subgenus **Paracalonyx** Lundblad (one described species: *N. longipalpis* Lundblad, 1941)
- 26b. Swimming setae either absent or only a single short seta on IV-Leg-5 (Fig. 71)..... subgenus **Neocalonyx** Walter 27
- 27a. Distal seta on P-IV dorsal and hook-shaped (Fig. 72).....
..... *diaguita* Rosso de Ferradás & Fernández
- 27b. Distal seta on P-IV lateral or medial and with different shapes..... 28
- 28a. Claws pectinate (Fig. 71)..... 29

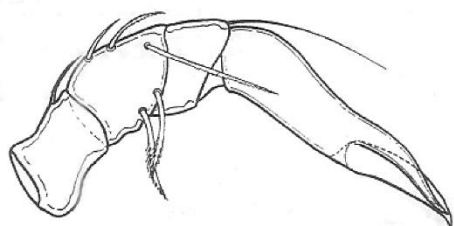
28b.	Claws simple (Fig. 72).....	35
29a.	Leg claws with 8 lateral clawlets (Fig. 71).....	<i>desajunos</i> Gerecke
29b.	Leg claws with less than 8 lateral clawlets (Fig. 81).....	30
30a.	Dorsum with dorsalia (Fig. 54).....	31
30b.	Dorsum without dorsalia (Fig. 74).....	33
31a.	Distal ends of posterior acetabula rounded (Fig. 75).....	32
31b.	Distal ends of posterior acetabula elongated (Fig. 76).....	<i>godeti</i> Walter
32a.	Coxae relatively large; number of genital acetabula 3/3-6/6 medially, 27/29-39/40 laterally (Fig. 77); gnathosoma long and slender (Fig. 79), ratio ventral L/H 3.92-4.21.....	<i>longimaxillaris</i> K. Viets
32b.	Coxae relatively small; number of genital acetabula 4/4 medially 17/19 laterally (Fig. 78); gnathosoma slender (Fig. 80), ratio ventral L/H 3.73.....	<i>frijolito</i> Gerecke
33a.	Claws with two clawlets on each side (Fig. 81).....	<i>tenuirostris</i> Lundblad
33b.	Claws with four or more clawlets on at least one side (Figs. 58, 82).....	34
34a.	Distal ends of posterior acetabula rounded (Fig. 83).....	<i>penai</i> Besch
34b.	Distal ends of posterior acetabula elongated (Fig. 84).....	<i>pectunguis</i> Lundblad
35a.	Medial margins of fourth coxae much longer than medial margins of third coxae (Fig. 85).....	<i>schindowskii</i> Besch
35b.	Medial margins of third and fourth coxae of approximately equal length (Fig. 86).....	36
36a.	Dorsalia relatively small; ventralia more or less rounded (Fig. 86).....	<i>keldomus</i> Cook
36b.	Dorsalia relatively large; ventralia decidedly elongated (Fig. 87).....	<i>placophorus</i> Cook

- 37a. Dorsalia in 2 medial and 2 lateral rows (Fig. 63); I-Leg with characteristic grasping structures (I-Leg-5 with ventral row of about 20 rounded peg-like setae, I-Leg-6 slightly curved, folding back to segment 5) (Fig. 64); P-2 and P-3 with ventral projections (Fig. 65)..... **Ankelothyadinae** Besch, **Ankelothyas** Besch (one described species: *A. emydoides* Besch, 1964).
- 37b. Dorsum without dorsalia (Fig. 66), with one medial row of dorsalia or with complete dorsal shield (but never 4 four rows as described above); I-Leg without special structures; palp segments without ventral projections (Fig. 67)..... **Euthyadinae** K. Viets, **Notopanisus** Besch (one described species: *N. wetzeli* Besch, 1964).
- 38a. 3 pairs of genital acetabula (Fig. 19)..... subgenus **Hydryphantes** Koch 42
- 38b. 5 or more pairs of genital acetabula (Fig. 88)..... 39
- 39a. Genital acetabula papillate (Fig. 89); frontal plate very narrow (Fig. 90)..... subgenus **Papilloporus** Walter (one species described: *H. papillosus* Lundblad)
- 39b. Genital acetabula not papillate (Fig. 88); frontal plate not as narrow as above..... subgenus **Polyhydryphantes** K. Viets 40
- 40a. Genital field with long setae; 6 acetabula on each side (Fig. 91).....
.....*pinguipalpis* K. Viets
- 40b. Genital field with short setae; 8-21 acetabula on each side..... 41
- 41a. Genital field with 8-11 acetabula on each side (Fig. 88)..... *alienus* Lundblad
- 41b. Genital field with 20-21 acetabula on each side (Fig. 92)..... *coscaroni* Cook
- 42a. Frontal shield anteriorly bulky, with central sclerotization and paired posterior arms slightly curved, with tapering tips (Fig. 93)..... 43
- 42b. Frontal shield anteriorly slender, without central sclerotization and paired posterior arms not curved, with rounded tips (Fig. 90)..... 44
- 43a. Paired posterior arms of frontal shield long (Fig. 93); 20 setae along the medial edges of the genital flaps (Fig. 95)..... *jujuyensis* Nordenskiöld

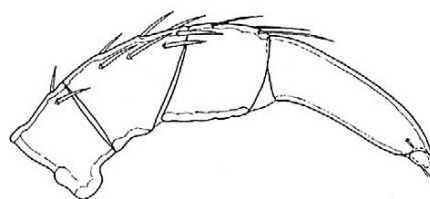
- 43b. Paired posterior arms of frontal shield shorter than above (Fig. 94); 18 setae along the medial edges of the genital flaps (Fig. 96)..... *thermalis* Cook
- 44a. 11-21 setae on medial margins of genital flaps arranged in a single row on medial and posterior borders (Fig. 97)..... 45
- 44b. 30-40 setae on medial margins of genital flaps arranged in several rows (Fig. 98)..... *ramosus* Nordenskiöld
- 45a. 11-12 setae on each genital flap (Fig. 97); III-Leg-3 with one seta; chelicerae stout (L/H 3.85-4.33)..... *undulatifrons* (K. Viets)
- 45b. 18-21 setae on each genital flap; III-Leg-3 without seta; chelicerae slender (L/H 4.44-5.53) (Fig. 99)..... *pumilus* (K. Viets)
- 46a. Complete dorsal and ventral shield (Figs. 100, 101); numerous acetabula postero-lateral to genital valves, 6-11 pairs of acetabula between genital valves beside gonopore, genital valves with many long setae (Fig. 102); numerous setae postero-lateral to camerostome on medially fused coxa-I (Fig. 101); P-2 medio-distally with two long, bi- or trifurcate setae (Fig. 103).....
Thermacaridae Sokolow, *Thermacarus* Sokolow (only one species described for South America: *T. andinus* Martin & Schwoerbel, 2002).
- 46b. Not with the described combination of characters; many acetabula on movable flaps; posterior coxae clearly longer than wide (Fig. 104); palps without protrusions or tubercles (Fig. 106); in most species, idiosoma covered by characteristic reticulate platelets (Fig. 105), or closely fitting porous platelets (Figs. 107, 108)..... **Rhynchohydracaridae** 47
- 47a. Mostly venter and dorsum loosely covered by (very characteristic) reticulate plates (Figs. 104, 105); coxa-I medially not fused (Fig. 104).....
..... **Clathrosperchontinae** Lundblad 48
- 47b. Dorsal plates large, densely arranged, nearly completely covering the idiosoma (Fig. 107); ventrally covered by densely arranged platelets; coxa-I medially fused (Fig. 108).....**Rhynchohydracarinae** Lundblad
Rhynchohydracarus Lundblad 54

- 48a. Capitulum attached to protrusible tube (Fig. 109); palps rather compact (Fig. 110)..... ***Clathrosperchon*** Lundblad 49
- 48b. Capitulum not attached to protrusible tube; palps rather slender (Fig. 111)..... ***Clathrosperchonella*** Lundblad 52
- 49a. P-II with a ventrodiscal seta (Fig. 112)..... 50
- 49b. P-II without a ventrodiscal seta (Fig. 106)..... *punctatus* Cook
- 50a. Median single dorsal plate (dorsocentralia 3) immediately posterior to the postocularia plate much wider than long (Fig. 113)..... *transversus* K. Viets
- 50b. Median single dorsal plate (dorsocentralia 3) immediately posterior to the postocularia platelets not much wider than long (Fig. 114)..... 51
- 51a. Dorsal (Fig. 114) and ventral (Fig. 115) platelets bearing long, narrow, and radiating pores..... *crassipalpis* Lundblad
- 51b. Dorsal (Fig. 116) and ventral (Fig. 109) platelets bearing roundish pores..... *minor* Lundblad
- 52a. Dorsal (Fig. 117) and ventral (Fig. 118) plates with radiating reticulations; palp slender (Fig. 111)..... 53
- 52b. Dorsal (Fig. 119) and ventral (Fig. 120) plates without radiating reticulations; palp stout (Fig. 121)..... *rutae* Lundblad
- 53a. Dorsoglandularia 2-4, lateroglandularia 2 (Fig. 117), coxoglandularia 1 and ventroglandularia 1-3 lying free on the integument; genital flaps bearing two distinct and clearly separated groups of genital acetabula (Fig. 118); P-4 bearing 2 long ventro-distal setae (Fig. 111)..... *asterifera* Lundblad
- 53b. Dorsoglandularia 2-4, lateroglandularia 2 (Fig. 122), coxoglandularia 1 and ventroglandularia 1-3 lying on irregular sclerites; genital flaps bearing three distinct and clearly separated groups of genital acetabula (Fig. 123); P-4 bearing 1 long ventro-distal seta (Fig. 124)..... *olovi* Castro, Proctor & Lofego
- 54a. Excretory plate pentagonal (Fig. 108) or hexagonal (Fig. 125)..... 55

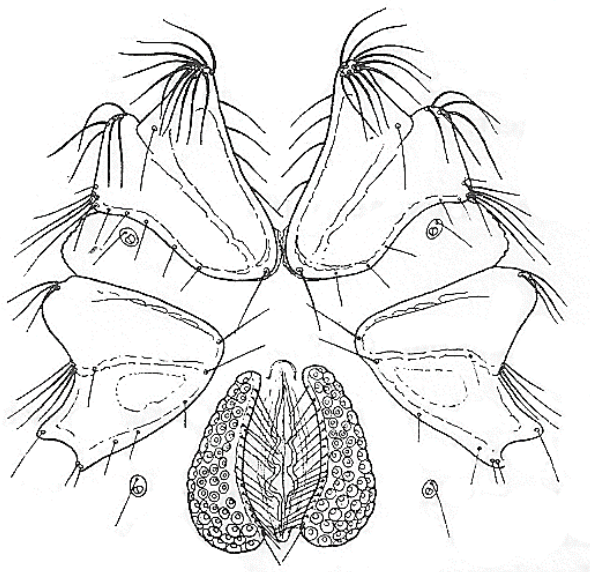
- 54b. Excretory plate oval (Fig. 126)..... *dividuus* Lundblad
- 55a. Excretory plate pentagonal; dorsocentralia 2-4 fused, forming a single dorsal plate; prodorsum integrate and smooth (Fig. 107)..... *testudo* Lundblad
- 55b. Excretory plate hexagonal; dorsocentralia 2-3 fused, separated from dorsocentralia 4, forming two dorsal plates; prodorsum medially divided and wrinkled (Fig. 127)..... *armiger* Castro, Proctor & Lofego



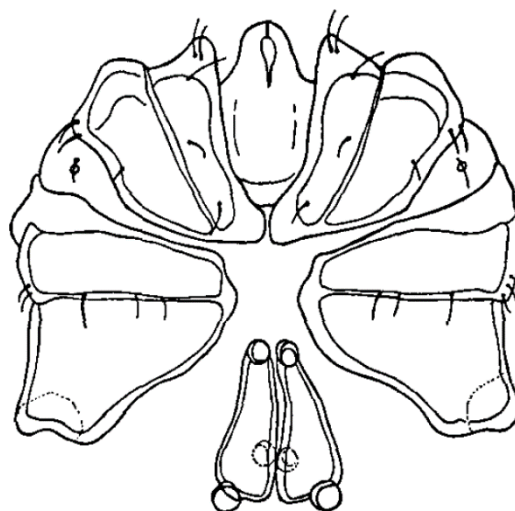
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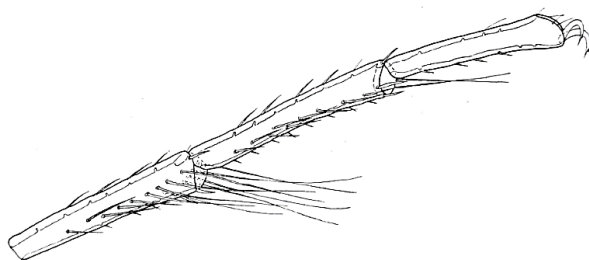
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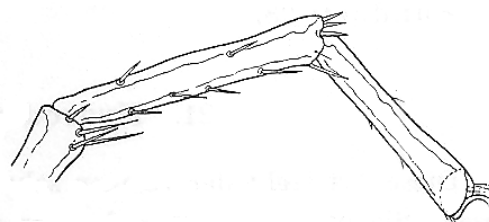
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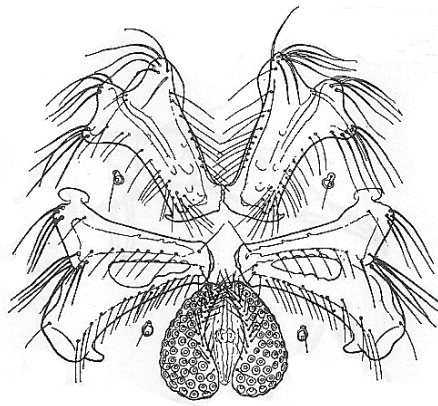


