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SUPPLEMENTARY DESCRIPTION OF TWO GALUMNID MITES, *PERGALUMNA TSAVOENSIS* AND *P. BIFISSURATA* (ACARI, ORIBATIDA, GALUMNIDAE)

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ABSTRACT: *Pergalumna tsavoensis* Mahunka, 1986 and *P. bifissurata* Hammer, 1972 are redescribed on the basis of specimens from Zambia and Brazil, respectively. The dentate anterior tectum of epimere I in *P. tsavoensis* and microgranular body surface, rounded rostrum and absence of postanal porose area in *P. bifissurata* should be considered in any future identification of these species.

KEY WORDS: oribatid mites, Galumnidae, *Pergalumna tsavoensis*, *P. bifissurata*, supplementary description, Zambia, Brazil

INTRODUCTION

Two species of the genus *Pergalumna*, *P. tsavoensis* Mahunka, 1986 from Kenya and *P. bifissurata* Hammer, 1972 from Tahiti, were described by Hammer (1972) and Mahunka (1986), respectively. To the present, *P. tsavoensis* is also recorded in Zambia (Ermilov 2012), whilst *P. bifissurata* is known from the Galápagos Islands (Schatz 1998) and Brazil (our data, see *Material and Methods*).

The original descriptions of both species are incomplete (lacking information about the lengths of morphological structures, leg setation and solenidia, gnathosoma). Besides, authors have not described some important diagnostic characters (see *Remarks*). The main goal of this paper is to redescribe and illustrate *P. tsavoensis* and *P. bifissurata* based on new material from Zambia and Brazil.

MATERIAL AND METHODS

Seven specimens (two females and five males) of *P. tsavoensis* Mahunka, 1986: Zambia, 53°16′34″N, 108°41′39″E, environs of Livingstone, Victoria Falls Gorge, rain forest, soil litter, 20.05.2011, collected by W. Niedbała.

Four specimens (one female and three males) of *P. bifissurata* Hammer, 1972: Brazil, 23°33′S 46°39′W, São Paulo, Parque Trianon, Atlantic forest, soil litter (unknown date and collector).

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. 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. General terminology used in this paper follows that of Grandjean (summarized by Norton and Behan-Pelletier 2009). Drawings were made with a drawing tube using the Carl Zeiss transmission light microscope “Axioskop-2 Plus”. Images were obtained by the AxioCam ICc3 camera using the Carl Zeiss transmission light microscope “Axio Lab.A1”.

