

A NEW GENUS AND A NEW SPECIES OF NEOPYGMEPHORIDAE (ACARI: PYGMEPHOROIDEA) PHORETIC ON *ANOMIOPSOIDES CAVIFRONS* (COLEOPTERA: SCARABAEIDAE) FROM ARGENTINA

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ABSTRACT: A new monobasic genus of Neopygmephorid mites (Acari: Neopygmephoridae)—*Rhombophorus brevipedis* gen. and sp. n.—collected from the beetle *Anomiopsoides cavifrons* (Burmeister) (Scarabaeidae: Eucraniini) in Argentina is described. Females of the new genus are characterized by a remarkable enlarged, poorly sclerotized and almost rhombic in outline claw on tibiotarsus I, as well as large pinnaculum, bearing two solenidia ($\omega 1$ and $\omega 2$) and four eupathidia (tc' , tc'' , ft' , ft'') on tibiotarsus I. A provisional key to the genera of Neopygmephoridae is also provided.

KEY WORDS: heterostigmata, systematics, new taxa, phoresy, Eucraniini, Neotropical Region

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INTRODUCTION

The cosmopolitan family Neopygmephoridae comprises 29 genera and about 300 species (Zhang *et al.* 2011; Khaustov and Frolov 2019; Rahiminejad *et al.* 2023). All neopygmephorid mites are probably fungivorous (Kaliszewski *et al.* 1995). Representatives of six genera are known as associates of scarab beetles: *Andrebochkovia* Khaustov and Frolov, 2019; *Nasutidania* Khaustov and Frolov, 2018; *Pseudokerdabania* Khaustov and Trach, 2012; *Pseudopygmephorus* Cross, 1965; *Scarabadania* Khaustov and Frolov, 2018; and *Troxodania* Khaustov and Trach 2014 (Khaustov 2010; Khaustov and Trach 2012, 2014; Sobhi *et al.* 2017; Khaustov and Frolov 2018a, b, 2019).

The neopygmephorid mites of Argentina are poorly studied. Currently, only 9 identified species have been reported from this country, namely *Bakerdania australis* (Mahunka, 1964), *B. lithobii* (Krczal, 1958), *B. longisetus* (Mahunka, 1964), *B. perforatus* (Mahunka, 1964), *B. topali* (Mahunka, 1964), *Protobakerdania arvorum* (Jacot, 1936), *Pseudopygmephorus argentiniensis* (Mahunka, 1964), *P. tarsalis* (Hirst, 1921) and *Zambedania argentiniana* Camerik and Magowski, 2014 (Mahunka 1964; Bedano 2004; Camerik and Magowski 2014). The latest key to the genera of Neopygmephoridae (as a subfamily Neopygmephorinae in the family Pygmephoridae) was published by Mahunka (1970), in which he included four genera. Since that time, the number of neopygmephorid genera has increased up to 30. A major problem in the construction of the key is the incomplete and inadequate original descriptions of some genera. Additionally, some species currently

placed in the genus *Bakerdania* Sasa, 1961 should be placed into separate (still undescribed) genera. Despite these problems, we have compiled a preliminary key to the genera in order to facilitate the identification of neopygmephorid mites.

During the study of heterostigmatic mites phoretic on scarab beetles, a new genus and species of Neopygmephorid mites—*Rhombophorus brevipedis* gen. and sp. n.—collected from the beetle *Anomiopsoides cavifrons* (Burmeister) in Argentina was found, as described here.

MATERIALS AND METHODS

The host beetle, housed in the entomological collection of the Federal University of Mato Grosso (UFMT), Cuiabá, Brazil, was apparently collected by hand. Unfortunately, the collecting circumstances were not recorded. The exact collecting locality is provided below. The mites were found attached between the anterior coxae of the beetles. The collected mites were preserved in 70–80% ethanol and later cleared in lactic acid and mounted in Hoyer's medium. Mite morphology was studied using a Carl Zeiss AxioImager A2 compound microscope equipped with phase contrast and DIC optical systems. Photomicrographs were taken with a Hitachi KP-HD20A digital camera.

The terminology of the idiosoma and legs follows Lindquist (1986); the nomenclature of subcapitular setae and the designation of cheliceral setae follow Grandjean (1944, 1947), respectively. The taxonomic system of Pygmephorodea follows Khaustov (2004, 2008). All measurements

are given in micrometers (μm) for the holotype and paratype (in parentheses). For leg chaetotaxy, the number of solenidia is given in parentheses.

SYSTEMATICS

Family **Neopygmephoridae** Cross, 1965

Genus **Rhombophorus** gen. n.

Type species: *Rhombophorus brevipedis* sp. n.

