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Three new species of the genus *Pergalumna* (Acari: Oribatida: Galumnidae) from India

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Abstract

Three new oribatid mite species of the genus *Pergalumna* (Galumnidae), *P. paratsurusakii* **sp. nov.**, *P. asetosa* **sp. nov.** and *P. mahunkai* **sp. nov.**, are described from India. *Pergalumna paratsurusakii* **sp. nov.** is most similar morphologically to *P. tsurusakii* Starý from Japan, however it differs from latter by the body surface, body size and morphology of some notogastral porose areas. *Pergalumna asetosa* **sp. nov.** is most similar morphologically to *P. rotunda* Starý from Japan and *Pergalumna yurtaevi* Ermilov & Anichkin from Vietnam, however it differs from both by the absence of interlamellar setae and the presence of notogastral furrows. *Pergalumna mahunkai* **sp. nov.** is most similar morphologically to *P. margaritata* Mahunka from Vietnam and *P. pseudomargaritata* Mahunka from Thailand, however it differs from both by the structure of anterior notogastral margin, body size and morphology of prodorsal setae.

Key words: oribatid mites, Galumnidae, *Pergalumna*, new species, India

Introduction

At present, the fauna of oribatid mites (Acari: Oribatida) of India is not poorly studied (for example: Chakrabarti *et al.* 1978; Chakrabarti & Mondal 1983; Mahunka 1985; Sanyal & Bhaduri 1989; Sanyal & Saha 1996; Ramani & Haq 1998; Sanyal 2000, 2009; Sanyal *et al.* 2006; Bayartogtokh & Chatterjee 2010).

In the course of taxonomic identification of Indian oribatid mite material we found three new species of the family Galumnidae, belonging to the genus *Pergalumna* Grandjean, 1936 (Galumnidae). The main purpose of this paper is to describe and illustrate these species under the names *Pergalumna paratsurusakii* **sp. nov.**, *P. asetosa* **sp. nov.** and *P. mahunkai* **sp. nov.**

The genus *Pergalumna* comprises more 120 species, which have a cosmopolitan distribution. Earlier 34 species of this genus were recorded in the Oriental region (Subías 2004, online version 2012; Subías *et al.* 2012). The main generic characters of this genus summarized by Engelbrecht (1972), Balogh & Balogh (1992). An identification key to many species of *Pergalumna* (including Oriental species) has been presented earlier (Balogh & Balogh 2002).

Material and methods

The locality and habitat data for the new species are given below (see *Material examined* section).

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. All body measurements are presented in micrometers. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral

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distortion. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect.

Descriptions of new species

Pergalumna paratsurusakii sp. nov.

(Figs 1–5)

Diagnosis. Body size 365–415 × 265–332. Body surface and pteromorphs foveolate and densely microgranulate, genital plates with one longitudinal striae, anogenital region with three striate bands. Rostrum pointed. Rostral, lamellar and interlamellar setae long, slightly barbed. Sensilli setiform, ciliate. Anterior notogastral margin absent. Three pairs of porose areas developed (*Aa* and *A1* elongate, *A3* oval). Median pore present. Adanal setae ad_1 considerably longer than other adanal setae. Postanal porose area absent.

Description. *Measurements*. Body length 365 (holotype), 365–415 (mean 403; seven paratypes); body width 282 (holotype), 265–332 (mean 303; seven paratypes).

Integument. Body color brown. Body surface and pteromorphs foveolate (diameter of foveolae up to 6) and densely microgranulate (diameter of granules less than 1). Pteromorphs with distinct wrinkles. Genital plates with one long, longitudinal striae in lateral part. Anogenital region with two lateral, transversal striate bands (*s*), which are located between genital and anal apertures, and one arcuate striate band, which is located posteriorly to anal plates and marginally in ano-adanal region.

Prodorsum. Rostrum with strong tooth (*t*). Rostral (*ro*, 57–65), lamellar (*le*, 77–82) and interlamellar (*in*, 94–102) setae setiform, slightly barbed. Sensilli (*ss*, 106–123) setiform, with short cilia. Exobothridial setae not present. Lamellar and sublamellar lines well developed, parallel. Insertions of lamellar setae located near to lamellar lines. Porose areas *Ad* not evident.

