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Article

Nymphal instars of *Pergalumna cienfuegosensis* (Acari, Oribatida, Galumnidae)

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ABSTRACT

This article describes the nymphal instars of *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (Oribatida, Galumnidae), based on material collected from leaf litter near a stream in a mixed forest in the Cienfuegos Province, Southern Cuba. The nymphs are characterized by a tripartite rostrum; transverse, concave medial prodorsal ridge; medium-sized rostral seta; long lamellar seta; short interlamellar and exobothridial setae; long, clavate, barbed bothridial seta; distinct gastronotic shield (macrosclerite); gastronotic setae of *d*-, *l*-, *h*-, and *p*-series represented by their alveoli (except short p_1–p_3 in protonymphal instar); transverse band on gastronotum and in aggenital region; two tubercles on subcapitular mentum; lamina between leg acetabula I and II; dorsal tooth on leg trochanter IV; and a delay in the development of some leg setae. Differences between the juvenile instars of *P. cienfuegosensis* and those of other known *Pergalumna* species are provided.

KEY WORDS: Cuba, juvenile instar, morphology, ontogeny, oribatid mite.

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INTRODUCTION

The genus *Pergalumna* Grandjean, 1936 (Acari, Oribatida, Galumnidae) was proposed by Grandjean (1936), with *Oribata nervosa* Berlese, 1914 as type species. The genus comprises two subgenera with about 200 species, which collectively have a cosmopolitan distribution (Subías 2022, online version 2024; including personal data).

Juvenile instars of *Pergalumna* are poorly studied. At present, juvenile data on five species (all from the nominate subgenus) are known (see summarized data in Norton and Ermilov 2014, 2024). Cooreman (1941) investigated the larval instar of *P. nervosa* (Berlese, 1914). Later, Sengbusch (1954), Seniczak (1972), Grishina (1977), and Seniczak *et al.* (2012) described all juvenile instars of this species. Rockett and Woodring (1966) studied larval and tritonymphal instars of *P. emarginata* (Banks, 1895) (as *P. omniphagous*). Bayartogtokh and Ermilov (2017) described the nymphal instars of *P. myrmophila* (Berlese, 1914) and *P. striatiprodorsum* Ermilov, Alvarado-Rodríguez & Retana-Salazar, 2014. Páez *et al*. (2019) investigated all juvenile instars of *P. ekaterinae* Páez, Villagomez & Palacios-Vargas, 2019. A comparative morphological analysis of juvenile instars of species belonging to Galumnidae was published by Bayartogtokh and Ermilov (2017).

In the course of a taxonomic survey of oribatid mite material from Cuba, we found adult and

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nymphal instars of *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023. The main goal of this paper is to describe the juveniles of this species and to compare them with those of other *Pergalumna* species.

MATERIAL AND METHODS

Specimens – Adults (25 specimens) and juvenile instars (eight protonymphs, six deutonymphs, and four tritonymphs) were collected from Southern Cuba, 22° 1′ N, 80° 7′ W, Cienfuegos Province, Sierra del Escambray, El Nicho, leaf litter near a stream in a mixed forest (data and collector unknown).

Juvenile specimens were associated with adults using criteria outlined by Norton and Ermilov (2014). In particular, they were found in the same sample and had the appropriate sizes and proportions.

Observation and documentation – For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. All measurements are in micrometers; body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the gastronotum; gastronotic width refers to the maximum measure on intact/unbroken specimens in dorsal aspect; setal lengths were measured in lateral aspect. 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 DM 2500 transmission light microscope.

Terminology – Morphological terminology is mostly that of Grandjean (references in Travé and Vachon 1975); leg setal nomenclature follows Norton (1977).

Abbreviations – *Prodorsum*: *lr* = lateral ridge; *mr* = medial ridge; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial setae, respectively. *Gastronotic region*: *b* = band; *c-*, *d-*, *l-*, *h-*, *p-* = series of setae; *ia*, *im*, *ip*, *ih*, *ips* = cupules; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *sup*, *inf*, *d*, *cm*, *acm*, *ul*, *su*, *vt*, *lt* = palp setae; *as* = axillary saccule; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *4a*, *4b*, *4c* = epimeral setae; *oh* = humeral organ; *z* = aperture of supracoxal gland; *l* = lamina; *t* = tooth. *Anogenital region*: *b* = band; *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal setae, respectively; *iad* = cupule. *Legs*: *t* = tooth; ω, φ, σ = solenidia; *e* = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = setae. *Instars*: PN, DN, TN, AD = protonymphal, deutonymphal, tritonymphal, and adult instars, respectively.

