



Persian J. Acarol., 2022, Vol. 11, No. 4, pp. 545–558.
https://doi.org/10.22073/pja.v11i4.76531
Journal homepage: <http://www.biotaxa.org/pja>



<http://zoobank.org/urn:lsid:zoobank.org:pub:B12CC5EF-552F-4628-B3A6-54EAF56D93D2>

Article

Two new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) associated with scarab beetles (Coleoptera: Scarabaeidae) from Tanzania and Madagascar

Alexander A. Khaustov^{1*}  and Andrey V. Frolov² 

1. Tyumen State University, Tyumen, 6 Volodarskogo Str., 625003 Russia; E-mail: alex1973khaustov@gmail.com

2. Zoological Institute of Russian Academy of Sciences, Universitetskaya Embankment 1, 199034, Saint Petersburg, Russia; E-mail: afrolov@zin.ru

* Corresponding author

ABSTRACT

Two new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) phoretic on dung beetles (Coleoptera: Scarabaeidae), *P. neoafricana* **sp. nov.** has been collected on *Helicopris neptunus* in Tanzania, and *P. madagascariensis* **sp. nov.** has been collected on *Helictipleurus quadripunctatus* in Madagascar are described. The updated key to species of the genus *Pavania* is provided. The family Dolichocybidae is reported from Madagascar for the first time.

KEY WORDS: Afrotropical region; dung beetle; key; phoresy; systematics.

PAPER INFO.: Received: 7 August 2022, Accepted: 9 September 2022, Published: 15 October 2022

INTRODUCTION

The family Dolichocybidae is a small group of early-derivative heterostigmatic mites that currently includes two subfamilies, six genera, 57 extant and one fossil species (Hajiqaanbar and Khaustov 2010; Rahiminejad *et al.* 2011; Loghmani *et al.* 2013; Katlav *et al.* 2014, 2020; Bahramian *et al.* 2015; Mortazavi *et al.* 2015; Sobhi *et al.* 2017; Khaustov and Frolov 2017, 2018a, b, 2020a, b; Khaustov 2017; Khaustov and Trach 2017, 2018; Hajiqaanbar *et al.* 2019; Katlav *et al.* 2020; Khaustov *et al.* 2021). Little is known about the way of life of dolichocybid mites, but all of them are probably fungivorous (Rack 1967; Magowski 1988; Kaliszewski *et al.* 1995); some species are important pests of edible mushrooms (Lan *et al.* 2017). On the other hand, most of them are associated with insects (mostly beetles) and utilize them for phoresy (Khaustov and Trach 2017). The genus *Pavania* Lombardini is the largest in the family and includes 34 species, described from Eurasia, Africa, South America and Australia (Khaustov & Frolov 2020b; Katlav *et al.* 2020).

At present, six species of *Pavania* have been reported from Africa, namely *P. perhirsuta* Mahunka, 1973, *P. simplex* Mahunka, 1973, *P. luisae* Mahunka, 1974, *P. endroedyi* Mahunka, 1975, *P. equisetosa* Mahunka, 1975 (all from Ghana), *P. tahanan* Sevastianov and Abo-Korah, 1985 (Egypt), *P. africana* Khaustov and Frolov, 2018 (South Africa) (Khaustov and Frolov 2020b). Previously no dolichocybid mites were recorded from Madagascar.

How to cite: Khaustov, A.A. & Frolov, A.V. (2022) Two new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) associated with scarab beetles (Coleoptera: Scarabaeidae) from Tanzania and Madagascar. *Persian Journal of Acarology*, 11(4): 545–558.

During the study of mites associated with scarab beetles, two new species of *Pavania* were recovered from Africa and Madagascar as phoretic on scarab beetles *Heliocopris neptunus* Boheman and *Helictipleurus quadripunctatus* (Olivier), respectively. The aim of this paper is describing these new species. Moreover, the updated key to species of the genus *Pavania* is provided.

MATERIAL AND METHODS

The host beetle, *H. neptunus*, was collected in northern Tanzania most probably in elephant dung and the other one host beetle species, *H. quadripunctatus*, was collected in central Madagascar in cow dung. The *Helictipleurus* beetle was kept in 96% ethanol until dissecting. The mites were found attached to the membrane connecting prothorax and mesothorax. Collected mites were kept in 96% ethanol and later cleared in lactic acid and mounted in Hoyer's medium. Mite morphology was studied using an AxioImager A2 (Carl Zeiss, Germany) compound microscope with phase contrast and DIC illumination. Photomicrographs were taken with an AxioCam ICc5 (Carl Zeiss, Germany) 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. All measurements are given in micrometers (μm) for the holotype and five paratypes (in parentheses). For leg chaetotaxy, the number of solenidia is given in parentheses.

RESULTS

Family Dolichocybidae Mahunka, 1970

Genus *Pavania* Lombardini, 1949

Type species: *Pavania fusiformis* Lombardini, 1949, by original designation.

Pavania neoafricana sp. nov. (Figs. 1–3)

<http://zoobank.org/urn:lsid:zoobank.org:act:5E86BBCC-CDC4-4314-9217-5E964E0B89FB>

Description

Female (Figs. 1–3) – Body weakly sclerotized. Length of idiosoma 125 (120–125), width 77 (72–78).

Gnathosoma – Gnathosomal capsule, excluding palps, almost round, its length 25 (23–25), width 24 (23–25). Dorsally with two pairs of smooth subequal cheliceral setae (*cha*, *chb*). Setae *cha* 12 (11–12) blunt-tipped; *chb* 11 (10–11) pointed. Dorsal median apodeme weakly developed. Postpalpal setae (*pp*) rod-like with tiny distal projections, situated posterolaterally to setae *cha*. Venter of gnathosoma with one pair of smooth, pointed subcapitular setae *m* 13 (11–13). Palps freely articulated to gnathosomal capsule, with smooth setae *dFe* and *dGe* dorsally, setae *dGe* 11 (10–11) pointed, about two times longer than weakly blunt-tipped *dFe* 4 (4–5). Palps ventrally with solenidion almost three times longer than accessory setigenous structure (*ass*). Palps terminated with a well-developed tibial claw. Palp tibiotarsus with tiny eupathid-like distal seta and small lateral seta *l*". Cheliceral stylets strong, curved. Pharynx poorly visible, with weak lateral projections.

Idiosomal dorsum (Figs. 1A, 3A) – All dorsal sclerites with clearly visible numerous round and very small puncta. Prodorsal shield with three pairs of setae (*v1*, *v2*, *sc2*) and one pair of clavate, barbed trichobothria *sc1* with rounded apex. All dorsal setae blunt-tipped; tips of setae *h2* club-shaped. Setae *v1*, *v2*, and *sc2* smooth, other dorsal setae weakly barbed. Only cupules *ia* on tergite D clearly visible; other cupules not evident. Posterior margins of tergites C, D, and EF with several distinct tooth-like projections. Lengths of dorsal setae: *v1* 13 (13–14), *v2* 7 (6–7), *sc2* 20 (20–22), *c1* 15 (14–15), *c2* 20 (19–21), *d* 13 (12–14), *e* 13 (12–13), *f* 13 (13–14), *h1* 13 (12–14), *h2* 37 (37–38).

Distances between setae: $v1-v1$ 17 (17), $v2-v2$ 26 (25–26), $sc2-sc2$ 27 (27), $c1-c1$ 23 (22–23), $c1-c2$ 18 (18–19), $d-d$ 32 (28–32), $e-e$ 41 (39–41), $f-f$ 29 (28–29), $h1-h1$ 12 (11–12), $h1-h2$ 7 (7).