SUPPLEMENTARY DESCRIPTIONS

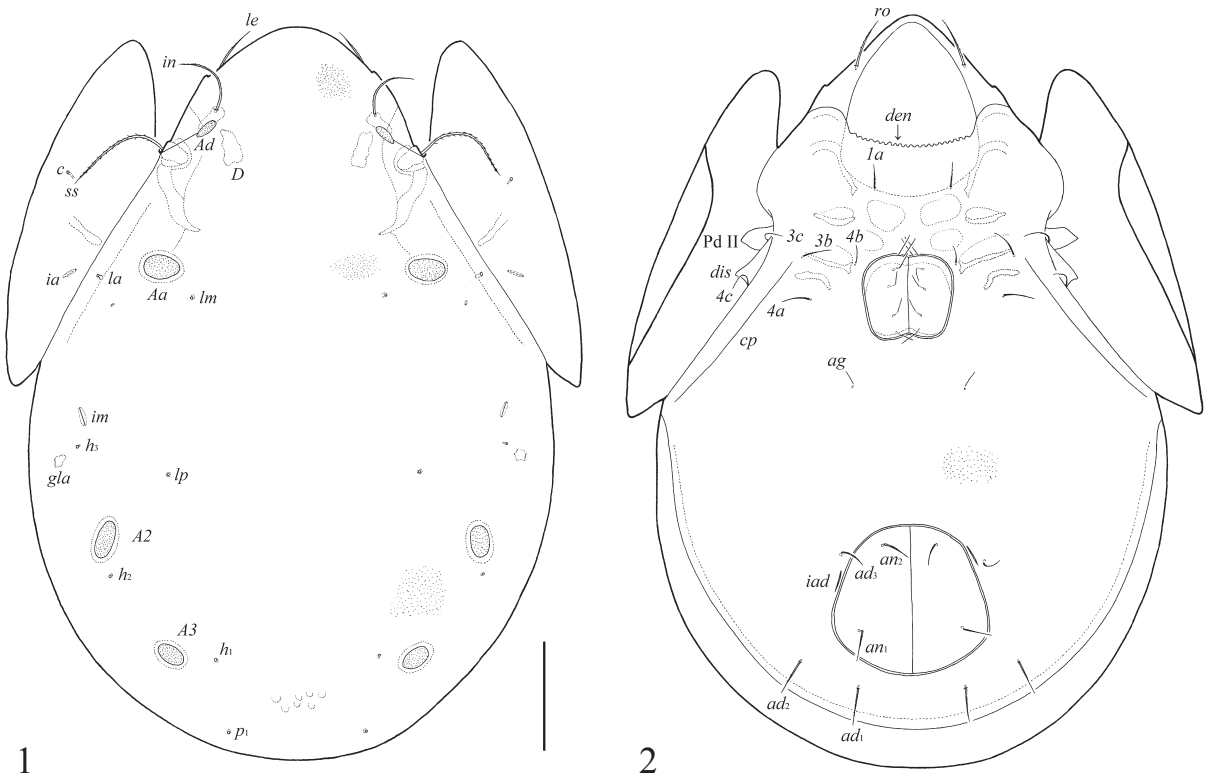
Pergalumna tsavoensis Mahunka, 1986

(description based on specimens from Zambia)

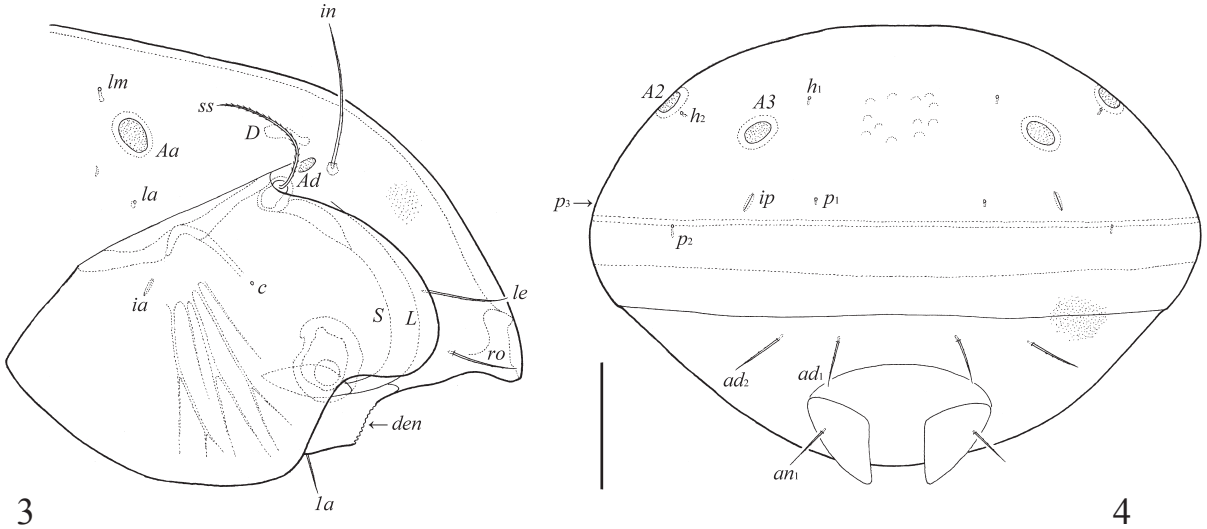
Figs 1–11

Measurements. Body length: 664–747 (seven specimens: two females and five males); notogastral width (without pteromorphs): 464–514 (seven specimens).

Integument (Figs 1–5, 11). Body color dark brown. Body surface, pteromorphs, subcapitular mentum, genital and anal plates covered by dense microgranular cerotegument (granules rounded, their diameter less than 1). Anogenital region with two lateral, transversal striate bands, which are located between genital and anal plates, and one arcuate striate band, which is located posteriorly to anal plates, extending marginally into the ano-adanal region (for example, as in *Pergalumna boliviana* Ermilov, 2013 — see Ermilov and Niedbała 2013, *P. paratsurusakii* Ermilov, Shtanchaeva, Kalúz et Subías, 2013 — see Ermilov et al. 2013,



Figs 1–2. *Pergalumna tsavoensis* Mahunka, 1986, adult: 1 — dorsal view; 2 — ventral view (gnathosoma and legs not illustrated). Scale bar 100 μm.

