

A new species of the subgenus *Cosmogalumna* (Acari: Oribatida: Galumnidae: *Galumna*) from Japan

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Abstract

A new species of oribatid mites, *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp., is described from the soil and litter of a *Cryptomeria* forest, Kirishima City, Kagoshima Prefecture, southwestern part of Japan. The new species is morphologically most similar to *Galumna* (*Cosmogalumna*) *praeoccupata* Subías, 2004 and *Galumna* (*Cosmogalumna*) *areticulata* Ermilov, Sandmann, Klarner, Widyastuti & Scheu, 2015, but it differs from these species in bifurcate lamellar lines, distinctive patterns suggestive of a neural network on the middle part of notogaster and ventral plate, several nodules (*Aa*) or one central nodule (*A1*, *A2* and *A3*) on the surface of porose areas, conspicuous granular ornamentation on the pteromorphs, and conspicuous linear structure on the middle part on the genital plates.

Keywords Galumnid mites | Morphology | SEM | subgenus *Cosmogalumna* | Taxonomy |
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1. Introduction

Kagoshima Prefecture is composed of both, a southern part of Kyushu Island and Satsunan Islands which includes Osumi Islands, Tokara Islands, and Amami Islands. According to comprehensive data provided by Aoki (2009), 13 species of the family Galumnidae are recorded from all areas of Kagoshima Prefecture, but in Kyushu Island (a part of Kagoshima Prefecture), only six species are recorded (Aoki 2009, Harada 1980), while many species remain unidentified.

The subgenus *Cosmogalumna* Aoki, 1988 comprises 12 species, which are distributed in the Oriental, Neotropical and Palearctic regions (Subías 2004 updated 2017, Hagino & Shimano in press). The main subgeneric traits were listed by Aoki (1988), modified subgeneric diagnosis were provided by Ermilov & Copuz-Raros (2015), and Hagino

& Shimano (in press). An identification key to many species of the subgenus *Cosmogalumna* was presented by Ermilov & Copuz-Raros (2015).

In the course of taxonomic identification of galumnid oribatid mites collected from Kirishima City, Kagoshima Prefecture in Kyushu Island, we found a new species of the subgenus *Cosmogalumna*.

2. Materials and methods

Material: Fifteen specimens (3 males, 10 females, and two of unknown sex) were collected from soil and litter of a *Cryptomeria* forest, Kirishima City, Kagoshima Prefecture, 31°42'34.6" N, 130° 48' 45.4" E, 260 m a.s.l., on the 27th of September, 2015, by W. Hagino and S. F. Hiruta.

Methods: Oribatid mites were mounted with lactic acid on temporary cavity slides for measurement and illustration, as well as specimens dissected and mounted with gum chloral liquid (gum arabic, chloral hydrate, glycerol, and glacial acetic acid) for permanent slides to observe under high magnification (1000x magnification). Several specimens were tested repeatedly in heated lactic acid, trying to remove the particular structures, and observed in temporary cavity slides for checking whether conspicuous sculptures on the notogaster and pteromorphs were cerotegumental or cuticular structures. For scanning electron microscopy (SEM), mites were fixed in 99.5% ethanol (guaranteed reagent). Dehydration was conducted with a graded ethanol series with acetone and pentane. The specimens were placed on aluminum stubs with a double-stick carbon tape and coated with palladium-gold. The specimens were studied using a Hitachi S3400-N scanning electron microscope. Some conspicuous sculptures on the notogaster and pteromorphs were tested whether they were cerotegumental or cuticular structures. Specimens were tested repeatedly in heated lactic acid, trying to remove the particular structures if they were cerotegumental. The morphological terminology used below is mostly that developed over many years by Grandjean: see Trávě & Vachon (1975) for references, Norton (1977) for leg setal nomenclature, and Norton & Behan-Pelletier (2009) for an overview. All measurements are given as a range, with the mean in parentheses. Body length was measured in dorsal or ventral view, from the tip of the rostrum to the posterior edge of the ventral plate. Setal formulas

are given as numbers per segment for appendages (from trochanter to tarsus, famulus included) as number per podosomal segment (I–IV).

Type series: Holotype (NSMT–Ac 14213, female) and four paratypes (NSMT–Ac 14214–14217, three females and one male) from soil and litter of a *Cryptomeria* forest, Kirishima City, Kagoshima Prefecture, Kyusyu Island, 31°42'34.6" N, 130° 48' 45.4" E, 260 m a.s.l., 27 September, 2015, by W. Hagino and S. F. Hiruta. The holotype and paratypes mounted on slides are to be deposited in the National Museum of Nature and Science, Tsukuba, Japan. Additional non-type specimens from the same locality as the holotype are preserved in the personal collection of W. Hagino.