Diagnosis. *Female.* Body broadly oval. Gnathosomal capsule of about equal length and width, dorsally with two pairs of cheliceral setae (*cha*, *chb*); postpalpal setae (*pp*) present; palps short, with two pairs of dorsal setae (*dFe*, *dGe*). Palpal tibiotarsus with small tibial claw. Subcapitulum with one pair of setae *m* and alveolar pits *n*; palps ventrally with accessory setigenous structure (*ass*) and tiny palpal solenidion (ω); cheliceral stylets and their levers small and thin. Pharyngeal pumps tripartite, situated separately from each other; pharyngeal pump 1 small, bow-shaped, striated, pharyngeal pump 2 large, oval and weakly striated laterally, pump 3 oval and striated, distinctly smaller than pump 2. Posterior margin of prodorsum slightly covered by anterior part of tergite C. Prodorsum with two pairs of simple setae (*v2*, *sc2*), pair of clavate trichobothria (*sc1*) and small, round stigmata located anteriorly setae *sc2*. Dorsal idiosomal setae not modified. Tergite C with two pairs of setae (*c1*, *c2*); tergite D with one pair of setae (*d*) and round cupules *ia*; tergite EF with two pairs of setae (*e*, *f*); tergite H with two pairs of setae (*h1*, *h2*) and round cupules *ih*. Coxisternal fields I with two pairs of setae (*1a*, *1b*); coxisternal fields II with two pairs of setae (*2a*, *2b*); coxisternal fields III with three pairs of setae (*3a*, *3b*, *3c*); coxisternal fields IV with three pairs of setae (*4a*, *4b*, *4c*). Pseudanal segment with three pairs of setae (*ps1*–*3*). Apodemes 1 (*ap1*) and 2 (*ap2*) well developed and joined with prosternal apodeme (*appr*), sejugal apodeme (*apsej*) well developed and joined with *appr*; apodemes 3 (*ap3*) linear, fused with poststernal apodeme (*appo*); apodemes 4 (*ap4*) long, reaching distinctly beyond bases of setae *3b*. Apodemes 5 absent. Secondary transverse apodeme absent. Posterior margin of posterior sternal plate entire. Anterior genital sclerite (*ags*) bell-shaped, posterior genital sclerite (*pgs*) subtriangular, median genital sclerite (*mgs*) present. Ventral idiosomal setae not modified. Leg I distinctly shorter than leg II. Tibiotarsus I slightly thickened, with weakly sclerotized, rhombic in outline and flattened claw,

situated on short pretarsus (Fig. 5); tibiotarsus I with large pinnaculum, clearly separated by less sclerotized cuticle and bearing two solenidia ($\omega 1$ and $\omega 2$) and four eupathidia (*tc'*, *tc''*, *ft'*, *ft''*); setae (*u*) of tibiotarsus I modified into short spiniform structure located ventrodistally; seta *d* of femur I hook-shaped, seta *k* smooth, blunt-tipped; Claws on tarsus IV simple, claws on tarsi II and III thickened medially. Tarsi II and III short and wide; empodia on tarsi II–IV relatively short and wide. Tarsus IV not strongly elongate. Femora III–IV divided into basi- and telofemur. Leg setation: leg I; Tr 1 (*v'*), Fe 3 (*d*, *l'*, *v''*), Ge 4 (*l'*, *l''*, *v'*, *v''*), TiTa 16(4) (*d*, *l'*, *l''*, *v'*, *v''*, *k*, *tc'*, *tc''*, *p''*, *ft'*, *ft''*, *pv'*, *pv''*, *pl'*, *pl''*, *s*, $\omega 1$, $\omega 2$, $\phi 1$, $\phi 2$); leg II: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *v''*), Ge 3 (*l'*, *l''*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, ϕ), ta 6(1) (*tc'*, *tc''*, *pl''*, *pv'*, *pv''*, *u'*, ω); leg III: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, ϕ), Ta 6 (*tc'*, *tc''*, *pl''*, *pv'*, *pv''*, *u'*); leg IV: Tr 1 (*v'*), F 2 (*d*, *v'*), Ge 1 (*v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, ϕ), Ta 6 (*tc'*, *tc''*, *pl''*, *u'*, *pv'*, *pv''*).

Male and larva unknown.

Differential diagnosis. Female of the new genus is most similar to *Aegyptophorus* Sevastianov and Abo-Korah, 1984 in having a large pinnaculum, bearing more than two setae on tibiotarsus I, as well as legs I distinctly shorter than legs II. The new genus differs from *Aegyptophorus* in having two solenidia and four eupathidia on the pinnaculum of tibiotarsus I (vs. one solenidion and four eupathidia on the pinnaculum in *Aegyptophorus*). Female of the new genus differs from all known neopygmephorid genera in having an unusual weakly sclerotized, flattened dorso-ventrally and rhombic in outline tarsal claw on tibiotarsus I (vs. claw on tibiotarsus I, if present, always well-sclerotized, hooked, and not flattened dorso-ventrally).

Species included. The genus *Rhombophorus* includes one species, *R. brevipedis* sp. n., phoretic on the scarab beetle *Anomiopsoides cavifrons* (Burmeister, 1861) (Scarabaeidae: Eucraniini), distributed in Argentina.

Etymology. The name of the new genus is a combination of two words: Latin *rhombus* (from Greek *rhombos*), referring to the unusual rhombic shape of the claw on tibiotarsus I; and ancient Greek *phérō*, meaning *to carry*.

Rhombophorus brevipedis sp. n.

(Figs. 1–5)

Description. *Female* (n=2). Length of idiosoma 225 (245), width 140 (160).