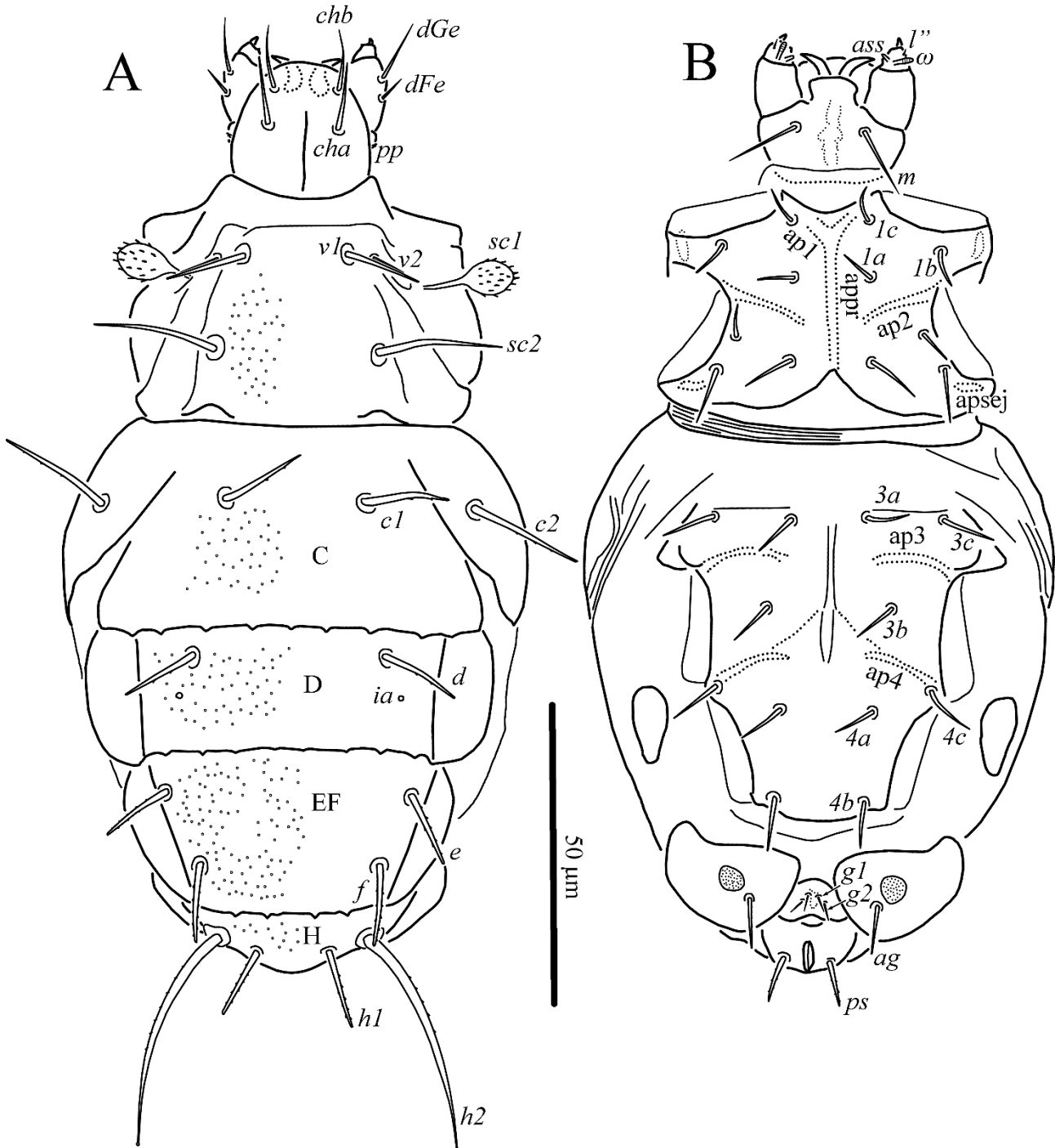


Figure 1. *Pavania neoafricana* sp. nov. (female) – **A.** Dorsum of body; **B.** Venter of body. Legs omitted.

Idiosomal venter (Figs 1B, 3B) – All ventral plates smooth. All ventral setae weakly blunt-tipped; setae *ps* weakly barbed, other ventral setae smooth. Apodemes 1 (*ap1*) and apodemes 2 (*ap2*) well developed; *ap1* joined with poorly visible prosternal apodeme (*appr*), sejugal apodeme represented by pair of small sclerites located posterolaterad setae *2c*; apodemes 3 (*ap3*) and 4 (*ap4*) well developed. Poststernal apodeme absent. Coxal fields I–IV each with three pairs of setae.

Lengths of ventral setae – *1a* 6 (6), *1b* 6 (6), *1c* 6 (6), *2a* 10 (8–10), *2b* 6 (5–6), *2c* 9 (8–9), *3a* 8 (7–8), *3b* 8 (7–8), *3c* 10 (9–11), *4a* 8 (7–8), *4b* 9 (9–10), *4c* 9 (9), *ag* 8 (8–9), *g1* 3 (3), *g2* 3 (3), *ps* 8 (8–9).

Legs (Fig. 2) – Leg I slightly longer than subequal legs II–IV. Leg I (Fig. 2A). Setal formula: 0–4–2–6(2)–11(2). Tarsus with two small claws and semioval empodium. All leg setae smooth. Setae *l'* of femur, *l'* and *v'* of genu, *k* and *v'* of tibia blunt-tipped; other leg setae (except eupathidia *p'*, *p''*, *ft'*, *ft''*) pointed; setae (*u*) and (*pv*) of tarsus not modified. Trochanter dorsally with four short tooth-like projections. Tarsus I with ventrodistal membranous flange. Lengths of solenidia $\omega 1$ 7 (6–7), $\omega 2$ 3 (3), $\phi 1$ 8 (8), $\phi 2$ 5 (4–5); solenidion $\omega 1$ digitiform; solenidia $\phi 2$ and $\omega 2$ baculiform; solenidion $\phi 1$ clavate. Leg II (Fig. 2B). Setal formula: 0–2–1–4(1)–6(1). Tarsal claws simple, hooked; empodium large, extending beyond tips of claws. Solenidion ω 5 (4–5) digitiform; solenidion ϕ 3 (3) weakly clavate. Trochanter dorsolaterally with two tooth-like projections. Seta *l'* of genu weakly barbed, other setae smooth; all setae pointed. Leg III (Fig. 2C). Setal formula: 0–1–1–4–5. Claws and empodium of same shape as on tarsus II. Setae *d* of femur blunt-tipped, other leg setae pointed; all setae smooth. Trochanter dorsolaterally with two tooth-like projections. Leg IV (Fig. 2D). Setal formula: 0–1–1–4–5. Claws and empodium of same shape as on tarsus II. Setae *d* of femur blunt-tipped, other leg setae pointed; all setae smooth. Trochanter ventrally with short lobe.