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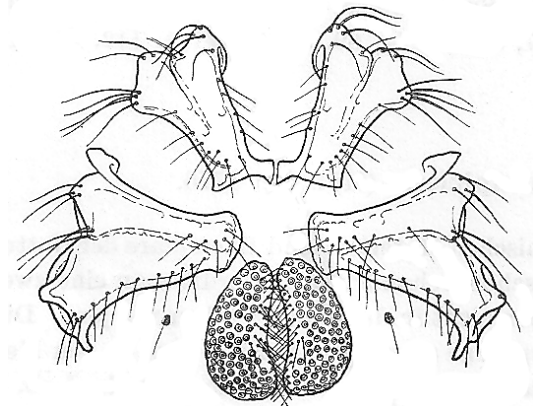


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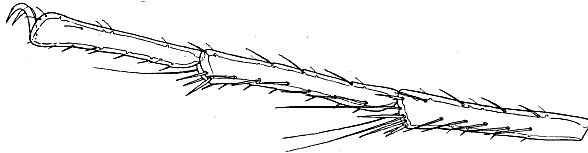
Figures 16-21. Fig. 16, *Hydrodroma peregrina*, male, palp (LUNDBLAD, 1941); Fig. 17, *Hydriphantes jujuyensis*, female, palp (COOK, 1980); Fig. 18, *Hydrodroma peregrina*, male, coxal groups and genital field (LUNDBLAD, 1941); Fig. 19, *Hydriphantes jujuyensis*, female, coxal groups and genital field (BESCH, 1964); Fig. 20, *Hydrodroma despiciens*, female, IV-Leg-4-6 (COOK, 1980); Fig. 21, *Hydrodroma stalagmophila*, male, IV-Leg-4-6 (LUNDBLAD, 1941b).



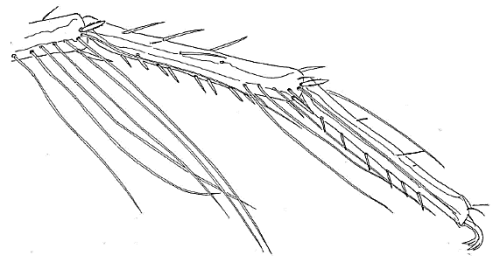
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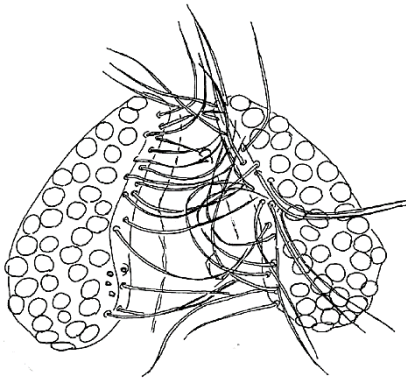
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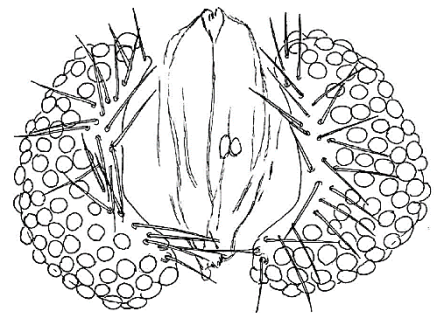
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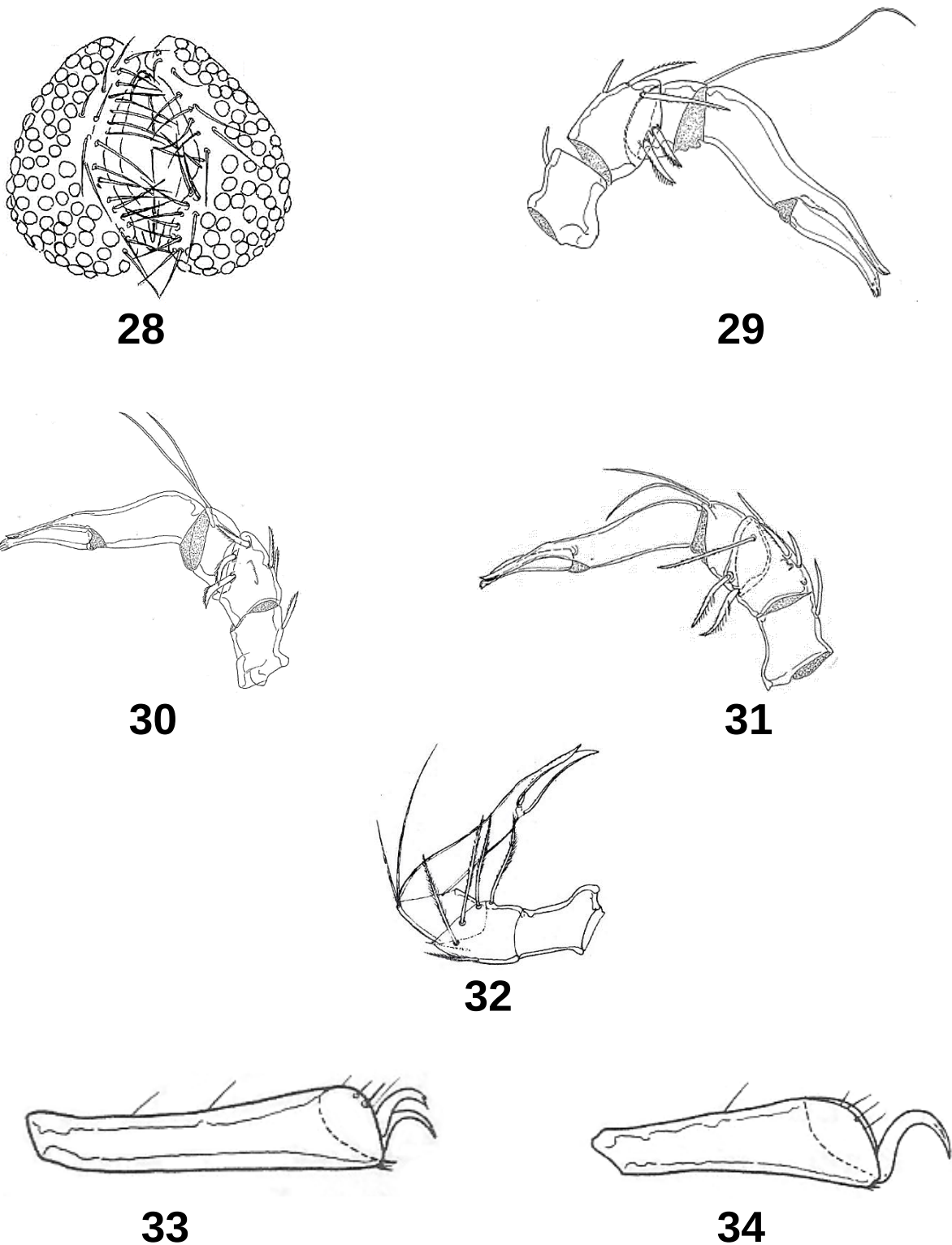


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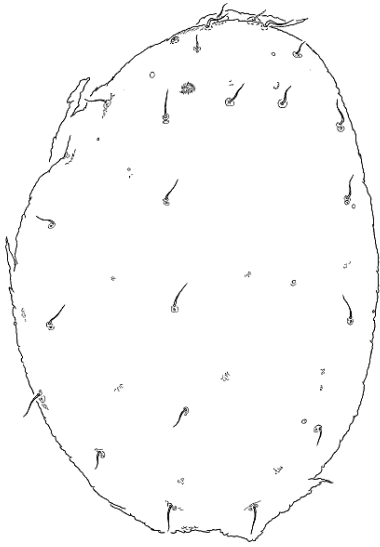


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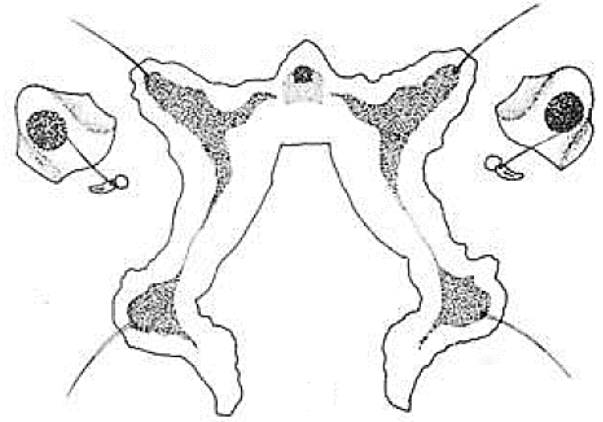
Figures 22-27. Fig. 22, *Hydrodroma despiciens*, female, coxal groups and genital field; (LUNDBLAD, 1941b); Fig. 23, *Hydrodroma peregrina*, male, coxal groups and genital field (LUNDBLAD, 1941b); Fig. 24, *Hydrodroma clavipes*, male, IV-Leg-4-6 (COOK, 1980); Fig. 25, *Hydrodroma argentinensis*, male, IV-Leg-4-6 (PEŠIĆ & SMIT, 2022); Fig. 26, *Hydrodroma ventana*, male, genital field (PEŠIĆ & SMIT, 2022); Fig. 27, *Hydrodroma argentinensis*, female, genital field (PEŠIĆ & SMIT, 2022).



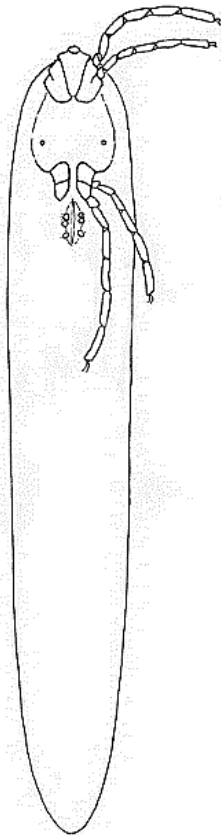
Figures 28-34. Fig. 28, *Hydrodroma longiseta*, male, genital field (PEŠIĆ & SMIT, 2022); Fig. 29, *Hydrodroma longiseta*, male, palp (PEŠIĆ & SMIT, 2022); Fig. 30, *Hydrodroma argentinensis*, male, palp (PEŠIĆ & SMIT, 2022); Fig. 31, *Hydrodroma peregrina*, female, palp (PEŠIĆ & SMIT, 2022); Fig. 32, *Hydrodroma robusta*, male, palp (VIETS, 1954a); Fig. 33, *Hydrodroma stalagmophila*, female, III-Leg-6 (LUNDBLAD, 1941); Fig. 34, *Hydrodroma unguolata*, female, III-Leg-6 (LUNDBLAD, 1941b).