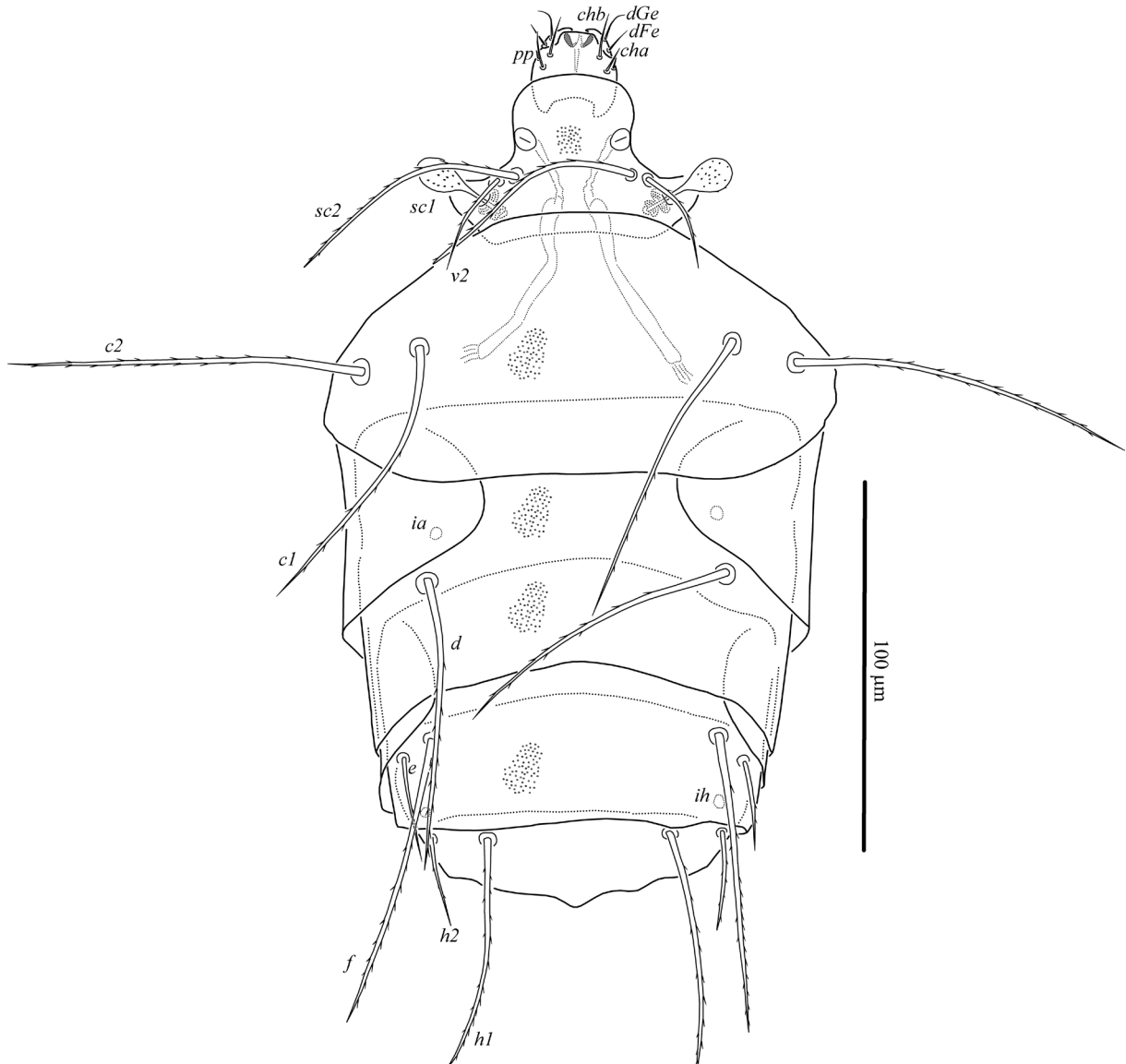


Fig. 1. *Rhombophorus brevipedis* gen. and sp.n., female: Dorsum of body.

Idiosomal dorsum (Fig 1). All dorsal shields with numerous very small uniform puncta. All dorsal setae barbed. Setae *f*, *h1*, and *h2* weakly blunt-tipped; other dorsal setae pointed; setae *sc2* in female holotype weakly blunt-tipped and pointed in paratype. Trichobothria with short stem, clavate, sparsely barbed, with rounded apex. Setae *v2* and *sc2* situate almost on the same transverse level. Posterior margin of tergite D concave. Lengths of dorsal setae: *v2* 29 (33), *sc2* 68 (78), *c1* 80 (87), *c2* 96 (112), *d* 83 (90), *e* 29 (34), *f* 82 (95), *h1* 66 (72), *h2* 27 (28). Distances between setae: *v2*–*v2* 41 (45), *sc2*–*sc2* 31 (35), *c1*–*c1* 84 (92), *c1*–*c2* 19 (21), *d*–*d* 80 (91), *e*–*f* 10 (12), *f*–*f* 77 (86), *h1*–*h1* 49 (60), *h1*–*h2* 14 (16).