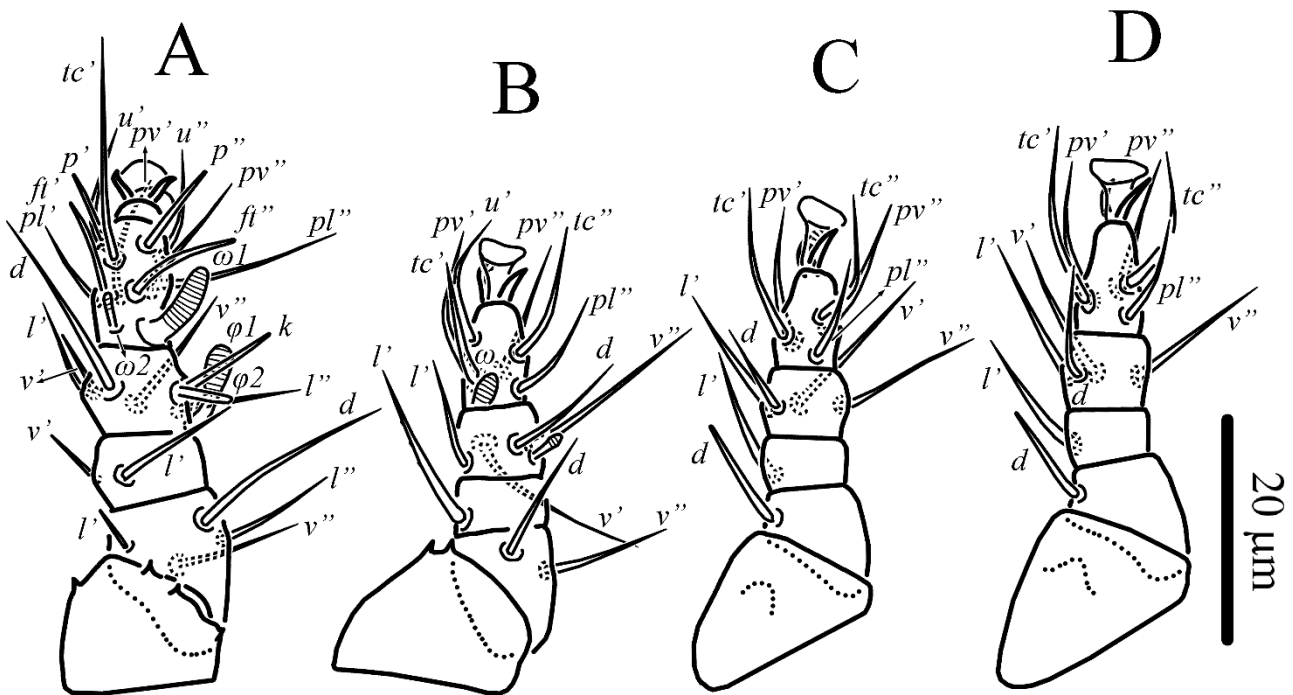


Figure 2. *Pavana neoafricana* sp. nov. (female) – A–D. Right legs I–IV, respectively.

Male – unknown

Type material

Female holotype, slide No. ZISP T-Dol-003, Tanzania, Arusha, 1975 (the original label includes only a code [1777]; the Arusha locality was inferred from the labels of the beetles collected apparently in the same locality), on *H. neptunus*; paratypes: 50 females, same data.

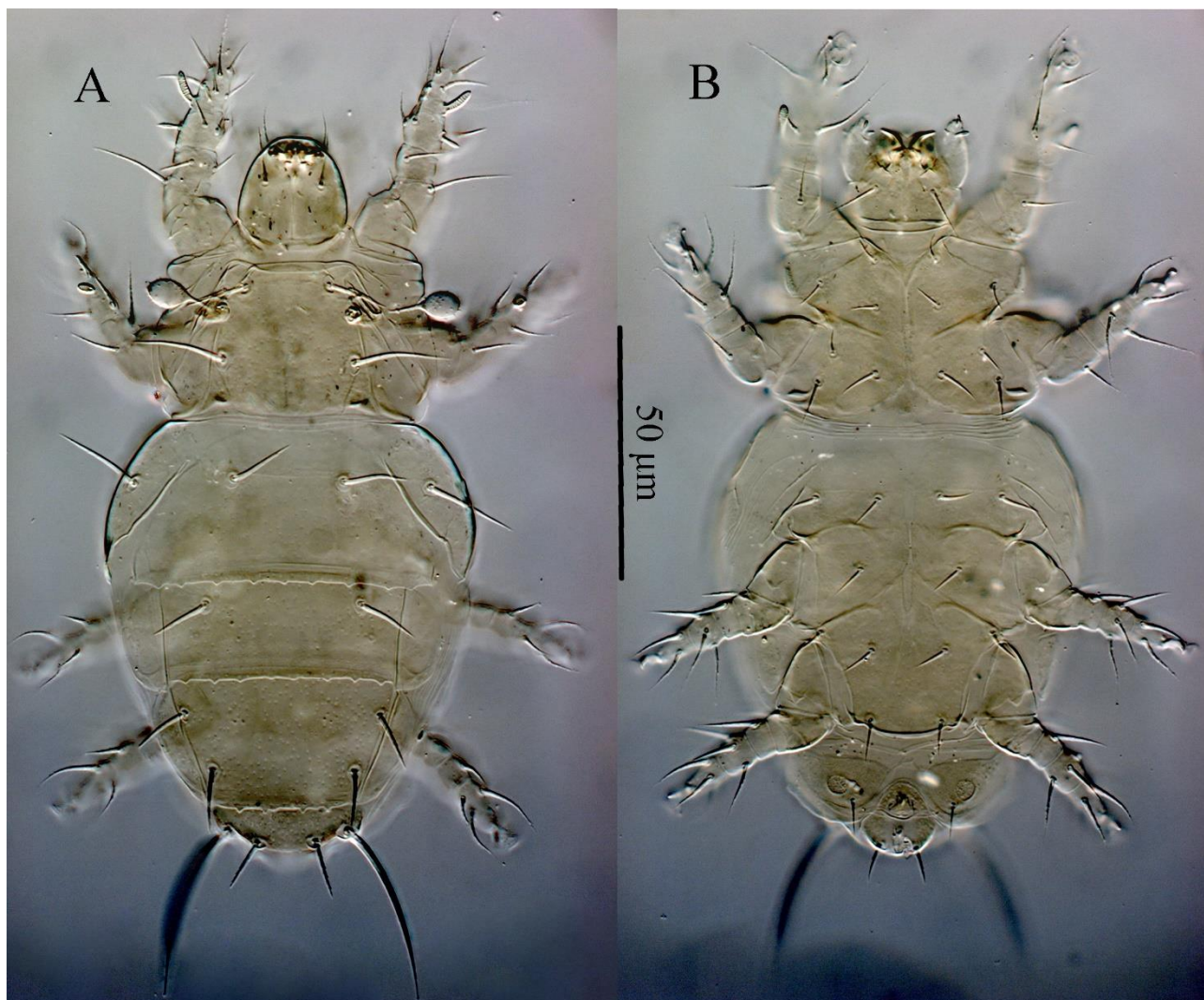


Figure 3. DIC micrographs of *Pavania neoafricana* sp. nov. (female) – **A.** Dorsal view; **B.** Ventral view.

Type deposition

The holotype and 10 paratypes are deposited in the collection of the Zoological Institute of RAS, Saint Petersburg, Russia; five female paratypes are deposited in the acarological collection of Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran (JAZM); other paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Differential diagnosis

The new species is most similar to *Pavania africana* Khaustov and Frolov, 2018 and *P. carabidophila* Khaustov, 2005 by the similar length of idiosomal setae and absence of modified setae on legs. The new species differs from *P. africana* in having seta *c2* blunt-tipped (pointed in *P. africana*), longer genital setae (3) (1–2 in *P. africana*), shorter setae *ps* (8–9) (14 in *P. africana*), in having four tooth-like projections on trochanter I (three projections in *P. africana*), and solenidion $\varphi 2$ with rounded tip ($\varphi 2$ with attenuate tip in *P. africana*). The new species differs from *P. carabidophila* in having setae *c2* blunt-tipped (pointed in *P. carabidophila*), setae *h2* with club-shaped tips (pointed in *P. carabidophila*), by much shorter solenidion $\omega 1$ (6–7) (11–12 in *P.*

carabidophila), and in having setae *cha* and *chb* subequal (*cha* distinctly longer than *chb* in *P. carabidophila*).

Etymology

The name of the new species is a combination of two words: Greek *neos* meaning *new* and *africana*, the name of closely related species.