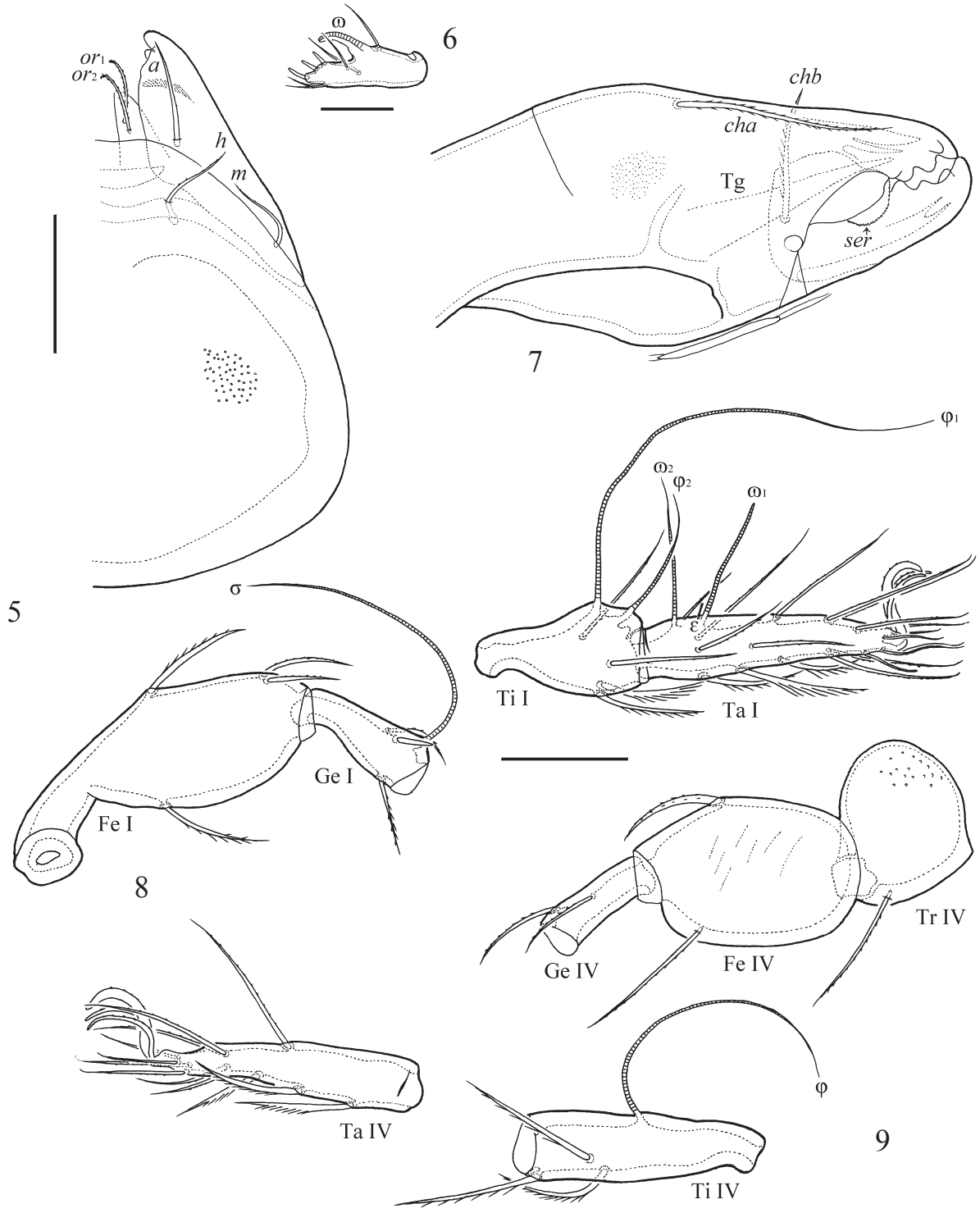


Figs 3–4. *Pergalumna tsavoensis* Mahunka, 1986, adult: 3 — lateral view of anterior part of body (gnathosoma and leg I not illustrated); 4 — posterior view. Scale bar 100 μm.

and *P. minituberculata* Ermilov et Martens, 2014 — see Ermilov and Martens 2014), however, all these bands visible only in dissected specimens.

Prodorsum (Figs 1, 3). Rostrum rounded. Lamellar (*L*) and sublamellar (*S*) lines distinct, parallel, curving backwards. Rostral setae (*ro*, 53–61), lamellar (*le*, 65–69) and interlamellar (*in*, 114–123) setae simple, barbed. Bothridial setae (*ss*, 123–135) setiform, with numerous short cilia bilaterally. Exobothridial setae absent without vestige. Porose areas *Ad* oval (20–24 × 8–10).