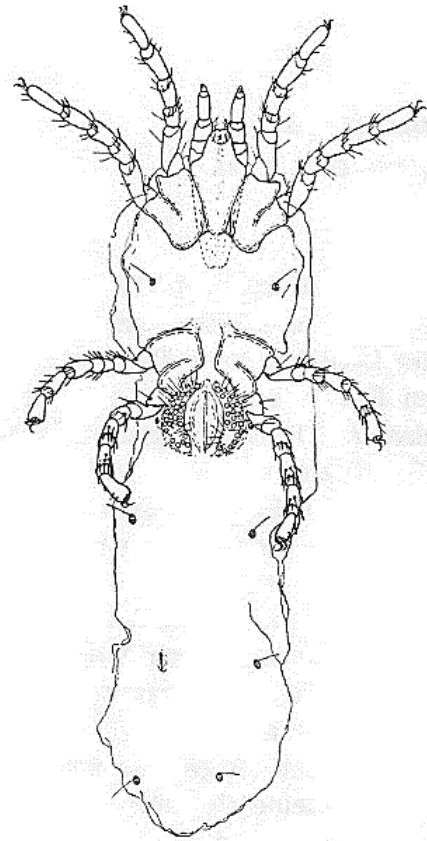
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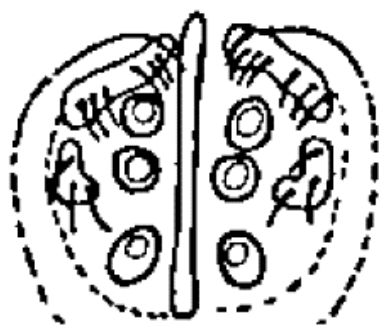


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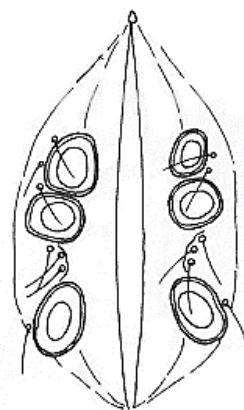


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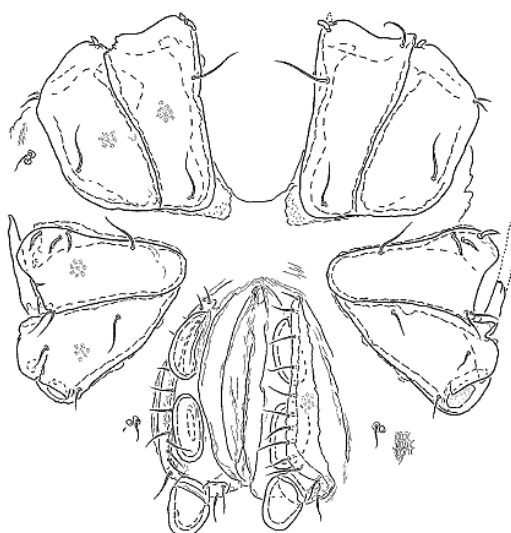
Figures 35-38. Fig. 35, *Tartarothyas xiua*, female, dorsum of idiosoma (GOLDSCHMIDT *et al.* 2021); Fig. 36, *Hydryphantes ramosus*, female, frontal plate (ROSSO DE FERRADÁS, 1981); Fig. 37; *Wandesia (Pseudowandesia) andiana*, female, venter of idiosoma (COOK, 1988); Fig. 38, *Wandesia (Partnuniella) walteri*, male, venter of idiosoma (LUNDBLAD, 1941b).



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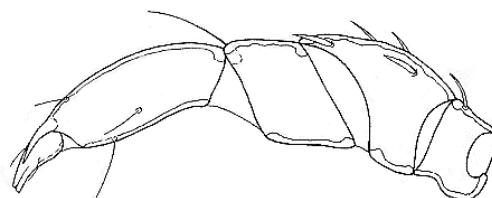
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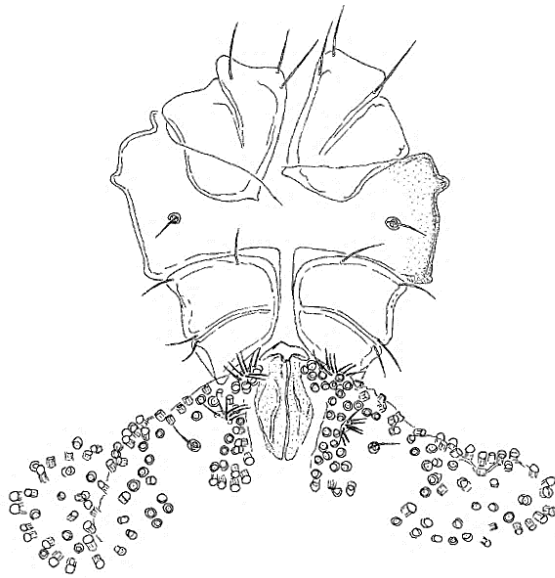


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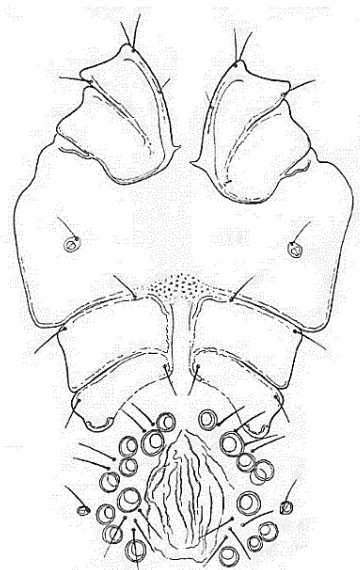


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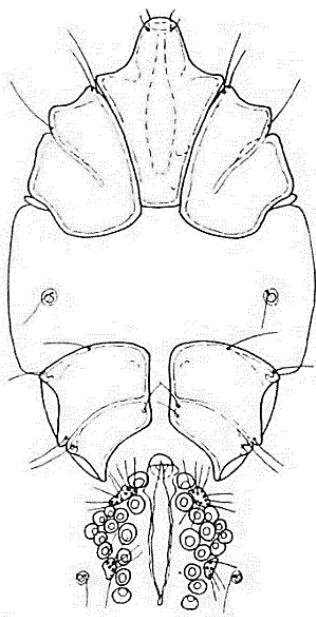
Figures 39-43. Fig. 39, *Wandesia (Pseudowandesia) lethaea*, female, genital field (BESCH, 1964); Fig. 40, *Wandesia (Pseudowandesia) andiana*, female, genital field (COOK, 1988); Fig. 41, *Tartarothyas xiua*, female, venter of idiosoma (GOLDSCHMIDT et al. 2021); Fig. 42, *Wandesia (Pseudowandesia) lethaea*, female, palp (BESCH, 1964); Fig. 43, *Wandesia (Pseudowandesia) andiana*, female, palp (COOK, 1988).



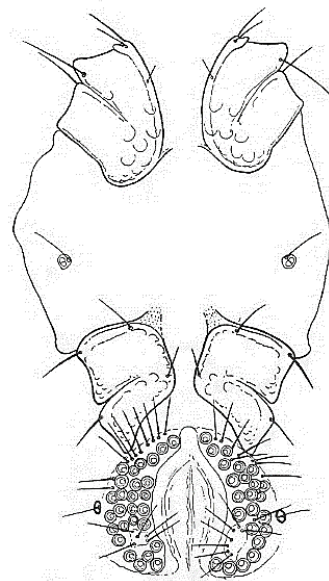
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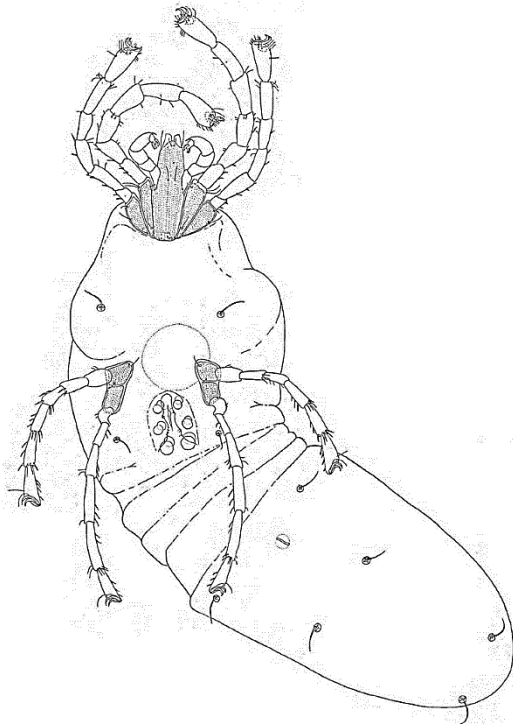


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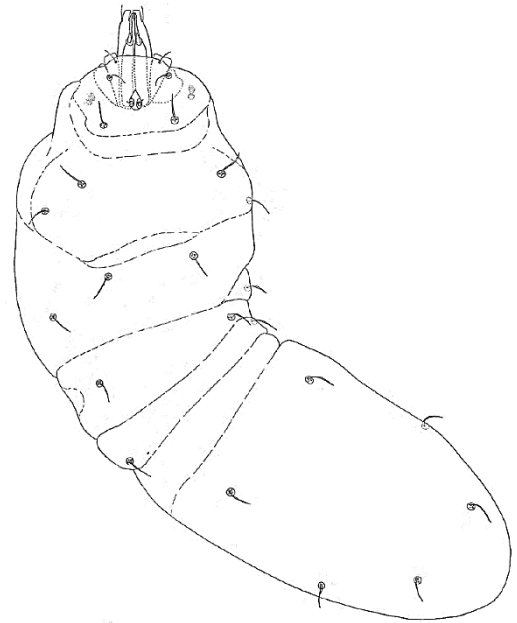


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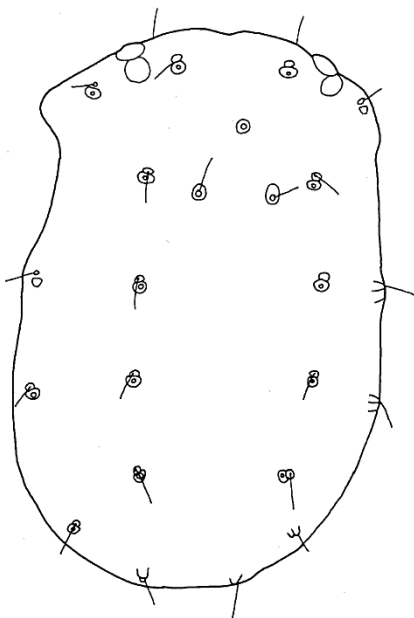
Figures 44-47. Fig. 44, *Wandesia (Partnuniella) lehmanni*, female, coxal groups and genital field (PEŠIĆ *et al.* 2010); Fig. 45, *Wandesia (Partnuniella) stalagmophila*, female, coxal groups and genital field (LUNDBLAD, 1941b); Fig. 46, *Wandesia (Partnuniella) chechoi*, female, coxal groups and genital field (COOK, 1988); Fig. 47, *Wandesia (Partnuniella) walteri*, male, coxal groups and genital field (LUNDBLAD, 1941b).



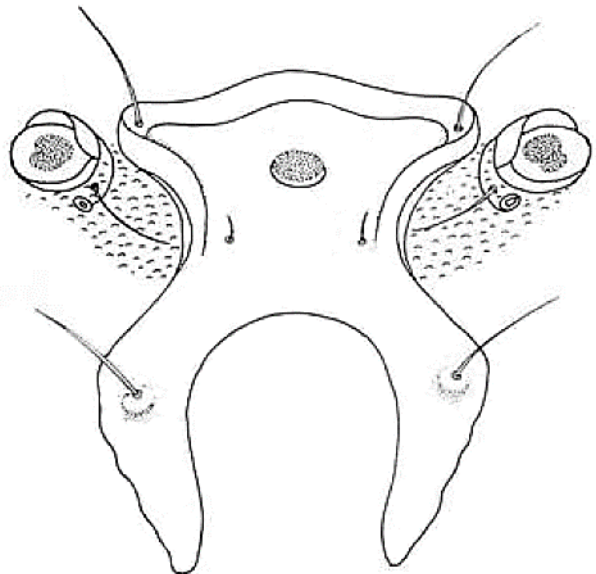
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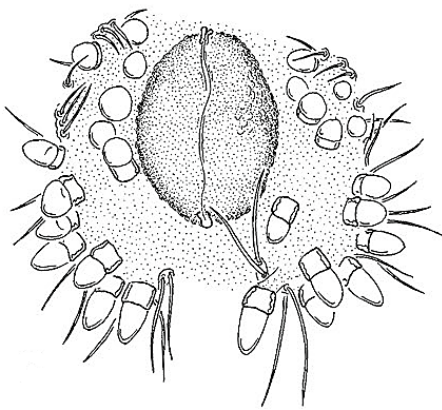


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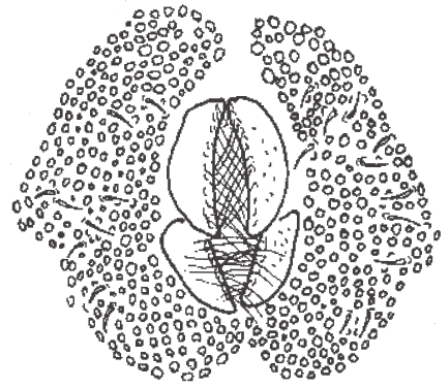


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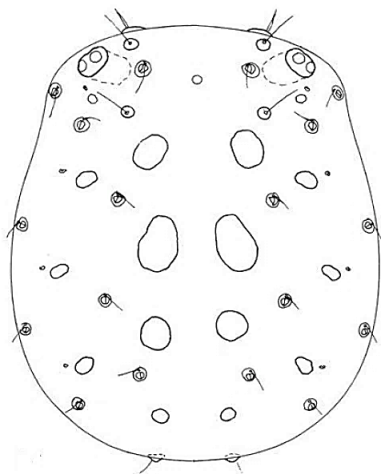
Figures 48-51. Fig. 48, *Euwandesia sensitiva*, female, ventral habitus (ANDRÉ & NAUDO, 1962); Fig. 49, *Euwandesia sensitiva*, dorsum of idiosoma (ANDRÉ & NAUDO, 1962; Fig. 50, *Pseudohydryphantes chilensis*, male, dorsum of idiosoma (SMIT, 2021); Fig. 51, *Hydryphantes pinguipalpis*, female, frontal plate and eyes (ROSSO DE FERRADÁS, 1981).