TAXONOMY

Family Galumnidae
Pergalumna Grandjean, 1936
Subgenus *Pergalumna* (*Pergalumna*) Grandjean, 1936

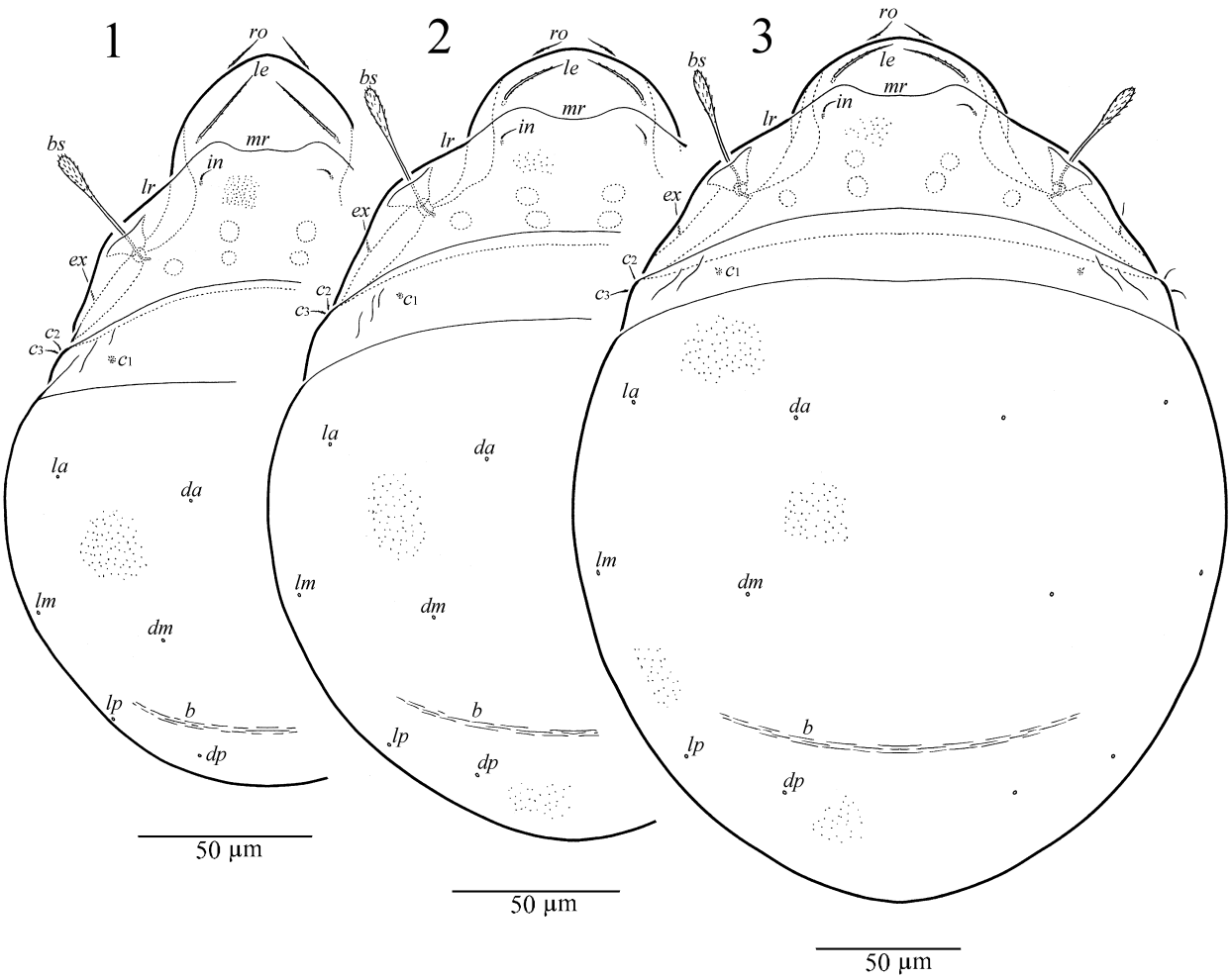
Type species: *Oribata nervosa* Berlese, 1914

Pergalumna cienfuegosensis Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (Figs. 1–16)

Description of nymphal instars

Measurements – Total lengths: PN: 199–232; DN: 232–255; TN: 277–315. Total widths: PN: 199–232; DN: 232–255; TN: 277–315.