***Pavania madagascariensis* sp. nov. (Figs. 4–6)**

<http://zoobank.org/urn:lsid:zoobank.org:act:CFDAAEAE-9088-4266-9812-EE93CB9AE306>

Description

Female (Figs. 4–6) – Body weakly sclerotized. Length of idiosoma 120 (115–120), width 78 (75–80).

Gnathosoma – Gnathosomal capsule, excluding palps, almost round, its length 24 (23–24), width 27 (27–28). Dorsally with two pairs of blunt-tipped cheliceral setae (*cha*, *chb*). Setae *cha* 15 (15–16) weakly barbed; *chb* 10 (10–11) smooth. Dorsal median apodeme weakly developed. Postpalpal setae (*pp*) rod-like with tiny distal projections, situated posterolaterally to setae *cha*. Venter of gnathosoma with one pair of smooth, pointed subcapitular setae *m* 12 (12–13). Palps with smooth setae *dFe* and *dGe* dorsally, setae *dGe* 11 (10–11) pointed, about two times longer than weakly blunt-tipped *dFe* 4 (4–5). Palps ventrally with solenidion almost two times longer than accessory setigenous structure. Palps terminated with well-developed tibial claw. Palp tibiotarsus with tiny eupathid-like distal seta and small lateral seta *l'*. Cheliceral stylets strong, curved. Pharynx poorly visible, with weak lateral projections.

Idiosomal dorsum (Figs. 4A, 6A) – Tergites D, EF and H with round and very small puncta, similar puncta also poorly visible on prodorsal shield; tergite C smooth. Prodorsal shield with three pairs of setae (*v1*, *v2*, *sc2*) and one pair of clavate, barbed trichobothria *sc1* with rounded apex. Setae *sc2* and *c1* pointed, other dorsal setae blunt-tipped; tips of setae *h2* club-shaped. Setae *v1*, *v2*, *sc2* and *c1* smooth, other dorsal setae weakly barbed. Cupules on tergites not evident. Posterior margins of tergites C, D, and EF with several very small tooth-like projections. Lengths of dorsal setae: *v1* 17 (17–18), *v2* 6 (6), *sc2* 41 (39–43), *c1* 30 (29–31), *c2* 18 (18–19), *d* 14 (15–16), *e* 9 (9–10), *f* 16 (17–19), *h1* 11 (10–11), *h2* 52 (52–54). Distances between setae: *v1*–*v1* 20 (21–23), *v2*–*v2* 31 (29–32), *sc2*–*sc2* 34 (33–35), *c1*–*c1* 26 (26–28), *c1*–*c2* 20 (19–22), *d*–*d* 53 (50–53), *e*–*e* 42 (39–43), *f*–*f* 32 (31–34), *h1*–*h1* 9 (8–10), *h1*–*h2* 8 (8).

Idiosomal venter (Figs. 4B, 6B) – All ventral plates smooth. Setae *2c* pointed, other ventral setae weakly blunt-tipped; all ventral setae smooth. Apodemes 1 (*ap1*) and apodemes 2 (*ap2*) well developed; *ap1* joined with poorly visible prosternal apodeme (*appr*), sejugal apodeme represented by pair of small sclerites located posterolaterad setae *2c*; apodemes 3 (*ap3*) and 4 (*ap4*) well developed. Poststernal apodeme absent. Coxal fields I–IV each with three pairs of setae. Lengths of ventral setae: *1a* 7 (6–7), *1b* 7 (6–7), *1c* 6 (6–7), *2a* 11 (10–11), *2b* 7 (7), *2c* 20 (18–20), *3a* 10 (8–10), *3b* 9 (8–10), *3c* 10 (9–10), *4a* 9 (9), *4b* 9 (9–10), *4c* 9 (8–9), *ag* 9 (8–9), *g1* 5 (5), *g2* 5 (5), *ps* 7 (7–8).

Legs (Fig. 5) – All legs subequal in length. Setation of legs I–IV as in *P. neoaficana* sp. nov. Leg I (Fig. 5A). Tarsus with two small claws and semi-oval empodium. At least seta *d* of femur weakly barbed, other setae smooth. Setae *l'* of femur, *l'* and *v'* of genu, *k*, *v'* of tibia, and (*u*) of tarsus blunt-tipped; other leg setae (except eupathidia *p'*, *p''*, *ft'*, *ft''*) pointed; setae (*u*) and (*pv*) of tarsus not modified. Trochanter dorsally with one short tooth-like projection. Tarsus I with large ventrodistal membranous flange. Lengths of solenidia $\omega 1$ 6 (6), $\omega 2$ 3 (3), $\phi 1$ 7 (7), $\phi 2$ 4 (4–5); solenidion $\omega 1$ digitiform; solenidia $\phi 2$ and $\omega 2$ baculiform; solenidion $\phi 1$ clavate. Leg II (Fig. 5B). Tarsal claws simple, hooked; empodium large, extending beyond tips of claws. Solenidion ω 5 (4–5) digitiform; solenidion ϕ 3 (1–3) weakly clavate. Trochanter dorsolaterally with two tooth-like projections. All

leg setae smooth; seta *l'* of tibia incrassate, spiniform and slightly curved; setae *tc''*, *u'* and (*pv*) weakly blunt-tipped; other setae pointed. Leg III (Fig. 5C). Claws and empodium of same shape as on tarsus II. All setae smooth; setae *d* of femur and (*tc*) of tarsus weakly blunt-tipped, other leg setae pointed. Trochanter ventrally with short lobe. Leg IV (Fig. 2D). Claws and empodium of same shape as on tarsus II. All setae smooth; setae *d* of femur, *pl''* and (*tc*) of tarsus weakly blunt-tipped, other leg setae pointed. Trochanter ventrally with short lobe.