Idiosomal venter (Fig. 2). Ventral plates with numerous very small puncta as on dorsal sclerites. All ventral setae pointed. Setae *3a*, *3b*, *4a*, *4b* smooth, other ventral setae barbed; setae *1b* slightly widened and flattened. Posterior margins of posterior sternal plate evenly concave; posterior margin of aggenital plate evenly rounded. Bases of setae *ps1* and *ps2* contiguous. Lengths of ventral setae: *1a* 27 (32), *1b* 26 (31), *2a* 34 (28), *2b* 30 (32), *3a* 30 (30), *3b* 33 (40), *3c* 28 (35), *4a* 34 (41), *4b* 44 (54), *4c* 38 (45), *ps1* 23 (25), *ps2* 23 (26), *ps3* 20 (21).

Gnathosoma (only holotype measured). Gnathosoma almost oval in outline. Length of gnathosoma 23, width 24. Dorsal median apodeme present.

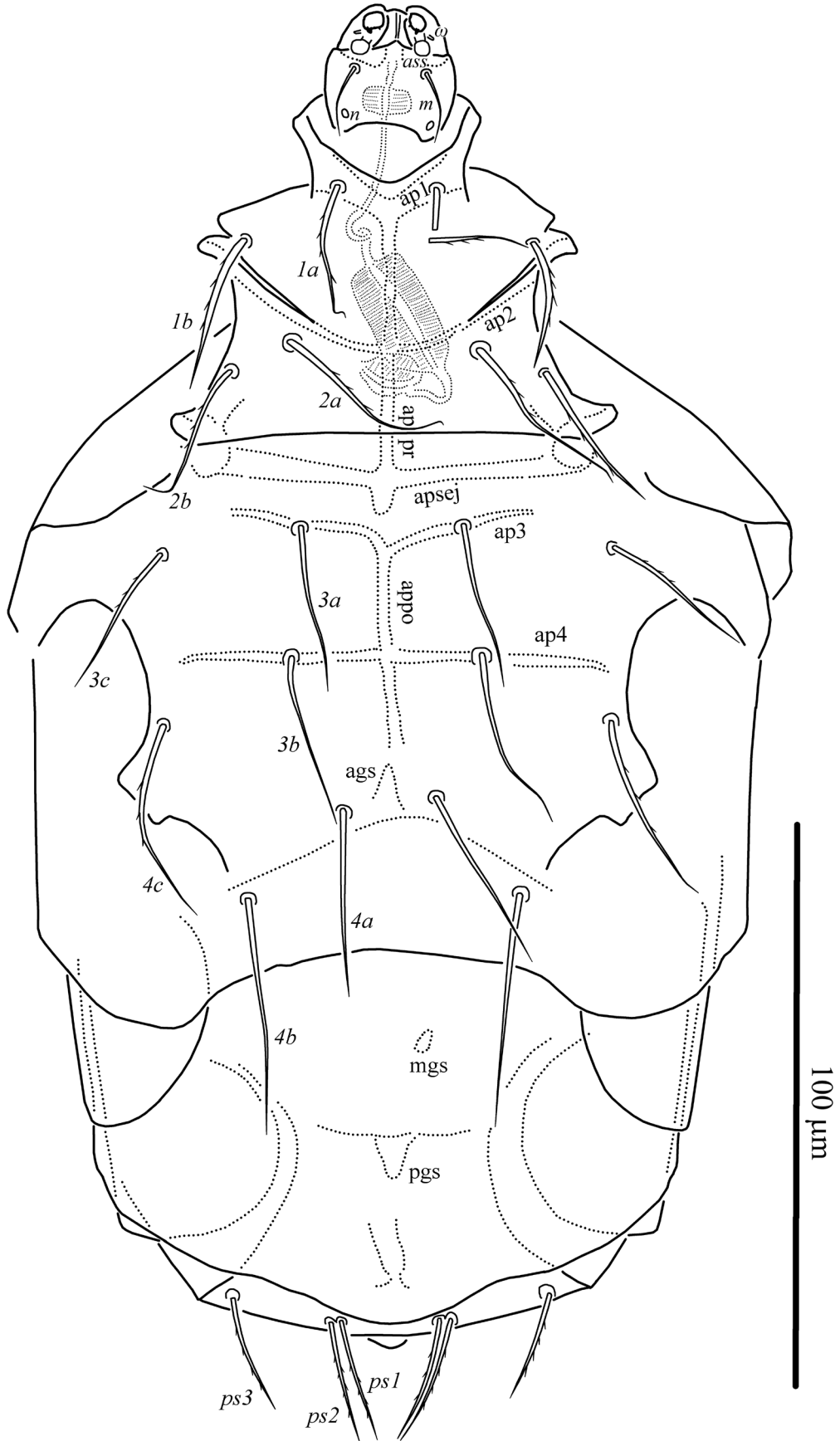


Fig. 2. *Rhombophorus brevipedis* gen. and sp.n., female: Venter of body.