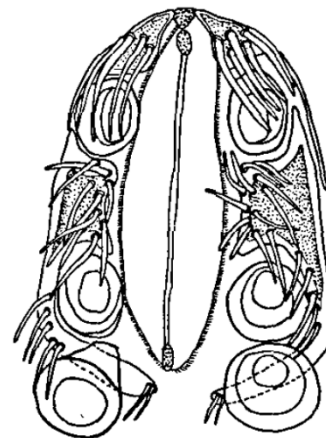
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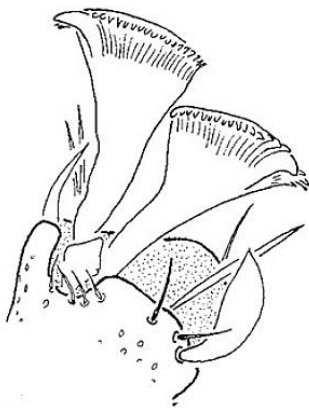
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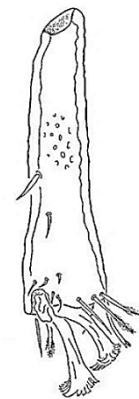
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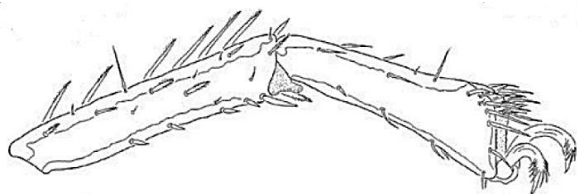


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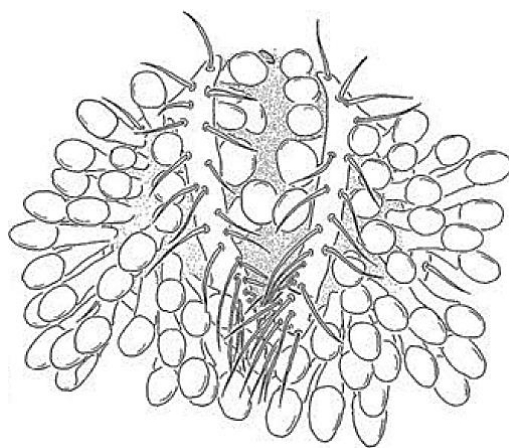


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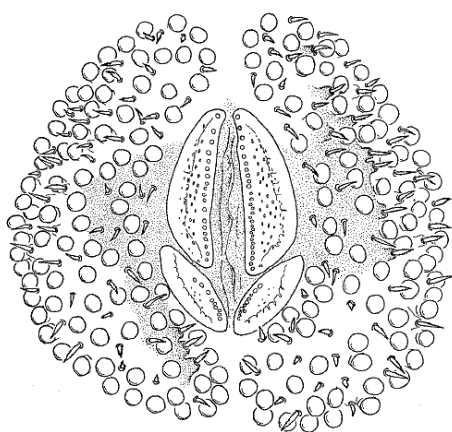
Figures 52-57. Fig. 52, *Protzia salsa*, female, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 53, *Eupatrella platano*, male, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 54, *Neocalonyx placophorus*, male, dorsum of idiosoma (COOK, 1988); Fig. 55, *Notopanisus wetzeli*, female, genital field (BESCH, 1964); Fig. 56, *Protzia salsa*, male, leg claws (GOLDSCHMIDT & GERECKE, 2003); Fig. 57, *Neocalonyx desajunos*, deutonymph, IV-leg-6 (GOLDSCHMIDT & GERECKE, 2003).



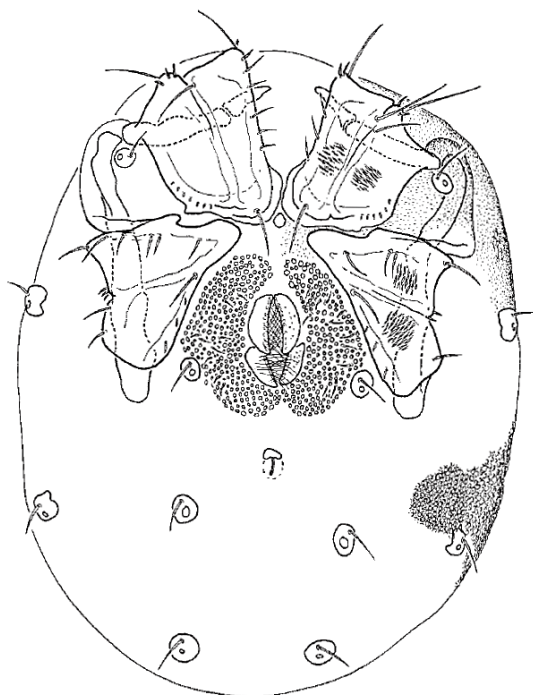
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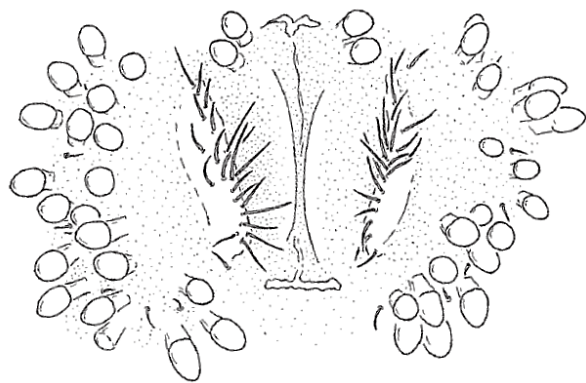


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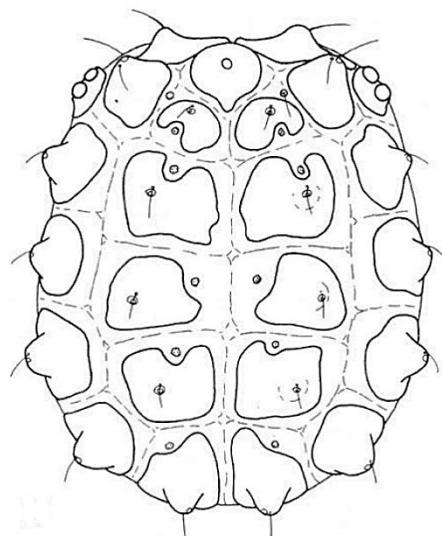


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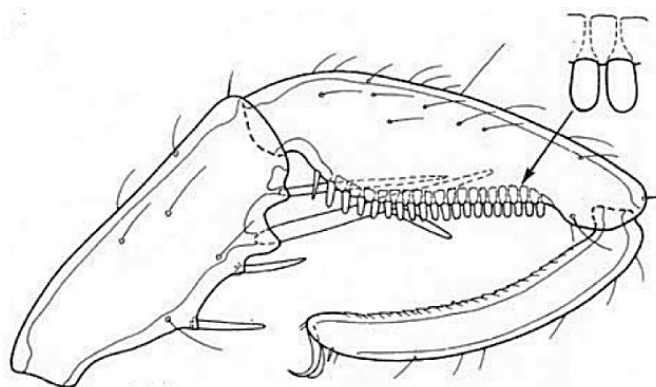
Figures 58-61. Fig. 58, *Neocalonyx pectunguis*, female, IV-leg-5-6 (GOLDSCHMIDT & GERECKE, 2003); Fig. 59, *Neocalonyx tenuirostris*, male, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 60, *Eupatrella platano*, female, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 61, *Eupatrella platano*, male, venter of idiosoma (GOLDSCHMIDT & GERECKE, 2003).



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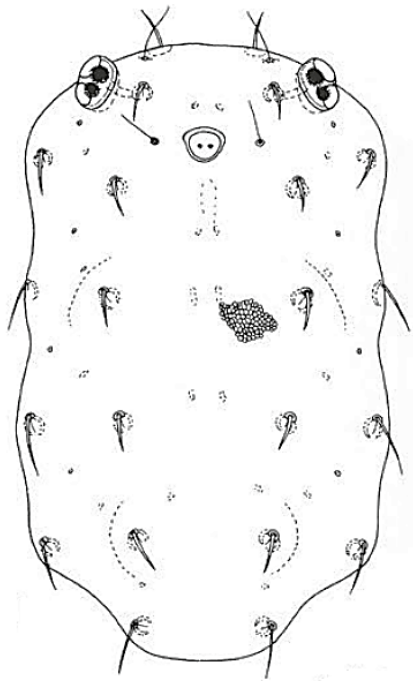


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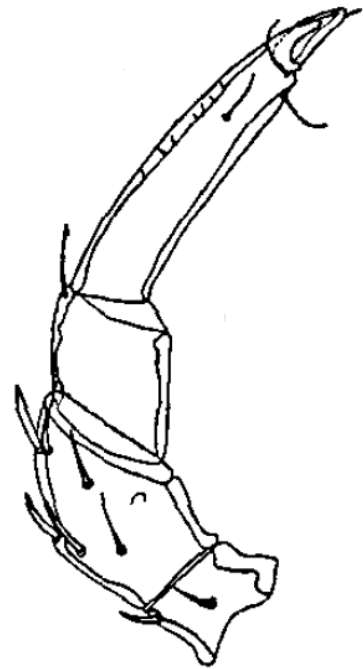


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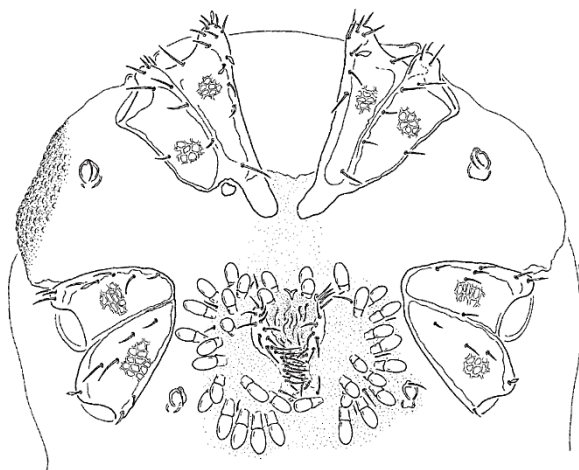
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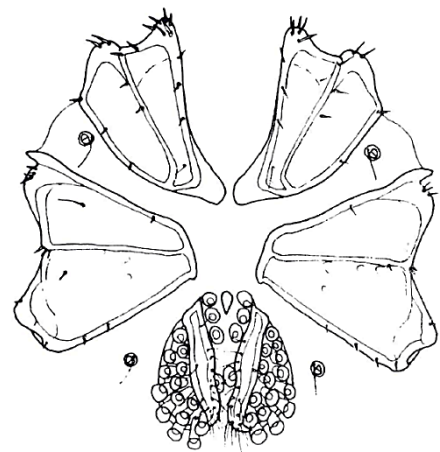
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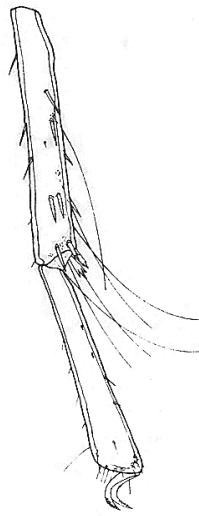


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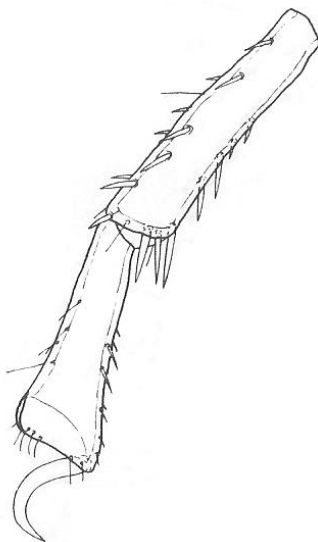
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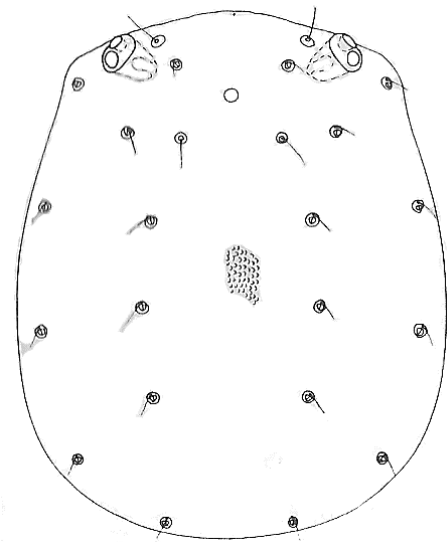
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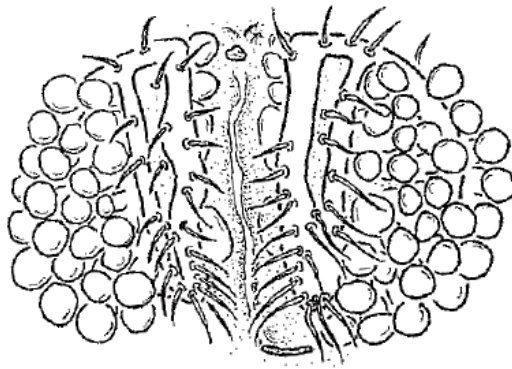
Figures 70-74. Fig. 70, *Neocalonyx (Paracalonyx) longipalpis*, male, IV-Leg-5-6 (COOK, 1988); Fig. 71, *Neocalonyx (Neocalonyx) desajunos*, male, IV-Leg-5-6 (GOLDSCHMIDT & GERECKE, 2003); Fig. 72, *Neocalonyx (Neocalonyx) diaguita*, female, palp (ROSSO DE FERRADÁS & FERNÁNDEZ, 2007); Fig. 73, *Neocalonyx (Neocalonyx) schindowskii*, male, IV-Leg-5-6 (COOK, 1988); Fig. 74, *Neocalonyx (Neocalonyx) penai*, male, dorsum of idiosoma (COOK, 1988).