Integument (Figs. 1–6, 10–12, 16) – Body cuticle pale to grey; legs and subcapitulum usually slightly darker. Surface densely microgranulate; granules slightly visible, but on prodorsum as well as on gastronotic and circumgenital macrosclerites larger and clearer; anterolateral part of gastronotic region between setae c_1 and c_2 with sparse folds; dorsal side of leg trochanter IV heavily granulate.

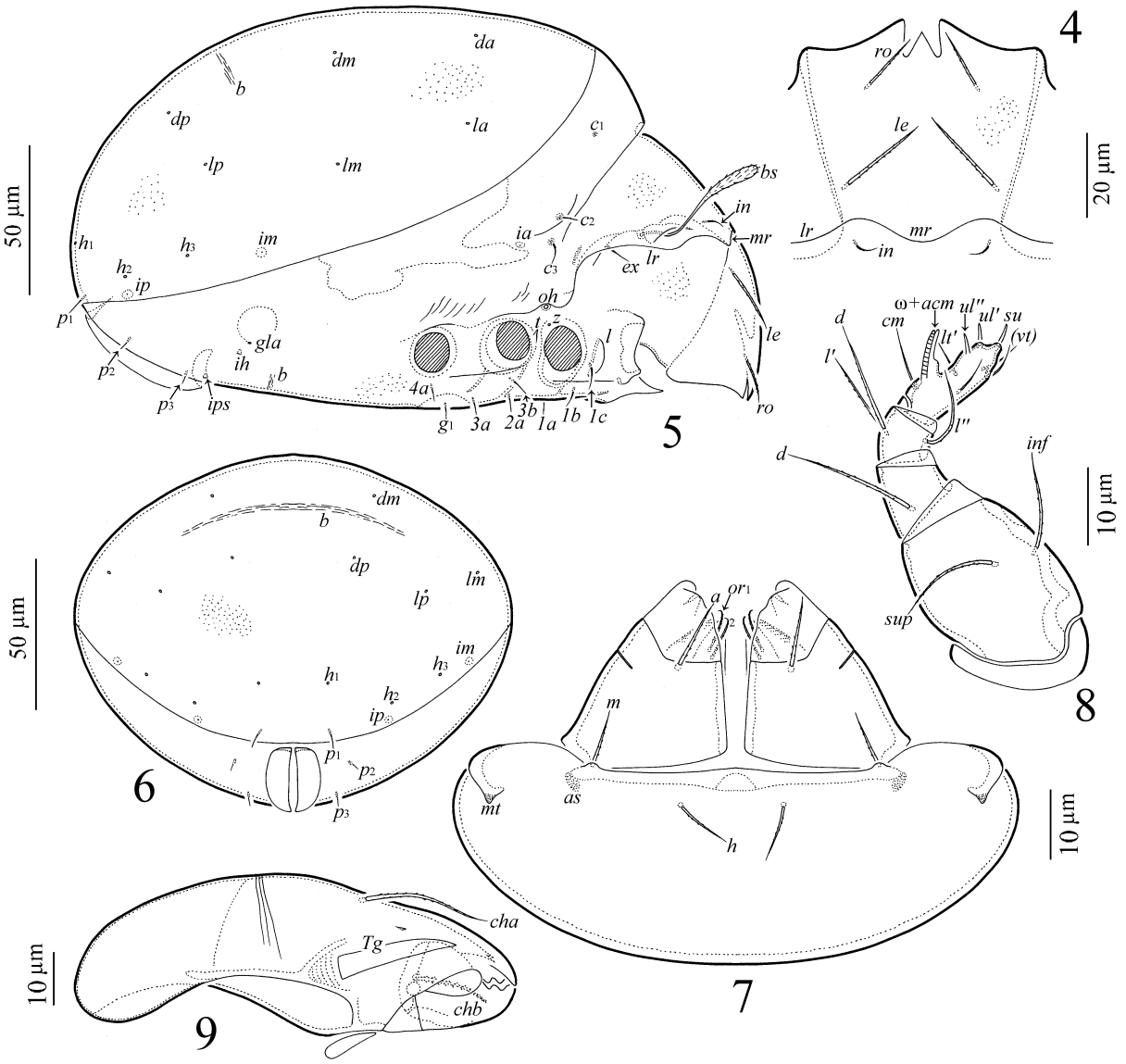


Figures 1–3. *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (juvenile instars) – 1. Protonymph, dorsal view (part of right half omitted); 2. Deutonymph, dorsal view (part of right half omitted); 3. Tritonymph, dorsal view.

