

A new species of rake-legged mite *Neocaeculus* (Acari, Caeculidae) from Brazilian semiarid and new data on distribution of *Andocaeculus caioi*

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ABSTRACT. A new caeculid species *Neocaeculus setecidades* sp. nov. from the semiarid is described from the National Park Sete Cidades located in the state of Piauí, Brazil. The species is included in *Neocaeculus* Coineau, 1967 due the presence of different sized claws on leg I, absence of bothridia in the tarsi of anterior legs and the aspidosomal sclerite not overhanging the gnathosoma in lateral view. New data on distribution of *Andocaeculus caioi* Ott & Ott, 2014 is presented.

KEYWORDS. Neotropical, South America, taxonomy.

RESUMO. Uma nova espécie de ácaro perna-de-ancinho *Neocaeculus* (Acari, Caeculidae) do semiárido brasileiro e novos dados de ocorrência de *Andocaeculus caioi*. Uma nova espécie de ceculídeo, *Neocaeculus setecidades* sp. nov. do semiárido é descrita do Parque Nacional Sete Cidades no Estado do Piauí. A espécie é incluída em *Neocaeculus* Coineau, 1967 pela presença de unhas de diferentes tamanhos no tarso da perna I, pela ausência de botrídeos nos tarsos das pernas anteriores e pelo escudo aspidossomal não sobressaindo anteriormente ao gnatossoma em vista lateral. Novos dados de ocorrência de *Andocaeculus caioi* Ott & Ott, 2014 são apresentados.

PALAVRAS-CHAVE. Neotropical, América do Sul, taxonomia.

Recently OTT & OTT (2014) described *Andocaeculus caioi*, the first rake-legged mite species registered to Brazil. In this way the authors enhanced the number of caeculid species described to South America to six including the above cited one and five additional ones described at least a half century ago: *Andocaeculus brundini* (Franz, 1962), *Neocaeculus bruchi* (Berlese, 1916), *Microcaeculus weyrauchi* Franz, 1964 from Argentina; *M. castrii* Franz, 1964 and *M. nudus* Franz, 1964 from Chile.

Neocaeculus was proposed by COINEAU (1967) to include *N. luxtoni* Coineau, 1967 from New Zealand. Since that the genus accounts ten species, nine from the Australian Region which has been originally described into this genus (COINEAU, 1967; 1974a,b; COINEAU & ENS, 1969; TAYLOR *et al.*, 2013; TAYLOR, 2014) and one species from the Neotropical Region (Argentina) originally described at *Caeculus* by BERLESE (1916) which was transferred to this genus by COINEAU (1974a).

TAYLOR (2014) raised interesting discussion about the possible synonymy between *Microcaeculus* Franz and *Neocaeculus*, regarding the difficulty to define the anterior

overhanging of the gnathosoma by the aspidosomal sclerite. We do agree with the author position but a deeper examination of the both genera types would be necessary to give more fundament to this question. However, it is very possible that both genera could be regarded as valid considering the genera types, with many species, for now, arbitrary placed in one or another genus.

The species herein described present aspidosomal sclerite not overhanging the gnathosoma, absence of dorsal bothridia in the tarsi legs I and II and differently sized claws of leg I. Based on this arguments we decide to place the new species into *Neocaeculus*. However it is very possible that this species are indeed not congeneric with *N. luxtoni* due the differently shaped nasus bothridial setae (*bo*) which could be a good character to define the both above discussed genera. The absence of the bothridium in the legs I and II could be also considered to place the new species in *Microcaeculus* but as stated by TAYLOR (2014) and OTT & OTT (2014) it is very likely that the genus does not have representatives in South America being all three species described by H. Franz for the continent possible belonging to *Andocaeculus*.

In this paper we describe a new species of *Neocaeculus* from South America, the second species of the genus known for the continent and the first of the genus known from Brazil; new distribution data is provided for *A. caioi*.

MATERIAL AND METHODS

Descriptions follow mainly OTT & OTT (2014), with six positions for spines and spine rows considered: d, dorsal; a, anterior; p, posterior; v, ventral; va, ventro-anterior; vp, ventro-posterior. Only leg articles with spines are indicated. Additional abbreviations used in text: tr, trochanter; bf, basifemur; fe, femur; ti, tibia; ta, tarsus.

Specimen for transmitted light examination was cleared with Nesbitt's fluid along two weeks and posteriorly washed out with acetic acid over one day and transferred to 80% ethanol; examination on compound microscope was made with the help of a excavated slide containing clove oil. Spines location and counts were accomplished using compound and stereomicroscope for confirmation. Incident light images of female paratype were taken using a Leica M205A stereomicroscope with attached DFC420 camera and assembled using the Leica application suite (LAS) software package. Transmitted light images of male holotype were taken through a Zeiss Standard compound microscope with attached Canon A620 camera and processed with Helicon Focus 5.3 multi-range program (Kozub et al., 2012). Drawings were made using printed images as models and compound microscope and stereomicroscope as three-dimensional shape confirmation tools. Electron scanning microscope (SEM) images were taken using a Jeol-JSM-5200 with attached SLR digital camera. All measurements are in micrometers. Locality data in brackets was taken from Google Earth for the main buildings of the National Park Sete Cidades, Piauí, Brazil.

Examined material is deposited at acarological collection of Museu Paraense Emílio Goeldi (MPEG, curator Alexandre B. Bonaldo); Coleção Científica de Acari do Departamento de Zoologia e Botânica da Universidade Estadual Paulista – IBILCE – Campus de São José do Rio Preto (DZSJRP, curator Reinaldo J. F. Feres) and Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (MCN, curator R. Ott).

RESULTS

Neocaeculus setecidades sp. nov.

(Figs 1-38)

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Type material. Holotype ♂ from Parque Nacional Sete Cidades (04°06'44.2"S - 41°41'47.7"W), sample site PNC7C 0323, Piracuruca, Piauí, Brazil, 06.XII.2006, L. C. Carvalho *et al.* leg. (MPEG - ACA 0081). Paratypes: ♀ same data of holotype; ♀, Parque Nacional Sete Cidades [04°05'59"S, 41°42'33"W], Brasileira e Piracuruca, Piauí,

Brazil, 2006-2007, same collector as holotype (MPEG ACA 0084); ♂ and 1 juv. (MCN ACA 1929; ex. MPEG ACA 0084) same data above; ♀, sample site PNC7C 0951, Piracuruca (04°05'57.5"S - 41°43'00.7"W), 26.I.2007, same collector above (MPEG ACA 0080); 1 juv. same locality, date and collector above (MPEG ACA 0082).