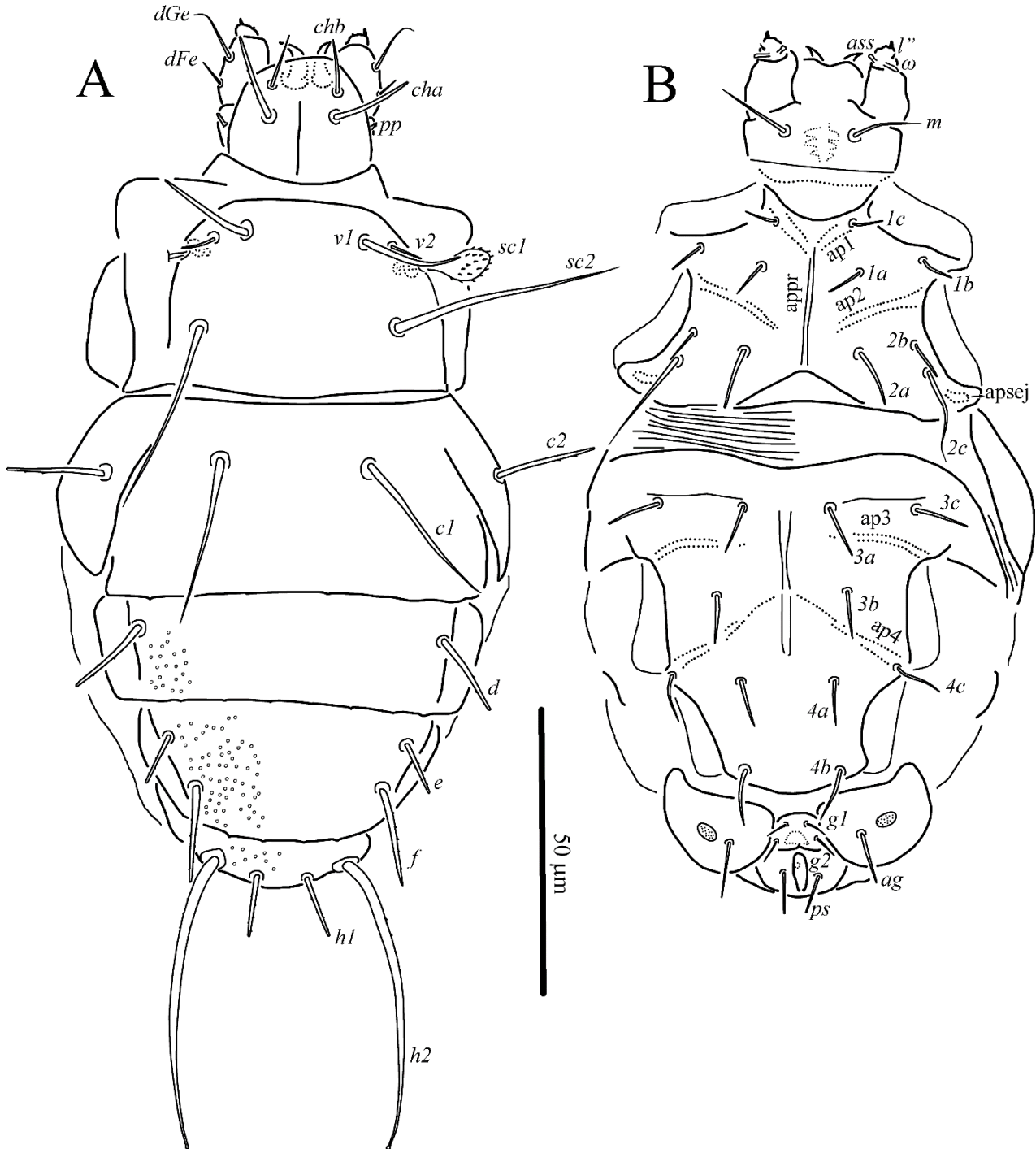


Figure 4. *Pavana madagascariensis* sp. nov. (female) – A. Dorsum of body; B. Venter of body. Legs omitted.

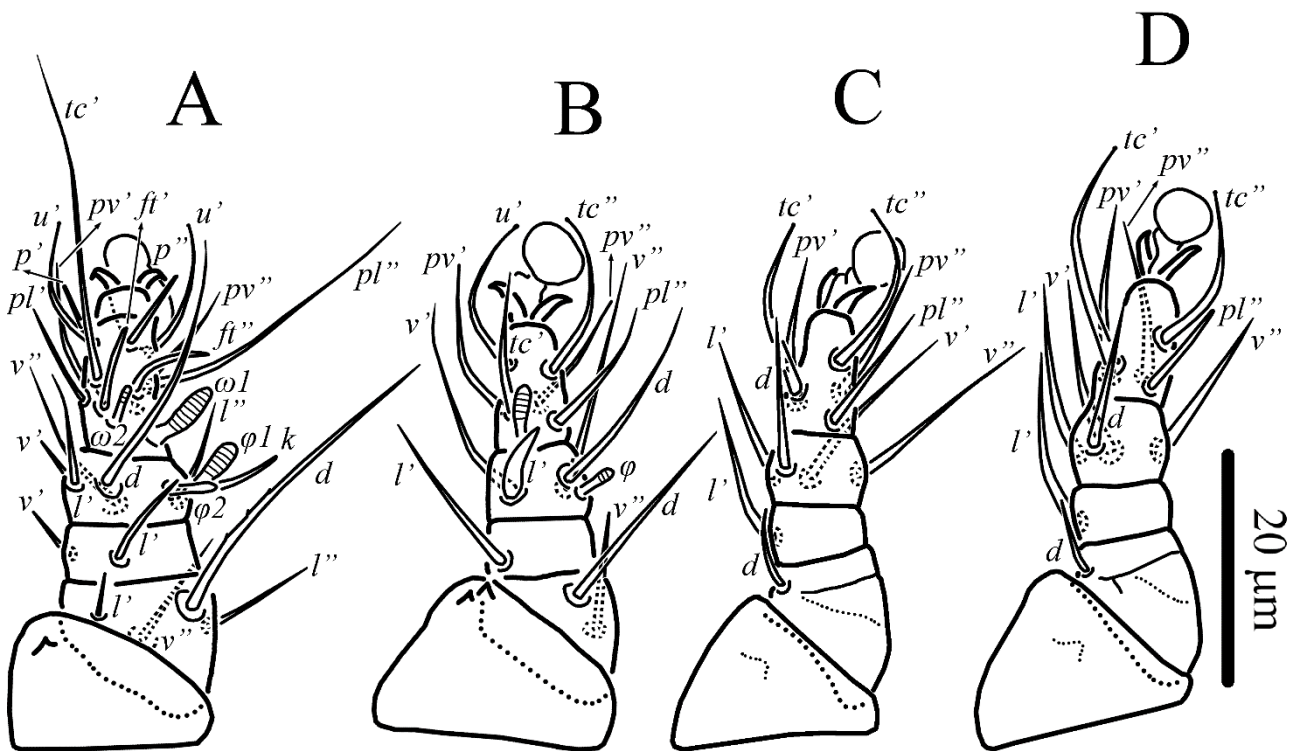


Figure 5. *Pavana madagascariensis* sp. nov. (female) – A–D. Right legs I–IV, respectively.