Prodorsum (Figs. 1–5, 10–12) – Relatively short, about 1/2 length of gastronotic region (in lateral aspect). Rostrum tripartite (not visible in dorsal aspect, but well visible in frontal aspect). Lateral ridges well developed and fused by transverse, thin medial ridge concave medially. Rostral (PN: 17–19; DN: 19–22; TN: 22–26) and lamellar (PN: 24–26; DN: 26–30; TN: 30–34) setae setiform, barbed; interlamellar seta (PN: 7; DN: 7–9; TN: 11) setiform, thin, slightly barbed; bothridial seta (PN, DN: 37–41; TN: 41–45) clavate, with long stalk and shorter, barbed head; exobothridial seta (PN, DN: 11; TN: 15) setiform, thin, nearly smooth. Interbothridial region with three separate pairs of muscle sigillae (two pairs located medially, in longitudinal row; one pair located laterally).

Gastronotic region (Figs. 1–4, 6, 10–12) – Anterior gastronotic region distinct. Dorsal region with large, well-bordered shield (macrosclerite); in TN, posterior part of macrosclerite concave.

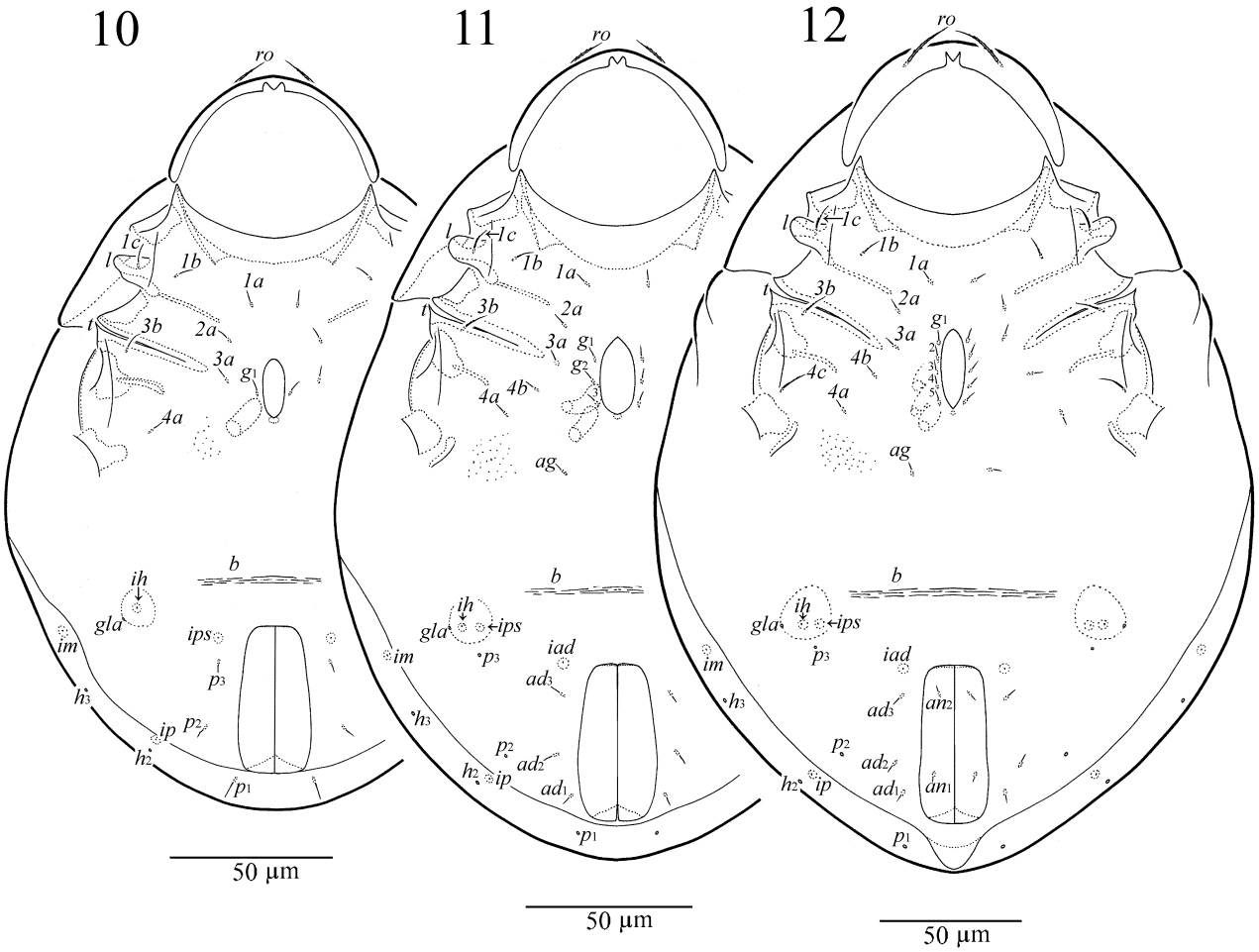
Posterior half with slightly developed transverse band represented by numerous, dense, thin ridges. Sclerites on lateral side of body (posterior to seta c_3) not visible, but large, amorphous, slightly pigmented region observed. Porose areas absent. Fifteen pairs of gastronotic setae, with 10 pairs (*da*, *la*, *dm*, *lm*, *dp*, *lp*, h_1–h_3, p_1) located on macrosclerite; c_1 vestigial, inserted on small sclerite; c_2 (PN, DN, TN: 7) and c_3 (PN, DN, TN: 9) setiform, thin, slightly barbed, inserted on small sclerites; *da*, *la*, *dm*, *lm*, *dp*, *lp*, h_1–h_3, and p_1–p_3 represented by alveoli except setiform, thin, smooth p_1 (7), p_2 (4), and p_3 (4) in PN. Cupules (*ia*, *im*, *ip*) slightly visible; *im* and *ip* located marginally on macrosclerite.