Notogaster. Anterior notogastral margin absent. Dorsophragmata (*D*) long. Notogastral setae represented by 10 pairs of alveoli. Three pairs of porose areas developed: *Aa* (32–36 × 8–12) and *A1* (41–45 × 10–12) elongate, *A3* (16–20 × 10–12) oval. Porose areas *Aa* with distinct margins, *A1* and *A3* without distinct margins. Alveoli of setae *la* inserted laterally to *Aa*. Median pore (*mp*) represented by several foveolae, located between porose areas *A1* (similar in males and females). All lyrifissures and opisthonotal gland openings (*gla*) distinct, located typical for *Pergalumna*.

Gnathosoma. Morphology of subcapitulum, palps and chelicerae typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*).

Epimeral and lateral podosomal regions. Apodemes 1, 2, sejugal and 3 well visible. Six pairs of setiform and smooth epimeral setae observed; setal formula: 1–0–2–3. Setae *1c*, *3c* and *4c* (8–12) longer than others (4). Pedotectae, discidia (*dis*) and circumpedal carinae (*cp*) located typical for the genus.

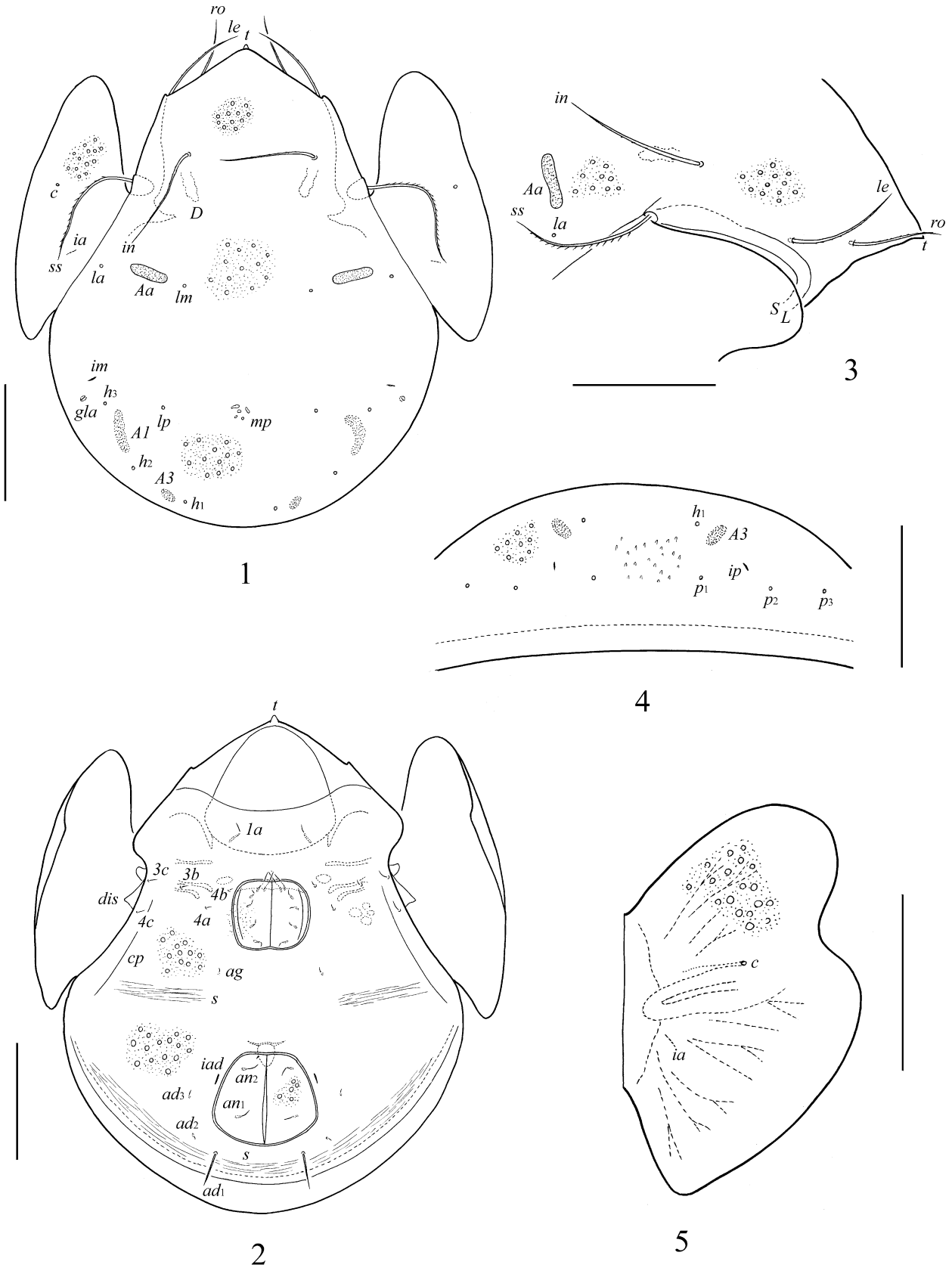
Anogenital region. Six pairs of genital (g_1, g_2, 12; g_3–g_6, 4), one pair of aggenital (4), two pairs of anal (12) and three pairs of adanal (ad_1, 24–32; ad_2, ad_3, 4) setae setiform, thin, smooth (except slightly barbed ad_1). Anterior part of genital plates with two (g_1, g_2) setae. Adanal setae ad_3 inserted postero-laterally to lyrifissures *iad*. Postanal porose area absent.