3. Descriptions

Galumna (*Cosmogalumna*) *kirishimaensis* Hagino & Shimano n. sp.

[Japanese name: *Kirishima kazari-furisodedani*] (Figs 1, 2, 3, 4, 5)

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Diagnosis. Body length and width: 333–368 × 268–286 µm. Sensillus with long stalk and short, rounded distal head with minute spicules (Figs 2D, and 4D). Lamellar line (Fig. 2C) bifurcated in the part above the lamellar seta. Lamellar seta inserted between lamellar lines. Middle

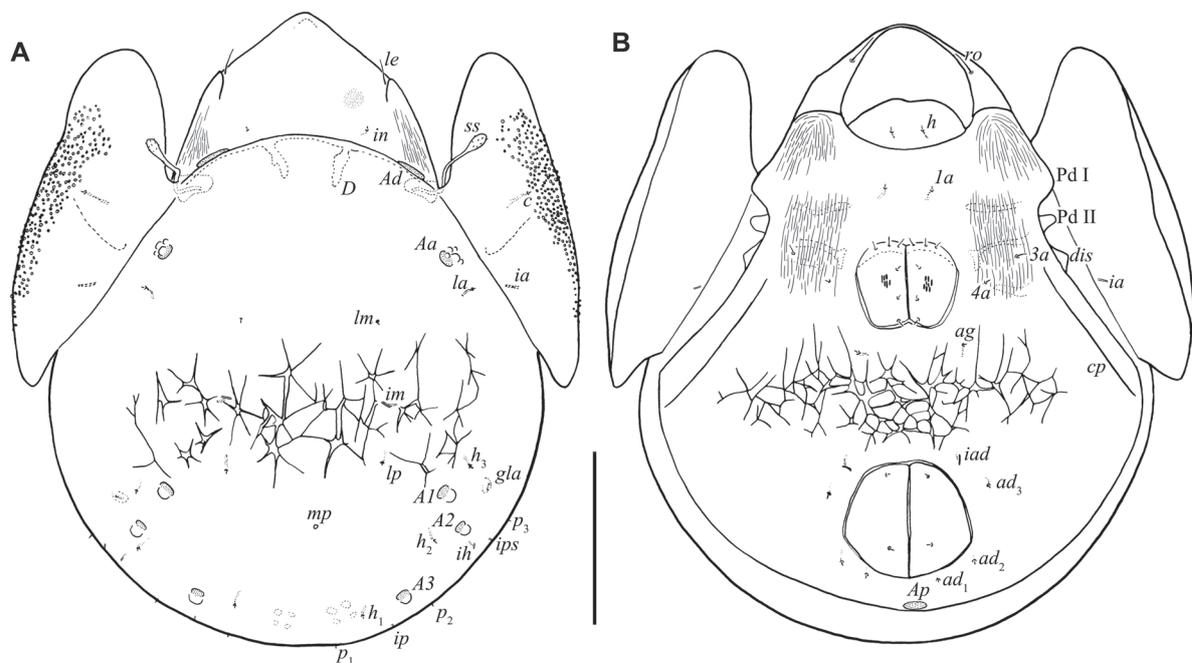


Figure 1. Adult *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp., holotype. (A) dorsal view, (B) ventral view (gnathosoma and legs not shown). Scale bar 100 µm.

part of notogaster and ventral plate ornamented with a distinctive pattern, suggestive of a neural network (Figs 5A and 5B). Notogastral porose area *Aa* slightly depressed, containing several conspicuous nodules (Fig. 5C), *A1*, *A2* and *A3* slightly depressed, containing a single

conspicuous nodule (Fig. 5D). Medial pore *mp* on notogaster present in male and female represented by one pore. Surface of pteromorph ornamented with conspicuous granules except in marginal part (Figs 1A, 2B, and 4E). Genital plate with conspicuous linear sculpture in central