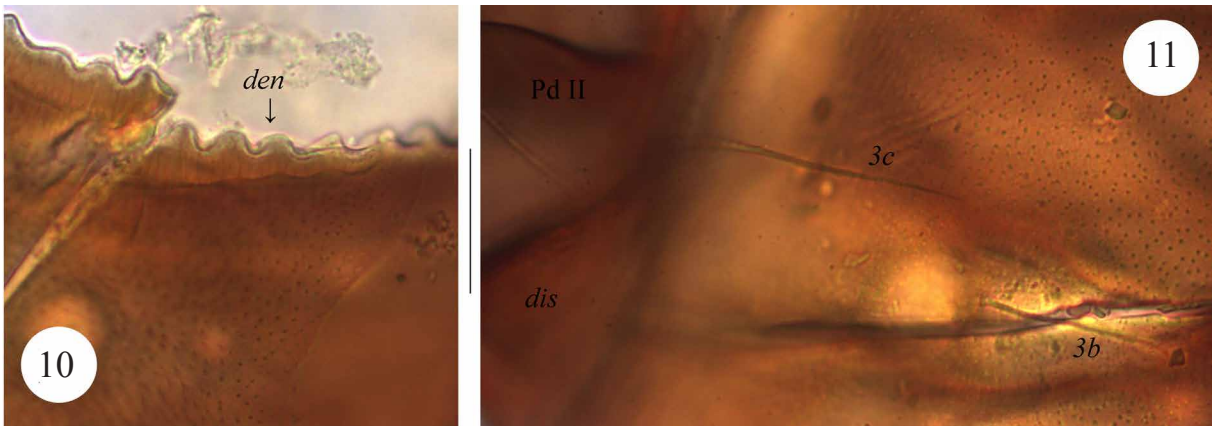
Notogaster (Figs 1, 3, 4). Anterior notogastral margin not developed. Dorsophragmata (*D*) of medium size, elongated longitudinally. Notogastral setae represented by 10 pairs of alveoli. Three pairs of oval porose areas well visible, with distinct margins: *Aa* weakly transversally oriented (28–36 × 16–20), *A2* (26–36 × 12–20), *A3*



Figs 5–9. *Pergalumna tsavoensis* Mahunka, 1986, adult: 5 — subcapitulum, left half, ventral view; 6 — palptarsus; 7 — anterior part of chelicera; 8 — leg I (without trochanter), right, antiaxial view; 9 — leg IV, right, antiaxial view. Scale bars 50 μm (5, 7–9), 20 μm (6).

(20–24 × 14–16). Porose areas *Aa* located between notogastral alveoli *la* and *lm*. Alveoli *la* inserted near to hinges. Median pore absent. All lyrifissures distinct; *im* located anteriorly to h_3. Opisthonotal gland openings (*gla*) located lateroposteriorly to h_3.

Gnathosoma (Figs 5–7). Morphology of subcapitulum, palps and chelicerae typical for *Pergalumna* (for example, Engelbrecht 1972; Ermilov et al. 2010; Ermilov and Anichkin 2011). Subcapitulum longer than wide (159–164 × 127–139). Subcapitular setae setiform, slightly barbed; *a* (32–36)



Figs 10–11. *Pergalumna tsavoensis* Mahunka, 1986, adult, microscope images: 10 — part of anterior tectum of epimere I; 11 — part of epimeral region with setae 3b and 3c. Scale bar 20 μm.

longer than *m* and *h* (both 24–28). Two pairs of adoral setae (or_1, or_2, 20) setiform, hook-like distally, barbed. Palps (127) with setation 0–2–1–3–9(+ω). Solenidion attached to eupathidium, both located on dorsal tubercle. Chelicerae (200–204) with two setiform, barbed setae; *cha* (53–57) longer than *chb* (36–41). Basal part of digits in paraxial view with serrate ledge (*ser*). Trägårdh's organ (Tg) long, tapered.

Epimeral and lateral podosomal regions (Figs 2, 3, 10, 11). Anterior tectum of epimere I with numerous rectangular teeth (*den*). Apodemes 1, 2, sejugal and 3 well visible. Six pairs of setiform, slightly barbed epimeral setae observed; setal formula: 1–0–2–3. Setae *3b*, *3c*, *4a*, *4c* (36–45) longer than *1a* (28–32) and *4b* (20–24). Pedotecta II (Pd II) scale-like, pointed in ventral view. Discidia (*dis*) pointly triangular. Circumpedal carinae (*cp*) distinct, directed posterior of setae *3b*.

Anogenital region (Figs 2, 4). Six pairs of genital (g_1, g_2, 20–24; g_3–g_6, 16–20), one pair of aggenital (*ag*, 16–20), two pairs of anal (an_1, an_2, 36–41) and three pairs of adanal (ad_1, ad_2, 45–57; ad_3, 20) setae thin, slightly barbed. Anterior parts of genital edges with two setae. Adanal setae ad_3 inserted laterally or anteriorly (sometimes asymmetrically) to adanal lyrifissures (*iad*). Postanal porose area absent.

Legs (Figs 8, 9). Morphology of leg segments, setae and solenidia typical for *Pergalumna* (for example, Engelbrecht 1972; Ermilov et al. 2010; Ermilov and Anichkin 2011). Claws serrate on dorsal side. Formulae 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. Solenidion φ on tibia IV inserted in the middle part.

