

## TWO NEW SPECIES OF ALLOGALUMNA (ACARI, ORIBATIDA, GALUMNIDAE) FROM MADAGASCAR

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Two new species of oribatid mites of the genus *Allogalumna* (Oribatida, Galumnidae) are described based on adult specimens from leaf litter in the Montagne d'Ambre National Park of Madagascar. *Allogalumna paramadagascarensis* **sp. n.** differs from *Allogalumna madagascarensis* by the morphology of notogastral porose areas *Aa*. *Allogalumna paravojnitsi* **sp. n.** differs from *Allogalumna vojnitsi* by the morphology of notogastral porose areas *Aa* and length of lamellar setae. An identification key to *Allogalumna*-species from Madagascar is presented.

Key words: galumnid mites, morphology, systematics, Madagascar, Ethiopian region.

### INTRODUCTION

*Allogalumna* (Acari, Oribatida, Galumnidae) was proposed by GRANDJEAN (1936) with *Galumna alamellae* Jacot, 1935 as type species. At present, *Allogalumna* comprises two subgenera (ERMILOV & KLIMOV 2017) and more than 50 species, having a cosmopolitan distribution. The generic and subgeneric diagnoses were summarized by ERMILOV and KLIMOV (2017).

During taxonomic identification of a random set of the Madagascar oribatid mites (Ethiopian region) which were received from the collection of the Moravian Museum in Brno (Czech Republic), we found two new species of *Allogalumna* (both belonging to the nominative subgenus).

The oribatid mite fauna of Madagascar has been poorly investigated, and only six species of *Allogalumna* are known from this country so far (BALOGH 1960, MAHUNKA 1996): *A. costata* Mahunka, 1996, *A. insolita* Mahunka, 1996, *A. longula* (Balogh, 1960), *A. madagascarensis* (Balogh, 1960), *A. pocsi* Mahunka, 1996, and *A. superporosa* Mahunka, 1996. The main goal of this paper is to describe and illustrate these new species. An additional goal of this paper is to present an identification key to known *Allogalumna* in Madagascar.

## MATERIAL AND METHODS

Oribatid mites were collected in the Montagne d'Ambre National Park (Madagascar) during a long-term official cooperation between the Moravian Museum in Brno (Czech Republic) and Université d'Antananarivo (Madagascar) in 2010–2014.

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Notogastral width refers to the maximum width of the notogaster in dorsal view (behind pteromorphs). Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus.

Drawings were made with a camera lucida using a Leica transmission light microscope "Leica DM 2500".

Morphological terminology used in this paper follows that of F. Grandjean (see ERMILOV & KLIMOV 2017 for review and application).

The following abbreviations are used: *S* = sublamellar line; *N* = prodorsal leg niche; *E*, *T* = lateral ridges of prodorsum; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial setae, respectively; *Ad* = dorsosejugal porose area; *D* = dorsophragma; *P* = pleurophragma; *c*, *la*, *lm*, *lp*, *h*, *p* = notogastral setal alveoli; *Aa*, *A1*, *A2*, *A3* = notogastral porose areas; *mp* = median pore; *ia*, *im*, *ip*, *ih*, *ips* = notogastral lyrifissures; *gla* = opisthotal gland opening; *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *v*, *cm*, *acm*, *ul*, *sul*, *vt*, *lt* = palp setae;  $\omega$  = palp and leg solenidion; *as* = axillary sacculle; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ; *I*, *II* = pedotecta I, II, respectively; *1b*, *3b*, *4a*, *4b* = epimeral setae; *dis* = discidium; *cp* = circumpedal carina; *g*, *ag*, *an*, *ad* = genital, aggenital, anal and adanal setae, respectively; *iad* = adanal lyrifissure; *po* = preanal organ; *Ap* = postanal porose area; *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = leg trochanter, femur, genu, tibia, tarsus, respectively; *pa* = leg porose area;  $\sigma$ ,  $\phi$  = leg solenidia;  $\varepsilon$  = leg famulus; *d*, *v*, *ev*, *bv*, *l*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = leg setae.

## SYSTEMATICS

Galumnidae Jacot, 1925

*Allogalumna* Grandjean, 1936

### *Allogalumna paramadagascarensis* sp. n.

(Figs 1–4)

Diagnosis. Body size: 315–348 × 232–265. Rostrum rounded. Bothridial seta long, slightly dilated in median part, ciliate unilaterally. Rostral, lamellar and interlamellar setae setiform, smooth, *ro* of medium size, *le* and *in* short. Dorsosejugal porose area oval. Dorsosejugal suture absent. Four pairs of rounded notogastral porose areas. Median pore present. Epimeral and anogenital setae short, setiform, smooth. Genital plate with one longitudinal strium in medial part. Postanal porose area oval. Solenidion of tibia IV inserted in the middle of the segment. Sexual dimorphism not observed.