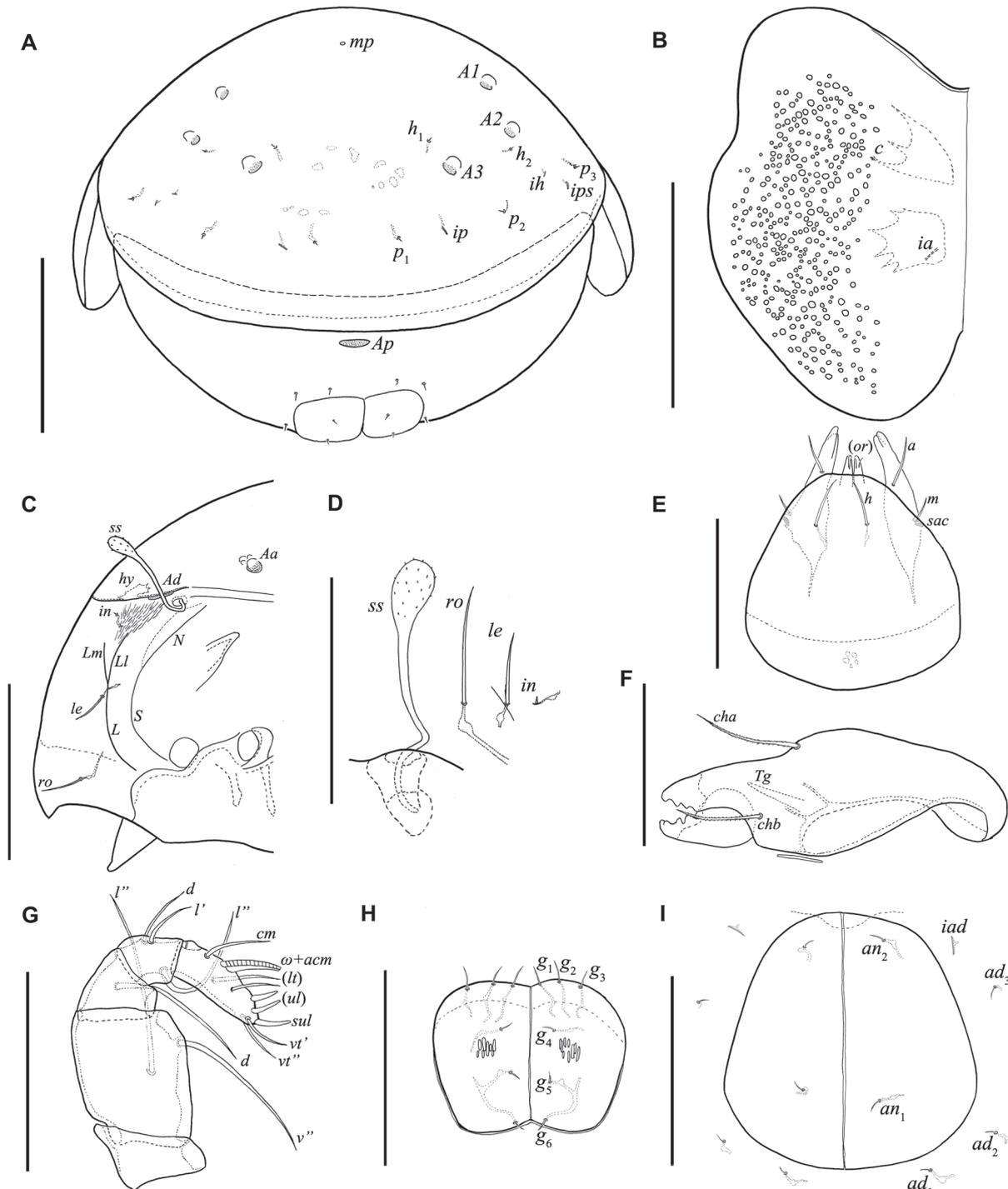


Figure 2. Adult *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp., holotype for **A**, **C**, and **D**, paratype (NSMT–Ac 14214) for **B**, **E**, **F**, **G**, **H**, and **I**. (**A**) posterior view, (**B**) pteromorph, left, (**C**) anterior part of body (pteromorph, gnathosoma except subcapitular mentum, and legs), lateral view, (**D**) rostral seta, lamellar seta, interlamellar seta, and sensillus, (**E**) subcapitulum, ventral view, (**F**) chelicera, left, antiaxial view, (**G**) palp, left, paraxial view, (**H**) genital plates, (**I**) anal plates. Scale bar (**A**, **B**, **C**) 100 μ m, (**D**, **E**, **F**, **G**, **H**, **I**) 50 μ m.

setiform, smooth, *a* (approx. 17 μm) longer and thicker than *h* (approx. 14), *m* shortest (approx. 7 μm) and thinnest. Length of palp: 74–88 μm . Axillary saccule (*sac*) distinct. Length of chelicera: 105–108 μm . Two cheliceral setae setiform, barbed, *cha* (approx. 31 μm) longer than *chb* (approx. 26 μm). Trägårdh's organ (*Tg*) long, elongate triangular.