Legs. Morphology of leg segments, setae and solenidia typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*). Homology of setae and solenidia indicated in Table 1.

TABLE 1. Leg setation and solenidia of *Pergalumna paratsurusakii* **sp. nov.** (same for *P. asetosa* **sp. nov.** and *P. mahunkai* **sp. nov.**).

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v′*	*d, (l), bv″*	*(l), v′*, σ	*(l), (v)*, φ1, φ2	*(ft), (tc), (it), (p), (u), (a), s, (pv), v′, (pl), l″, e*, ω_1, ω_2
II	*v′*	*d, (l), bv″*	*(l), v′*, σ	*(l), (v)*, φ	*(ft), (tc), (it), (p), (u), (a), s, (pv)*, ω_1, ω_2
III	*v′*	*d, ev′*	*l′*, σ	*l′, (v)*, φ	*(ft), (tc), (it), (p), (u), (a), s, (pv)*
IV	*v′*	*d, ev′*	*d, l′*	*l′, (v)*, φ	*ft″, (tc), (p), (u), (a), s, (pv)*

Roman letters refer to normal setae (*e* to famulus), Greek letters to solenidia. Single prime (′) marks setae on anterior and double prime (″) setae on posterior side of the given leg segment. Parentheses refer to a pseudosymmetrical of setae.



FIGURES 1–5. *Pergalumna paratsurusakii* **sp. nov.**, adult: 1—dorsal view of body, 2—ventral view of body (legs not shown), 3—dorso-lateral view of prodorsum, 4—medio-posterior view of notogaster, 5—right pteromorpha. Scale bar 100 μm.

Material examined. Holotype (female) and seven paratypes (three males and four females): India, 28°19′32″N 95°57′31″E, Arunachal Pradesh, Hunli vicinity, 1300 m a.s.l., collected 01.06.2012 by L. Dembický & O. Šauša.

Type deposition. The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; four paratypes are in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; three paratypes are in the personal collection of the first author.

Etymology. The prefix *para* is Latin meaning "near" and refers the similarity between the new species and the species *Pergalumna tsurusakii* Starý, 2005.