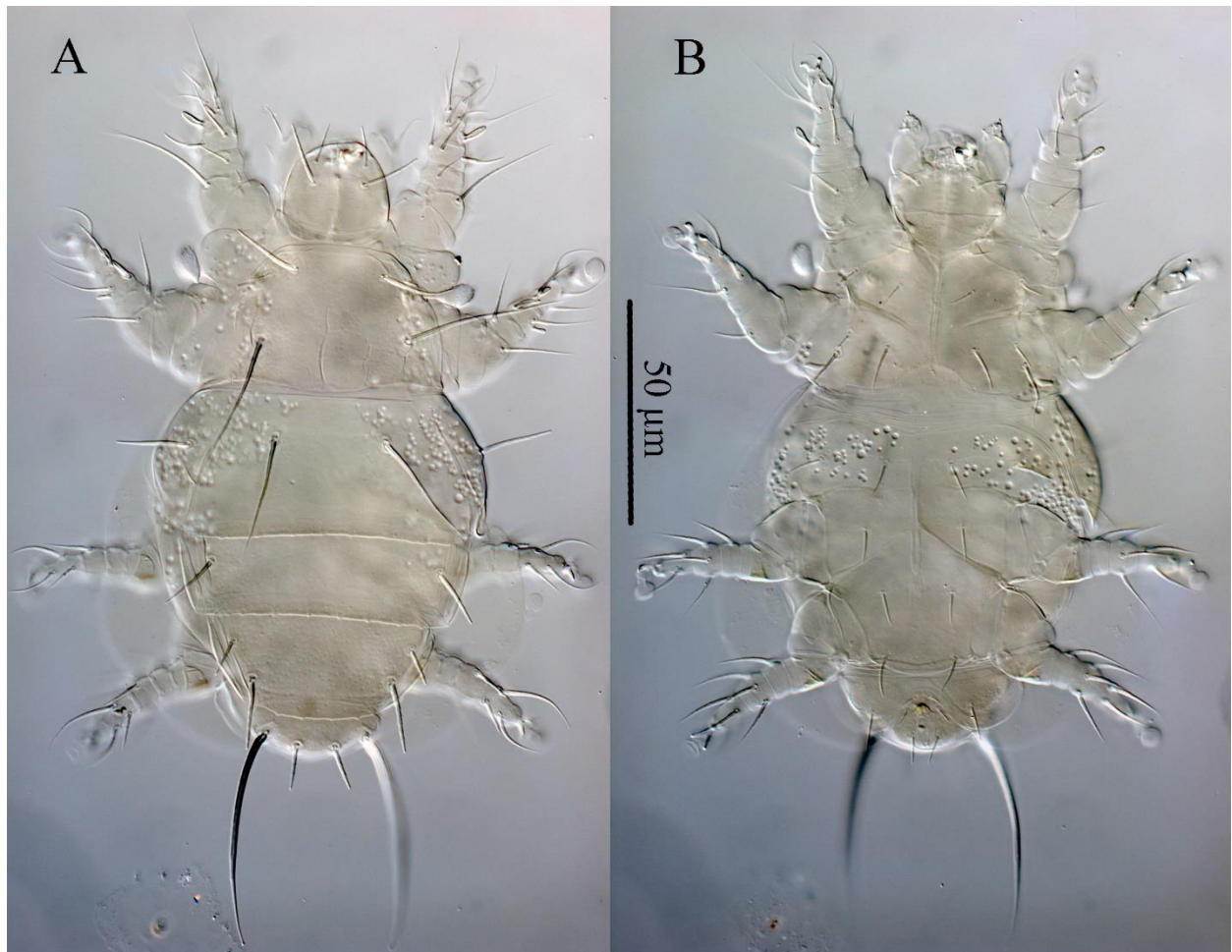


Figure 6. DIC micrographs of *Pavana madagascariensis* sp. nov. (female) – A. Dorsal view; B. Ventral view.

Male – unknown.

Type material

Female holotype, slide No. ZISP T-Dol-004, Madagascar, Ankaratra Andraraty, 19° 21' 20.78" S, 47° 18' 18.71" E, on beetle *Helictipleurus quadripunctatus* collected in cow dung, 23.02.2022, A.V. Frolov leg; paratypes: 48 females, same data.

Type deposition

The holotype and 10 paratypes are deposited in the collection of the Zoological Institute of RAS, Saint Petersburg, Russia; five female paratypes are deposited in the acarological collection of Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran (JAZM); other paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Differential diagnosis

The new species is most similar to *Pavania riparia* Sevastianov, 1980 and *P. copridis* Khaustov and Frolov, 2020a by the similar length of idiosomal setae and setae 2c pointed and about twice longer than 2a. The new species differs from both species in having seta l' on tibia II spiniform (setiform in *P. riparia* and *P. copridis*) and in having only one tooth-like projection on trochanter I (four in *P. riparia*, five in *P. copridis*).

Etymology

The name of the new species refers to its geographical distribution.

Key to world species of *Pavania* (based on Khaustov & Frolov 2020b)

1. Setae *sc1* absent 2
- Setae *sc1* present 9
2. Setae *2b* present 5
- Setae *2b* absent 3
3. Setae *1c* present, seta *d* of femur IV absent 4
- Setae *1c* absent, seta *d* of femur IV present *P. neotropica* Khaustov & Frolov, 2017 (Brazil)
4. Seta *d* of femur III present; setae *d* pointed, distinctly longer than *c2*
..... *P. semireducta* Khaustov & Frolov, 2020a (French Guiana)
- Seta *d* of femur III absent; setae *d* blunt-tipped, distinctly shorter than *c2*
..... *P. brevicaudata* Khaustov & Frolov, 2020a (French Guiana)
5. Seta *d* absent on each femora III and IV 6
- Seta *d* present on each femora III and IV 7
6. All dorsal setae blunt-tipped; setae *c2* only slightly longer than *c1*
..... *P. pusilla* Khaustov & Frolov, 2020a (French Guiana)
- Setae *sc2*, *c2* and *d* pointed; setae *c2* about three times longer than *c1*
..... *P. hansreiaphila* Khaustov & Frolov, 2020a (French Guiana)
7. Setae *v1* shorter than distance between their bases; setae *cha* less than three times longer than *chb*; setae *e* never longer than *f*; setae *h2* at most seven times longer than *h1* 8
- Setae *v1* longer than distance between their bases; setae *cha* three times longer than *chb*; setae *e* longer than *f*; setae *h2* 15 times longer than *h1*
..... *P. gymnopleuri* Hajiqanbar & Khaustov, 2010 (Iran)
8. Genu I with one seta (*v'*); dorsal idiosomal setae smooth; setae *c1* longer than *c2*; setae *c1* and *d* pointed *P. sabzevarensis* Hajiqanbar & Khaustov, 2010 (Iran)

- Genu I with two setae (v' , l'); dorsal idiosomal setae weakly barbed; setae $c2$ longer than $c1$; setae $c1$ and d distinctly blunt-tipped *P. onthophagi* Hajiqaanbar & Khaustov, 2010 (Iran)
- 9. Setae $sc1$ capitate 10
 - Setae $sc1$ seta-like *P. setiformis* Loghmani & Hajiqaanbar, 2013 (Iran)
- 10. Setae (u) and (pv) of tarsus I not lanceolate 14
 - Setae (u) and (pv) of tarsus I lanceolate 11
- 11. Seta pv'' of tarsus III lanceolate 12
 - Seta pv'' of tarsus III not modified 13
- 12. Seta tc'' of tarsus II lanceolate, setae $c2$ distinctly longer than $c1$
 - *P. lanceolata* Bahramian & Hajiqaanbar, 2015 (Iran)
 - Seta tc'' of tarsus II not modified, setae $c1$ distinctly longer than $c2$
 - *P. foliata* Khaustov & Frolov, 2020b (Russia)
- 13. Setae $c1$, $c2$ and d pointed; setae $2c$ distinctly longer than $2a$
 - *P. kermaniensis* Hajiqaanbar, Khaustov & Mortazavi, 2019 (Iran)
 - Setae $c1$, $c2$ and d blunt-tipped; setae $2c$ and $2a$ subequal
 - *P. scarabaeophilus* Hajiqaanbar, Khaustov & Mortazavi, 2019 (Iran)
- 14. Coxal fields II with 3 pairs of setae 15
 - Coxal fields II with 2 pairs of setae *P. equisetosa* Mahunka, 1975 (Ghana)
- 15. Empodium on tarsi II-IV small, not exceeding beyond tips of claws 16
 - Empodium on tarsi II-IV large, exceeding beyond tips of claws 17
- 16. Seta pv' on tarsi III and IV thickened, spiniform and blunt-tipped, solenidia on tibiae III and IV absent
 - *P. protracta* Sevastianov, 1980 (Russia)
 - Seta pv' on tarsi III and IV simple, solenidia on tibiae III and IV present
 - *P. tahanae* Sevastianov and Abo-Korah, 1985 (Egypt)
- 17. Setae $h2$ less than 3.5 times longer than $h1$ 18
 - Setae $h2$ more than 3.5 times longer than $h1$ 24
- 18. Setae $c1$ never reaching beyond bases of setae f ; setae $c1$ shorter than $h2$; setae d shorter than $h2$ 19
 - Setae $c1$ reaching beyond bases of setae f ; setae $c1$ longer than $h2$; setae d and $h2$ subequal
 - *P. perhirsuta* Mahunka, 1973 (Ghana)
- 19. Setae $sc2$ subequal to distance between their bases 21
 - Setae $sc2$ distinctly longer than distance between their bases 20
- 20. Setae $h2$ more than twice longer than $h1$; posterior margins of tergites C, D, and EF with distinct tooth-shaped projections
 - *P. luisiae* Mahunka, 1974 (Ghana)
 - Setae $h2$ less than twice longer than $h1$; posterior margins of tergites C, D, and EF with very weak projections
 - *P. megasolenidia* Hajiqaanbar, Khaustov & Mortazavi, 2019 (Iran)
- 21. Setae $c1$, d , e and f blunt-tipped 22
 - Setae $c1$, d , e and f pointed *P. bembidii* Khaustov, 2005 (Russia: Crimea)
- 22. Tips of setae $h2$ club-shaped, solenidion $\omega 1$ 6–7 in length 23
 - Tips of setae $h2$ pointed, solenidion $\omega 1$ 11–12 in length
 - *P. carabidophila* Khaustov, 2005 (Russia: Krasnodarskiy Kray, Primorskiy Kray)
- 23. Setae $c2$ pointed; trochanter I with three tooth-like projections; solenidion $\phi 2$ with attenuate tip
 - *P. africana* Khaustov & Frolov, 2018 (South Africa)
 - Setae $c2$ blunt-tipped; trochanter I with four tooth-like projections; solenidion $\phi 2$ with rounded tip
 - *P. neoafricana* **sp. nov.**
- 24. Setae $h2$ more than six times longer than $h1$ 25
 - Setae $h2$ less than six times longer than $h1$ 29
- 25. Setae $sc2$ less than 2.5 times longer than vl ; setae f less than twice as long as e ; setae e shorter than vl 26