Epimeral and podosomal region (Figs 1B, 4B): Pedotectum I (Pd I) broadly rounded, pedotectum II (Pd II) elongated with round tip. Discidium (*dis*) sharply triangular. Circumpedal carina (*cp*) thin, interrupted in level posterior to 3*a*. Setal formula of epimera: 1–0–1–1. Six pairs of thin, short, smooth genital setae; *g*₁, *g*₂, and *g*₃ (approx. 6 μm) inserted on anterior margin of

genital plate; *g*₄, *g*₅, and *g*₆ (approx. 3 μm) shorter than the previous ones, arranged longitudinally. A pair of aggenital setae *ag* (approx. 3 μm) in posterior region of genital plates.

Anogenital region (Figs 1B, 2H, 2I, 4B, 5B, 5E): Two pairs of anal setae *an*₁ and *an*₂ (approx. 5 μm) thin, smooth. Three pairs of adanal setae; *ad*₁ and *ad*₂ (approx. 4 μm) short, posterior to anal plates, *ad*₃ (approx. 4 μm) short, situated on paraanal position, posterior to *iad*. Adanal lyrifissure *iad* situated anteromedially to adanal setae *ad*₃. Posterior porose area (*Ap*) one, large (approx. 6 \times 17 μm), oval, posterior to anal plate.

Legs (Figs 3, Table 1): All legs tridactylous, median claw distinctly thicker than laterals, all claws smooth.