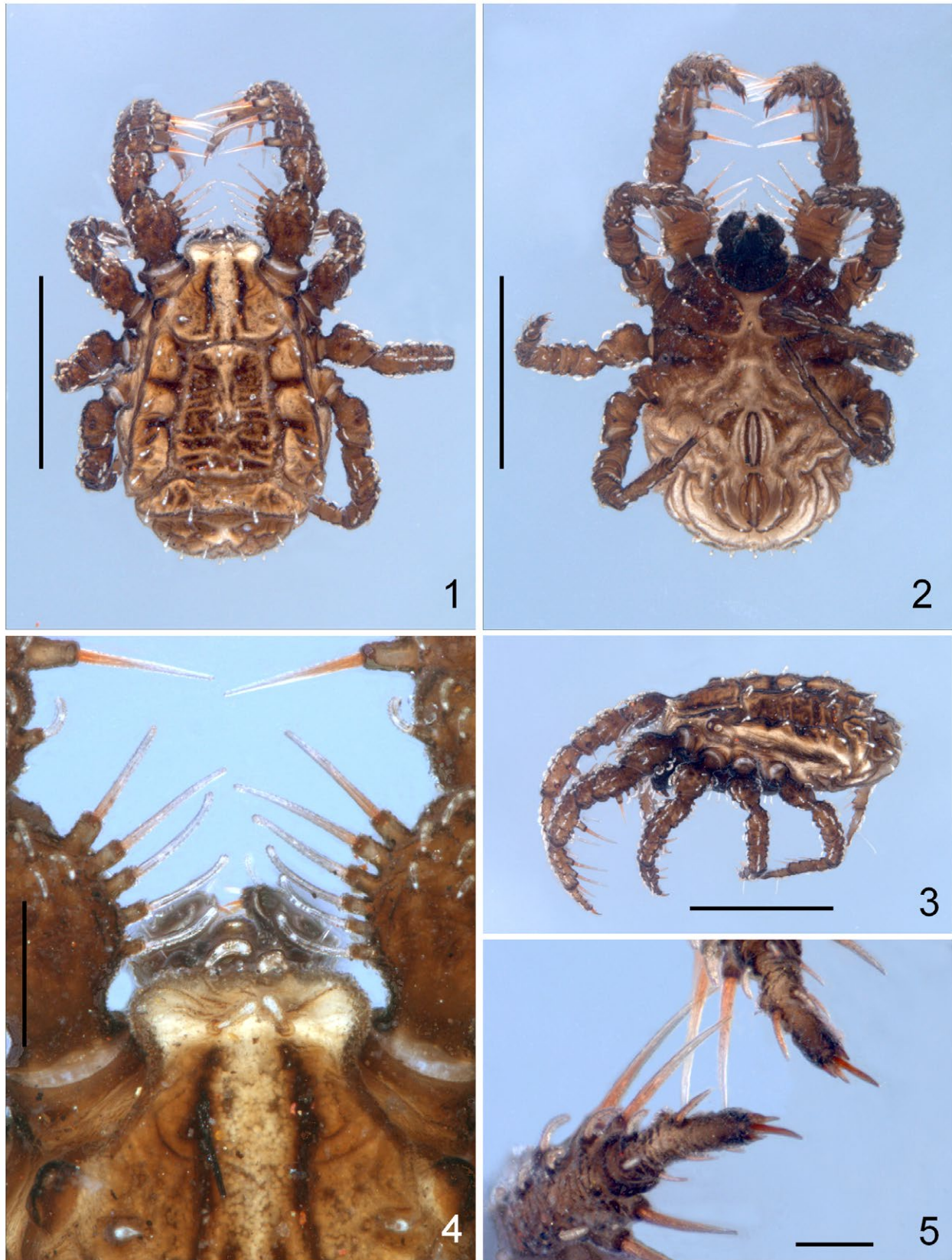
Etymology. The noun in apposition is taken from the type locality.

Diagnosis. *Neocaeculus setecidades* sp. nov. is close to *N. bornemisszai* Coineau & Enns, 1969, *N. johnstoni* Coineau, 1974, *N. kinnearae* Taylor, 2014, *N. knoepffleri* Coineau & Enns, 1969 and *N. womersleyi* Coineau, 1974 in having a narrow and straight nasus bothridial setae *bo* (Fig. 11) rather to "globose-capitate" ones (see COINEAU, 1967: 59, fig. 2A). The species can be distinguished from *N. bruchi* by the different spines number and distribution on leg I (see BERLESE, 1916: 290, 291). It can be recognized by the presence of 5-6 blunt tip spines on prolateral side of trochanter I (Figs 1, 2, 4, 15).

Description. Male (MPEG ACA 0081, holotype). Idiossoma 1,481 long, 950 wide.

Dorsum: yellowish brown tegument with dark brown markings surrounding sclerites (in ethanol, as in Figs 1-3). Aspidosomal sclerite yellowish brown with brown markings, mesal portion lighter, anterior portion much lighter, almost whitish, 531 long, 580 wide; setae *Pa* close together, on anterior border of sclerite; setae *Pm* close together on the anterior third of sclerite; setae *Pp* wide apart, on the posterior third of sclerite, just behind the posterior eyes line (Figs 6, 8). Two pair of eyes on small rounded and brown sclerite at level of posterior third of aspidosomal sclerite (Figs 1, 4, 6, 8). Centrodorsal sclerite yellowish brown with brown markings, 612 long, 483 wide; setae *a1*, *b1*, *c1* present; setae *a1* and *b1* closer together as both *c1*, *a1* separated from each other around one and a half time their length and *b1* about two times their length, setae *c1* wider apart from each other, around three to four times their length (Figs 6, 8). Lateral sclerite yellowish brown with brown markings, 692 long, 193 wide; setae *a2*, *b2*, *c2* present, all positioned on middle line of sclerite, *a2*, *b2* single, *c2* double but not close together; lyrifissure *ia* transversal, between *a2* and *b2*, on the ectal border of sclerite; lyrifissure *im* obliquous between *b2* and *c2*, somewhat apart from the ectal border of the sclerite (Figs 6, 8). Medial sclerite in one piece, occupying the whole width of posterior portion of idiossoma, yellowish brown with brown markings, narrow trapezoidal shaped, 225 long, 757 wide; setae *d1*, *d2* present, single, *ds* present; all setae almost in transversal straight line with *d2* at lateral border of sclerite. Posterior sclerites very weakly defined, 64 long, 242 wide; setae *e1*, *e2* present, *es* absent (Figs 6, 8). Pseudoanal sclerite not clearly defined, setae *h1*, *h2* and *hs* present.

