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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

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Original research

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.

Keywords water mites; streams; integrative taxonomy; COI

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

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 and Ramírez-Sánchez 2020) and is composed of three subfamilies: Rhynchohydracarinae Lundblad, 1936, Clathrosperchontinae Lundblad, 1936, and Santiagocarinae Valdecasas, 2001 (Walter *et al.* 2009; Goldschmidt and 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 dividius* 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 and

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Ramírez-Sánchez 2020). *Rhynchohydracarus* species are often found associated with substrate such as sand and small pebbles collected from hyporheic habitats (L.A.S. de 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 and Fossati-Gaschnard (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 Rhynchohydracaridae is also provided, followed by an identification key for the known species of *Rhynchohydracarus*.

Material and methods

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° E, 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 São Paulo State University (Piracicaba, Brazil), 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.

Molecular analysis

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.

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

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

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.

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.

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[®] NIS-Elements. 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 and Cook (2016) and Goldschmidt and 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—leg segments from proximal to distal; n—number of specimens measured. All measurements are given in µm.

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.

Description. Female

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

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.

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).

Description. 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 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.

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.

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).

Figure 5 Homologies between the hypothetical plesiotypical arrangement of dorsal features of Hydrachnidiae and those of the Rhynchohydracaridae. 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 (prefr), postfrontalia (postfr), dorsocentralia (dc) and dorsolateralia (dl); B – *Rhynchohydracaridae armiger n. sp.* (female); coloured lines in dc and dl indicating their respective homologies with plesiotypical idiosoma organization in Hydrachnidiae. Terminology used follows Lundblad (1927).

Remarks

Based on the plesiotypical idiosoma organization of Hydrachnidiae 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 “lateralialia”. This proposal should help to facilitate and standardize future morphological studies and descriptions of new species in this family.

Dorsalia

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

Figure 6 Ventral homologies between a plesiotypic Hydrachnidae and Rhynchohydracaridae. A – Plesiotypic 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); coloured lines in pregen, postgen and v-1-4 indicating their respective homologies with plesiotypic idiosoma organization in Hydrachnidae. Terminology used follows Lundblad (1927).

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 *Santiagocarus* 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 dorsolateralia (Figs. 2A, 3A, 4A, 5B). None of these lateralia 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*.

Ventralia

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, 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 Rhynchohydracaridae. 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).

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. dividiuus* 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)

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. dividiuus* 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.

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