- Setae *sc2* at least 3.5 times longer than *v1*; setae *f* more than twice as long as *e*; setae *e* longer than *v1* *P. endroedyi* Mahunka, 1975 (Ghana)
- 26. Setae *sc2* more than twice as long as *v1*; setae *f* and *d* subequal; setae *c1* never reaching beyond posterior border of tergite C 27
- Setae *sc2* less than twice as long as *v1*; setae *f* longer than *d*; setae *c1* reaching beyond posterior border of tergite C *P. brasiliensis* Mahunka, 1970b (Brazil)
- 27. Setae *2a* as long as *2c* and both longer than *c1*, *d* and *f*; setae *m* protruding beyond anterior border of gnathosoma *P. elongata* Hajiqanbar & Khaustov, 2010 (Iran)
- Setae *2a* longer than *2c* and both shorter than *c1*, *d* and *f*; setae *m* never protruding beyond anterior border of gnathosoma 28
- 28. Setae *c1*, *d* and *f* subequal and shorter than *c2* *P. gazellatrix* Katlav & Seeman, 2020 (Australia)
- Setae *c1*, *d*, *f* and *c2* subequal *P. simplex* Mahunka, 1973 (Ghana)
- 29. Empodium on tarsus I with rounded anterior margin; solenidia on tibiae III and IV absent 30
- Empodium on tarsus I with 3 lobes; tibiae III and IV with tiny solenidion *P. magowskii* Hajiqanbar, Khaustov & Mortazavi, 2019 (Iran)
- 30. Setae *f* distinctly longer than *e*; setae *e* and *h1* subequal 31
- Setae *e* and *f* subequal; setae *e* longer than *h1* *P. tadjikistanica* Sevastianov, 1980 (Tadjikistan, Iran)
- 31. Setae *2c* subequal with *2a* 34
- Setae *2c* about two times longer than *2a* 32
- 32. Seta *l''* on tibia II setiform; trochanter I with 4-5 tooth-like projections 33
- Seta *l''* on tibia II spiniform; trochanter I with 1 tooth-like projection *P. madagascariensis* **sp. nov.**
- 33. Setae *c1* distinctly longer than *c2*; setae *chb* blunt-tipped *P. riparia* Sevastianov, 1980 (Ukraine, Slovakia)
- Setae *c1* and *c2* subequal; setae *chb* pointed *P. copridis* Khaustov & Frolov, 2020 (Borneo island)
- 34. Setae *f* more than two times longer than *e* 34
- Setae *f* less than 1.5 times longer than *e* *P. khiavensis* Sobhi & Hajiqanbar, 2017 (in Sobhi *et al.* 2017) (Iran)
- 35. Most dorsal idiosomal setae weakly barbed and blunt-tipped; setae *c1* longer than *c2*; setae *sc2* less than twice as long as *c1* *P. kamalii* Hajiqanbar & Khaustov, 2010 (Iran)
- Dorsal idiosomal setae smooth and pointed; setae *c2* longer than *c1*; setae *sc2* more than twice as long as *c1* *P. fusiformis* Lombardini, 1949 (Italy, Iran)

ACKNOWLEDGEMENTS

The study of Alexander Khaustov was supported by the cooperative agreement No. FEWZ-2021-0004 from the Russian Ministry of Science and Higher Education. The study of Andrey Frolov was performed in the framework of the Russian State research project 122031100272-3.

REFERENCES

- Bahramian, M., Hajiqanbar, H. & Talebi, A.A. (2015) Two heterostigmatic mite species (Acari: Dolichocybidae, Podapolipidae) associated with *Scarabaeus pius* (Coleoptera: Scarabaeidae) from Iran. *Acta Zoologica Academiae Scientiarum Hungaricae*, 61: 25–32. DOI: [10.11158/saa.24.8.3](https://doi.org/10.11158/saa.24.8.3)

- Grandjean, F. (1944) Observations sur les Acariens de la famille des Stigmaeidae. *Archives des Sciences Physiques et Naturelles*, 26: 103–131.
- Grandjean, F. (1947) L'origine pileuse des mors et la chaetotaxie de la mandibule chez les Acariens actinochitineux. *Comptes rendus des Séances de l'Académie des Sciences*, 224: 1251–1254.
- Hajiqaanbar, H. & Khaustov, A.A. (2010) A new species group and five new species of the genus *Pavania* (Acari: Dolichocybidae) associated with insects, with notes on leg chaetotaxy and the distribution of genera. *European Journal of Entomology*, 107: 441–453.
- Hajiqaanbar, H., Khaustov, A. & Mortazavi, A. (2019) New species of the genera *Dolichocybe* and *Pavania* (Acari: Dolichocybidae), phoretic on scarab beetles (Coleoptera: Scarabaeidae) from Iran. *Systematic & Applied Acarology*, 24(8): 1363–1382. DOI: [10.11158/saa.24.8.3](https://doi.org/10.11158/saa.24.8.3)
- Kaliszewski, M., Athias-Binche, F. & Lindquist, E.E. (1995) Parasitism and parasitoidism in Tarso-nemina (Acari: Heterostigmata) and evolutionary considerations. *Advances in Parasitology*, 35: 335–367. DOI: [10.1016/S0065-308X\(08\)60074-3](https://doi.org/10.1016/S0065-308X(08)60074-3)
- Katlav, A., Hajiqaanbar, H. & Talebi, A.A. (2014) First record of the genus *Acanthomastix* Mahunka, 1972 (Acari: Dolichocybidae) from Asia, with the description of a new species. *International Journal of Acarology*, 40: 7–14. DOI: [10.1080/01647954.2014.883429](https://doi.org/10.1080/01647954.2014.883429)
- Katlav, A., Riegler, M. & Seeman, O.D. (2020) Tiny hitchhikers and parasites: a review of Australian heterostigmatic mites (Acari: Prostigmata) associated with insects, with description of three new species. *Austral Entomology*, 59: 401–421. DOI: [10.1111/aen.12484](https://doi.org/10.1111/aen.12484)
- Khaustov, A.A. (2005) Two new mite species of the genus *Pavania* (Heterostigmata, Dolichocybidae) from the Crimea and southern European Russia. *Zoologicheskii Zhurnal*, 84: 1515–1521.
- Khaustov, A.A. (2017) A new species of *Dolichocybe* (Acari: Dolichocybidae) from Western Siberia, Russia. *Systematic and Applied Acarology*, 22: 1678–1687.
- Khaustov, A.A. & Frolov, A.V. (2017) New species of heterostigmatic mites (Acari: Heterostigmata: Athyreacaridae, Dolichocybidae, Pygmephoridae) associated with scarab beetles (Coleoptera: Geotrupidae, Scarabaeidae) from Brazil. *Zootaxa*, 4294: 501–521. DOI: [10.11646/zootaxa.4294.5.1](https://doi.org/10.11646/zootaxa.4294.5.1)
- Khaustov, A.A. & Frolov, A.V. (2018a) A new species of *Formicomotes* Sevastianov (Acari: Heterostigmata: Dolichocybidae) associated with termites (Isoptera: Termitidae) from Brazil, with redescription of *Formicomotes octipes* Sevastianov, 1980. *Zootaxa*, 4382: 393–400. DOI: [10.11646/zootaxa.4382.2.10](https://doi.org/10.11646/zootaxa.4382.2.10)
- Khaustov, A.A. & Frolov, A.V. (2018b) A new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) associated with *Frankenbergerius gomesi* (Coleoptera: Scarabaeidae) from South Africa. *Acarina*, 26(1): 133–140. DOI: [10.21684/0132-8077-2018-26-1-133-140](https://doi.org/10.21684/0132-8077-2018-26-1-133-140)
- Khaustov, A.A. & Frolov, A.V. (2020a) Five new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) phoretic on scarab beetles (Coleoptera: Scarabaeidae) from French Guiana and Malaysia. *Systematic and Applied Acarology*, 25(4): 707–727. DOI: [10.11158/saa.25.4.10](https://doi.org/10.11158/saa.25.4.10)
- Khaustov, A.A. & Frolov, A.V. (2020b) A new species of *Pavania* (Acari: Heterostigmata: Dolichocybidae) associated with *Scarabaeus typhon* (Coleoptera: Scarabaeidae) from Russia. *Acarina*, 28(2): 169–176. DOI: [10.21684/0132-8077-2020-28-2-169-176](https://doi.org/10.21684/0132-8077-2020-28-2-169-176)
- Khaustov, A.A. & Trach V.A. (2017) On the phoresy and morphology of *Pavania carabidophila* Khaustov, 2005 (Acari: Dolichocybidae). *Acarina*, 25(1): 25–28. Doi: [10.21684/0132-8077-2017-25-1-25-28](https://doi.org/10.21684/0132-8077-2017-25-1-25-28)