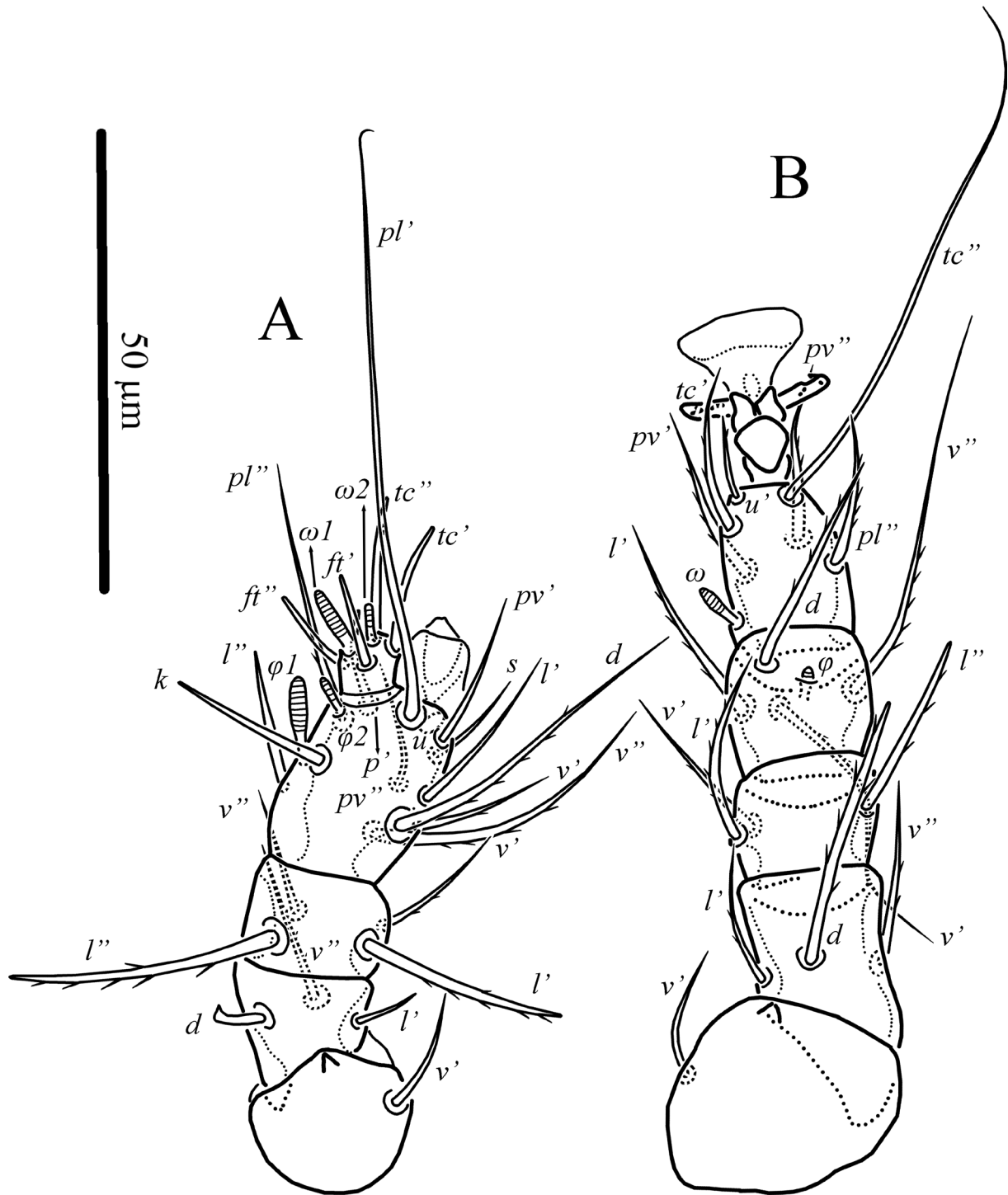


Fig. 3. *Rhombophorus brevipedis* gen. and sp.n., female: A—left leg I, dorsal aspect, B—right leg II, dorsal aspect.

Postpalpal setae *pp* 3 needle-like, other gnathosomal setae smooth and pointed. Lengths of gnathosomal setae: *cha* 9, *chb* 13, *dFe* 8, *dGe* 11, *m* 14.

Legs (Figs. 3, 4, 5). Leg I (Figs. 3A, 5). Lengths of solenidia $\omega 1$ 7 (7), $\omega 2$ 5 (5), $\phi 1$ 8 (9), $\phi 2$ 5 (4); $\omega 1$ and $\phi 1$ digitiform, $\omega 2$ and $\phi 2$ baculiform.

Setae *v'* of trochanter, *l'* of femur, *k*, (*l*), (*pl*), (*pv*) and *s* of tibiotarsus smooth; other leg setae (except eupathidia (*ft*), (*tc*), *p''* and hook-like seta *d* of femur) barbed; setae *l'* of femur, (*l*) of genu, *k*, *l''* of tibiotarsus and all eupathidia blunt-tipped; other setae pointed. Leg II (Fig. 3B). Solenidion $\omega 5$ (5) digiti-