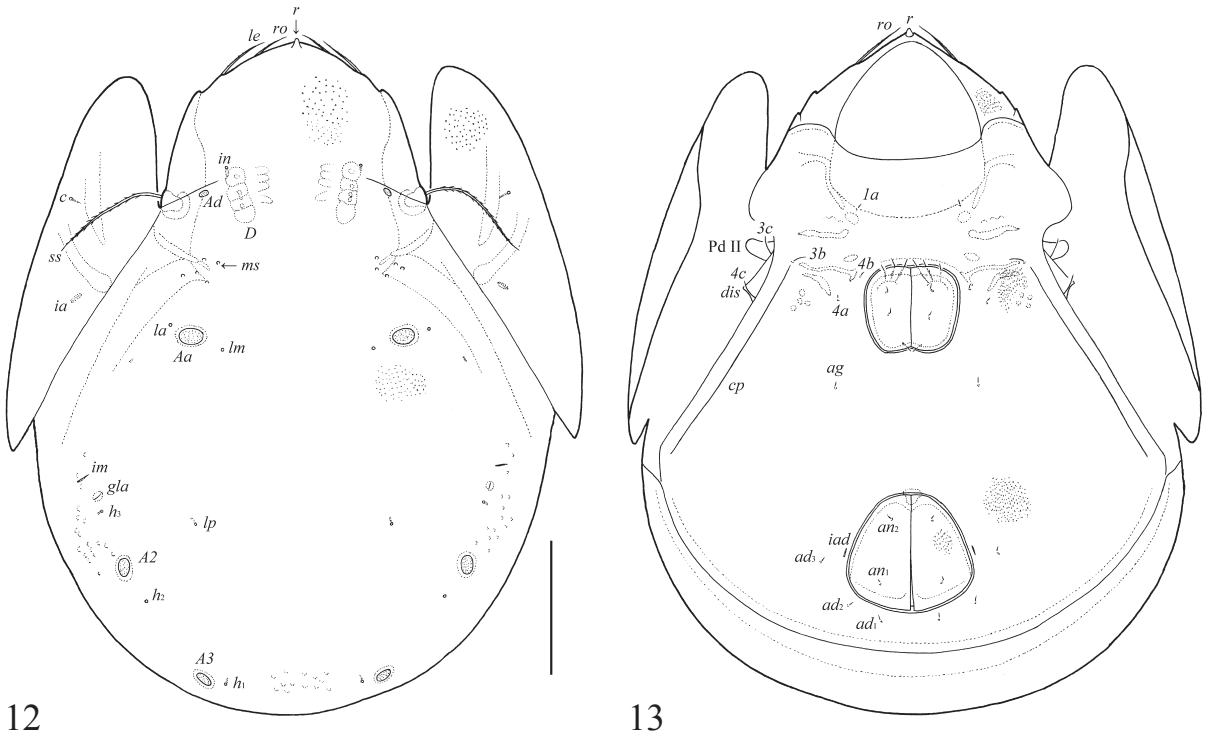
Remarks. The specimens of *P. tsavoensis* from Zambia are similar in general appearance to those from Kenya according to the original description (Mahunka 1986). However, they are distinguishable from the latter by the following characters: 1) rostral setae are distant from lamellar lines (versus inserted near to lamellar lines in specimens from Kenya), 2) porose areas Ad smaller than notogastral porose areas (versus similar in size in Kenyan specimens). We believe these differences represent intraspecific (perhaps geographical) variability.

Also, the specimens from Zambia have specific structure of anterior tectum of epimere I: with

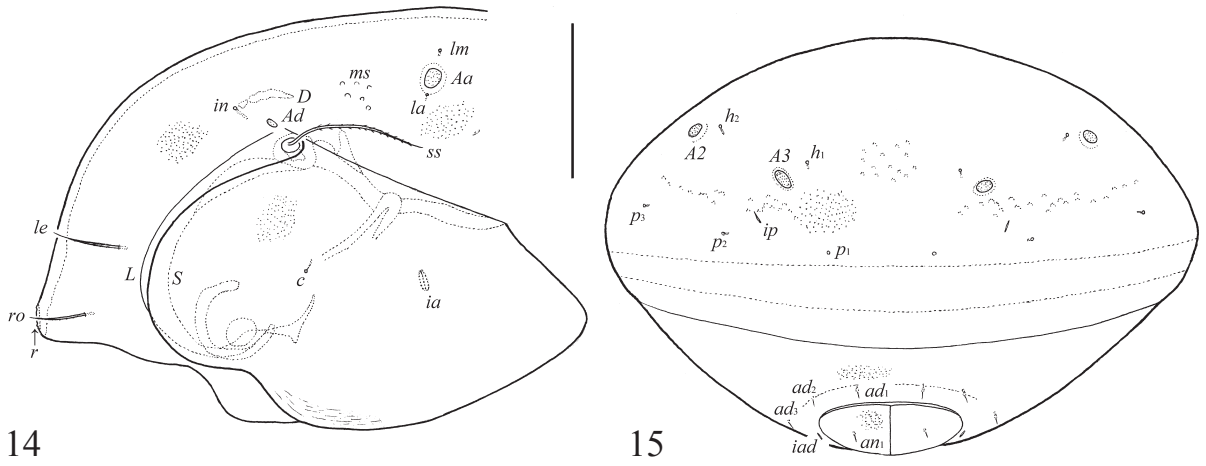
Table 1.
Leg setation and solenidia of *Pergalumna tsavoensis* Mahunka, 1986 (same data for *P. bifissurata* Hammer, 1972)