Venter: yellowish brown tegument with brown ridges; epimeres brown, wrinkled aspect; dark brown genital valve, brown anal valves (Figs 2, 7). Epimeres I not touching the gnathosoma, with a clear seam between them; epimeres I and II totally fused from the base to half of its length showing a groove from this point until distal end; epimeres I with four



Figs 1-5. *Neocaeculus setecidades* sp. nov., paratype ♀: 1, dorsal view; 2, ventral view; 3, lateral view; 4, anterior portion of aspidosomal sclerite, dorsal view; 5, tarsi of legs I, dorso-anterior view. Scales bars: 1, 2, 3, 1000 μm ; 4, 250 μm ; 5, 100 μm

equally spaced medial clavate setae, which increases in size from the proximal to the distal position; epimeres II with two medial clavate setae, close together and positioned at half length of the epimere; epimeres II and III, separated by a seam; epimeres III and IV fused, with a groove between them on its total length; both with two small medial, almost same sized clavate setae.

Genital valves with five pairs of small and thin needle like setae, each valve 290 long, 32 wide, genital; agenital sclerite well sclerotized, brown, triangular in shape, 225 long, 161, wide. Anal valves with two-three clavate setae, 209 long, 64 wide; pseudoanal sclerites, brown, semicircular, with two-three clavate setae, 242 long, 80 wide, reaching until three quarters of the total length of the anal valves (Figs 7, 9). Remaining ventral a genital seta distribution as in Fig. 9. Internal genital sclerite bell shaped, with 4 pairs of visible setae forming a circular pattern on the anterior portion, no visible acetabula (Figs. 7, 14).

Gnathosoma: nasu seta *Po* very short, bothridia *bo* long and narrow (Fig. 11); subcapitulum dark brown, wrinkled aspect, with two pairs of clavate setae. Hypostome with one pair of clavate setae near base. Chelicera with one dorso-distal needle like seta; movable finger terminal, fixed finger regressed and tooth like. Palp (Figs 12, 13) four segmented, with femur-genu not fused, femur with two dorsal clavate setae and genu with a single clavate seta; tibia with five setae being two dorso-retrolateral clavate and three robust prolateral spiniform setae, being the proximal one sharp pointed and both distal with blunt tip; tibia also with one dorsal solenidion (Fig. 12); tarsus with three setae, one ventral, one prolateral and one retrolaterally directed, five eupathidia: four more prolateral positioned being the two median very close together, the fifth one slightly in retrolateral position (Fig. 13).

Legs (Figs 10, 15-38): light brown with whitish clavate setae on dorsum, laterals and some scarce ones ventrally at trochanter, basifemur, femur and genu of legs II-IV; all legs with divided femura; rake setae light orange. Distal tip of tarsi of legs I-IV bearing large and peculiar foliar setae positioned one on each side of the tarsal claws (Figs 24, 25, 36). Legs I and II bearing very long rake like setae (mainly on anterior and ventral sides of femur, genu and tibia), most setae and eupathidia originating on tubercles. Leg I (Figs 15, 16, 23-30) with 16 visible eupathidia (Figs 26, 27), distributed on basifemur (2), femur (1) genu (2), tibia (4) and tarsus (7); trochanter with five to six strong, long, narrow and slightly clavate prolateral setae; one distal solenidion on retrolateral side of tibia (Fig. 28) and a very large prolateral tarsal solenidium (11.90 diameter; Figs 10, 16, 29, 30) present at distal third of tarsus; tarsal bothridium absent (Figs 16, 23); clavate setae distribution: tr, a1-1-1-1 (very long, sometimes six setae), d3-3-3, p1-1-0; bf, a0-1-0, d3-3-2; fe, d0-2-2; ge, d3-3-2-3-1, p1-1-1-0, vp1-0-1-1; ti, d3-1-3-1-1, vp1-0-0-0; ta, d1-0-0, p1-0-0, vp, 1-1-1; needle like setae distribution: bf, va1; fe, a1; ge, a1-1, vp1; ti, a1-1-1-1, vp1-1-1; ta, a1-1-1-1, d0-1-0, vp1-1-1-1. Leg II (Figs 17, 18, 31, 32) with 18 visible eupathidia, distributed

on basifemur (2), femur (2), genu (4), tibia (5) and tarsus (8) (Figs 17, 18); one distal solenidion on tibia in retrolateral position (Fig. 32) and one very large prolateral solenidium (11.00 diameter; Fig. 18) present at distal third of tarsus; tarsal bothridium absent (Figs 18, 31); clavate setae distribution: tr, a1-0-0, d1-3-1; bf, a1-0, d1-3-2; fe, a1, d2-1; ge, a1-1 d3-3-1, vp1-1-0-0; ti, d2-2-3, va1-1-1-1; ta, d2-1-1; needle like setae distribution: bf, vp1; ge, va1-1, vp1-0; ti, v0-1; ta, a1-1-1-1, vp1-1-1-1. Leg III (Figs 19, 20, 33-36) with 14 visible eupathidia distributed on basifemur (2), femur (1) genu (2) tibia (5) and tarsus (4) (Figs 19, 20), one distal solenidion on tibia (Fig. 35) in retrolateral position; one dorsal bothridium (159.50 long) at three quarters of the length of tarsus (Figs 20, 33, 34); clavate setae distribution: tr, a2-1-1, d1-2-2; bf, a1, d1-2; fe, a1, d1; ge, d2-3-2, v0-1, vp1-1; ti, d2-1-1, va2-0-0-0; ta, d2-2-0; needle like setae distribution: ti, va0-1-1-1, v1-1-1-1; ta, v1-1-1, va1-1-1-1. Leg IV (Figs 21, 22, 37, 38) with 15 visible eupathidia distributed on femur (2), genu (3), tibia (7) and tarsus (3) (Figs 21, 22), one dorsal long bothridium (173.80 long) positioned near to three quarters of the length of tarsus (Figs 22, 37, 38); clavate setae distribution: tr, a1-0-1, d1-1-1; bf, d2-1, a1, v2-0-1; fe, d1; ge, a0-0-1, d2-1-1, va1-1-1; ti, d2-0-1-0; ta, d2-2-0; needle like setae distribution: ti, va1-1-1-1-1, vp1-1-1-1-0; ta, va1-1-1-1-1, vp0-1-1-1-1.

Variation (n=2). Idiossoma length 1,481 (no variation detected), width 950-966.

Female (MPEG ACA 0084, paratype, Figs 1-5). Idiossoma length 1,666; width 1,137. As for male except noted. Aspidosomal sclerite, 580 long, 628 wide. Centrodorsal sclerite 757 long, 547 wide. Lateral sclerite 869 long, 225 wide. Medial sclerite 193 long, 338 wide. Posterior sclerites 209 long, 403 wide.