Figures 4–9. *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (juvenile instars) – 4. Protonymph, anterior part of prodorsum, frontal view; 5. Protonymph, right lateral view (gnathosoma and legs omitted); 6. Protonymph, posterior view; 7. Tritonymph, dissected subcapitulum, ventral view; 8. Tritonymph, dissected palp, right, antiaxial view; 9. Tritonymph, dissected chelicera, left, paraxial view.

Gnathosoma (Figs. 7–9) – Subcapitulum slightly shorter (or distinctly shorter in dissected specimens) than wide: PN: 45–49 × 49–52; DN: 49–52 × 52–60; TN: 60–64 × 64–71; mentum with one pair of lateral triangular tubercles; three pairs of subcapitular setae (*a*: PN: 7; DN: 7–9; TN: 9–

11; *m*, *h*: PN: 4; DN: 4–7; TN: 7–9) setiform, slightly barbed; two pairs of adoral setae (PN: 2; DN: 4–6; TN: 7) setiform, roughened. Palp lengths: PN: 37; DN: 45–49; TN: 56; setation: 0-2-1-3-9(+ω); solenidion bacilliform, attached to eupathidium, both located on tubercle; postpalpal seta (PN, DN: 2; TN: 4) spiniform, smooth; axillary saccule small, well visible. Chelicera lengths: PN: 64; DN: 77–82; TN: 90–97; setae (*cha*: PN: 19; DN: 22; TN: 26–28; *chb*: PN: 11; DN: 15; TN: 17–19) setiform, barbed.