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v′*	*d, (l), bv″*	*(l), v′,* σ	*(l), (v),* $φ_1$, $φ_2$	*(ft), (tc), (it), (p), (u), (a), s, (pv), v′, (pl), l″,* ε, $ω_1$, $ω_2$
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 (ε 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 pair of setae.



Figs 12–13. *Pergalumna bifissurata* Hammer, 1972, adult: 12 — dorsal view; 13 — ventral view (gnathosoma and legs not illustrated). Scale bar 100 μm.



Figs 14–15. *Pergalumna bifissurata* Hammer, 1972, adult: 14 — lateral view of anterior part of body (gnathosoma and leg I not illustrated); 15 — posterior view. Scale bar 100 μm.

numerous rectangular teeth. The dentate tectum is very rare in the Galumnidae; for example, it is known in *Galumna crenata* Deb et Raychaudhuri, 1975 (see Deb and Raychaudhuri 1975; Sarkar et al. 2007; Ermilov et al. 2014). Mahunka (1986) illustrated the anterior tectum of epimere I of *P. tsavoensis* as smooth (Fig. 49 in Mahunka 1986). However, we studied the type material and can confirm that Kenyan specimens have a dentate tectum. Hence, new data should be considered in any future identification of this species.

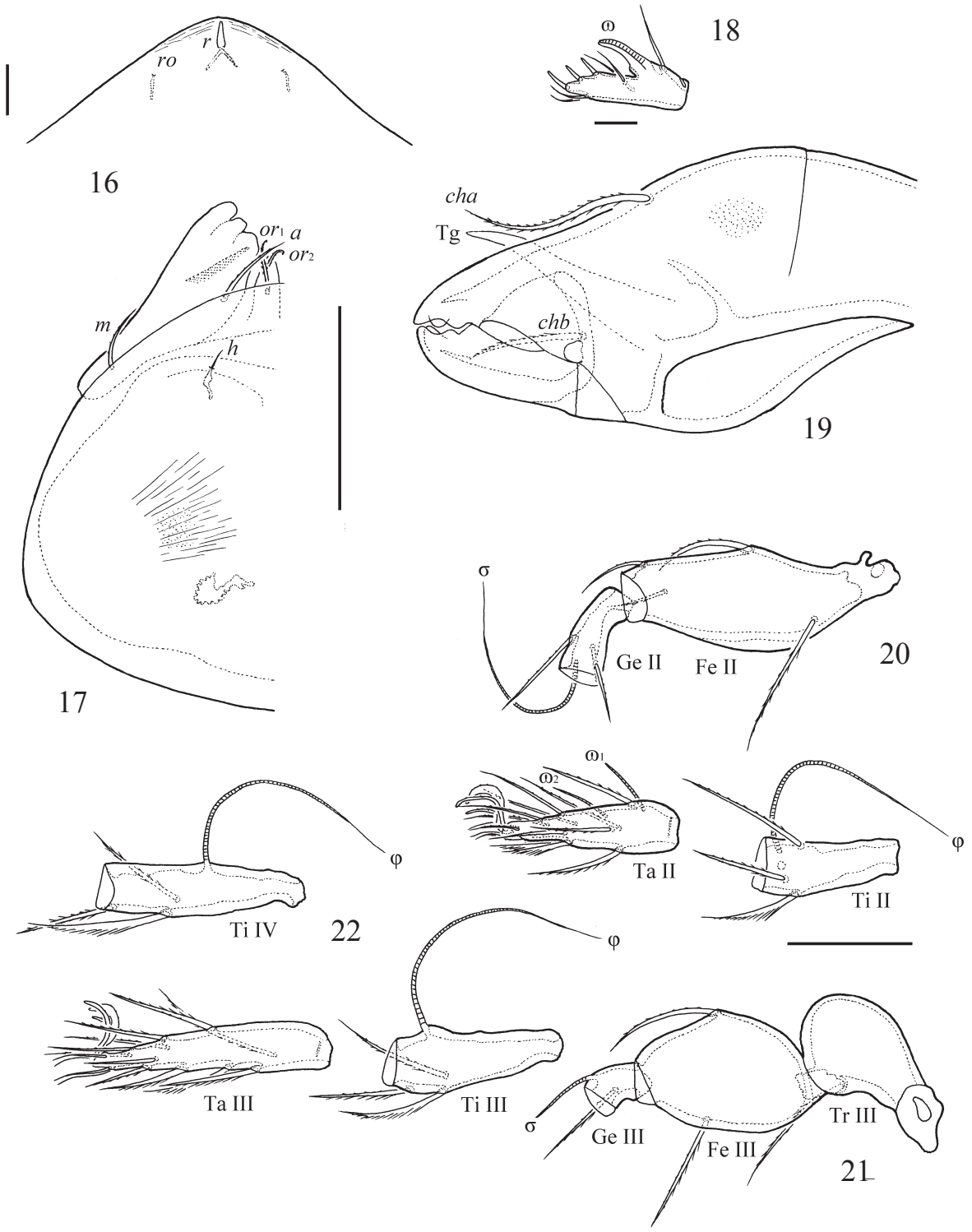
Pergalumna bifissurata **Hammer, 1972**

(description based on specimens from Brazil)

Figs 12–24

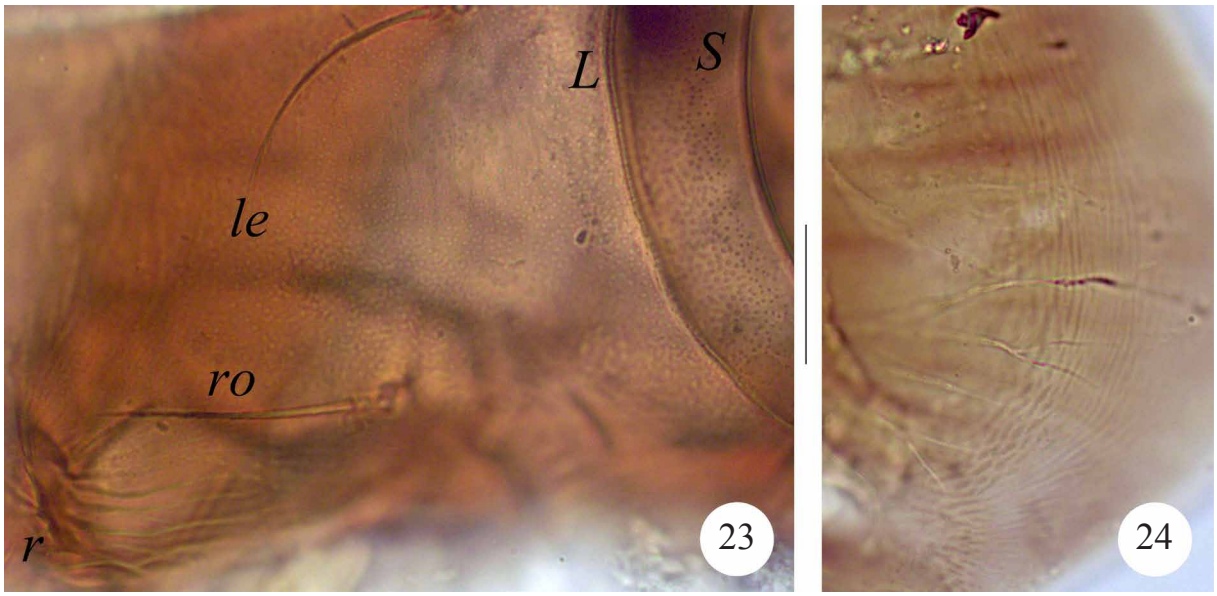