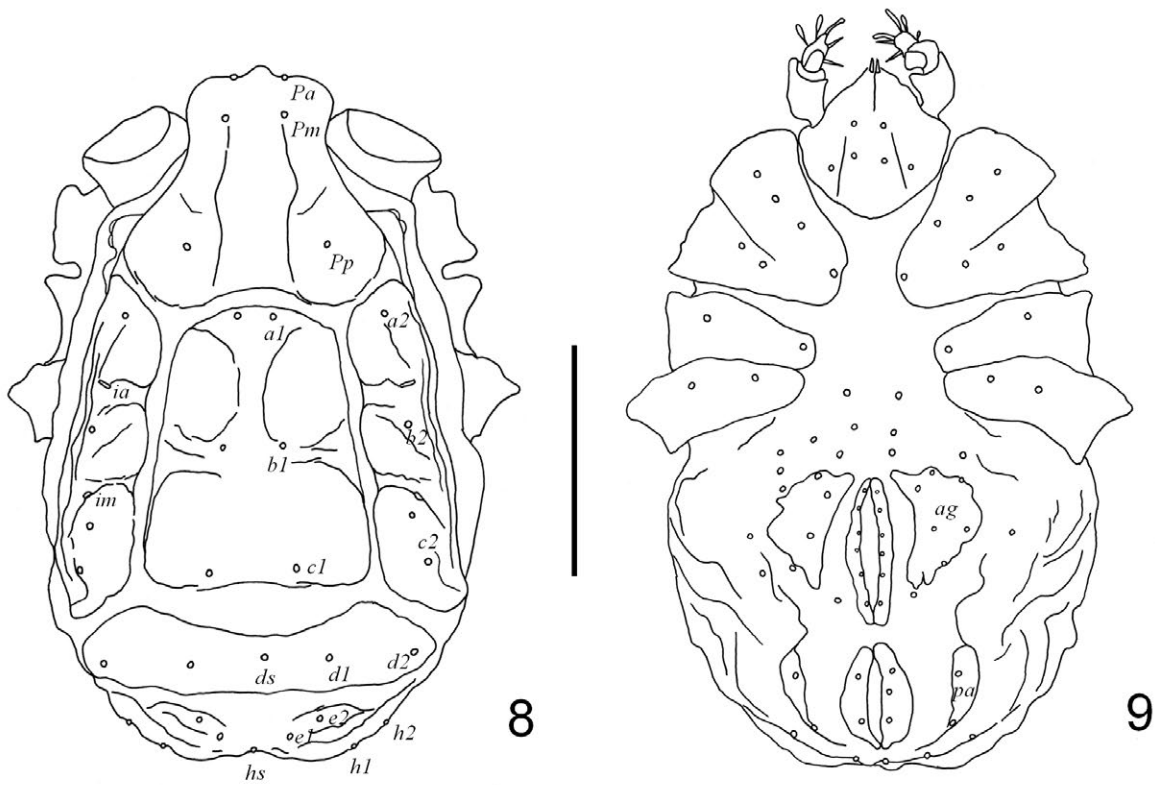
Genital valves, 290 long, 32 wide; aggenital sclerite, proportionally smaller as in male, 225 long, 113 wide, reaching just to the half length of the genital valves. Adanal sclerites 306 long, 80 wide; pseudoanal sclerites 338 long, 97 wide (Fig. 2).

Variation (n=3). Idiossoma length 1,433-1,666, width 950-1,137.

Other examined material. None.

Distribution. Known only for the type locality.

Natural History. The available information for sample sites of some of the collected specimens indicate that the species can be found in grasslands (pitfall sampling method; PN7C 0323 sample site; Figs 39, 40) and dry semideciduous forests litter (winkler sampling method; PNC7C 0951 sample site; Figs 41, 42), both sites are defined respectively as "campo graminoide cespitoso médio" and "floresta tropical semidecídua" (OLIVEIRA *et al.*, 2007). The "Parque Nacional Sete Cidades" is mainly geomorphologically characterized by sand stone formations as table mountains ("chapadas"), sand stone slopes ("cuestas") and typical sedimentary basins sandy soil (SANTOS & PELLERIN, 2003). The collection sites characteristics and methodologies evidences suggests that the species is probably a sandy ground/litter dweller (also observed by the collector, L. Carvalho pers. comm.)



Figs 6-9. *Neocaeculus setecidades* sp. nov., holotype ♂, cleared: 6, 8, dorsal view; 7, 9, ventral view. Scale bars: 500 µm.

differently from the another species registered to Brazil, *A. caioi*, which was until now found exclusively in outcrops under stones (OTT & OTT, 2014).

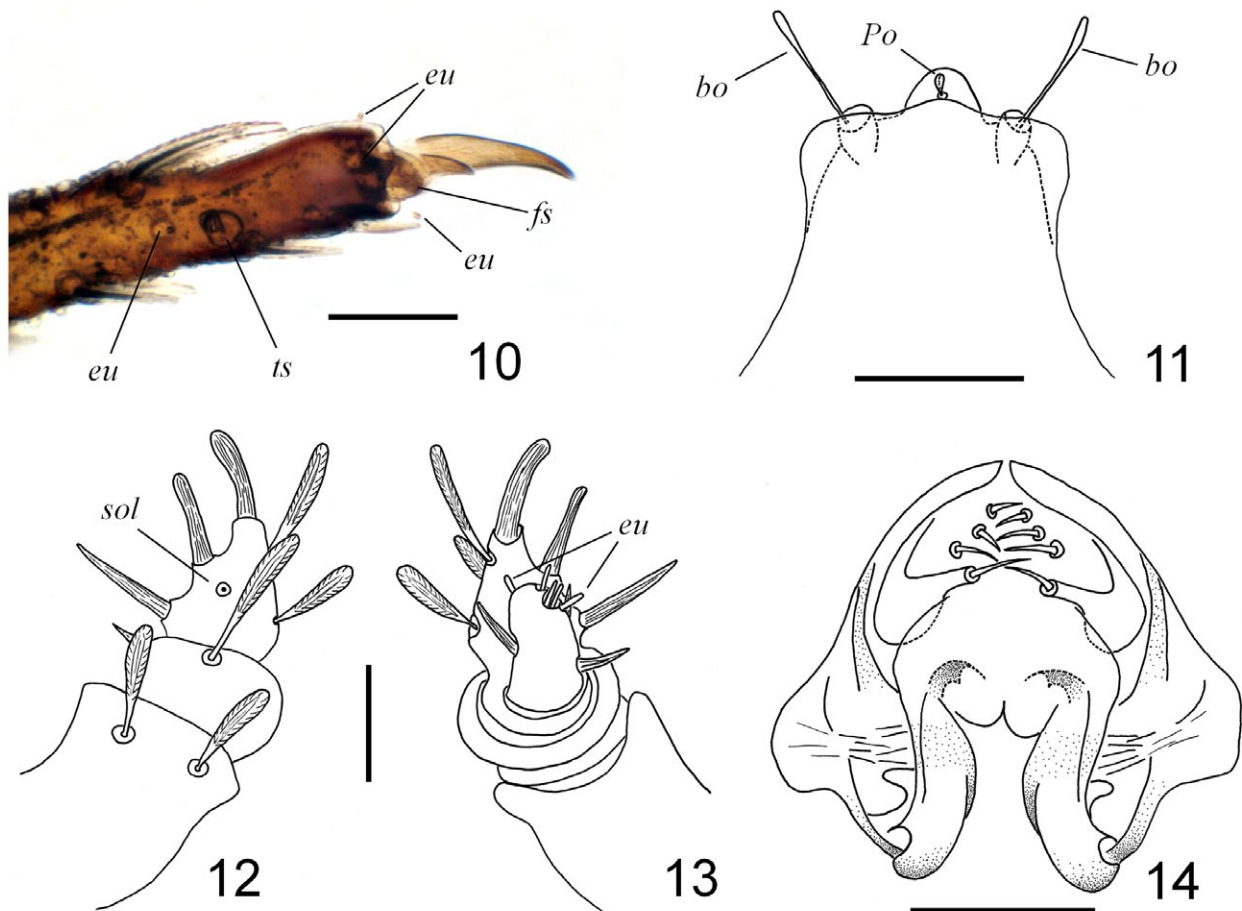
***Andocaeculus caioi* Ott & Ott, 2014**