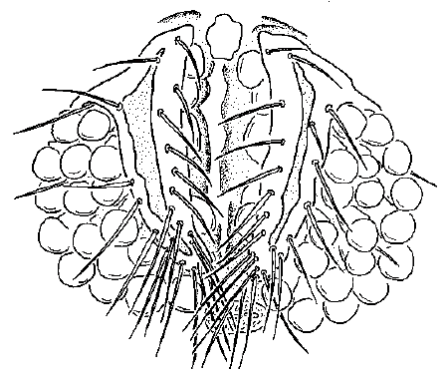
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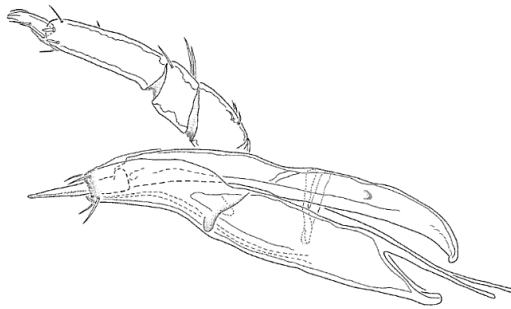
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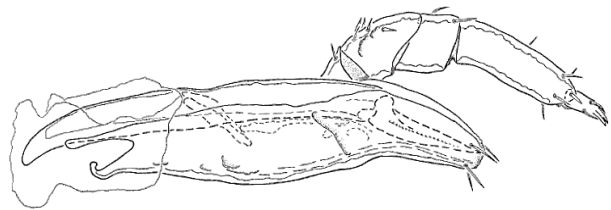
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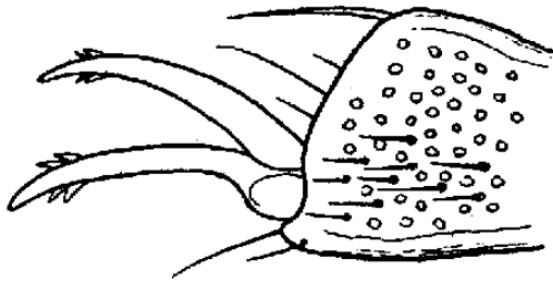


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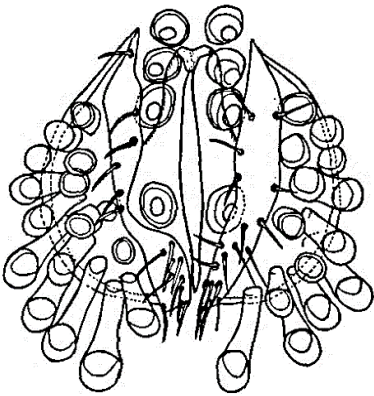
Figures 75-80. Fig. 75, *Neocalonyx (Neocalonyx) penai*, female, genital acetabulum (COOK, 1988); Fig. 76, *Neocalonyx (Neocalonyx) godeti*, male, genital acetabulum (COOK, 1988); Fig. 77, *Neocalonyx (Neocalonyx) longimaxillaris*, male, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 78, *Neocalonyx (Neocalonyx) frijolito*, male, genital field (GOLDSCHMIDT & GERECKE, 2003); Fig. 79, *Neocalonyx (Neocalonyx) longimaxillaris*, male, gnathosoma (GOLDSCHMIDT & GERECKE, 2003); Fig. 80, *Neocalonyx (Neocalonyx) frijolito*, male, gnathosoma (GOLDSCHMIDT & GERECKE, 2003).



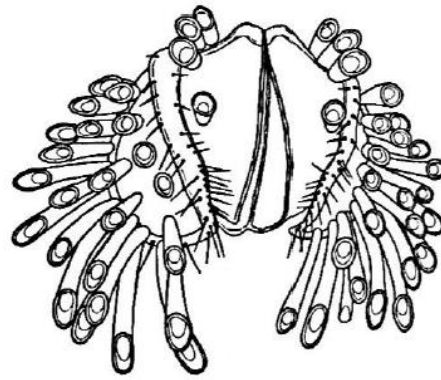
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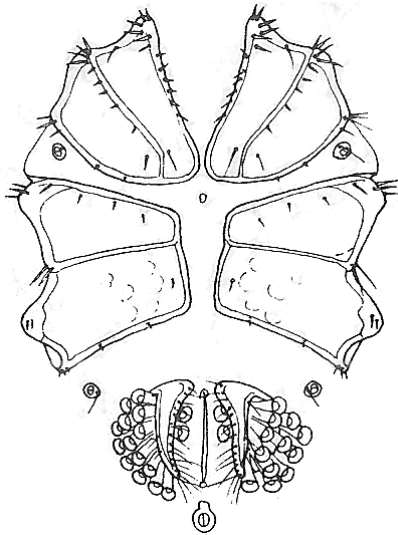
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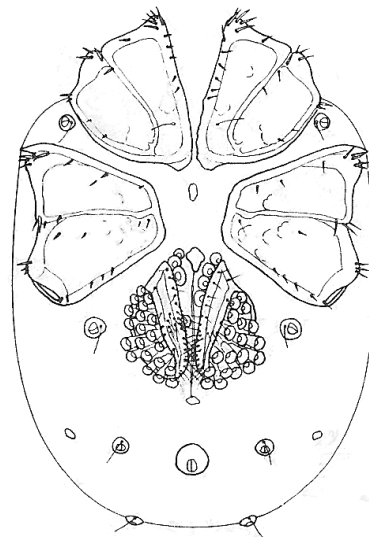
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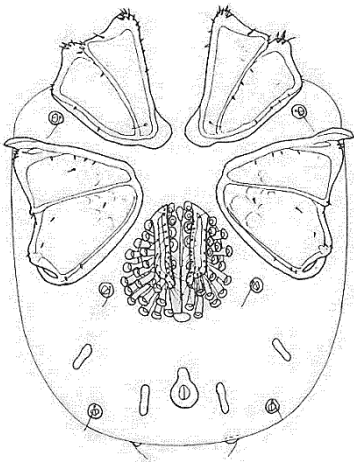


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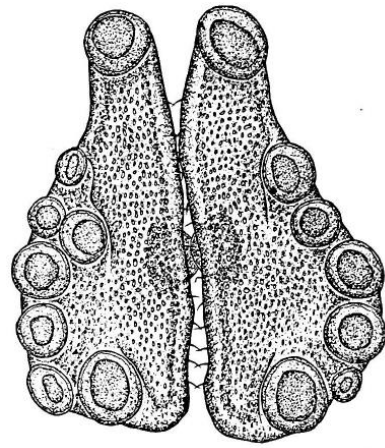


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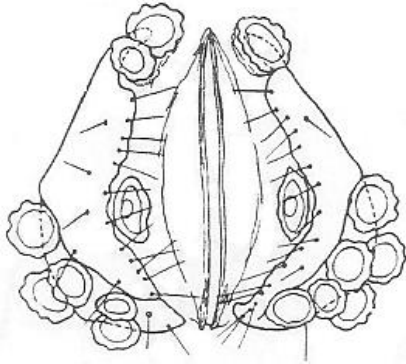
Figures 81-86. Fig. 81, *Neocalonyx (Neocalonyx) tenuirostris*, female, claws and clawlets of III-Leg-6 (LUNDBLAD, 1944); Fig. 82, *Neocalonyx (Neocalonyx) pectunguis*, female, claws and clawlets of II-Leg-6; Fig. 83, *Neocalonyx (Neocalonyx) penai*, female, genital field (BESCH, 1964); Fig. 84, *Neocalonyx (Neocalonyx) pectunguis*, female, genital field (LUNDBLAD, 1953); Fig. 85, *Neocalonyx (Neocalonyx) schindowskii*, male, venter of idiossoma (COOK, 1988); Fig. 86, *Neocalonyx (Neocalonyx) keldomus*, female, venter of idiossoma (COOK, 1980).



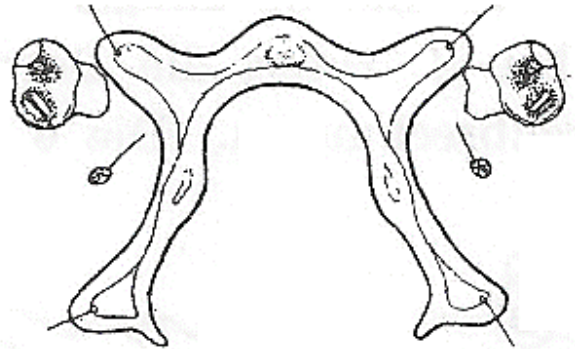
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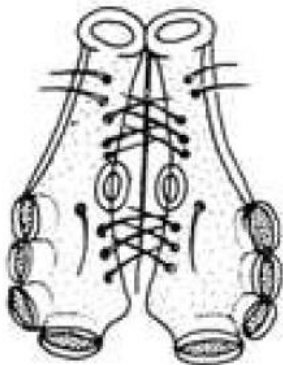
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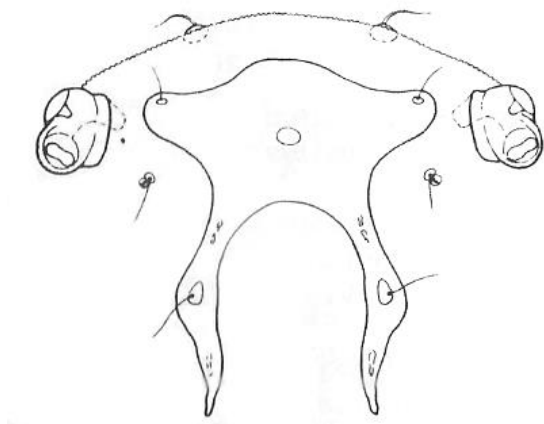


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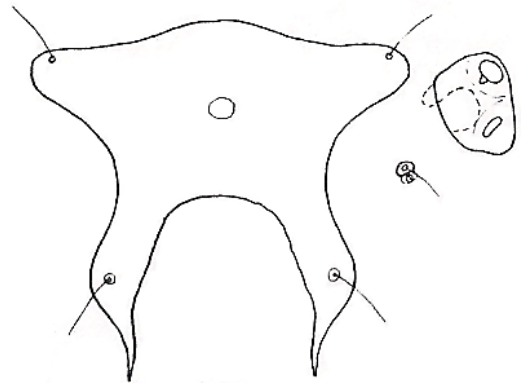


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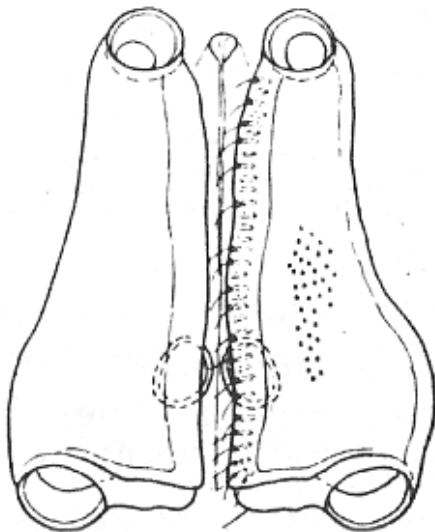
Figures 87-92 Fig. 87, *Neocalonyx (Neocalonyx) placophorus*, male, venter of idiosoma (COOK, 1988); Fig. 88, *Hydriphantes (Polyhydriphantes) alienus*, female, genital field (LUNDBLAD, 1924); Fig. 89, *Hydriphantes (Papilloporus) papillosus*, male, genital field (LUNDBLAD, 1941); Fig. 90, *Hydriphantes (Papilloporus) papillosus*, male, frontal shield (LUNDBLAD, 1941); Fig. 91, *Hydriphantes (Polyhydriphantes) pinguipalpis*, female, genital field (ROSSO DE FERRADÁS, 1981); Fig. 92, *Hydriphantes (Polyhydriphantes) coscaroni*, female, genital field (COOK, 1980).