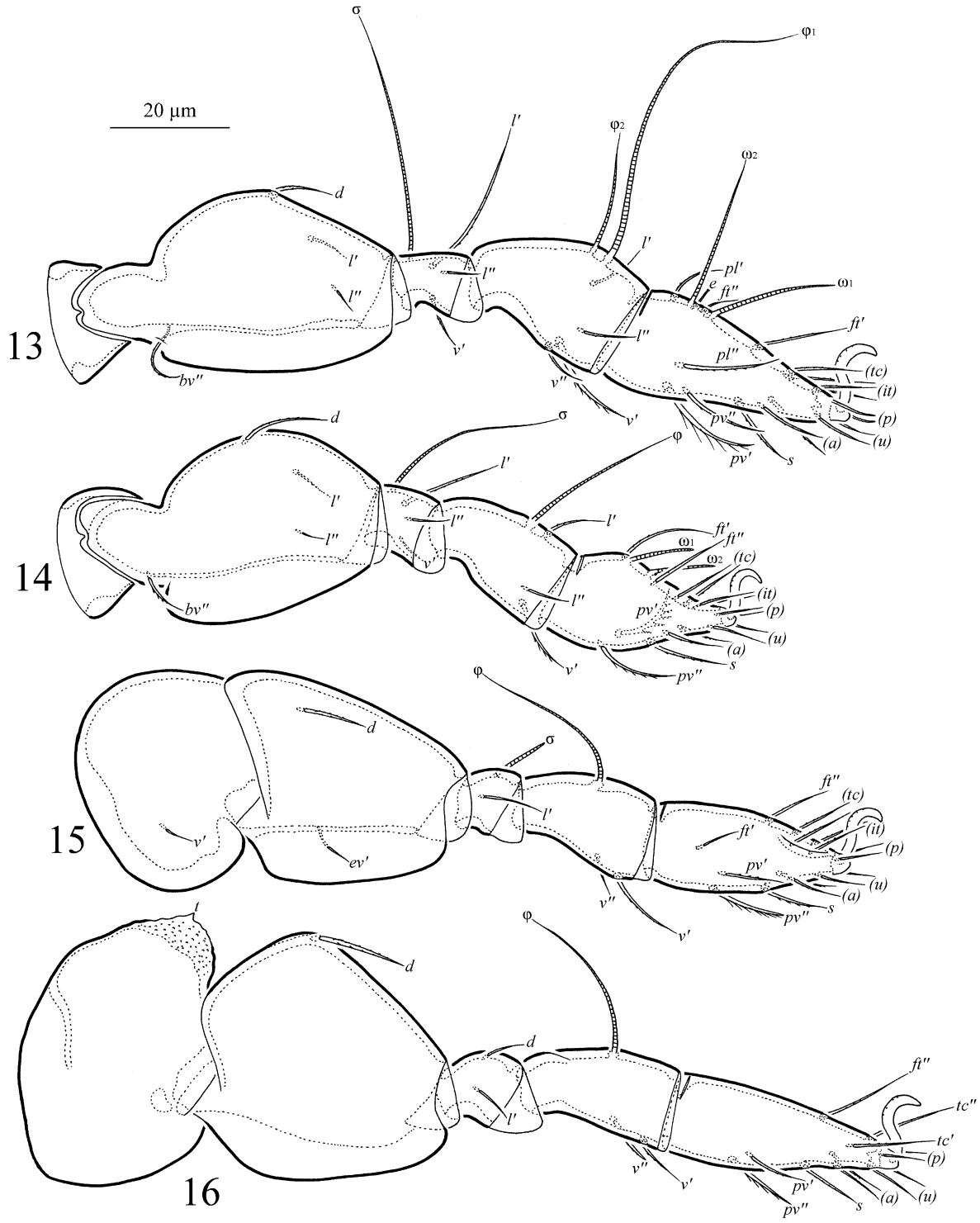
Figures 10–12. *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (juvenile instars) – 10. Protonymph, ventral view (gnathosoma, legs, and part of left half omitted); 11. Deutonymph, ventral view (gnathosoma, legs, and part of left half omitted); 12. Tritonymph, ventral view (gnathosoma and legs omitted).

Epimeral and lateral podosomal regions (Figs. 5, 10–12) – Setal formulas for epimeres: PN: 3-1-2-1; DN: 3-1-2-2; TN: 3-1-2-3; epimeral setae (PN, DN: *1b*, *1c*, *3b*: 7, others: 4; TN: *1b*, *1c*, *3b*, *4c*: 7–11, others: 4–7) setiform, thin, roughened (*1b*, *1c*, *3b*, *4c*) or smooth (other setae). Large lamina between acetabula I and II. Tooth between acetabula II and III.

Anogenital region (Figs. 5, 10–12) – Circumgenital macrosclerite present, but slightly bordered. Aggenital region with slightly developed transverse band represented by numerous, dense, thin ridges. Ontogeny of genital (PN, DN: 4; TN: 7), aggenital (DN: 4; TN: 7), adanal (DN: 4; TN: 7), and anal (TN: 4) setal formulas, from PN to TN: 1-3-5, 0-1-1, 0-3-3, 0-0-2, respectively; all setae setiform, thin, smooth. Cupules *ih*, *ips*, and *iad* appearing in normal ontogenetic pattern. Opisthonotal gland opening distinct.