Andocaeculus caioi OTT & OTT, 2014:356, figs 1-42.

Notes. Regarding recent information about caeculids collected some time ago in a cemetery in Botucatu, São Paulo (G. R. S. Ruiz, pers. comm.), it was possible to locate, examine and identify the specimens as *A. caioi*. Besides of some variations in chaetotaxy in aspidosomal and dorsal plates it was not possible to identify consistent differences on the specimens with the material from Rio Grande do Sul. Interestingly specimens of both populations were collected in areas with basalt and sandstone formations. Locally the both formations are popularly called also “cuestas” (“Cuesta do Haedo” in Rio Grande do Sul and “Cuesta de Botucatu” in São Paulo). Cuestas are defined by plateau slopes were, in this case, the sandstone layers emerge beneath the basalt. However, the regions are some thousand kilometers apart and the species distribution range is considerably enhanced.

Recently we receive the information that the species is also present in Argentina (A. Porta, pers. comm.). Material collected at Lavras do Sul was found on granite outcrops. Despite the larger amount of material collected after the description of the species, to date no males of this species were recognized; similar findings were reported by COINEAU (1967) regarding *Neocaeculus luxtoni*.

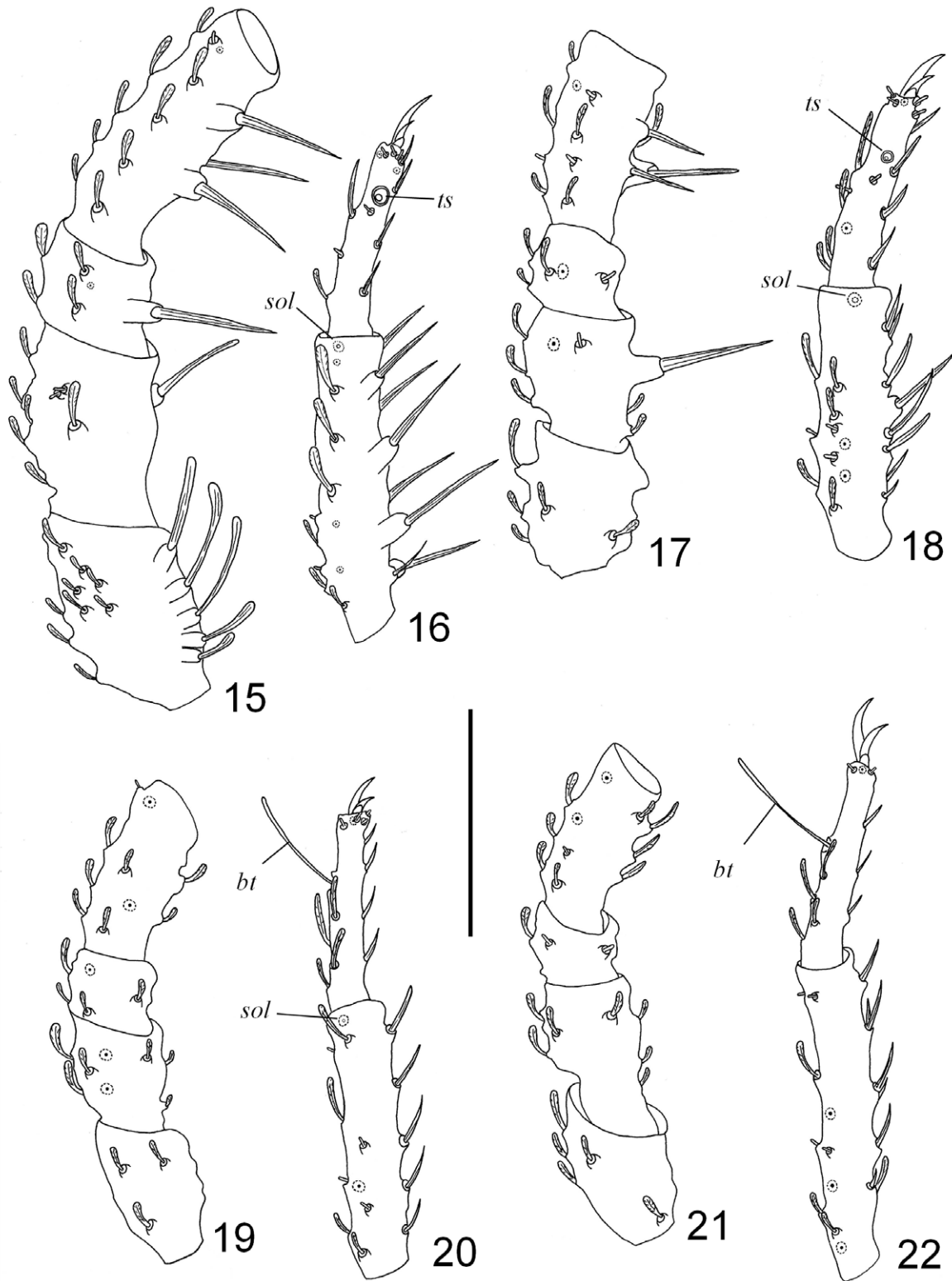
New records. BRAZIL, **São Paulo**: Botucatu: 2♀, 2 juv. “under stone in cemetery”, Cemitério antigo de Botucatu (22°53'55”S, 48°26'42”W), 13.X.2002, G. R. S. Ruiz leg. (DZSJRP-ACARI 9552). **Rio Grande do Sul**: Sant’Ana do Livramento: 74♀, 25 juv. in basalt outcrop, Fazenda Bela Vista, Área de Proteção Ambiental do Rio Ibirapuitã (30°25'53.94”S, 55°38'54.59”W), 18.V.2014, R. Ott & C. Mansan leg. (MCN-ACA 1922); 9♀, 2 juv. in sandstone outcrop, Área de Proteção Ambiental do Rio Ibirapuitã (30°30.43.90”S, 55°36'0.29”W), 18.V.2014, R. Ott leg. (MCN-ACA 1923); 2♀, 13 juv. in basalt outcrop, Estância do Açude (30°28'56.91”S, 55°32'56.97”W), 4.XII.2014, R. Ott leg. (MCN-ACA 1924); 4♀, 1 juv. in basalt outcrop near bridge over creek, 4.XII.2014, R. Ott leg. (MCN-ACA 1925); 3♀, 1 juv. Faz. da D. Laura, Rincão Bonito (30°34'40.27”S; 55°31'10.21”W),