Remarks. In having the combination of pointed rostrum, setiform sensilli, development of prodorsal setae, absence of anterior notogastral margin, presence of three pairs of notogastral porose areas, striate genital plates, long adanal setae ad_1, *Pergalumna paratsurusakii* **sp. nov.** is most similar to *P. tsurusakii* Starý, 2005 from Japan, however it clearly differs from the latter by the body surface with foveolae, microgranules and striate bands (versus smooth in *P. tsurusakii*), smaller body size (365–415 × 265–332 versus 608 × 432 in *P. tsurusakii*), elongate notogastral porose areas *Aa* and *A1* (versus oval in *P. tsurusakii*) and the absence of postanal porose area (versus present in *P. tsurusakii*).

Also, *Pergalumna paratsurusakii* **sp. nov.** is similar morphologically to *P. amorpha* Mahunka, 2008 from Thailand and *P. pterinervis* (Canestrini, 1898) from New Guinea and the Oriental region (see also Mahunka 1992), however it clearly differs from both by following characters: pointed rostrum (versus rounded in *P. amorpha* and *P. pterinervis*), body surface with foveolae, microgranules and striate bands (versus punctate in *P. amorpha* or smooth and *P. pterinervis*), presence of three pairs of notogastral porose areas (versus four pairs present in *P. pterinervis*), presence of median pore (versus absent in *P. amorpha* and *P. pterinervis*) and long adanal setae ad_1 (versus short in *P. amorpha*).

***Pergalumna asetosa* sp. nov.**
(Figs 6–10)

Diagnosis. Body size 813–846 × 664–697. Body surface indistinctly microfoveolate, posterior part of notogaster with a pair of longitudinal furrows, genital plates with longitudinal stria. Rostrum pointed. Interlamellar setae represented by alveoli. Sensilli long, clavate. Anterior notogastral margin present. Three pairs of oval porose areas developed. Median pore present. Postanal porose area present, elongate.

Description. *Measurements*. Body length 830 (holotype), 813–846 (mean 830; four paratypes); body width 697 (holotype), 664–697 (mean 680; four paratypes).

Integument. Body color brown. Body surface and pteromorphs densely and indistinctly microfoveolate (diameter of foveolae less than 1), it is visible only under high magnification. Pteromorphs with weakly developed wrinkles. Posterior part of notogaster with a pair of longitudinal furrows *(f)*. Genital plates with longitudinal stria.