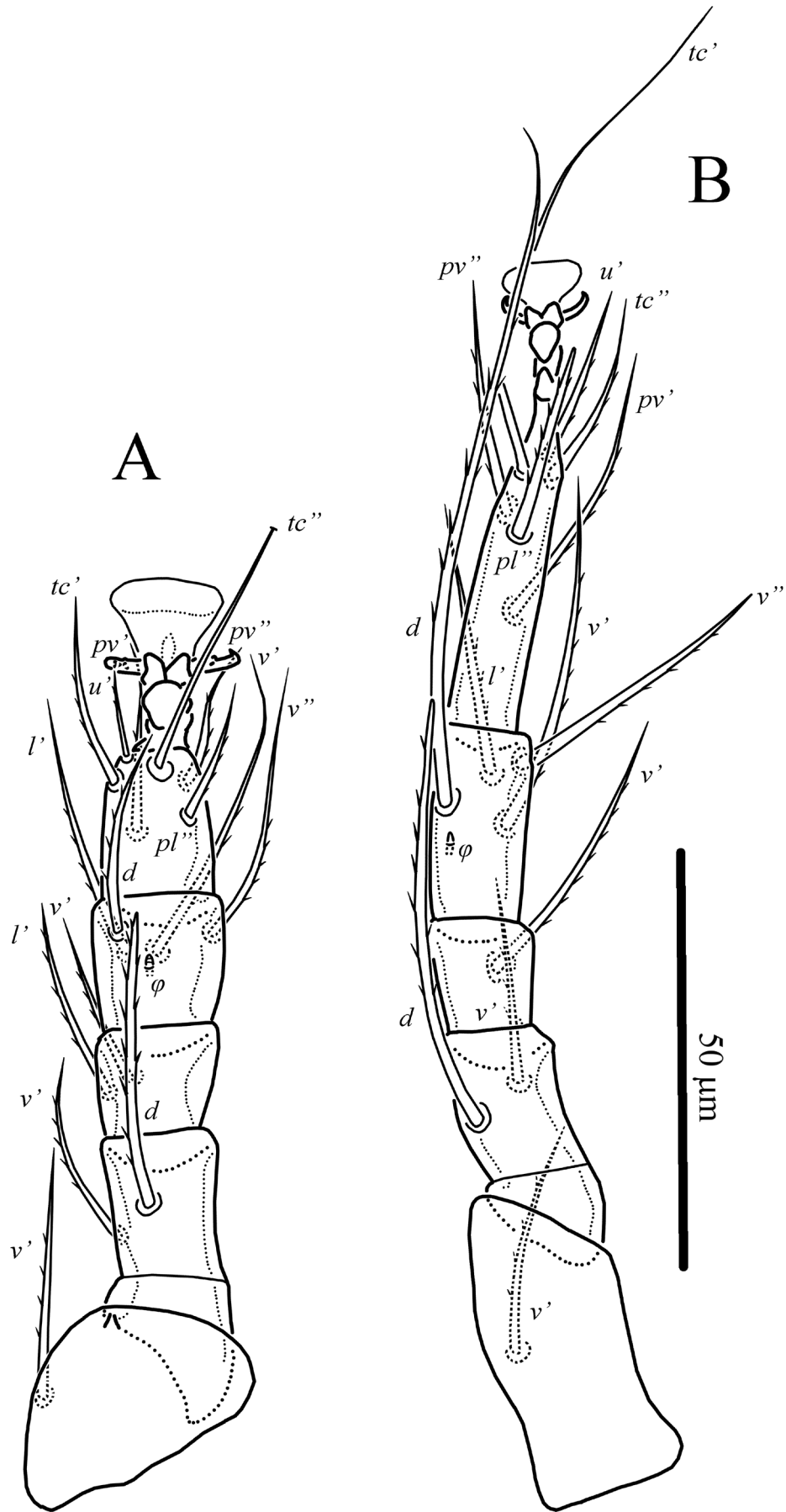


Fig. 4. *Rhombophorus brevipedis* gen. and sp.n., female: A—right leg III, dorsal aspect, B—right leg IV, dorsal aspect.