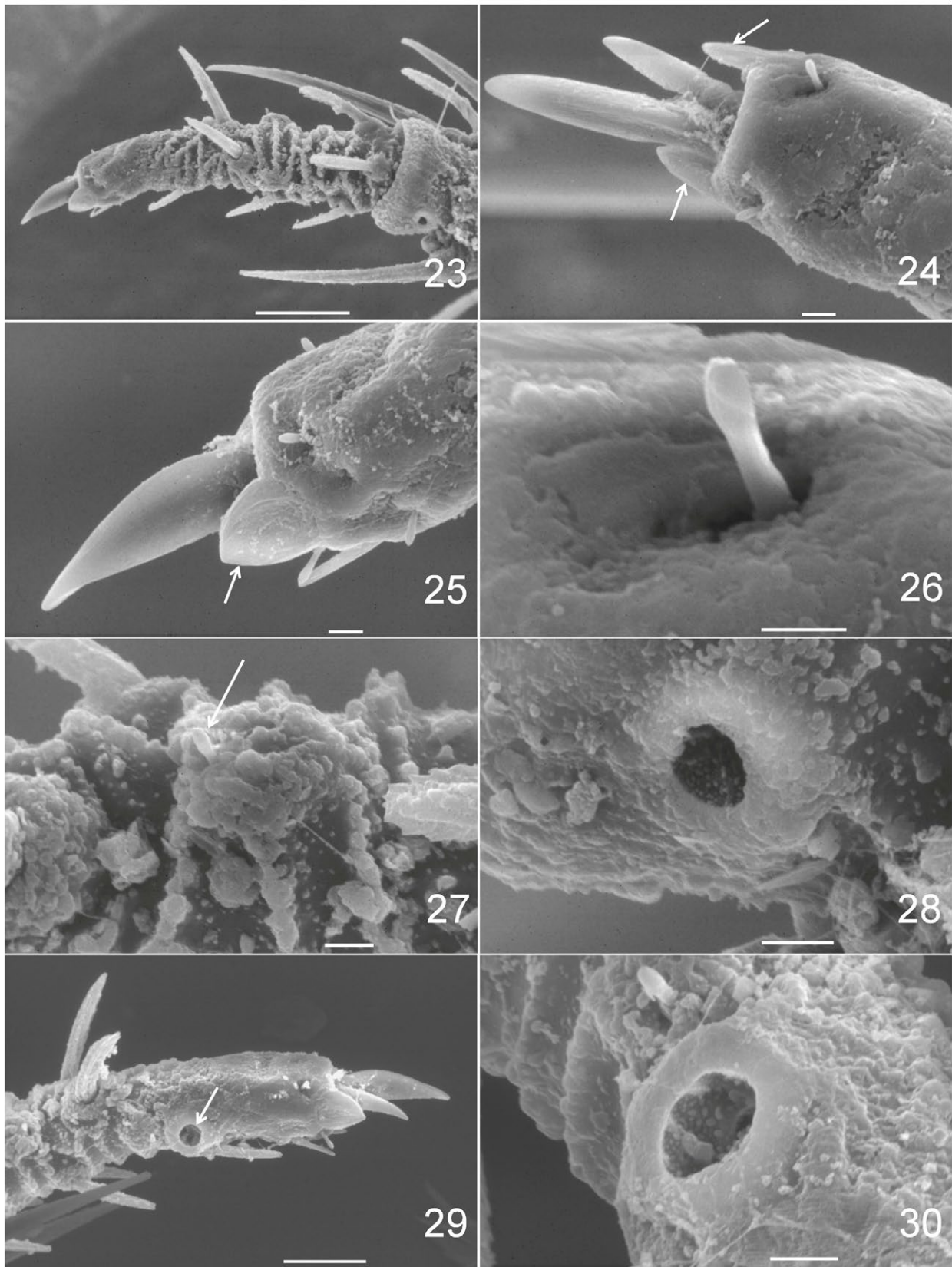
Figs 10-14. *Neocaeculus setecidades* sp. nov., holotype ♂: 10, anterior portion of tarsus of leg I, prolatral view; 11, anterior portion of aspidosomal sclerite, dorsal view; 12, palp, dorsal view; 13, palp, ventral view; 14, internal genital sclerite, ventral view (bo, bothridium; eu, eupathidium; fs, foliar seta; Po, naso seta; sol, solenidion; ts, tarsal solenidion). Scale bars: 10, 12, 13, 50 µm; 11, 250 µm; 14, 100 µm.