Legs (Figs. 13–16) – Claw of each leg slightly barbed on dorsal side. Trochanter IV with small, but distinct dorsal tooth. Porose area not visible on segments. Leg setal formulas: PN: I (0-2-2-3-16)

[1-1-2], II (0-2-2-2-13) [1-1-1], III (0-2-1-1-13) [1-1-0], IV (0-0-0-0-7) [0-0-0]; DN: I (0-4-2-3-16) [1-2-2], II (0-4-2-2-13) [1-1-2], III (1-2-1-1-13) [1-1-0], IV (0-1-2-1-12) [0-1-0]; TN: I (0-4-3-4-18) [1-2-2], II (0-4-3-3-15) [1-1-2], III (1-2-1-2-15) [1-1-0], IV (0-1-2-2-12) [0-1-0]; AD: 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 (1-1[or 2]-2-2[or 3]-12) [0-1-0]; homology of setae and solenidia indicated in Table 1.



Figures 13–16. *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (tritonymph) – 13. Leg I, right, antiaxial view; 14. Leg II, right, antiaxial view; 15. Leg III, left, antiaxial view; 16. Leg IV, left, antiaxial view.

Table 1. Development of leg setation of *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023.

	Tr	***Fe***	***Ge***	***Ti***	***Ta***
Leg I					
PN	–	*d*, *bv″*	*(l)*, σ	*(l)*, *v′*, φ$_1$	*(ft)*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *(pl)*, ε, ω$_1$, ω$_2$
DN	–	*(l)*	–	φ$_2$	–
TN	–	–	*v′*	*v″*	*(it)*
AD	*v′*	–	–	–	*l″*, *v′*
Leg II					
PN	–	*d*, *bv″*	*(l)*, σ	*l′*, *v′*, φ	*(ft)*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, ω$_1$
DN	–	*(l)*	–	–	ω$_2$
TN	–	–	*v′*	*l″*	*(it)*
AD	*v′*	–	–	*v″*	–
Leg III					
PN	–	*d*, *ev′*	*l′*, σ	*v′*, φ	*(ft)*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*
DN	*v′*	–	–	–	–
TN	–	–	–	*v″*	*(it)*
AD	–	–	–	*l′*	–
Leg IV					
PN	–	–	–	–	*ft″*, *(p)*, *(u)*, *(pv)*
DN	–	*d*	*d*, *l′*	*v′*, φ	*(tc)*, *(a)*, *s*
TN	–	–	–	*v″*	–
AD	*v′*	*ev′**	–	*l′**	–

Note: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, tarsus, respectively. Roman letters refer to normal setae; Greek letters refer to solenidia; single quotation mark (′) designates setae on the anterior and double quotation mark (″) – setae on the posterior sides of a given leg segment; parentheses refer to a pair of setae. Setae are listed only for the instar in which they first appear, but most setae and solenidia listed for the PN first form in the LA (Norton 1977). * – *l′* on Ti IV and *ev′* on Fe IV added in AD, but sometimes not developed.

Remarks

Generally, the known juvenile instars within Galumnidae are quite uniform, differing only in a few characters (e.g., body size; length of prodorsal setae; shape of the rostrum; length of some gastronotic setae; development of porose areas and macro- and microsclerites; etc.). As mentioned above, juveniles of most *Pergalumna* are still unknown except for five species (Norton and Ermilov 2014, 2024). The nymphal instars of *P. cienfuegosensis* can be easily distinguished from those of other *Pergalumna* (only TN in *P. emarginata*) as follows.

Nymphs of *P. cienfuegosensis* differ from those of *P. ekaterinae* (see Páez *et al*. 2019, but due to insufficient description, some characters cannot be compared) in body size (lengths: PN: 199–232; DN: 232–255; TN: 277–315 versus PN: 239; DN: 312; TN: 392); the presence (versus absence) of transverse, concave medial prodorsal ridge; the length and the morphology of the interlamellar seta (short, setiform versus long, thickened); the morphology of the exobothridial seta (setiform versus thickened); the absence (versus presence) of porose areas on the gastronotum; distinctly longer gastronotic seta p_1 in PN; and the development of leg setation.