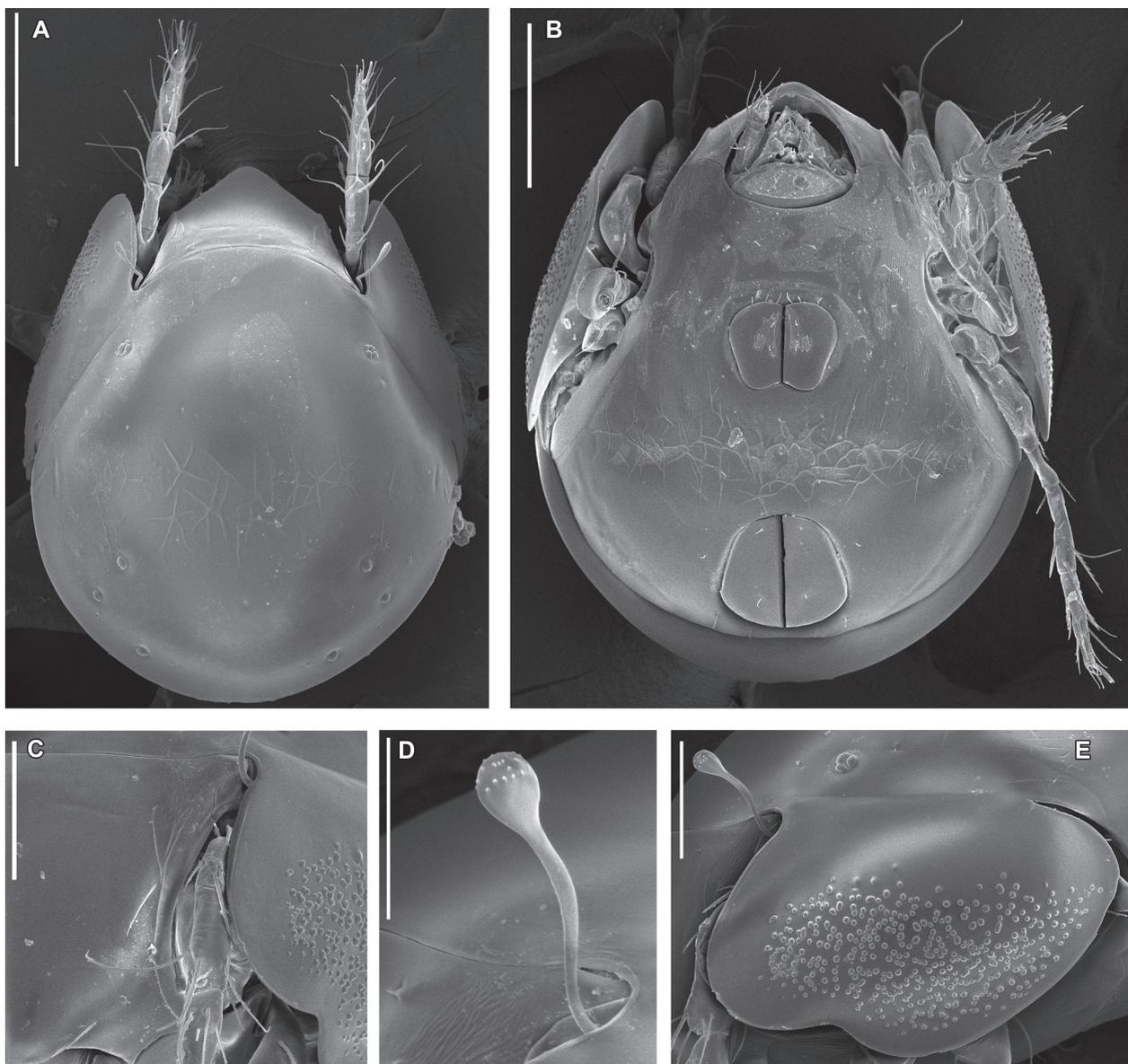


Figure 4. Scanning electron micrographs of adult *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp., non-type specimens. (A) dorsal view, (B) ventral view, (C) partial anterior view, (D) sensillus, (E) lateral view of pteromorph. Scale bar (A, B) 100 μm , (C, E) 50 μm , (D) 30 μm .

Morphology of leg segments, setae and solenidia generally typical for species of the subgenus *Cosmogalumna* and the other members of Galumnidae (Engelbrecht 1972, Ermilov & Anichkin 2013). Porose area on all femora and on trochanters III, IV slightly visible. Leg setation (Tr–Fe–Ge–Ti–Ta) including famulus: leg I (1–4–3–4–20); II (1–4–3–4–15); III (1–2–1–3–15); IV (1–2–2–3–12). Solenidiotaxy (Ge–Ti–Ta): I (1–2–2); II (1–1–2); III (1–1–0); IV (0–1–0). Homology of setae and solenidia indicated in Table 1. Solenidion of tibiae IV inserted in the anterior part of segment. Famulus inserted anterior to solenidion ω_1 .

Etymology: The specific name ‘*kirishimaensis*’ refers to the site of origin, Kirishima City, Japan.

4. Remarks

Among the 12 species of the subgenus *Cosmogalumna*, is one new species described by Hagino & Shimano (in press). *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp. most closely resembles *Galumna* (*Cosmogalumna*) *praeoccupata* Subías, 2004 (= *Cosmogalumna imperfecta* Aoki & Hu, 1993) from China, and *Galumna* (*Cosmogalumna*) *areticulata* Ermilov, Sandmann, Klärner, Widyastuti & Scheu, 2015 from Indonesia due to 1) shape of sensilli, 2) presence of medial pore, and 3) middle part of notogaster and ventral plate ornamented with integumental patterns. However, *Galumna*