Description. Measurements. Body length 332 (holotype, female), 315–348 (four paratypes, two females and two males); notogaster width 249 (holotype), 232–265 (four paratypes). No clear differences between females and males in body size.

Integument. Body color brown. Body surface (including pteromorphs, subcapitular mentum, genital and anal plates, legs) sparsely microfoveolate (visible under high magnification,  $\times 1000$ ). All leg femora and trochanters III, IV with rounded or elongate tubercles antiaxially. Genital plate with one longitudinal strium in medial part.

Prodorsum (Figs 1A, 2A). Rostrum broadly rounded. Sublamellar line slightly visible, thin, curving backwards. Prodorsal leg niches and lateral ridges of prodorsum well-developed. Rostral (32–36), lamellar (6–8) and interlamellar (2) setae setiform, thin, smooth, *ro* thickest. Bothridial seta (82–94) slightly dilated (in median part) and ciliate unilaterally. Exobothridial seta represented by alveolus. Dorsosejugal porose area (18–20  $\times$  6–8) elongate oval, transversely oriented, located posterolateral to *in*.

Notogaster (Figs 1A, 2A–C). Dorsosejugal suture absent. Dorsophragma elongated longitudinally, with variable number of components. With 10 pairs of setal alveoli and four pairs of rounded porose areas, *Aa* (12–16) larger than others (8–12). Median pore present in

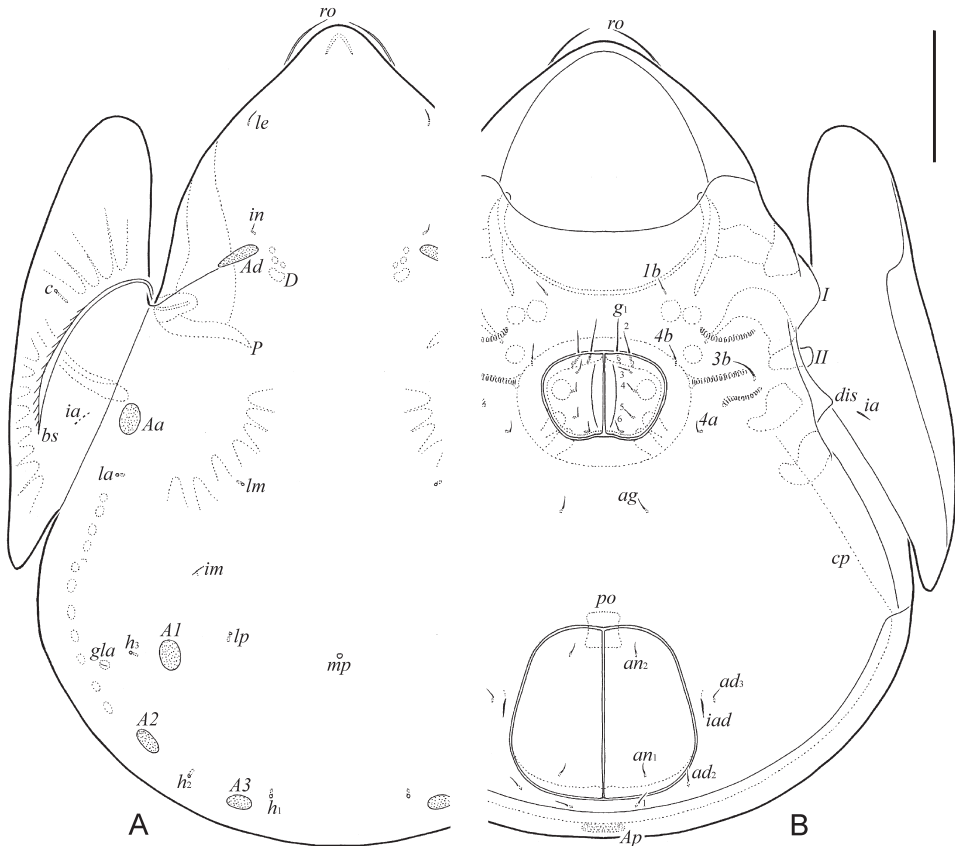
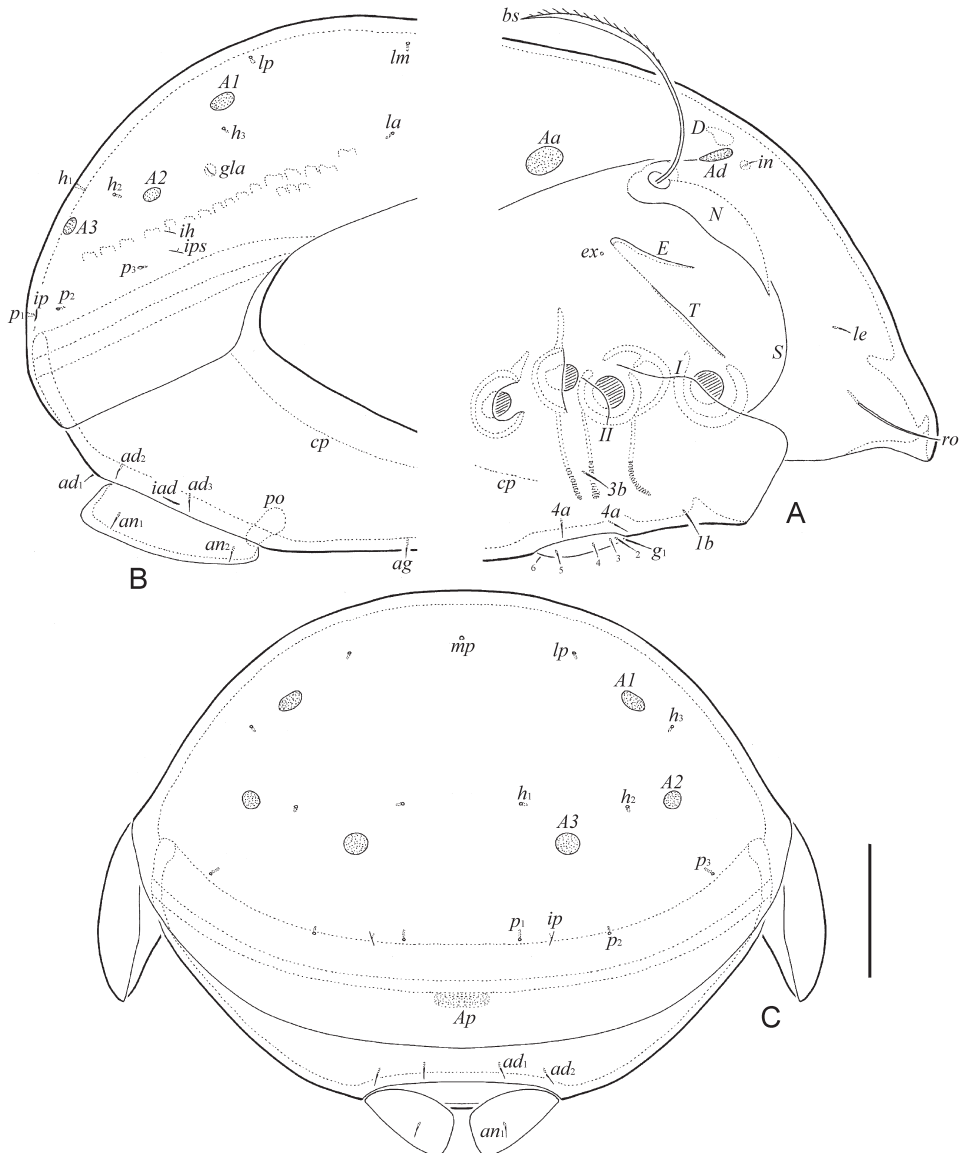