3-7.XII.2014, R. Botero & R. Ott leg. (MCN-ACA 1926); São Francisco de Assis: 11♀, 1 juv. under sandstone rocks layers at slope of hill, (29°30'59.63"S, 55°7'26.80"W), 8.XII.2014, R. Ott & R. Botero leg. (MCN-ACA 1927); Lavras do Sul: 17♀, 1 juv., under

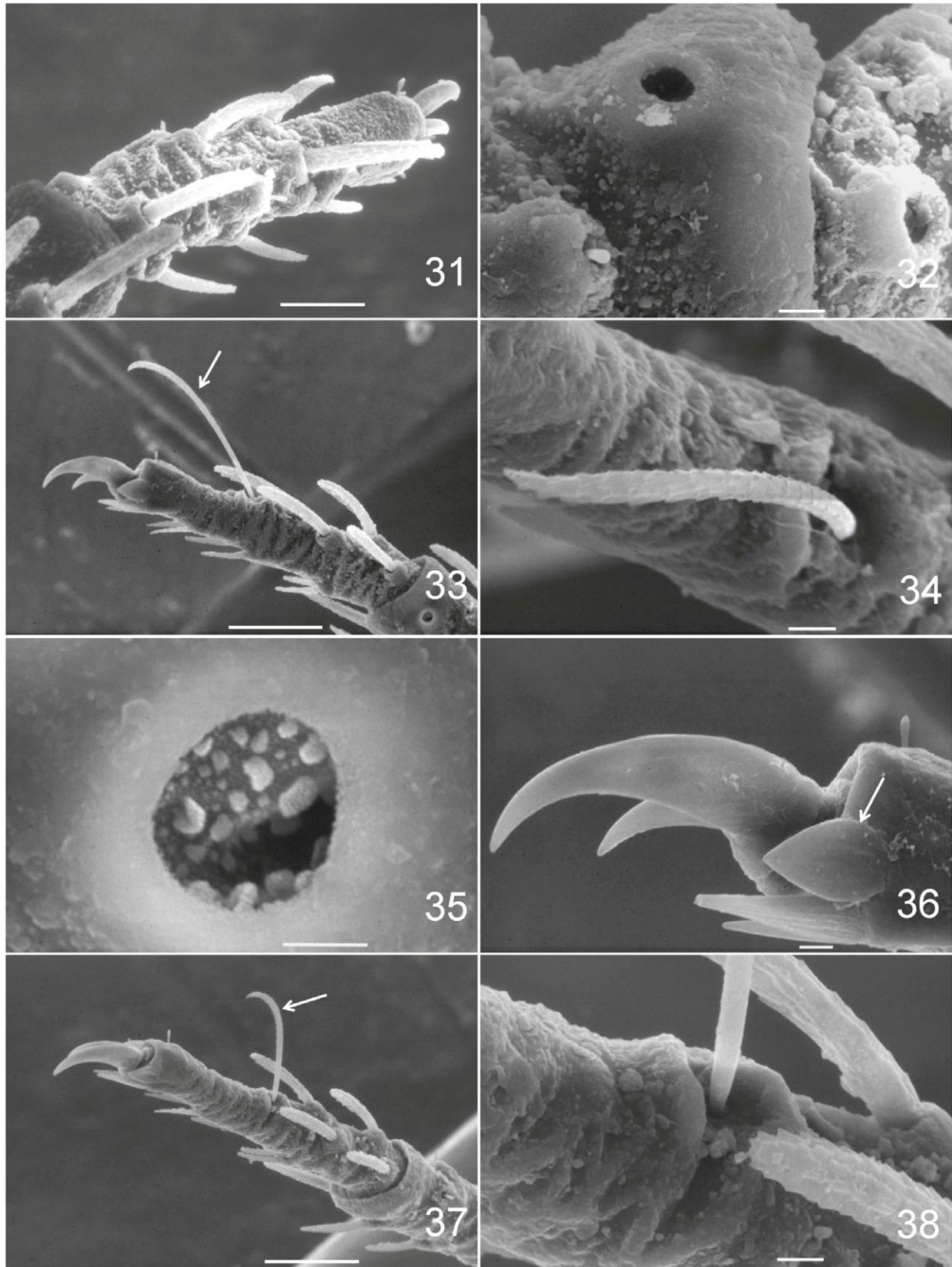
stones in outcrop at road side, RS-630 (30°45'11.30"S; 54°22'47.37"W), 29.I.2015, R. Ott & R. Teixeira leg. (MCN-ACA 1928); 10♀, 1 juv., under stones in outcrop at road side, RS-630 (30°49'19.64"S, 54°28'51.86"W), 30.I.2015, R. Ott & R. Teixeira leg. (MCN-ACA 1930).



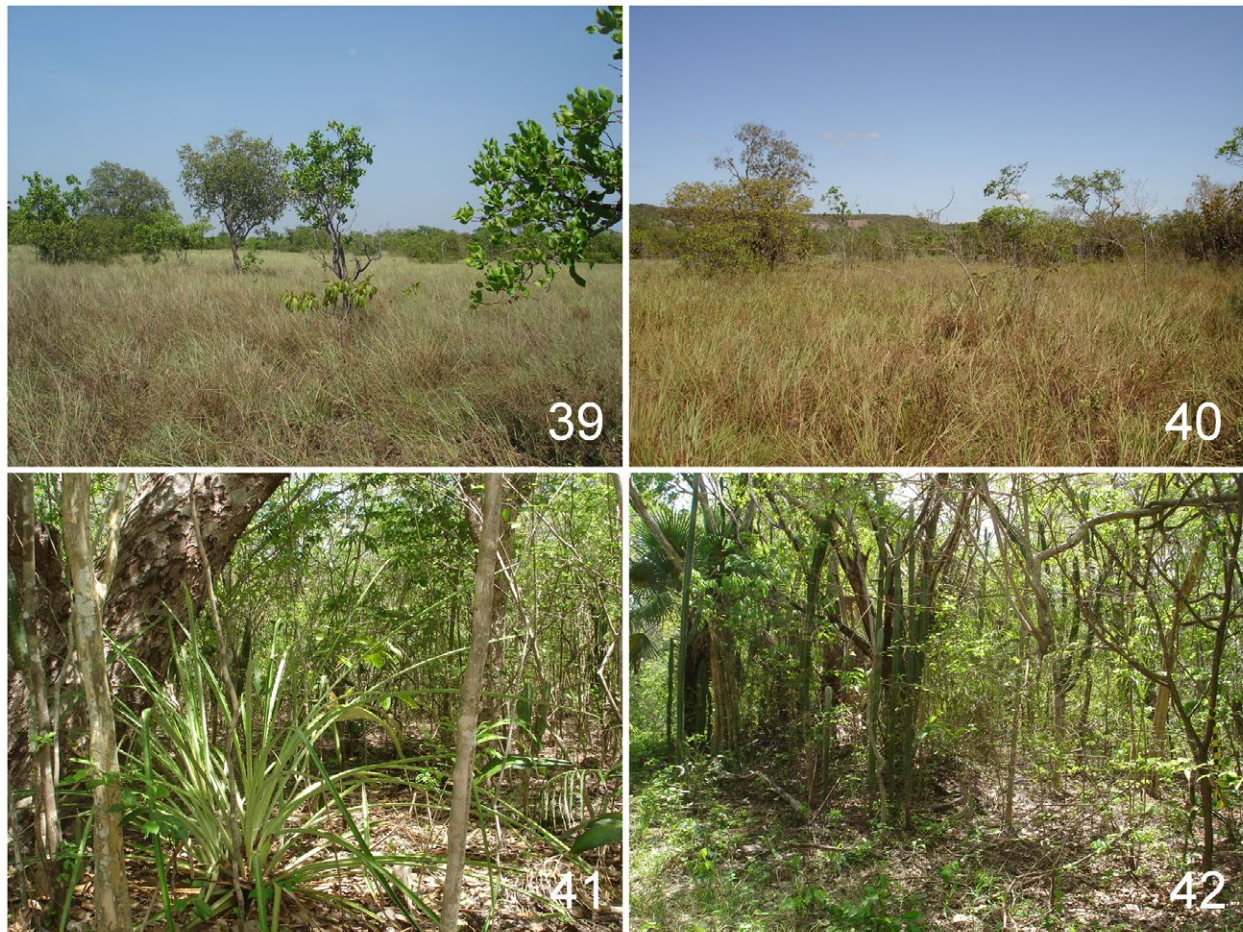
Figs 15-22. *Neocaeculus setecidades* sp. nov.: 15, 17, 19, 21, trochanter, basifemur, femur and genu, respectively Legs I, II, III, IV, dorso-prolateral view; 16, 18, 20, 22, tibia and tarsus, respectively Legs I, II, III, IV, prolateral view (*bt*, tarsal bothridium; *sol*, solenidion; *ts*, tarsal solenidion). Scale bar: 250 μ m. Dotted circles indicate solenidia and eupathidia at retrolateral positions.