Nymphs of *P. cienfuegosensis* differ from those of *P. emarginata* (as *P. omniphagous* – see Rockett and Woodring 1966, but due to insufficient description, many characters cannot be compared) in the presence (versus absence) of transverse, concave medial prodorsal ridge; the length of the interlamellar seta (short versus medium-sized); and distinctly shorter gastronotic seta c_3.

Nymphs of *P. cienfuegosensis* differ from those of *P. myrmophila* (see Bayartogtokh and Ermilov 2017) in body size (length: PN: 199–232; DN: 232–255; TN: 277–315 versus PN: 315–365; DN: 415–464; TN: 531–564); the shape of the rostrum (tripartite versus rounded); the presence (versus absence) of transverse, concave medial prodorsal ridge; the length of the interlamellar seta (short versus medium-sized); the length of the gastronotic seta c_2 (well-developed, slightly shorter

than c_3 versus minute); distinctly longer gastronotic seta p_1 in PN; the presence (versus absence) of one pair of tubercles on subcapitular mentum; the number of setae on the epimere III (two pairs versus three pairs); and the development of leg setation.

Nymphs of *P. cienfuegosensis* differ from those of *P. nervosa* (see Sengbusch 1954; Seniczak 1972; Grishina 1977; Seniczak *et al.* 2012, but due to insufficient description, some characters cannot be compared) in body size (lengths: PN: 199–232; DN: 232–255; TN: 277–315 versus PN: 325–407; DN: 429–486; TN: 582–593); the presence (versus absence) of transverse, concave medial prodorsal ridge; the length of the interlamellar seta (short versus medium-sized); distinctly shorter gastronotic seta c_3; and the development of leg setation.

Nymphs of *P. cienfuegosensis* differ from those of *P. striatiprodorsum* (see Bayartogtokh and Ermilov 2017) in body size (lengths: PN: 199–232; DN: 232–255; TN: 277–315 versus PN: 298–315; DN: 398–415; TN: 498–564); the shape of the rostrum (narrow versus broad incisions); the presence (versus absence) of transverse, concave medial prodorsal ridge; the length of the interlamellar seta (short versus medium-sized); the shape of the posterior part of the gastronotic shield (concave versus rounded); the length of the gastronotic seta c_2 (well-developed, slightly shorter than c_3 versus minute); the presence (versus absence) of one pair of tubercles on the subcapitular mentum; the number of setae on epimere III (two versus three pairs); and the development of leg setation.

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سنین پورگی *Pergalumna cienfuegosensis* (Acari, Oribatida, Galumnidae)

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چکیده

این مقاله سنین پورگی *Pergalumna cienfuegosensis* Ermilov, Kolesnikov, Kontschán & Klimov, 2023 (Oribatida, Galumnidae) را بر اساس نمونه‌های جمع‌آوری‌شده از بستر برگ در نزدیکی رودخانه‌ای در جنگلی مخلوط در استان سینفوگوس، کوبای جنوبی، توصیف می‌کند. پوره‌ها با خرطوم سه قسمتی، خط میانی فرورفته عرضی روی پُشته، موهای خرطومی با اندازهٔ متوسط؛ موهای تیغه‌ای بلند؛ موهای کوتاه بین تیغه‌ای و برون وشادی؛ موهای بلند، چماقی و خاردار وشادی؛ صفحه شکمی مشخص (ماکرواسکلریت)؛ موهای شکمی ردیف *d*، *l* و *h* و *p* که توسط حفره‌های آنها نشان داده می‌شوند (به جز p_1–p_3 کوتاه در سن پوره یکم)؛ نوار عرضی روی شکم‌گُرده و در ناحیه کنارجنسی؛ دو برآمدگی روی چانهٔ زیرسرواره؛ تیغه بین حفره پاهای یکم و دوم؛ دندانه پشتی روی پی‌ران پاهای چهارم؛ و تأخیر در رشد برخی از موهای پا مشخص می شوند. تفاوت‌های بین سنین نابالغ *P. cienfuegosensis* و سایر گونه‌های شناخته شده *Pergalumna* ارایه می‌شود.

واژگان کلیدی: کوبا، سن نابالغ، ریخت‌شناسی، تکوین، هرنای اریباتید.

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