Fig. 1. *Allogalumna paramadagascarensis* sp. n., adult: A = dorsal view; B = ventral view (gnathosoma and legs not shown). Scale bar: 50  $\mu$ m

both sexes, located between *A1*. All lyrifissures distinct, *im* located between *lm* and *A1*, *ip* between *p*<sub>1</sub> and *p*<sub>2</sub>, *ih* and *ips* close to each other, anterior to *p*<sub>3</sub>. Opisthontal gland opening located posterolateral to *A1* and distanced from it.

Gnathosoma (Figs 3A-C). Subcapitulum longer than wide: 82–90 × 73–82. Three pairs of subcapitular setae setiform, smooth, *a* (14) longer and thicker than *m* (10) and *h* (6). Two



**Fig. 2.** *Allogalumna paramadagascarensis* sp. n., adult: A = anterior part of body, lateral view (pteromorph, gnathosoma and legs not shown); B = posterior part of body, lateral view; C = posterior view. Scale bar: 50  $\mu$ m

**Table 1.** Leg setation and solenidia of adult *Allogalumna paramadagascarensis* sp. n. and *A. paravojnitsi* sp. n.

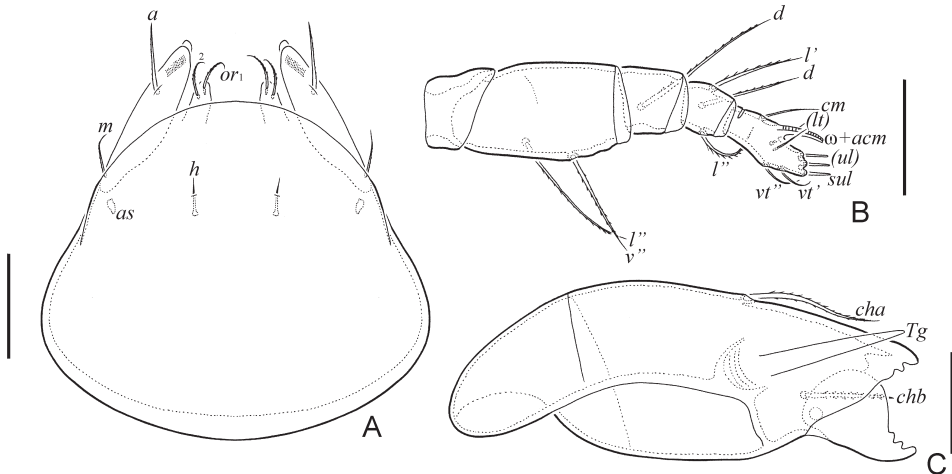
Leg	Tr	Fe	Ge	Ti	Ta
I	<i>v'</i>	<i>d, (l), bv''</i>	<i>(l), v', σ</i>	<i>(l), (v), φ<sub>1</sub>, φ<sub>2</sub></i>	<i>(ft), (tc), (it), (p), (u), (a), s, (pv), v', (pl), l'', ε, ω<sub>1</sub>, ω<sub>2</sub></i>
II	<i>v'</i>	<i>d, (l), bv''</i>	<i>(l), v', σ</i>	<i>(l), (v), φ</i>	<i>(ft), (tc), (it), (p), (u), (a), s, (pv), ω<sub>1</sub>, ω<sub>2</sub></i>
III	<i>v'</i>	<i>d, ev'</i>	<i>l', σ</i>	<i>l', (v), φ</i>	<i>(ft), (tc), (it), (p), (u), (a), s, (pv)</i>
IV	<i>v'</i>	<i>d, ev'</i>	<i>d, l'</i>	<i>l', (v), φ</i>	<i>ft'', (tc), (p), (u), (a), s, (pv)</i>