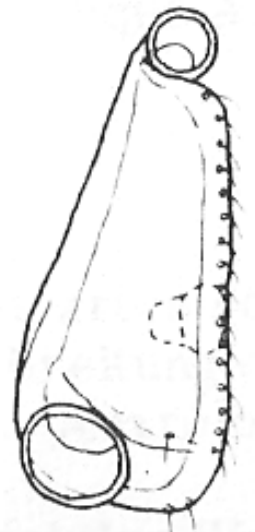
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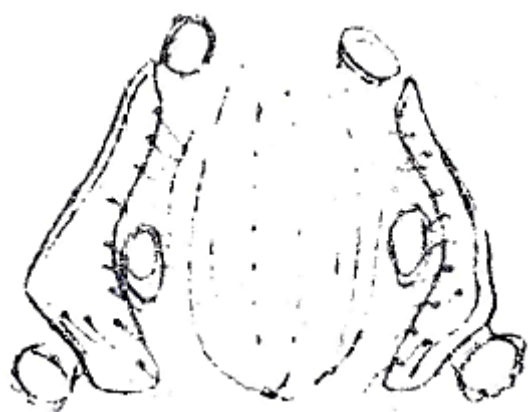


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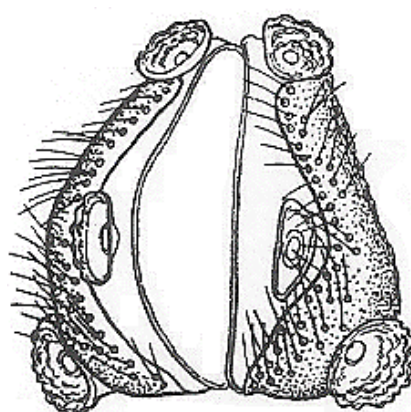


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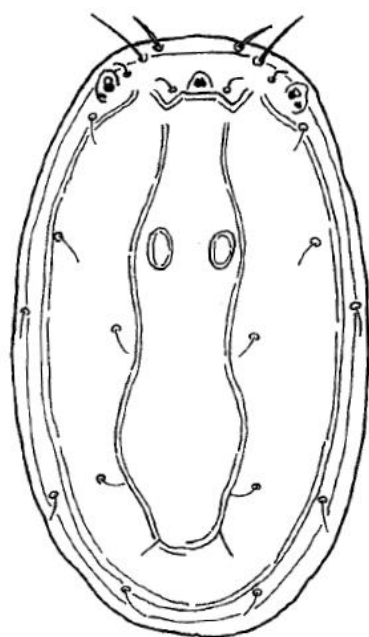
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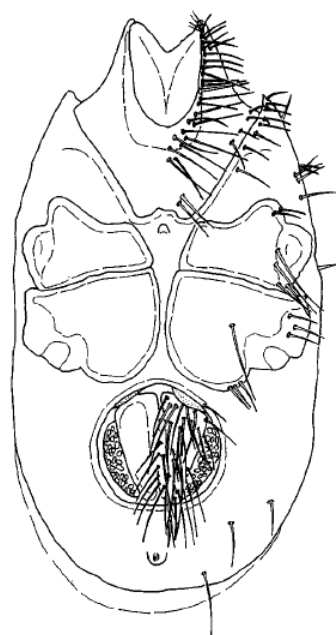
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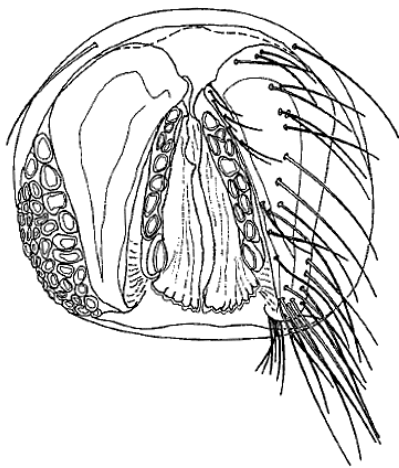


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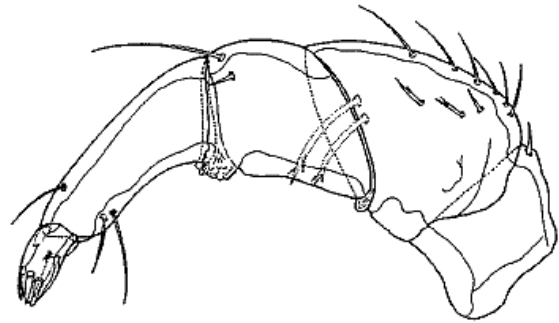


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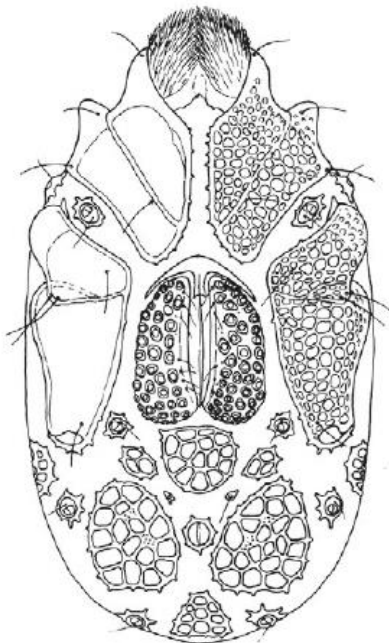
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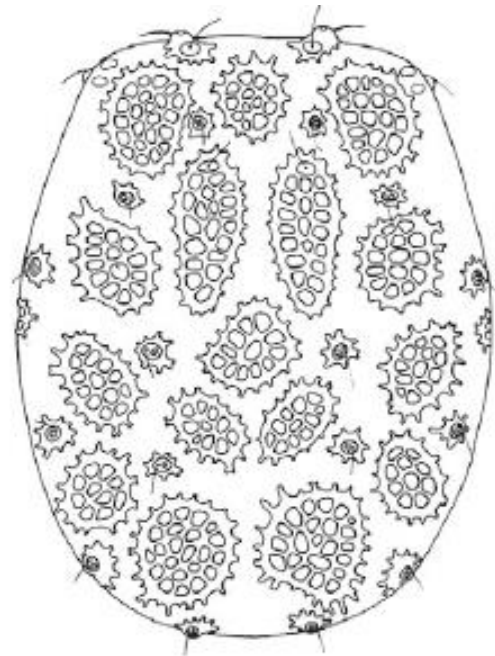
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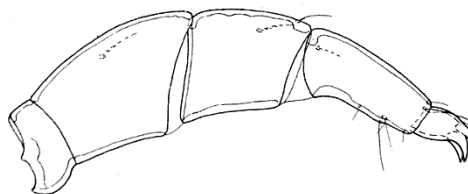
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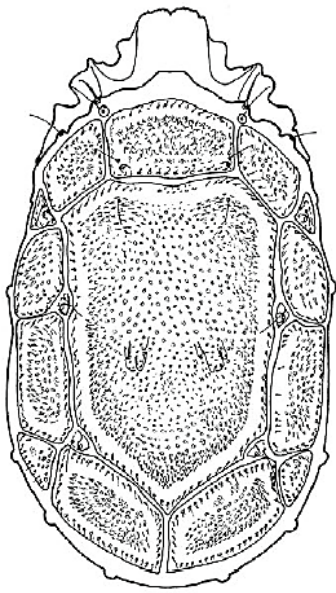


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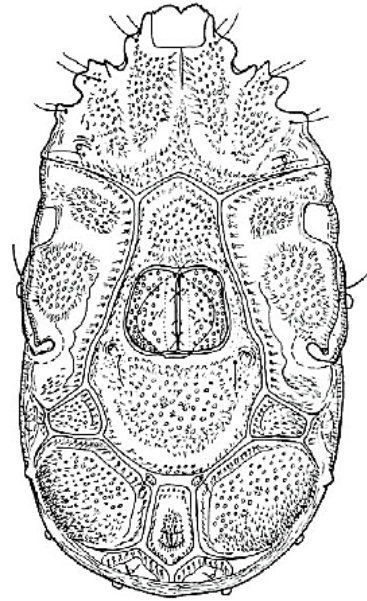


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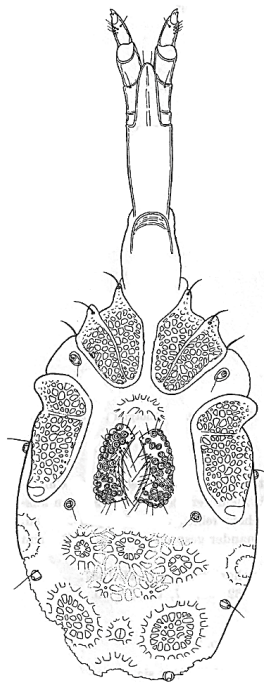
Figures 102-106. Fig. 102, *Thermacarus andinus*, male, genital field (MARTIN & SCHWOERBEL, 2002); Fig. 103, *Thermacarus andinus*, male, palp (MARTIN & SCHWOERBEL, 2002); Fig. 104, *Clathrosperchon punctatus*, female, venter of idiosoma (COOK, 1980); Fig. 105, *Clathrosperchon punctatus*, female, dorsum of idiosoma (COOK, 1980) Fig. 106, *Clathrosperchon punctatus*, female, palp (COOK, 1980).



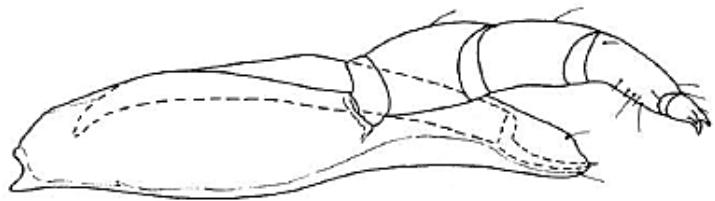
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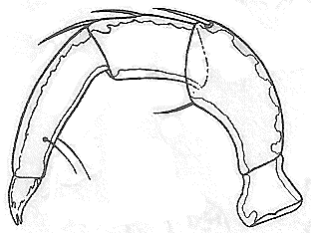


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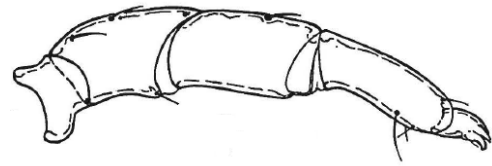


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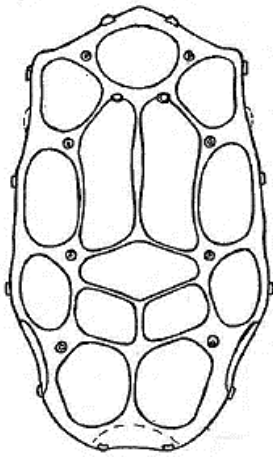
Figures 107-110. Fig. 107, *Rhynchohydracarus testudo*, male, dorsum of idiosoma (LUNDBLAD, 1941b); Fig. 108, *Rhynchohydracarus testudo*, male, venter of idiosoma (LUNDBLAD, 1941b); Fig. 109, *Clathrosperchon minor*, male, capitulum and venter of idiosoma (LUNDBLAD, 1941b); Fig. 110, *Clathrosperchon punctatus*, female, capitulum, chelicera and right palp lateral (COOK, 1980).