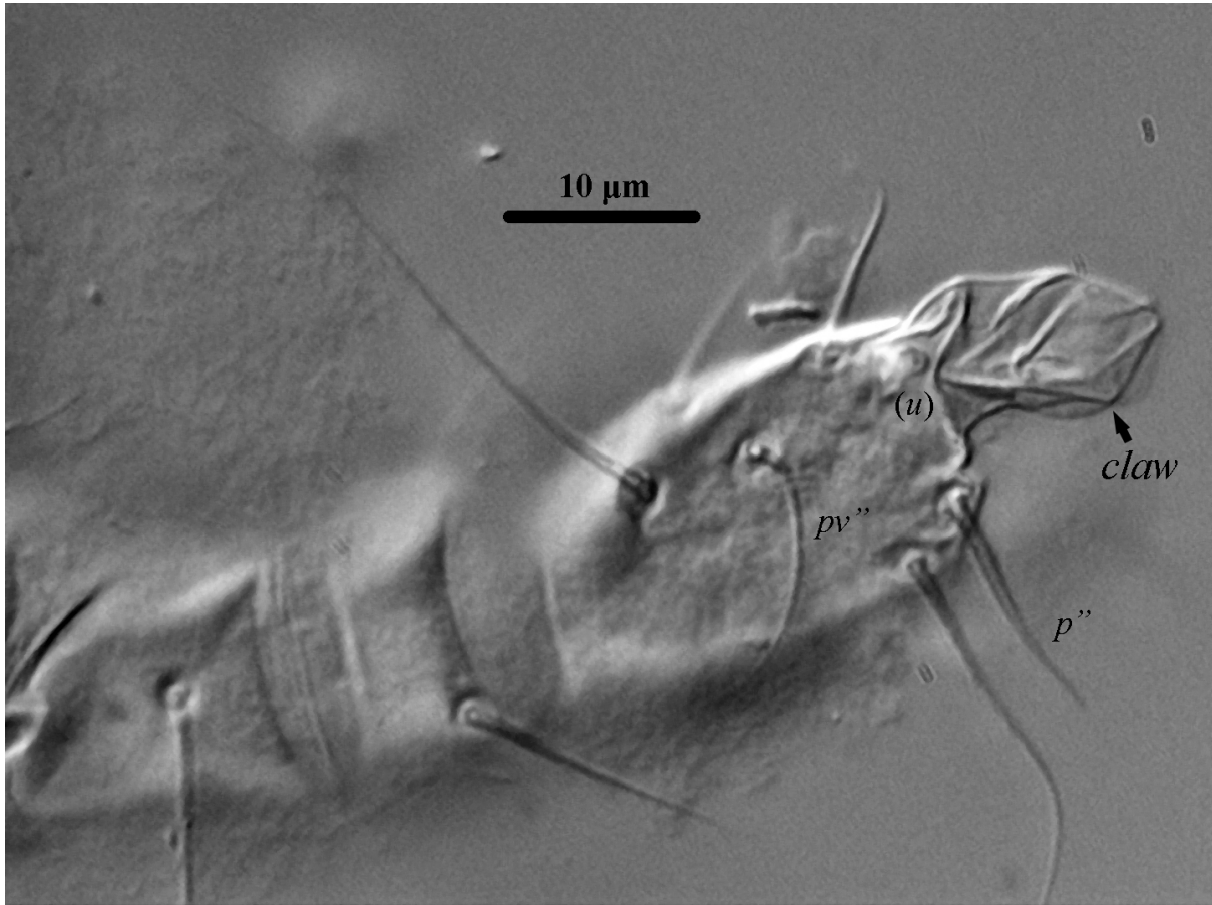


Fig. 5. DIC micrograph of *Rhombophorus brevipedis* gen. and sp.n., female: right leg I, ventral aspect.

form; solenidium φ 4 (4) weakly clavate, situated in depression. Setae v' of trochanter and tc'' of tarsus smooth, other leg setae barbed; setae d of femur and l'' of genu blunt-tipped; other leg setae pointed. Leg III (Fig. 4A). Solenidium φ 4 (4) weakly clavate, situated in depression. Seta tc'' of tarsus smooth, other leg setae barbed. Seta d of femur blunt-tipped; other leg setae pointed. Leg IV (Fig. 4B). Solenidium φ 3 (3) weakly clavate, situated in depression. Seta tc'' of tarsus smooth, other leg setae barbed. Setae d of femur and v'' of tibia blunt-tipped; other leg setae pointed.

Type material. Female holotype, slide ZISP T-Neop-005, between anterior coxae of the beetle *Anomiopsoides cavifrons*: Argentina, La Rioja, Punta de los Llanos, 30°09'14"S 66°32'43"E, J.A. Rosas Costa leg. (without date); paratype: 1 female, same data.

Type deposition. The holotype and one paratype are deposited in the collection of the Zoological Institute of RAS, St. Petersburg, Russia.

Etymology. The name of the new species is derived from Latin *brevis*, meaning *short*, and *pedis*, meaning *leg*, and refers to short legs I.

A provisional key to the genera of Neopygmephoridae (based on females)

1. Seta d of femur I not modified, filiform 2
- Seta d of femur I modified 3
2. Trichobotria *scl* present, clavate, posterior margin of posterior sternal plate entire
..... *Zambedania* Mahunka, 1972. Phoretic on spiders.
- Trichobotria *scl* completely absent, posterior margin of posterior sternal plate tripartite
..... *Nipponophorus* Kurosa, 2001. Associated with termites.
3. Pinnaculum on tibiotarsus I very large, bearing four setae and at least one solenidium 4
- Pinnaculum on tibiotarsus I, if present, with no more than two setae 5
4. Pinnaculum on tibiotarsus I with one solenidium and four setae; claw on tibiotarsus I large, well-sclerotized, hooked
Aegyptophorus Sevastianov and Abo-Korah, 1984. Phoretic on scarab beetles.
- Pinnaculum on tibiotarsus I with two solenidia and four setae; claw on tibiotarsus I weakly scler-