Note: Roman letters refer to normal setae, Greek letters to solenidia (except  $\epsilon$  = famulus). Single prime (') marks setae on anterior and double prime (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

pairs of adoral setae (10–12) setiform, roughened. Length of palp: 69–73. Axillary sacculle distinct, elongated. Postpalpal seta (4) spiniform, smooth. Length of chelicera: 98–106. Two cheliceral setae setiform, barbed, *cha* (28–32) longer than *chb* (18–20). Trägårdh's organ of chelicera long, elongate triangular.

Epimeral and lateral podosomal regions (Figs 1B, 2A). Anterior margin of epimere I smooth. Pedotectum I broadly rounded, pedotectum II quadrangular, rounded distally in ventral view. Discidium triangular. Circumpedial carina slightly visible, thin, directed to seta *3b*, but distinctly not reaching it. Epimeral setal formula: 1–0–1–2. Epimeral setae setiform, thin, smooth, *1b* and *3b* (10) longer than *4a* and *4b* (8).

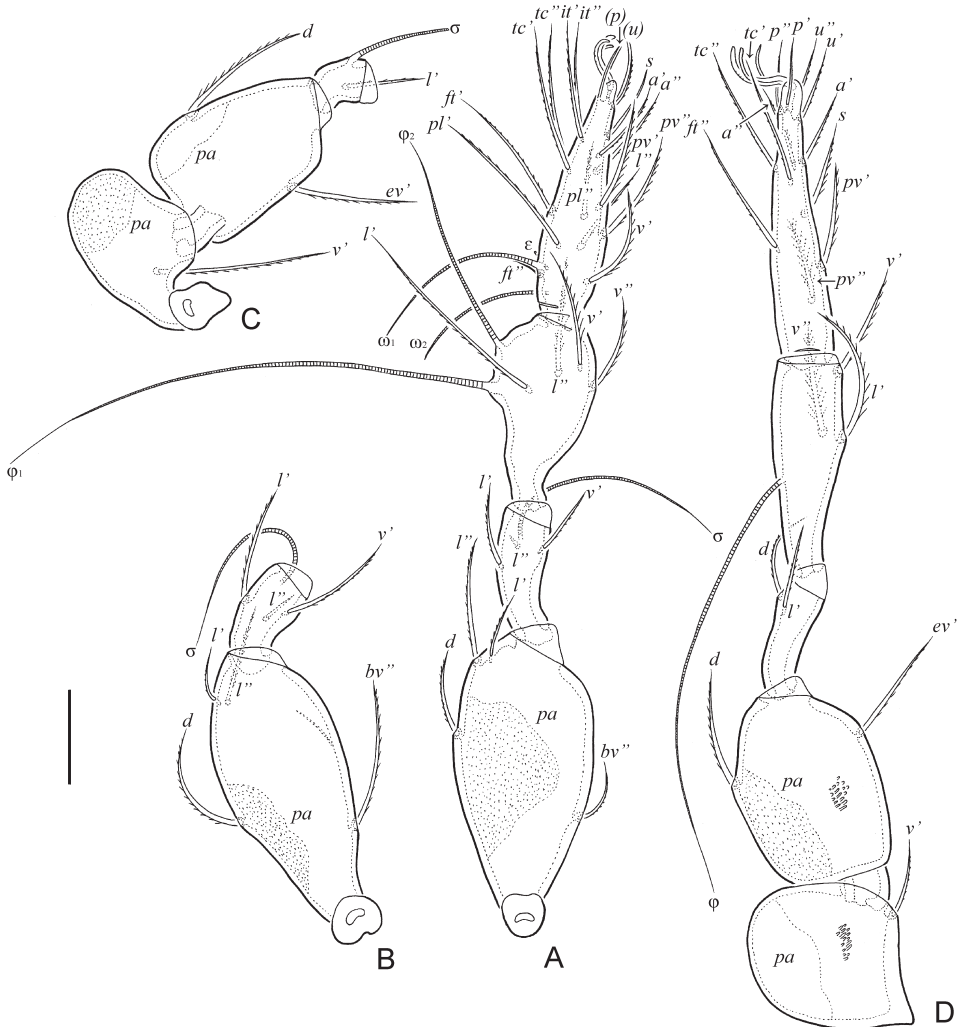
Anogenital region (Figs 1B, 2A–C). Six pairs of genital ( $g_1$ , 14;  $g_2$ , 10;  $g_3$ – $g_6$ , 6), one pair of aggenital (6), two pairs of anal (6) and three pairs of adanal (6) setae setiform, thin, smooth. Anterior edge of genital plate with two setae. Aggenital seta inserted between genital and anal apertures, closer to the former. Adanal lyrifissure located close and parallel to anal plate. Adanal setae  $ad_1$  and  $ad_2$  postanal,  $ad_3$  paraanal and lateral to *iad*. Distance  $ad_1$ – $ad_2$  shorter than  $ad_2$ – $ad_3$ . Unpaired postanal porose area oval (18–20 × 6–8).