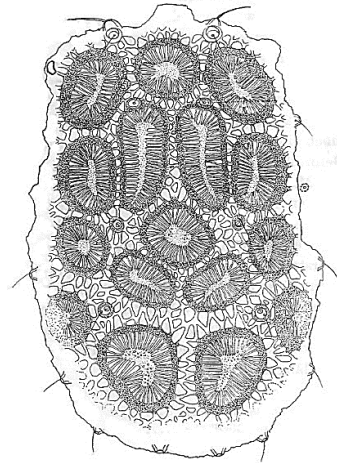
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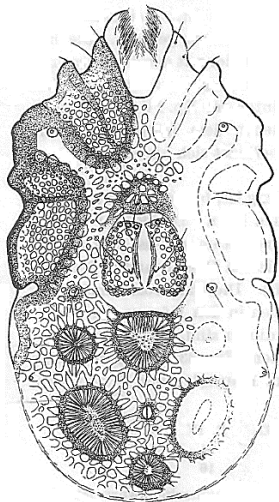
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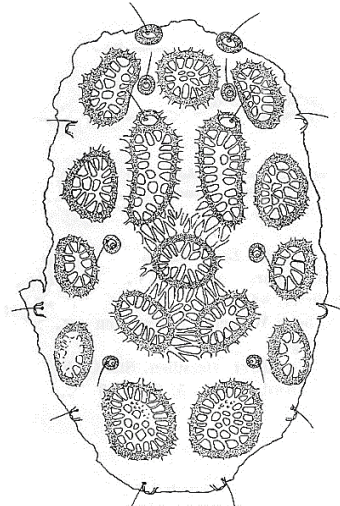
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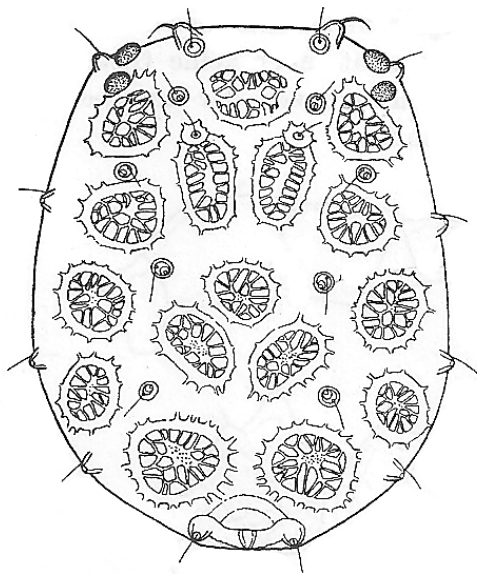


115

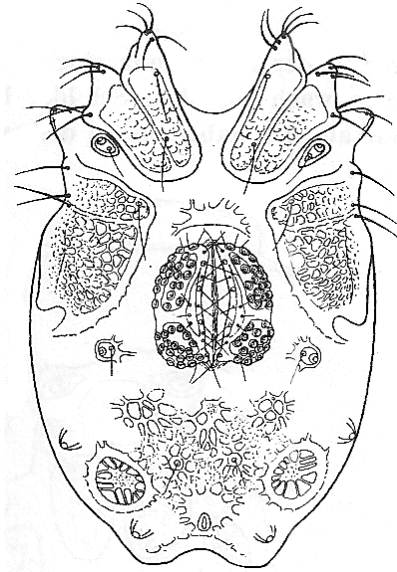


116

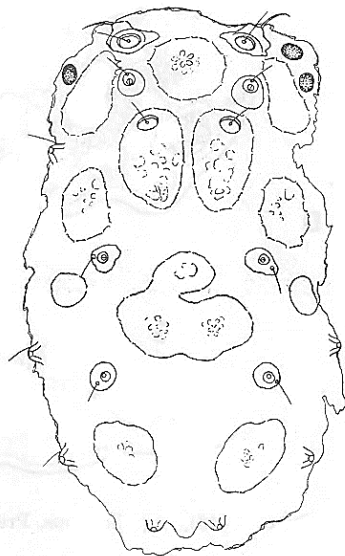
Figures 111-116. Fig. 111, *Clathrosperchonella asterifera*, male, palp (LUNDBLAD, 1941b); Fig. 112, *Clathrosperchon transversus*, female, palp (K.O. VIETS, 1977); Fig. 113, *Clathrosperchon transversus*, female, dorsum of idiosoma (K.O. VIETS, 1977); Fig. 114, *Clathrosperchon crassipalpis*, male, dorsum of idiosoma (LUNDBLAD, 1941); Fig. 115, *Clathrosperchon crassipalpis*, male, venter of idiosoma (LUNDBLAD, 1941b); Fig. 116, *Clathrosperchon minor*, male, dorsum of idiosoma (LUNDBLAD, 1941b).



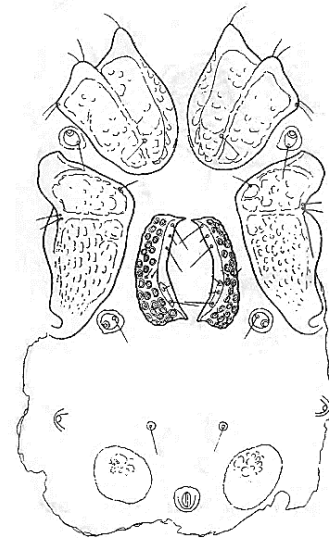
117



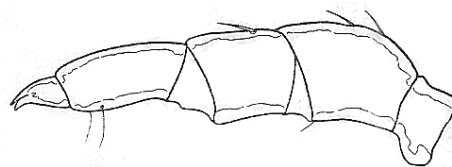
118



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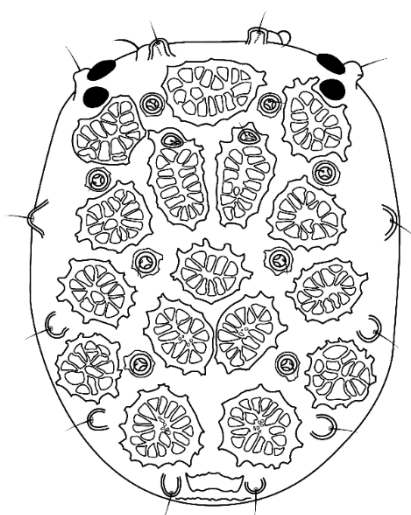


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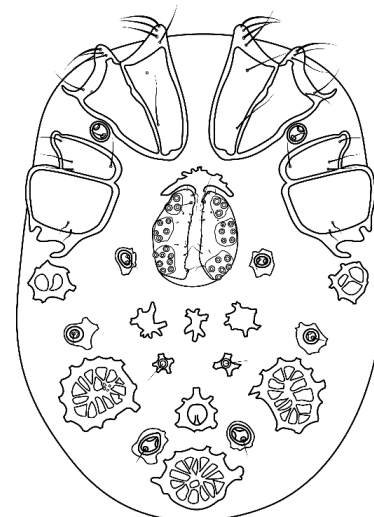


121

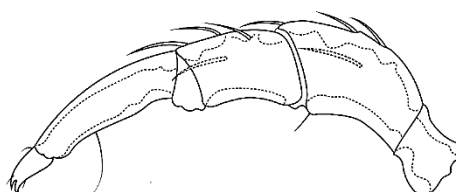
Figures 117-121. Fig. 117, *Clathrosperchonella asterifera*, male, dorsum of idiosoma (LUNDBLAD, 1941b); Fig. 118, *Clathrosperchonella asterifera*, male, venter of idiosoma (LUNDBLAD, 1941b); Fig. 119, *Clathrosperchonella rutae*, male, dorsum of idiosoma (LUNDBLAD, 1941b); Fig. 120, *Clathrosperchonella rutae*, male, venter of idiosoma, (LUNDBLAD, 1941b); Fig. 121, *Clathrosperchonella rutae*, male, palp (LUNDBLAD, 1941b).



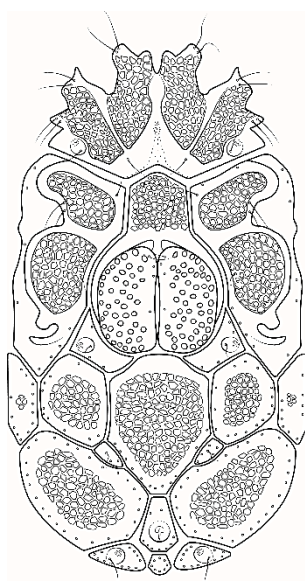
122



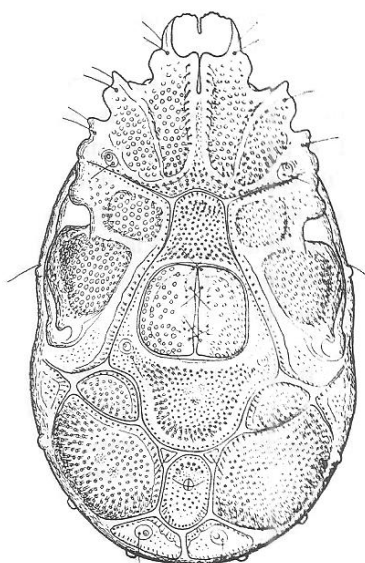
123



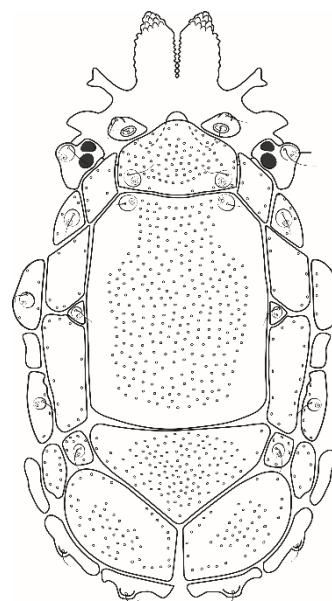
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Figures 122-127. Fig. 122, *Clathrosperchonella olovi*, female, dorsum of idiosoma (CASTRO *et al.* 2020); Fig. 123, *Clathrosperchonella olovi*, female, venter of idiosoma (CASTRO *et al.* 2020); Fig. 124, *Clathrosperchonella olovi*, female, palp (CASTRO *et al.* 2020); Fig. 125, *Rhynchohydracarus armiger*, female, venter of idiosoma (CASTRO *et al.* 2022); Fig. 126, *Rhynchohydracarus dividuus*, male, venter of idiosoma (LUNDBLAD, 1941b); fig. 127, *Rhynchohydracarus armiger*, female, dorsum of idiosoma (CASTRO *et al.* 2022).

Table 3. Number of species of Hydryphantoidea so far recorded in each country of South America

Family/Genus	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Surinam	Uruguay	Venezuela
Hydryphantidae											
<i>Ankelothyas</i>				1							
<i>Eupatrella</i>						1					
<i>Euwandesia</i>	1			1							
<i>Hydryphantes</i>	5		3	3	1		2	1	2	1	
<i>Neocalonyx</i>	3	1		6	1	9		2			
<i>Notopanisus</i>	1			1							
<i>Protzia</i>						1					
<i>Pseudohydryphantes</i>				1							
<i>Tartarothyas</i>					1						
<i>Wandesia</i>	2		2	2	1		1				
Hydrodromidae											
<i>Hydrodroma</i>	6		6	1	1		3	1	1		
Rhynchohydracaridae											
<i>Clathrosperchon</i>	1		3		2		2		2		1
<i>Clathrosperchonella</i>			3				1				
<i>Rhynchohydracarus</i>			2			*	1				
Thermacaridae											
<i>Thermacarus</i>		1		1							
Total genera	7	2	6	9	6	4	6	3	3	1	1
Total species	19	2	19	17	7	11	10	4	5	1	1

Guiana and the overseas territory of French Guiana with no occurrences; (*) there is a record of the genus, but none described species (GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020)

4.5 Discussion

Currently, 56 valid species of Hydrypahntoidea are recorded from Sotu America, distributed in 15 genera and 4 families (Table 3). The paraphyletic family Hydryphantidae comprises the largest number of subfamilies (8) and genera (10), with a wide distribution in the South American continent. Five out of these 10 genera are represented by just one described species, each of them known from just one country: *Pseudohydyphantes chilensis* Smit (Chile, Fig. 2), *Tartarothyas xiuia* Goldschmidt, Pimiento-Ortega & Herrera-Martínez (Colombia, Fig. 3), *Protzia salsa* Gerecke (Ecuador, Fig. 5), *Eupatrella platano* Gerecke (Ecuador, Fig. 7) and *Ankelothyas emydoides* Besch (Chile, Fig. 10). Both species *Notopanisus wetzeli* Besch and *Euwandesia sensitiva* André & Naudo are reported for Argentina and Chile (Figs. 4 and 9, respectively). Most of these species are distributed in the western region of South America, along the Andes mountains range, at high altitude, except *Pseudohydyphantes*, collected at Chiloé Island, close to the Chilean coast, 100 meters above the sea level (Smit, 2021) and also *Protzia* and *Eupatrella*, which were reported in the Esmeraldas Province (at Yungas biome, in the rainforest) at 300 and 500 m asl (GOLDSCHMIDT & GERECKE, 2003). The genus *Neocalonyx* is represented by 13 described species, distributed in 3 subgenera (Fig. 6) and found in 6 different countries (Table 3) at the biomes of Yungas and Páramo (ROSSO DE FERRADÁS & FERNÁNDEZ, 2005). The only two genera of Hydryphantidae as well represented in the eastern part of South America are *Hydryphantes* and *Wandesia*. The first one is more diverse, with 3 subgenera and 9 described species, known from 8 different countries, from northern Colombia to southern Argentina and Chile and also in the tropical regions of Amazonian basin (Suriname and Brazil), Atlantic rainforest and Pantanal (Fig. 1). The genus *Wandesia* has 7 known species (Fig. 8). This vermiform genus inhabits interstitial waters and can be found both in cold and hot springs (PROCTOR *et al.* 2015) probably throughout the continent.

The monotypic Hydrodromidae is the only monophyletic lineage within Hydryphantoidea. This widespread family can be found in almost all regions of South America, with 9 described species (Fig. 11). Historically, there have been several sub-species described by Lundblad (1941b) and K. Viets (1954a, 1954b), albeit some recent works have been discussing the status of some species (GERECKE, 2017), e.g *Hydrodroma despiciens* Müller, which were originally considered cosmopolitan.