Measurements. Body length: 514–581 (four specimens: one female and three males); notogastral width (without pteromorphs): 398–415 (four specimens).

Integument (Figs 12–15, 17, 23, 24). Body color dark brown. Body surface, pteromorphs, subcapitular mentum, genital and anal plates cov-



Figs 16–22. *Pergalumna bifissurata* Hammer, 1972, adult: 16 — rostrum, frontal view; 17 — subcapitulum, right half, ventral view; 18 — palptarsus; 19 — anterior part of chelicera; 20 — leg II (without trochanter), left, antiaxial view; 21 — leg III, left, paraxial view; 22 — tibia of leg IV, left, paraxial view. Scale bars 20 μm (16), 50 μm (17, 19–22), 10 μm (18).

ered by dense microgranular cerotegument (granules rounded, their diameter less than 1). Microgranules sometimes connected by the raised lines, forming the longitudinal striate patterns on prodorsum and epimeral region and reticulate patterns on basal part of pteromorphs and anal plates, but these patterns visible only in dissected specimens. Also, distal part of pteromorphs and subcapitular



Figs 23–24. *Pergalumna bifissurata* Hammer, 1972, adult, microscope images: 23 — latero-frontal part of anterior part of prodorsum; 24 — striae in distal part of pteromorph. Scale bar 20 μm.

mentum with striae. Anogenital region with striate bands as in *Pergalumna tsavoensis*; bands visible only in dissected specimens.