- Khaustov, A.A. & Trach, V.A. (2018) Revision of the family Dolichocybidae (Acari: Heterostigmata) from the collection of V.D. Sevastianov. *Acarologia*, 58(4): 897–918. DOI: [10.24349/acarologia/20184295](https://doi.org/10.24349/acarologia/20184295)
- Khaustov, A.A., Vorontsov, D.D., Perkovsky, E.E. & Lindquist, E.E. (2021) Review of fossil heterostigmatic mites (Acari: Heterostigmata) from late Eocene Rovno Amber. I. Families Tarsocheylidae, Dolichocybidae and Acarophenacidae. *Systematic and Applied Acarology*, 26(1): 33–61. DOI: [10.11158/saa.26.1.3](https://doi.org/10.11158/saa.26.1.3)
- Lan, Q., Lu, Zh., Ke, B., Liao, J. & Fan, Q.-H. (2017) Temperature and humidity effects on physogastric development and reproduction of the mushroom mite *Dolichocybe perniciosus* (Acari: Dolichocybidae). *Systematic and Applied Acarology*, 22(11): 1843–1848. DOI: [10.11158/saa.22.11.5](https://doi.org/10.11158/saa.22.11.5)
- Lindquist, E.E. (1986) The world genera of Tarsonemidae (Acari: Heterostigmata): a morpho-logical, phylogenetic, and systematic revision, with a reclassification of family-group taxa in the Heterostigmata. *Memoirs of Entomological Society of Canada*, 118: 1–517 DOI: [10.4039/entm118136fv](https://doi.org/10.4039/entm118136fv)
- Loghmani, A., Hajiqanbar, H. & Talebi, A.A. (2013) A new species group and species of the genus *Pavania* (Acari: Dolichocybidae), phoretic on *Onthophagus vitulus* (Coleoptera: Scarabaeidae) from Iran. *Zootaxa*, 3693: 320–328. DOI: [10.11646/zootaxa.3693.3.2](https://doi.org/10.11646/zootaxa.3693.3.2)
- Lombardini, G. (1949) Acari Nuovi. *Redia*, 34: 67–74.
- Magowski, W.L. (1988) Description of a new species of *Formicomotes* Sevastianov, 1980 (Acari: Dolichocybidae) with notes on the female dimorphism within this genus. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 85: 163–182.
- Mortazavi, A., Hajiqanbar, H. & Kamali, K. (2015) A new species of the family Dolichocybidae Mahunka, 1970 (Acari: Heterostigmata) associated with *Sinoxylon pugnax* Lesne (Coleoptera: Bostrichidae) from Iran. *Systematic and Applied Acarology*, 20: 441–448. DOI: [10.11158/saa.20.4.9](https://doi.org/10.11158/saa.20.4.9)
- Rahiminejad, V., Hajiqanbar, H. & Fathipour, Y. (2011) Redefinition of the genus *Dolichocybe* (Acari: Dolichocybidae), with description of two new species associated with insects. *Annals of the Entomological Society of America*, 104: 627–635. DOI: [10.1603/AN11006](https://doi.org/10.1603/AN11006)
- Rack, V.G. (1967) Untersuchungen über die biologie von *Dolichocybe* Krantz, 1957 und beschreibung von zwei neuen Arten (Acarina, Pyemotidae). *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 64: 29–42.
- Sevastianov, V.D. (1980) New taxa of mites of the family Dolichocybidae (Trombidiformes, Tarsonemina) and phylogenetic relations of its subfamilies. *Zoologicheskij Zhurnal*, 59: 1453–1462.
- Sobhi, M., Hajiqanbar, H. & Mortazavi, A. (2017) New species and records of heterostigmatic mites (Acari: Prostigmata: Heterostigmata) phoretic on scarabaeid dung beetles (Coleoptera: Scarabaeidae) from northwestern Iran. *Zootaxa*, 4276: 427–434. DOI: [10.11646/zootaxa.4276.3.7](https://doi.org/10.11646/zootaxa.4276.3.7)

COPYRIGHT

Khaustov and Frolov. Persian Journal of Acarology is under a free license. This open-access article is distributed under the terms of the Creative Commons-BY-NC-ND which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

دو گونه جدید (*Pavania* (Acari: Heterostigmata: Dolichocybidae) مرتبط با سوسک‌های اسکاراب (*Coleoptera: Scarabaeidae*) از تانزانیا و ماداگاسکار

آکساندر ای. خاستوف^{۱*} و آندری وی. فرولوف^۲

۱. دانشگاه ایالتی تیومن، تیومن، خیابان ولودارسکوگو ۶، ۶۲۵۰۰۳ روسیه؛ رایانامه: alex1973khaustov@gmail.com

۲. موسسه جانورشناسی آکادمی علوم روسیه، دانشگاه امبانکمنت ۱، ۱۹۹۰۳۴، سنت پترزبورگ، روسیه؛ رایانامه: afrolov@zin.ru

* نویسنده مسئول

چکیده

دو گونه جدید پاونیا (*Pavania* (Acari: Heterostigmata: Dolichocybidae) به صورت هم‌سفر روی سوسک‌های سرگین (*Coleoptera: Scarabaeidae*). *P. neoafricana* sp. nov. روی *Helicopriss neptunus* در تانزانیا و *P. madagascariensis* sp. nov. جمع‌آوری شده از روی *Helictipleurus quadripunctatus* در ماداگاسکار توصیف شده‌اند. کلید به روز شده برای گونه‌های جنس *Pavania* ارائه شده است. خانواده Dolichocybidae برای نخستین بار از ماداگاسکار گزارش می‌شود.

واژگان کلیدی: ناحیه افروتروپیکال؛ سوسک سرگین؛ کلید؛ هم‌سفری؛ رده‌بندی.

اطلاعات مقاله: تاریخ دریافت: ۱۴۰۱/۵/۱۶، تاریخ پذیرش: ۱۴۰۱/۶/۱۸، تاریخ چاپ: ۱۴۰۱/۷/۲۳