More recently, PEŠIĆ & SMIT (2022) elevated two subspecies of *Hydrodroma* to full species and described two new species for South America. The Rhynchohydracaridae occur only in the New World and comprise two subfamilies: Clathrosperchontinae and the endemic Rhynchohydracarinae. The genus *Clathrosperchon* is known for the north, central and south America, with 4 described species for the latter region (Fig. 13), whereas *Clathrosperchonella* has been found only in Brazil and Paraguay (Table 3), with 3 described species (Fig. 14). The genus *Rhynchohydracarus* is also known only for Brazil and Paraguay (3 described species), although an undescribed species is mentioned for Ecuador (GOLDSCHMIDT & RAMÍREZ-SÁNCHEZ, 2020). Concerning Thermacaridae, only one species is reported for South America (Fig. 15), the uncommon *Thermacarus andinus* Martin & Schwoerbel, collected in hot springs at high altitudes of Bolivia and Chile. Larvae of this species were found parasitizing toads and described with the adults (MARTIN & SCHWOERBEL 2002).

Concluding, the real diversity of the whole group is probably clearly higher and thus, it is very important to continue the studies, collecting and describing more species, in order to better understand patterns of distribution of Hydryphantoidea in the New World. Prospective molecular works will certainly contribute for a better comprehension about the position of the families among this paraphyletic superfamily.

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5 GENERAL CONCLUSION

The early derivative Hydryphantoidea occurs in all continents, except Antarctica, and comprises 7 families. Four of them are found in South America, with a great richness of genera and species. The Hydryphantidae represents the major group, composed of 10 genera. The knowledge of this lineage of interesting soft-bodied water mites is far from being totally understood. Some regions are poorly sampled or completely unknown in terms of the composition of fauna. The diversity of different biomes and the extensive hydrography enable each watercourse to harbor a myriad of new taxa. Furthermore, the association between water mites and their insect hosts remains largely unknown. Several hydryphantids, for instance, and all rhynchohydracarids inhabit pristine running waters and their prey and hosts during the larval stage still have been waiting to be discovered. Moreover, these have been rapidly destroyed and most species will get extinct before we will be able to describe or even collect them. Therefore, probably a large part of the diversity of water mites will never be described.

Prospective works might focus on sampling greater varieties of freshwater environments, including stagnant and running waters. However, it is necessary not only to discover new species of Hydryphantoidea and describe them, but also recollecting the already described species for improving the barcode library. Presenting a catalog, with a key for all species for this paraphyletic lineage was one of the first steps for further investigations. Furthermore, establishing a regular pattern for idiosomal structures in Rhynchohydracaridae will be very important for future taxonomic issues.

5.1 REFERENCE

DAWKINS, R. **The magic of reality: how we know what's really true.** London: Transworld Publishers, 272 p., 2011.

APPENDIX – List of sequences of the first third of the mitochondrial cytochrome oxidase subunit I (mtCOI) gene amplified for species of the family Rhynchohydracarinae

>CSP001_ *Clathrosperchon minor* (537 bp)

CAAATCATAAAGATATTGGAACATTATATTTTGCTTTAGGAATATGATCGGGGATA
ATAGGAGCAAGATTAAGAACAATTATTTCGATTAGAATTAGGCCAACCAGGATCAT
TAATTGGAAATGACCAAATTTATAATACCATTGTAAGTCTCATGCTTTTATTATA
ATTTTTTTTATAGTTATACCCATAATAATTGGAGGATTTGGAAATTGATTAGTTCC
ACTTATATTAAGAGCTCCAGATATAGCTTTCCCACGAATAAACAATATAAGATTTT
GATTGCTTCCACCATCTCTAATTTTACTAATGTCCAGATCTATATCCTCTACAGGA
GCAGGAACAGGATGAACAGTATACCCCCCATTATCAAGAACTTAGCTCATAAC
GGAACGTCTGTAGATTTAGCAATTTTTTCTCTACATTTAGCAGGAATTTCTCAAT
TTTAGGAGCTATTAATTTTATAGCAACCACAATAAATATAAAACCAAAAATAATAA
CAATAGAACAAATCCCACTATTTGTTTGATCTATTT

>CSP002_ *Clathrosperchon punctatus* (533 bp)

AGATCAAACAAATAGTGGGATTTGTTCTATTGTTATTATTTTGGTTTTATATTTAT
TGTGGTTGCTATAAAATTAATAGCTCCTAAAATTGAGGAAATTCCTGCTAAATGTA
GAGAAAAAATTGCTAAATCTACAGACGTTCCGTTATGAGCTAAGTTTCTTGATAA
TGGGGGGTATACTGTTTCATCCTGTTCTGCTCCTGTAGAGGATATAGATCTGGA
CATTAGTAAAATTAGAGATGGTGGGAAGCAATCAAATCTTATATTGTTTATTCGTG
GGAAAGCTATATCTGGAGCTCTTAATATAAGTGGAACTAATCAATTTCCAAATCC
TCCAATTATTATGGGTATAACTATAAAAAAAATTATAATAAAGCATGAGCAGTTA
CAATGGTATTATAAATTTGGTCATTTCCAATTAATGATCCTGGTTGGCCTAATTCT
AATCGAATAATTGTTCTTAATCTTGCTCCTATTATCCCCGATCATATTCCTAAAGC
AAAATATAATGTTCCAATATCTTTATGATTTG

>CSP009_ *Clathrosperchon punctatus* (679 bp)

CCAAAAAATCAAATAGATGTTGATATAAGATTGGGTCTCCTCCTCCCGTGGGGT
CGAAGAAAGAAGTGTTAAAGTTTCGGTCGGTTAGAAGTATTGTAATAGCTCCAG
CTAATACAGGTAATGAAAGAAGCAATAAAATCGTTGTAATAAAAATTGATCAAAC
AAACAATGGGACTTGTTCAAAGTTTATTATTTTGGGTTTTATTTATTGTTGTAG
CTATAAAATTGATGGCCCCTAAAATGGAAGAGATTCCAGCTAGGTGTAGAGAAA
AAATTGCTAAATCTACTGAGGGTCCATTGTGTGCTAAATTTCTTGACAAAGGTGG
GTAAACTGTTTCATCCTGTTCCAGCACCTGTAGAAGATAATGAACTAGAAATTAAT
AAAATTAGTGATGGTGGAAGAAGTCAAAAGCTTATATTGTTTATTCGTGGGAAGG
CCATATCGGGGGCTCTTAGCATTAAAGGGAAGTCTAGTCAGTTCCCGAAGCCCCCG
ATTATTATAGGTATAACTATAAAAAAGATTATAATGAAAGCGTGAGCGGTTACAAT
GGTGTTATAAATTTGATCATTTCCAATAAATGAGCCAGGTTGCCCTAGTTCTAAA
CGAATAACAGTTCTTAGTCTTGCTCCTAGTATACCTGATCATATTCCTAATCCAAA
ATATAATGTTCCAATATCTT

>CSP010_ *Clathrosperchon punctatus* (683 bp)

TGACCAAAAAATCAGAATAAATGTTGATATAAAATTGGGTCTCCTCCGCCTGTTG
GGTCAAAGAATGATGTGTTAAAATTTTCGGTCTGTAAAAGTATTGTAATAGCTCC
TGCTAATACAGGTAAAGATAGAAGTAGTAAAATTGTAGTAATGAAAATTGATCAA
ACAAATAATGGAATTTGTTCTATTCTTATTCTTTTTGGTTTTATTTTATAGTAGTT
GCTATAAAATTAATTGCTCCTAAAATAGAGGAAATACCTGCTAAATGTAATGAAAA
AATTGCTAAATCTACCGATGGCCCATTATGAGCTAAGTTTCTTGATAGTGGTGGA
TAGACTGTTTCATCCAGTTCCAGCCCCTGTTGATGATAAAGAGCTTGAAATTAATA
AAATTAATGATGGTGGTAAAAGTCAAAAACCTTATATTATTTATTCGTGGGAAAGCT
ATATCTGGTGCTCTGAGTATCAATGGCACCAATCAGTTTCCGAACCCACCAATTA
TTATGGGTATCACTATAAAGAAAATTATAATAAAAGCATGGGCTGTTACAACAGT
GTTATAAATTTGATCATTTCTGATGAAGGAACCAGGTTGCCCTAACTCTAGACGG
ATTATTGTTCTTAGGCTTGCTCCCAATATTCCAGATCATATTCCTAAAGCAAAGTA
TAATGTCCCAATATCTTT

>CIC002_ *Clathrosperchonella olovi* (683 bp)

CCAAAAAATCAAAATAGATGTTGGTATAAGATTGGGTCTCCTCCACCAGTAGGAT
CGAAAAATGAAGTGTTAAAATTTTCGGTCTGTTAATAATATTGTGATTGCTCCAGC
TAGAACTGGTAATGAGAGTAGAAGAAGAACAGTTGTGATAAAGATTGATCAAACA
AATAAAGGTACTTGTCTAAATTTATTATTTTTGGTTTTATATTTATTGTTGTAGCT
ATAAAGTTAATAGCTCCTAAGATGGACGAGATTCCTGCTAAATGAAGTGAAAAGA
TTGCTAAATCTACTGATGGGCCATTGTGAGCCAGATTTCTTGATAAAGGTGGATA
AACTGTCCATCCAGTTCCAGCGCCGGTAGAAGAGAGAGATCTAGAACTAGAAG
AATTAATGAAGGAGGAAGAAGCCAAAATCTTATATTATTTATTCGTGGAAAAGCC
ATGTCTGGAGCTCTTAACATAAGAGGAATTAGTCAGTTTCCAAATCCTCCAATTA
TTATTGGTATAACTATAAAAAAAATTATAATGAATGCGTGTGCTGTTACAATAGTA
TTATAAATTTGATCATTTCCAATAAATGAGCCAGGTTGTCCTAGTTCTAGTCGAAT
AATTGTTCTTAGTCTTGCTCCTAGTATTCCTGCTCATATCCCTAAAGCAAATAAA
GAGTTCCAATATCTTTATG

>RGO001_ *Rhynchohydracarus armiger* (679 bp)

AAAGATATTGGAACACTTTACTTCGCTCTGGGAACATGATCAGGTATATTAGGAG
CAAGTTTAAGAACTATTATTTCGATTAGAATTAGGTCAACCTGGATCTTTCATAGG
GAACGATCAAATTTATAATAACAATTGTAAGTCTCACGCATTTCATCATAATTTTCT
TCATAGTAATACCTATAATAATTGGAGGATTTGGAAATTGATTGGTTCCATTAATG
TTAAGAGCTCCAGACATAGCTTTCCCTCGAATAAATAACATAAGATTCTGACTTC
TCCCCCTTCTTTAACATTTCTTCTTTCTAGATCTATATCATCTGTTGGAGCAGGG
ACCGGATGAACGGTCTATCCGCCTTTATCAAGAAATCTTTCTCATAGAGGTACCT
CAGTAGATTTAGCAATCTTTTCTCTCCATTTAGCCGGTATTTCTTCTATTTTAGGA
GCAATCAATTTTATAGCTACCACAATAAATATAAAACCAAAGAGAATAAGTTTAGA
ACAAGTCCCATTATTCGTCTGATCAATTTTTATTACTACAATTCTTCTTCTCTCTC
TTTACCAGTTCTAGCAGGTGCTATTACCATATTATTAACAGATCGAAACTTTAACA
CCTCATTTTTTCGACCCAACAGGAGGGGGAGACCCTATTTTATATCAACATCTATT
TTGATTTTTTG

>RGO002_ *Rhynchohydracarus armiger* (679 bp)

AAAGATATTGGAACACTTTACTTCGCTCTGGGAACATGATCAGGTATATTAGGAG
CAAGTTTAAGAACTATTATTCGATTAGAATTAGGTCAACCGGGATCTTTCATAGG
GAACGATCAAATTTATAATAACAATTGTAAGTCTCACGCATTCATCATAATTTTCT
TCATAGTAATACCTATAATAATTGGAGGATTTGGAAATTGATTGGTTCCATTAATG
TTAAGAGCTCCAGACATAGCTTTCCCTCGAATAAATAACATAAGATTCTGACTTC
TCCCCCCTTCTTTAACATTTCTTCTTTCTAGATCTATATCATCTGTTGGAGCAGGG
ACCGGATGAACGGTCTATCCGCCTTTATCAAGAAATCTTTCTCATAGAGGTACCT
CAGTAGATTTAGCAATCTTTTCTCTCCATTTAGCCGGTATTTCTTCTATTTTAGGA
GCAATCAATTTTATAGCTACCACAATAAATATAAAACCAAAGAGAATAAGTTTAGA
ACAAGTCCCATTATTCGTCTGATCAATTTTTATTACTACAATTCTTCTTCTTCTCTC
TTTACCAGTTCTAGCAGGTGCTATTACCATATTATTAACAGATCGAACTTTAACA
CCTCATTTTTTCGACCCAACAGGAGGGGGAGACCCTATTTTATATCAACATCTATT
TTGATTTTTTG