Prodorsum (Figs 12–14, 16, 23). Rostrum distally rounded; antero-medially with strong longitudinal dorsal ridge (*r*), creating illusion of a pointed rostrum in dorsal view. Lamellar and sublamellar lines distinct, parallel, curving backwards. Rostral setae (36–41), lamellar (45–49) setae simple, slightly barbed. Interlamellar setae absent, represented by alveoli. Bothridial setae (98–110) setiform, with numerous short cilia bilaterally. Exobothridial setae absent without vestige. Porose areas *Ad* small, oval (8 × 4).

Notogaster (Figs 12, 14, 15, 24). Anterior notogastral margin not developed. Dorsophragmata long, elongated longitudinally. Notogastral setae represented by 10 pairs of alveoli. Three pairs of oval porose areas well visible, with distinct margins: *Aa* weakly transversally oriented (20–24 × 12–16), *A2* (16–24 × 8–16), *A3* (12–20 × 8–12). Porose areas *Aa* located between notogastral alveoli *la* and *lm*. Alveoli *la* clearly removed from hinges. Five to six muscle sigillae (*ms*) located anteriorly to *Aa*. Median pore absent. All lyrifissures distinct; *im* and opisthonotal gland openings located latero-anteriorly to h_3.

Gnathosoma (Figs 17–19). Morphology of subcapitulum, palps and chelicerae typical for *Pergalumna* (for example, Engelbrecht 1972; Ermilov et al. 2010; Ermilov and Anichkin 2011). Subcapitulum longer than wide (159–164 × 127–139). Subcapitular setae setiform, slightly barbed; *h* (8) shorter and thinner than *m* and *a* (both 24). Two pairs of adoral setae (16) setiform, hook-like distally, barbed. Palps (114) with setation 0–2–1–3–9(+ω). Solenidion attached to eupathidium, both located on dorsal tubercle. Chelicerae (176) with two setiform, barbed setae; *cha* (49–53) longer than *chb* (28–32). Trägårdh's organ long, tapered.

Epimeral and lateral podosomal regions (Fig. 13). Anterior tectum of epimere I smooth. Apodemes 1, 2, sejugal and 3 well visible. Six pairs of setiform, smooth epimeral setae observed; setal formula: 1–0–2–3. Setae *3b*, *3c*, *4c* (20–28) longer than *1a*, *4a*, *4b* (6–12). Pedotecta II scale-like, rounded in ventral view. Discidia pointly triangular. Circumpedal carinae distinct, directed posterior of setae *3b*.

Anogenital region (Figs 13, 15). Six pairs of genital (g_1, g_2, 8–12; g_3, 6–10; g_4–g_6, 4–8), one pair of aggenital (6–10), two pairs of anal (6–10) and three pairs of adanal (6–10) setae thin, smooth. Anterior parts of genital edges with three setae. Adanal setae ad_3 inserted laterally to adanal lyrifissures. Postanal porose area absent.

Legs (Figs 20–22). Morphology of leg segments, setae and solenidia typical for *Pergalumna* (for example, Engelbrecht 1972; Ermilov et al. 2010; Ermilov and Anichkin 2011). Claws serrate on dorsal side. Formulae 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 in-

dicated in Table 1. Solenidion φ on tibia IV inserted in the middle part.

Remarks. The specimens of *P. bifissurata* from Brazil are similar in general appearance to the specimens from Tahiti according to the original description (Hammer 1972), but differ from the latter by the smaller body length (514–581 versus 620 in the Tahiti specimens). We believe this difference represents intraspecific (perhaps geographical) variability.

Also, we mark three important additions to the original description:

1) Hammer (1972) not described and illustrated the body surface. The specimens from Brazil have dense microgranular cerotegument; microgranules sometimes connected by the raised lines, forming the longitudinal striate patterns on prodorsum and epimeral region and reticulate patterns on basal part of pteromorphs, but these microgranules and patterns are visible only in dissected specimens.

2) Hammer (1972) described rostrum as being pointed. It seems like that in dorsal and ventral views, but it appears to be illusory. The prodorsum has a strong longitudinal dorsal ridge antero-medially. This ridge creates illusion of the pointed rostrum. In fact, the rostrum is rounded (that is well visible in lateral or frontal views).

3) Hammer (1972) stated: "… area porose postanalis is very indistinct and might be questionable". Brazilian specimens are without postanal porose area.

Hence, new data should be considered in any future identification of this species.

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