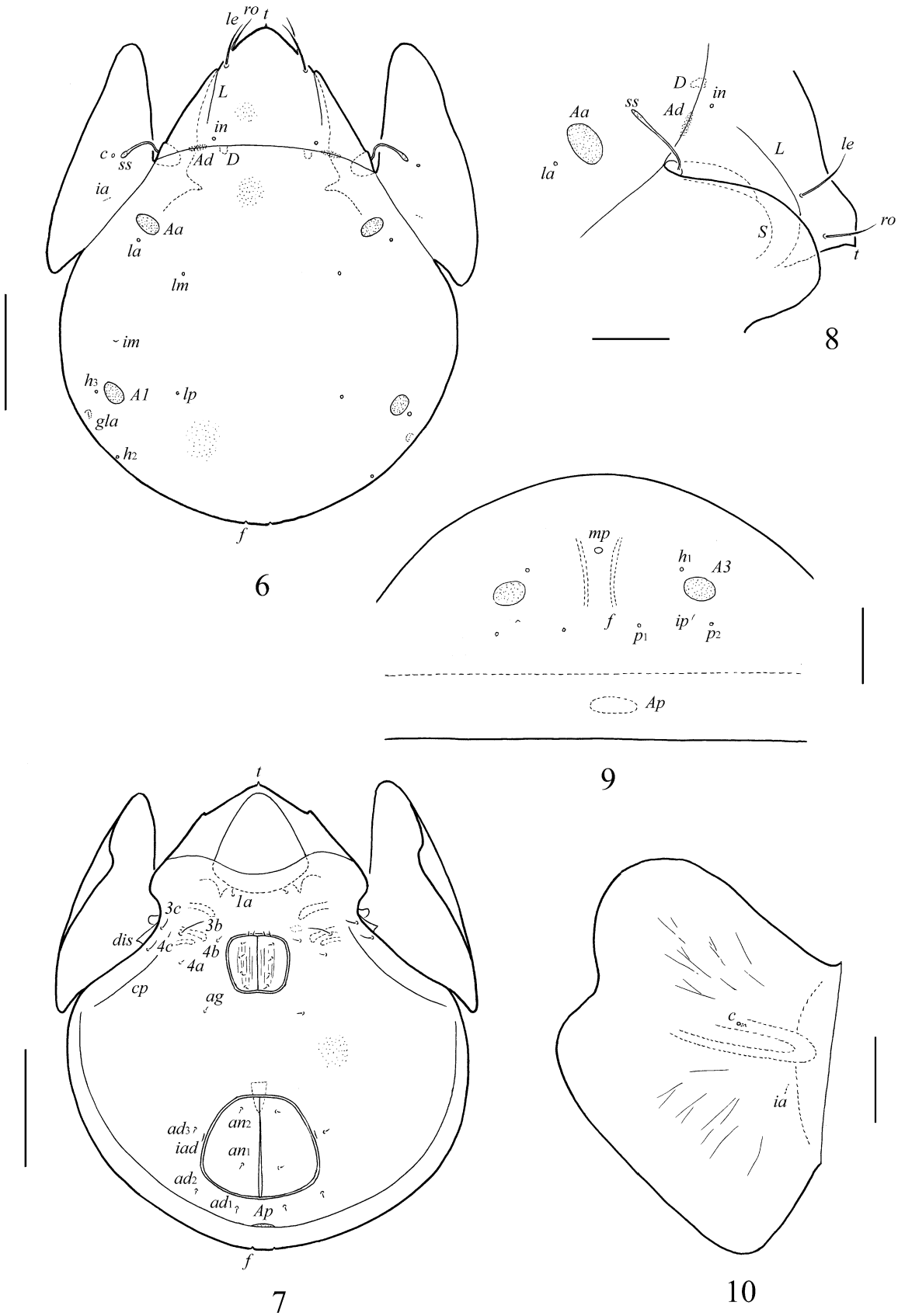
Prodorsum. Rostrum with small tooth. Rostral (69–77) and lamellar (86–98) setae setiform, thin, indistinctly barbed. Interlamellar setae represented by alveoli. Sensilli (110–123) with long stalk and small, slightly barbed head. Exobothridial setae not present. Lamellar and sublamellar lines well developed, parallel, but their basal parts are divergent. Insertions of lamellar setae located near to lamellar lines. Porose areas *Ad* present, elongate.

Notogaster. Anterior notogastral margin present. Dorsophragmata short. Notogastral setae represented by 10 pairs of alveoli. Three pairs of oval porose areas developed: *Aa* (49–57 × 28–36), *A1* (41–53 × 28–36), *A3* (41–49 × 28–36). Alveoli of setae *la* inserted posteriorly to *Aa*. Median pore represented by large foveum, which are located between furrows, antero-medially to *A3* (similar in males and females). All lyrifissures and opisthonotal gland openings distinct, located typical for *Pergalumna*.

Gnathosoma. Morphology of subcapitulum, palps and chelicerae typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*).

Epimeral and lateral podosomal regions. Apodemes 1, 2, sejugal and 3 well visible. Six pairs of setiform and smooth epimeral setae observed; setal formula: 1–0–2–3. Setae *3b* (41–45) longer than *3c*, *4c* (20–24) and *1a*, *4a*, *4b* (10–12). Pedotectae, discidia and circumpedal carinae located typical for the genus.

Anogenital region. Six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae similar in length (10–12), setiform, thin, smooth. Anterior part of genital plates with two (g_1, g_2) setae. Adanal setae ad_3 inserted laterally or antero-laterally to lyrifissures *iad*. Postanal porose area (*Ap*, 57–61 × 12–18) elongate.



FIGURES 6–10. *Pergalumna asetosa* **sp. nov.**, adult: 6—dorsal view of body, 7—ventral view of body (legs not shown), 8—dorso-lateral view of prodorsum, 9—medio-posterior view of notogaster, 10—left pteromorpha. Scale bars (6, 7) 200 µm, (8–10) 100 µm.