Figs 23-30. *Neocaeculus setecidades* sp. nov., paratype ♂, scanning electron microscope images, Leg I: 23, tarsus, dorso-retrolateral view; 24, tarsal claws, dorsal view (arrows: foliar setae); 25, same, retrolateral view (arrow: foliar seta); 26, tarsal distal eupathidium, ventral view; 27, tarsal medial eupathidium elevated base, lateral view (arrow: eupathidium); 28, tibial solenidion, retrolateral view; 29, tarsus, prolateral view (arrow: tarsal solenidion); 30, same, solenidion detail. Scale bars: 23, 100 μ m; 24, 25, 27, 28, 30, 10 μ m; 26, 5 μ m; 29, 50 μ m.



Figs 31-38. *Neocaeculus setecidades* sp. nov., paratype ♂, scanning electron microscope images: 31, 32, Leg II; 33-36, Leg III; 37, 38, Leg IV. Fig. 31, tarsus, dorso-prolateral view; 32, tibial solenidion, dorso-retrolateral view; 33, tarsus, retrolateral view (arrow: tarsal bothridium); 34, tarsal bothridium, dorso-retrolateral view; 35, tibial solenidion, retrolateral view; 36, tarsal claws, retrolateral view (arrow: foliar seta); 37, tarsus, retrolateral view (arrow: tarsal bothridium); 38, tarsal bothridium base, dorso-retrolateral view. Scale bars: 31, 50 μ m; 32, 34, 36, 38, 10 μ m; 33, 37, 100 μ m; 35, 5 μ m.



Figs 39-42. *Neocaeculus setecidades* sp. nov. habitats in the Parque Nacional Sete Cidades, Piracuruca, Piauí, Brazil. 39, 40, grasslands; 41, 42, dry semideciduous Forest.

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REFERENCES

- BERLESE A. 1916. Centuria terza di Acari nuovi. *Redia* **12**:289-338.
- COINEAU, Y. 1967. Contribution à l'étude des Caeculidae, Troisième série. Développement postlarvaire de *Neocaeculus luxtoni* n. gen., n. sp. *Acarologia* **9**(1):55-75.
- COINEAU, Y. 1974a. Éléments pour une monographie morphologique, écologique et biologique des Caeculidae (Acariens). *Mémoires du Museum National d'Histoire Naturelle, Série A, Zoologie* **81**:1-299.
- COINEAU, Y. 1974b. Contribution à l'étude des Caeculidae. Neuvième partie. Deux nouvelles espèces de Caeculidae de la région Australienne *Neocaeculus johnstoni* n. sp. et *N. womersleyi* n. sp. *Vie et Milieu* **24**(1):65-86.
- COINEAU, Y. & ENNS, W. R. 1969. Contribution à l'étude des Caeculidae. 8e série. Deux nouvelles espèces d'Australie: *Neocaeculus knoeffleri* n. sp.; *N. bornemisszai* n. sp. *Acarologia* **11**(4):207-221.
- KOZUB, D.; KHMELIK, K.; SHAPOVAL, J.; CHENTSOV, V.; LITOVSHENKO, B. & STARIKH, V. 2012. *Helicon Focus* **5.3**. Helicon Focus Ltda. Available at <<http://cybercom.net/~dcoffin/dcrow/>>. Accessed on 23 May 2013.
- OLIVEIRA, M. E. A.; MARTINS, F. R.; CASTRO, A. A. J. F. & SANTOS, J. R. 2007. Classes de cobertura vegetal do Parque Nacional de Sete Cidades (transição campo-floresta) utilizando imagens TM/Landsat, NE do Brasil. *Anais XIII Simpósio Brasileiro de Sensoriamento Remoto*. Available at <<http://marte.sid.inpe.br/col/dpi.inpe.br/sbsr@80/2006/11.18.01.58/doc/1775-1783.pdf>>. Accessed 20 June 2017.
- OTT, A. P. & OTT, R. 2014. A new species of *Andocaeculus* (Acari, Caeculidae) from the Pampa biome, southern Brazil. *Iheringia, Série Zoologia* **104**(3):355-363.
- SANTOS, J. & PELLERIN, J. 2003. Mapeamento Geomorfológico do Parque Nacional Sete Cidades, Piracuruca, Piauí. In: *IX Congresso da Associação Brasileira de Estudos do Quaternário/II Congresso do Quaternário de Países de Línguas Ibéricas/II Congresso sobre Planejamento e Gestão da Zona Costeira dos Países de Expressão Portuguesa*. Recife. São Paulo, Associação Brasileira de Estudos do Quaternário. 3p. [CD Rom].
- TAYLOR, C. K. 2014. Two further *Neocaeculus* species (Acari: Prostigmata: Caeculidae) from Barrow Island, Western Australia. *Acarologia* **54**(3):347-358.
- TAYLOR, C. K.; GUNAWARDENE, N. R. & KINNEAR, A. 2013. A new species of *Neocaeculus* (Acari: Prostigmata: Caeculidae) from Barrow Island, Western Australia, with a checklist of world Caeculidae. *Acarologia* **53**(4):439-452.