**Fig. 3.** *Allogalumna paramadagascarensis* sp. n., adult: A = subcapitulum, ventral view; B = palp, left, paraxial view; C = chelicera, left, paraxial. Scale bars: 20  $\mu$ m

Legs (Figs 4A-D). Median claw distinctly thicker than laterals, all smooth on dorsal side. Porose area on all femora and on trochanters III, IV well visible. Formulas of leg setation and solenidia: I (1-4-3-4-20) [1-2-2], II (1-4-3-4-15) [1-1-2], III (1-2-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology of setae and solenidia indicated in Table 1. Famulus on tarsus I inserted lateral to solenidion  $\omega_1$ . Solenidion of tibia IV inserted in the middle of the segment.

Material examined. Holotype (female) and four paratypes (two females and two males): Madagascar, Montagne d'Ambre National Park, circuit Ampijoroana, evergreen



**Fig. 4.** *Allogalumna paramadagascarensis* sp. n., adult: A = leg I, without trochanter, left, paraxial view; B = femur and genu of leg II, left, paraxial view; C = trochanter, femur and genu of leg III, left, paraxial view; D = leg IV, left, antiaxial view. Scale bar: 20  $\mu$ m

rain forest, 12°31'28"S, 49°09'52"E, 950 m a.s.l., sifting of leaf litter sample under big unidentified tree, Winkler apparatus extraction, 13.I.2014 (R. Ravebolun and L. Rabotenson).

Type deposition. The holotype is deposited in the collection of the Senckenberg Institute, Görlitz, Germany. Four paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in ethanol with a drop of glycerol.

Etymology. The species name *paramadagascarensis* refers to the similarity between the new species and *Allogalumna madagascarensis* (Balogh, 1960).

Remarks. *Allogalumna paramadagascarensis* sp. n. is morphologically similar to *Allogalumna madagascarensis* (Balogh, 1960) from Madagascar (see BALOGH 1960, МАГУНКА 1996) in having small body size, bothridial seta dilated and ciliate unilaterally, rostral seta of medium size, lamellar and interlamellar setae short, four pairs of notogastral porose areas, median pore, and the absence of dorsosejugal suture. However, the new species differs from *A. madagascarensis* by the presence of rounded notogastral porose areas *Aa* (versus distinctly elongate triangular, transversely oriented).

Also, *A. paramadagascarensis* sp. n. is morphologically similar to *Allogalumna longula* (Balogh, 1960) from Madagascar (see BALOGH 1960) in having a small body size, bothridial seta dilated and ciliate unilaterally, lamellar and interlamellar setae short, four pairs of rounded notogastral porose areas, and the absence of dorsosejugal porose area. However, the new species differs from *A. longula* by the presence of an oval postanal porose area (versus band-like, unusually long), median pore (versus absent) and rostral setae of medium size (versus short), and the localization of notogastral porose areas *A1* (dorsomedially versus laterally on the notogaster).