Legs. Morphology of leg segments, setae and solenidia typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*). Homology of setae and solenidia indicated in Table 1.

Material examined. Holotype (female) and four paratypes (one male and three females): India, 28°19′32″N 95°57′31″E, Arunachal Pradesh, Hunli vicinity, 1300 m a.s.l., collected 01.06.2012 by L. Dembický & O. Šauša.

Type deposition. The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; two paratypes are in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; two paratypes are in the personal collection of the first author.

Etymology. The specific name "*asetosa*" refers to the absence of interlamellar setae.

Remarks. In having the combination of pointed rostrum, clavate sensilli, presence of anterior notogastral margin and three pairs of notogastral porose areas, striate genital plates, *Pergalumna asetosa* **sp. nov.** is most similar to *P. rotunda* Starý, 2005 from Japan and *P. yurtaevi* Ermilov & Anichkin, 2011(*a*) from Vietnam, however it clearly differs from both by the absence of interlamellar setae (versus present in *P. rotunda* and *P. yurtaevi*) and the presence of notogastral furrows (versus absent in *P. rotunda* and *P. yurtaevi*).

Also, *Pergalumna asetosa* **sp. nov.** is similar morphologically to *P. operata* Tseng, 1984 from Taiwan, however it clearly differs from the letter by the pointed rostrum (versus rounded in *P. operata*), absence of interlamellar and notogastral setae (versus short setae present in *P. operata*) and presence of three pairs of notogastral porose areas (versus four pairs present in *P. operata*).

Pergalumna mahunkai sp. nov.

(Figs 11–15)

Diagnosis. Body size 498–531 × 381–398. Body surface microgranulate, genital plates striate. Rostrum pointed. Prodorsal setae of medium size, slightly barbed. Sensilli setiform, ciliate. Distinct anterior notogastral margin absent (it is unclearly visible under high magnification). Three pairs of oval porose areas developed. Median pore present. Postanal porose area absent.

Description. *Measurements*. Body length 498 (holotype), 498–531 (mean 525; three paratypes); body width 381 (holotype), 381–398 (mean 392; three paratypes).

Integument. Body color brown. Body surface densely microgranulate (diameter of granules less than 1). Pteromorphs with distinct wrinkles. Genital plates with two or three long, longitudinal striae in median part.

Prodorsum. Rostrum with strong tooth. Rostral, lamellar and interlamellar setae similar in length (45–49), setiform, slightly barbed. Sensilli (98–102) setiform, with short cilia. Exobothridial setae not present. Lamellar and sublamellar lines well developed, parallel. Insertions of lamellar setae removed from lamellar lines. Porose areas *Ad* not evident.

Notogaster. Distinct anterior notogastral margin absent, but it is unclearly visible under high magnification. Dorsophragmata long. Notogastral setae represented by 10 pairs of alveoli. Three pairs of oval porose areas developed: *Aa* (24–28 × 10–20), *A1* (20–24 × 12–16), *A3* (12–16 × 10–14). Alveoli of setae *la* inserted laterally to *Aa*. Median pore represented by small foveum, located between porose areas *A1* (similar in males and females). All lyrifissures and opisthonotal gland openings distinct, located typical for *Pergalumna*.

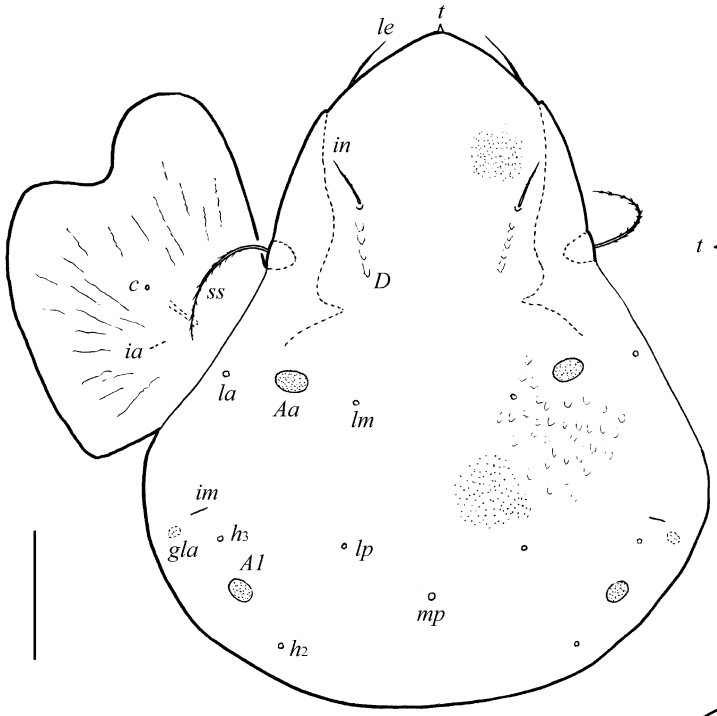
Gnathosoma. Morphology of subcapitulum, palps and chelicerae typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*).