- otized, flattened and rhombic in outline
 *Rhombophorus* gen.n.
5. Gnathosomal capsule strongly elongate, beak-like 6
 — Gnathosomal capsule not beak-like 9
6. Palps short 7
 — Palps very long 8
7. Posterior genital sclerite very small, round
 *Rhinopygmephorus* Kurosa, 2001.
 Associated with bees.
 — Posterior genital sclerite large, triangular ...
 *Rackia* Mahunka, 1975
8. Palpal solenidion and accessory setigenous structure present
 *Xystrorostrium* Mahunka, 1968
 — Palpal solenidion and accessory setigenous structure absent
 *Nasutidania* Khaustov and Frolov, 2018.
 Associated with geotrupid beetles.
9. All dorsal hysterosomal setae modified, very short, thick, strongly barbed; two pairs of pseudanal setae longitudinally aligned
 *Singhalophorus* Mahunka, 1979
 — Dorsal hysterosomal setae usually not modified; usually with three pairs of pseudanal setae transversely aligned 10
10. Trichobothria *sc1* reduced
 *Insensilla*, Kurosa, 2009.
 Associated with bees.
 — Trichobothria *sc1* well-developed, clavate
 11
11. Palps with one dorsal seta
 *Scarabadania* Khaustov and Frolov, 2018.
 Phoretic on scarab beetles.
 — Palps with two dorsal setae 12
12. Seta *d* of femur I fan-like
 *Theriadania* Khaustov and Whitaker, 2019.
 Associated with small mammals.
 — Seta *d* of femur I hook-like or spine-like
 13
13. Some setae on tarsus and tibia II very thick, comb-like, tarsus IV without claws and with unusually long empodium
 *Crossdania* Khaustov and Whitaker, 2019.
 Associated with small mammals.
 — Setae on tarsus and tibia II not comb-like, tarsus IV with claws and short empodium 14
14. Prodorsum with two pairs of setae 15
 — Prodorsum with only one pair of setae
 *Allopygmephorus* Cross, 1965.
 Phoretic on aquatic or semiaquatic beetles.
15. Tibiotarsus I with 17 setae (simple seta *u* present) 16
 — Tibiotarsus I with 16 setae (setae (*u*) usually modified into spine-like structure opposing claw or absent) 17
16. Tibiotarsus I with thin claw, setae *h1* thin, not modified
 *Protobakerdania* Khaustov and Minor, 2018
 — Tibiotarsus I without claw, setae *h1* usually modified, distinctly thickened
 *Neobakerdania* Khaustov and Minor, 2018
17. All setae of anterior sternal plate and most setae of posterior sternal plate modified, bullet-shaped
 *Guttacarus* Mahunka, 1973
 — All setae of anterior sternal plate and most setae of posterior sternal plate not modified, if modified, than tarsus IV much longer than tarsus III 18
18. Median genital sclerite present (sometimes poorly visible) 19
 — Median genital sclerite absent 25
19. Setae *1b* and *2b* not modified (*1b* sometimes bifurcate) 20
 — Setae *1b* and *2b* modified, greatly enlarged, clavate, compressed, etc.
 *Acinogaster* Cross, 1965.
 Associated with ants.
20. Legs I and II usually of similar length and width, or legs I thicker than legs II, tarsus IV usually not thin and long 21
 — Leg I thinner and shorter than leg II, tarsus and usually pretarsus IV thin and very long
 *Petalomium* Cross, 1965.
 Associated with ants.
21. Empodium on tarsi II–IV attenuate distally ...

 *Protoallopygmephorus* Khaustov and Sazhnev, 2016.
 Phoretic on heterocerid beetles.
 — Empodium on tarsi II–IV rounded distally ...
 22
22. Solenidion $\omega 1$ completely or partly fused with surface of tibiotarsus I
 *Pseudopygmephorus* Cross, 1965.
 — Solenidion $\omega 1$ erect 23
23. Palpal solenidion absent; pharyngeal pump II extremely long, sausage-like
 *Andrebochkovia* Khaustov and Frolov, 2019.
 Phoretic on scarab beetles.
 — Palpal solenidion present; pharyngeal pump II usually oval 24
24. Tibiotarsus I greatly enlarged, posterior margin of poststernal plate straight
 *Troxodania* Khaustov and Trach, 2013.
 Phoretic on trogid and scarab beetles.
 — Tibiotarsus I usually not greatly enlarged, posterior margin of poststernal plate with distinct

median lobe *Coleopygmephorus* Khaustov and Mandelshtam, 2017. Phoretic on beetles (especially subcortical).
 25. Posterior margin of posterior sternal plate tripartite (with three large lobes) 26
 — Posterior margin of posterior sternal plate entire (without lobes) 27
 26. Pharyngeal pump 2 large, longer than gnathosomal capsule, pharyngeal pump 3 very small, vestigial, gnathosoma dorsally with two pairs of cheliceral setae
 ... *Pseudokerdabania* Khaustov and Trach, 2012. Phoretic on Geotrupidae.
 — Pharyngeal pump 2 distinctly shorter than gnathosomal capsule, pharyngeal pump 3 well-developed, oval, gnathosoma dorsally with one pair of cheliceral setae *Kerdabania* Khaustov, 2009
 27. Leg I usually distinctly shorter and thinner than leg II, trochanter IV usually not distinctly constricted in middle part, associated with bees ... 28
 — Leg I usually subequal with leg II, trochanter IV distinctly constricted in middle part 29
 28. Tibiotarsus I distinctly thicker than femur I ...
 *Sicilipes* Cross, 1965
 — Tibiotarsus I not distinctly thicker than femur I
 *Parapygmephorus* Cross, 1965
 29. Empodium on tarsi II and III large, almost rectangular in outline; bases of setae of posterior sternal plate slightly or distinctly thickened basally
 *Geophilophagus* Goux, 1950. Phoretic on centipedes of the family Geophilidae.
 — Empodium on tarsi II and III usually smaller, not rectangular in outline; setae of posterior sternal plate usually not thickened basally
 *Bakerdania* Sasa, 1961

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