### ***Allogalumna paravojnitsi* sp. n.**

(Figs 5–6)

Diagnosis. Body size: 332–348 × 232–265. Rostrum rounded. Bothridial seta long, with long stalk and small, elongate head, truncated and ciliated apically. Rostral, lamellar and interlamellar setae setiform, smooth, *ro* of medium size, *le* and *in* short. Dorsosejugal porose area oval. Dorsosejugal suture absent. Four pairs of notogastral porose areas, *Aa* triangular, transversely oriented, others rounded. Median pore present. Epimeral and anogenital setae short, setiform, smooth. Postanal porose area oval. Solenidion of tibia IV inserted in the middle of the segment. Sexual dimorphism not observed.

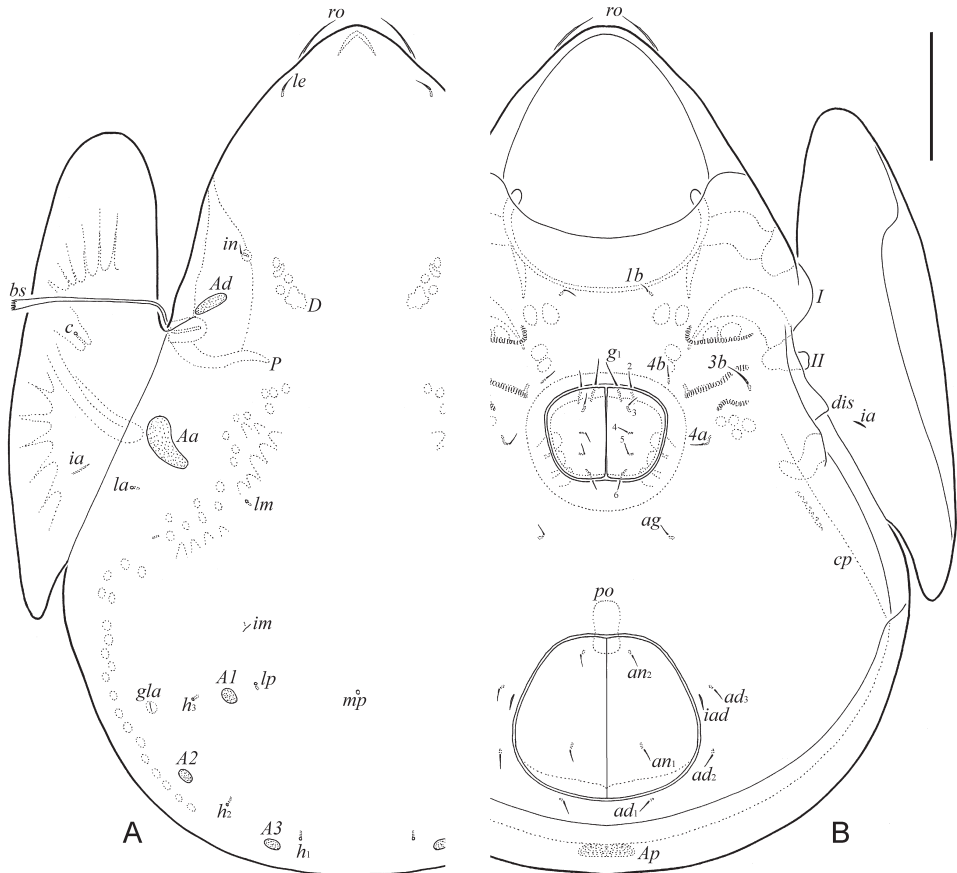
Description. Measurements. Body length 348 (holotype, female), 332–348 (five paratypes, one female and four males); notogaster width 249 (holotype), 232–265 (five paratypes). No clear differences between females and males in body size.

Integument. Body color light brown. Body surface (including pteromorphs, subcapitular mentum, genital and anal plates, legs) sparsely microfoveolate (visible under high

magnification,  $\times 1000$ ). All leg femora and trochanters III, IV with rounded or elongate tubercles antiaxially.