Epimeral and lateral podosomal regions. Apodemes 1, 2, sejugal and 3 well visible. Six pairs of short (8), setiform and smooth epimeral setae observed; setal formula: 1–0–2–3. Setae *3c* and *4c* visible in dissected specimens. Pedotectae, discidia and circumpedal carinae (*cp*) located typical for the genus.

Anogenital region. Six pairs of genital (g_1, g_2, 12–16; g_3–g_6, 8), one pair of aggenital (8), two pairs of anal (8) and three pairs of adanal (ad_1, ad_2, 12–16; ad_3, 8) setae setiform, thin, smooth. Anterior part of genital plates with two (g_1, g_2) setae. Adanal setae ad_3 inserted postero-laterally to lyrifissures *iad*. Postanal porose area absent.

Legs. Morphology of leg segments, setae and solenidia typical for *Pergalumna* (see Engelbrecht 1972; Ermilov & Anichkin 2011*a*, 2011*b*). Homology of setae and solenidia indicated in Table 1.

Material examined. Holotype (male) and eight paratypes (male and two females; sex not studied in five specimens): India, Tripura, Maharanipur, leaf debris underneath shrubs, collected by 05.04.1976, S. Sarkar.



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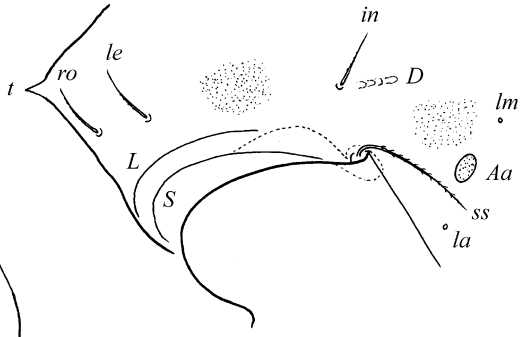

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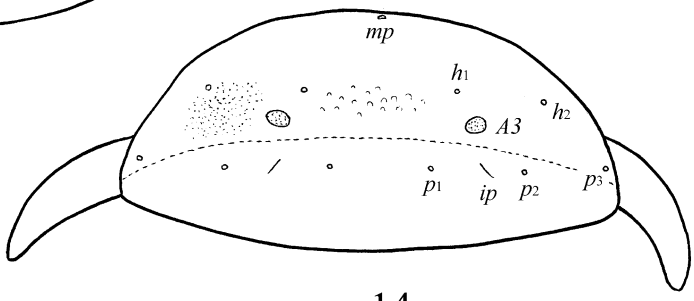