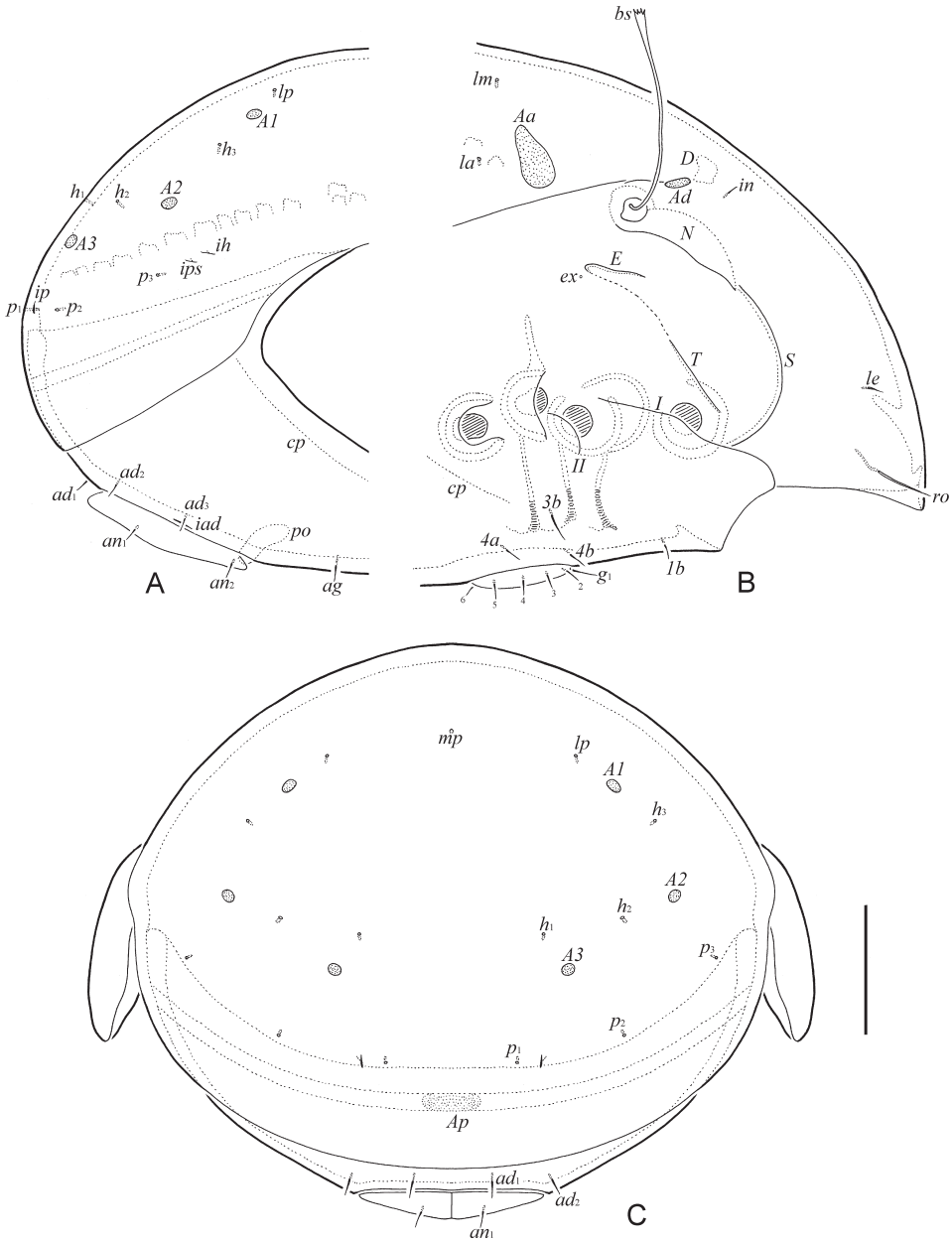
Prodorsum (Figs 5A, 6A). Rostrum broadly rounded. Sublamellar line slightly visible, thin, curving backwards. Prodorsal leg niches and lateral ridges of prodorsum well-developed. Rostral (26–28), lamellar (6–8) and interlamellar (2) setae setiform, thin, smooth, *ro* thickest. Bothridial seta (73–82) with long stalk and small, elongate head, truncated and ciliated apically. Exobothridial seta represented by alveolus. Dorsosejugal porose area ( $12-14 \times 6-8$ ) elongate oval, transversely oriented, located posterolateral to *in*.

Notogaster (Figs 5A, 6A–C). Dorsosejugal suture absent. Dorsophragma elongated longitudinally, with variable number of components. With 10 pairs of setal alveoli and four pairs of porose areas, *Aa* (length 24–32) triangular, transversely oriented, other porose areas rounded (6–10). Median pore present in both sexes, located between *A1*. All lyrifissures distinct, *im* located between *lm* and *A1* and closer to the later, *ip* between *p*<sub>1</sub> and *p*<sub>2</sub>, *ih* and *ips* close to each other, anterior to *p*<sub>3</sub>. Opisthotal gland opening located posterolateral to *A1* and distanced from it.



**Fig. 5.** *Allogalumna paravojnitsi* sp. n., adult: A = dorsal view; B = ventral view (gnathosoma and legs not shown). Scale bar: 50  $\mu$ m





**Fig. 6.** *Allogalumna paravojnitsi* sp. n., adult: A = anterior part of body, lateral view (ptero-morph, gnathosoma and legs not shown); B = posterior part of body, lateral view; C = posterior view. Scale bar: 50 μm

Gnathosoma. Generally, similar to *Allogalumna paramadagascarensis* sp. n. Subcapitulum longer than wide: 86–90 × 77–82. Three pairs of subcapitular setae setiform, smooth, *a* (12–14) longer and thicker than *m* (8–10) and *h* (6). Two pairs of adoral setae (10–12) setiform, roughened. Length of palp: 69–73. Axillary saccule distinct, elongated. Postpalpal seta (4) spiniform, smooth. Length of chelicera: 102–106. Two cheliceral setae setiform, barbed, *cha* (30–32) longer than *chb* (18–20). Trägårdh's organ of chelicera long, elongate triangular.