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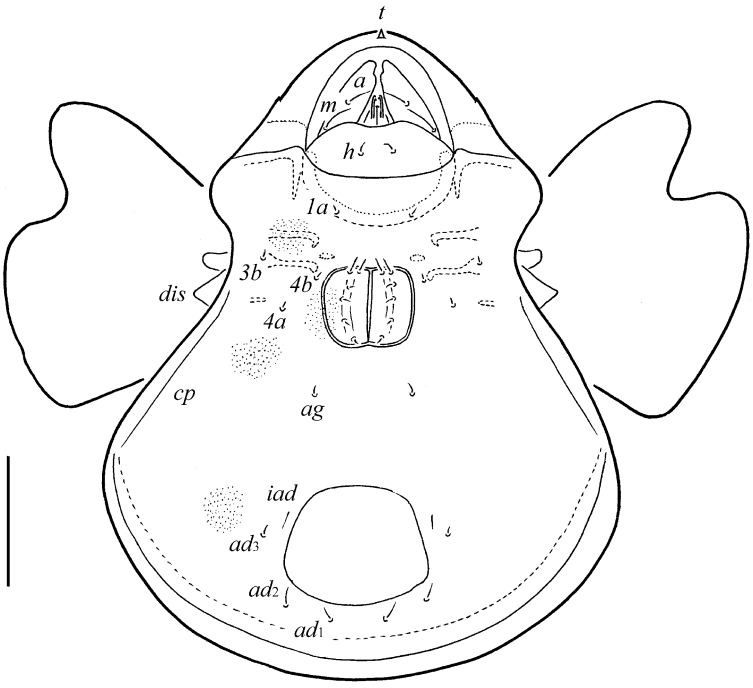

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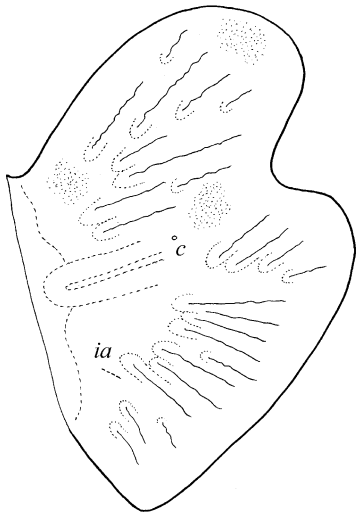

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FIGURES 11–15. *Pergalumna mahunkai* **sp. nov.**, adult: 11—dorsal view of body (right pteromorph not shown), 12—ventral view of body (anal plates and legs not shown), 13—dorso-lateral view of prodorsum, 14—posterior view of notogaster, 15—right pteromorpha. Scale bar 100 µm.

Type deposition. The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; one paratype is in the collection of the Siberian Zoological Museum, Novosibirsk, Russia; two paratypes are in the personal collection of the first author; five additional paratypes (not studied in detail) are in the collection of Department of Zoology, Faculty of Biology, Complutense University, Madrid, Spain.

Etymology. The species is named after the late Prof. Dr. Sándor Mahunka, the distinguished acarologist from Budapest, Hungary.

Remarks. In having the combination of microgranulate body surface, pointed rostrum, setiform sensilli, medium length of rostral, lamellar and interlamellar setae, presence of three pairs of notogastral porose areas, striate genital plates, *Pergalumna mahunkai* **sp. nov.** is most similar to *Pergalumna margaritata* Mahunka, 1989 from Vietnam and *Pergalumna pseudomargaritata* Mahunka, 1994 from Thailand, however it clearly differs from both species by absence of distinct anterior notogastral margin (versus presence of specific-tuberculate anterior notogastral margin in *P. margaritata* and *P. pseudomargaritata*), larger body size (498–531 × 381–398 versus 451–490 × 326–366 in *P. margaritata*, 402–447 × 281–315 in *P. pseudomargaritata*) and more thin and slightly barbed rostral, lamellar and interlamellar setae (versus thicker and well barbed in *P. margaritata* and *P. pseudomargaritata*).

Also, *Pergalumna mahunkai* **sp. nov.** is similar morphologically to *P. foveolata* Hammer,1973 from Polynesia, India and Brazil (see also Bayartogtokh & Chattarjee 2010; also after unpublished data of the first author) and *P. jongkyui* Choi, 1986 from Korea, however it clearly differs from both by following characters: pointed rostrum (versus rounded in *P. foveolata* and *P. jongkyui*), absence of developed anterior margin of notogaster (versus present in *P. foveolata*), genital plates with longitudinal striae (versus absent in *P. foveolata*), small notogastral porose areas (versus large in *P. jongkyui*) and the presence of median pore (absent in in *P. jongkyui*).

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