Epimeral and lateral podosomal regions (Figs 5B, 6A). Anterior margin of epimere I smooth. Pedotectum I broadly rounded, pedotectum II quadrangular, rounded distally in ventral view. Discidium triangular. Circumpedal carina slightly visible, thin, directed to seta *3b*, but distinctly not reaching it. Epimeral setal formula: 1–0–1–2. Epimeral setae setiform, thin, smooth, *3b* (10) longer than *1b*, *4a* and *4b* (6).

Anogenital region (Figs 5B, 6A–C). Six pairs of genital ( $g_1$ , 10;  $g_2$ – $g_6$ , 6), one pair of aggenital (6), two pairs of anal (6) and three pairs of adanal (6) setae setiform, thin, smooth. Anterior edge of genital plate with two setae. Aggenital seta inserted between genital and anal apertures, closer to the former. Adanal lyrifissure located close and parallel to anal plate. Adanal setae  $ad_1$  and  $ad_2$  postanal,  $ad_3$  paraanal and lateral to *iad*. Distance  $ad_1$ – $ad_2$  equal to  $ad_2$ – $ad_3$ . Unpaired postanal porose area oval (20 × 6–8).

Legs. Generally, similar to *Allogalumna paramadagascarensis* sp. n. Median claw distinctly thicker than laterals, all smooth on dorsal side. Porose area on all femora and on trochanters III, IV well visible. Formulas of leg setation and solenidia: I (1–4–3–4–20) [1–2–2], II (1–4–3–4–15) [1–1–2], III (1–2–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Famulus on tarsus I inserted lateral to solenidion  $\omega_1$ . Solenidion of tibia IV inserted in the middle of the segment.

Material examined. Holotype (female) and five paratypes (one female and four males): Madagascar, Montagne d'Ambre National Park, circuit Ampijoroana, evergreen rain forest, 12°31'28''S, 49°09'52''E, 950 m a.s.l., sifting of leaf litter sample under big unidentified tree, Winkler apparatus extraction, 13.I.2014 (R. Ravebolun and L. Rabotenson).

Type deposition. The holotype is deposited in the collection of the Senckenberg Institute, Görlitz, Germany. Five paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in ethanol with a drop of glycerol.

Etymology. The species name *paravojnitsi* refers to the similarity between the new species and *Allogalumna vojnitsi* Mahunka, 1993.

Remarks. *Allogalumna paravojnitsi* sp. n. is morphologically similar to *Allogalumna vojnitsi* Mahunka, 1993 from the Ethiopian region (see MAHUNKA 1993) in having small body size, bothridial seta with long stalk and short head truncated and ciliated apically, rostral seta of medium size, interlamellar setae short, four pairs of notogastral porose areas, median pore, and the absence of dorsosejugal suture. However, the new species differs from *A. paravojnitsi* by the presence of triangular notogastral porose areas *Aa* (versus rounded) and short lamellar setae (versus medium size).

KEY TO SPECIES OF *ALLOGALUMNA* FROM MADAGASCAR

1. Bothridial seta with developed head distally (2)
  - Bothridial seta setiform or dilated in median part (4)
2. Notogastral porose area *Aa* triangular; bothridial seta with small, elongate head, truncated apically; body size: 332–348 × 232–265  
*A. paravojnitsi* sp. n.
  - Notogastral porose area *Aa* rounded; bothridial seta with comparatively large head, rounded apically (3)
3. Notogaster strongly narrowed posteriorly; median pore absent; body size: 372–390 × 174–280 *A. superporosa* Mahunka, 1996
  - Notogaster normal, broadly narrowed posteriorly; median pore present; body size: 252–296 × 197–214 *A. pocsi* Mahunka, 1996
4. Notogastral porose area *Aa* triangular (5)
  - Notogastral porose area *Aa* rounded (6)
5. Notogastral porose areas *A1* and *A2* located very close to each other; bothridial seta with two to three cilia; body size: 394–428 × 312–340  
*A. insolita* Mahunka, 1996
  - Notogastral porose areas *A1* and *A2* removed from each other; bothridial seta with six to ten cilia; body size: 301–354 × 261–274  
*Allogalumna madagascarensis* (Balogh, 1960)
6. Genital and anal plates densely striate; body size: 542–598 × 403–445  
*A. costata* Mahunka, 1996
  - Genital and anal plates not densely striate (7)
7. Postanal porose area band-like, unusually long; median pore absent; notogastral porose area *A1* located laterally on the notogaster; body size: 341 × 210  
*A. longula* (Balogh, 1960)
  - Postanal porose area oval; median pore present; notogastral porose area *A1* located dorsomedially on the notogaster; body size: 315–348 × 232–265  
*A. paramadagascarensis* sp. n.

\*

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