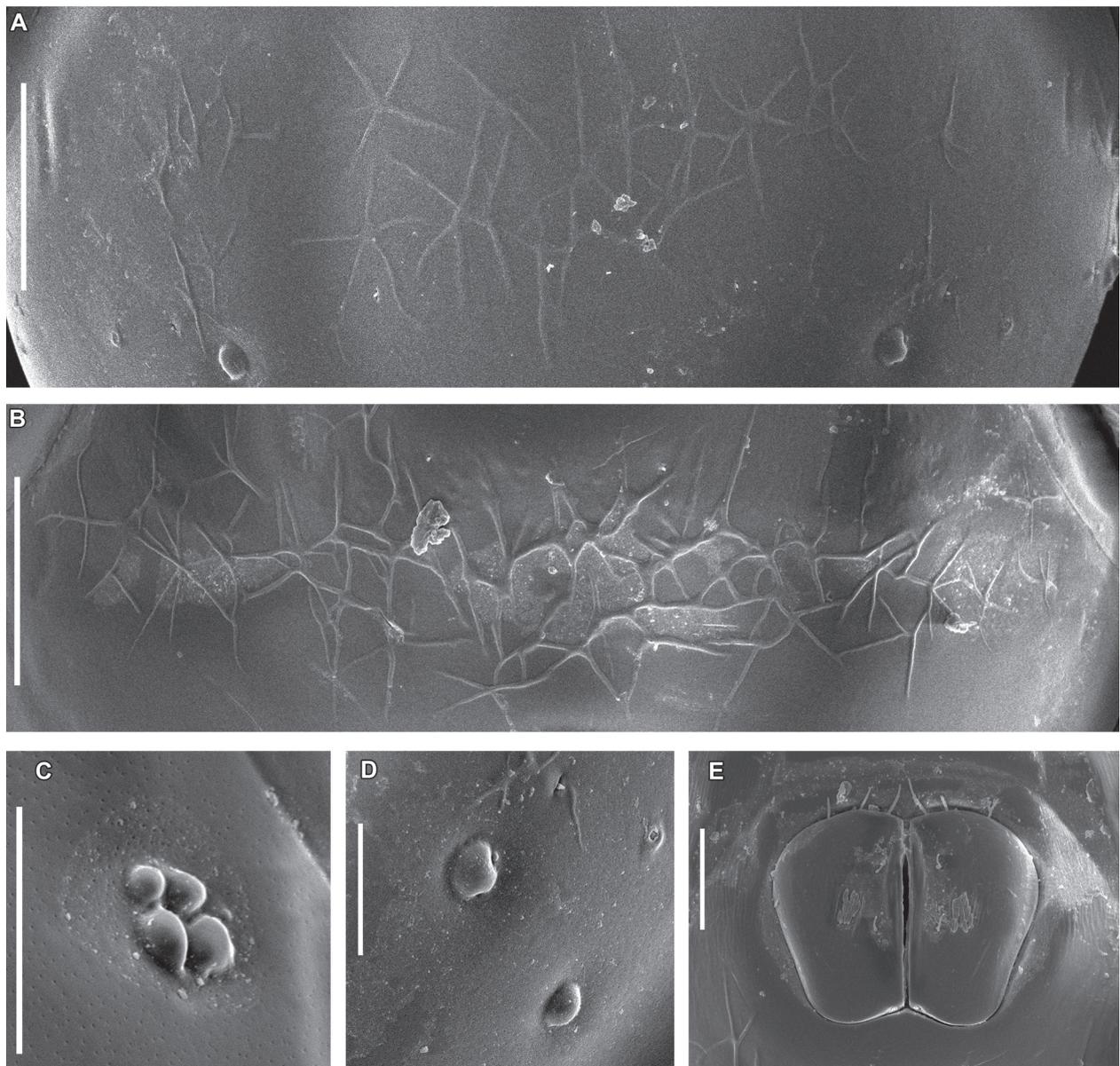


Figure 5. Scanning electron micrographs of adult *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp., non-type specimens. (A) area of notogaster showing distinctive pattern, suggestive of a neural network, (B) area of ventral plate showing distinctive pattern, suggestive of a neural network, (C) notogastral porose area *Aa*, (D) notogastral porose areas *A1* and *A2*, (E) genital plates. Scale bar (A, B) 50 μ m, (C, D, E) 20 μ m.

Table 1. Leg setation of adult *Galumna* (*Cosmogalumna*) *kirishimaensis* n. sp. Roman letters refer to normal setae (ε to famulus), Greek letters to solenidia. Single prime (') marks setae on the anterior and double prime (") setae on the posterior face of the given leg segment. Parentheses refer to a pair of setae.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	$d, (l), bv''$	$(l), v', \sigma$	$(l), (v), \varphi_1, \varphi_2$	$(fi), (tc), (it), (p), (u), (a), s, (pv), v', (pl), l'', \varepsilon, \omega_1, \omega_2$
II	v'	$d, (l), bv''$	$(l), v', \sigma$	$(l), (v), \varphi$	$(fi), (tc), (it), (p), (u), (a), s, (pv), \omega_1, \omega_2$
III	v'	d, ev'	l', σ	$l', (v), \varphi$	$(fi), (tc), (it), (p), (u), (a), s, (pv)$
IV	v'	d, ev'	d, l'	$l', (v), \varphi$	$fi'', (tc), (p), (u), (a), s, (pv)$

(*Cosmogalumna*) *kirishimaensis* n. sp. differs from *G. (C.) praeoccupata* and *G. (C.) areticulata* in 1) bifurcate lamellar lines, 2) distinctive pattern, suggestive of a neural network on the middle part of the notogaster and the ventral plate, 3) several nodules (*Aa*) or one central nodule (*AI, A2* and *A3*) on the surface of the porose areas, 4) conspicuous granular ornamentation on the surface of the pteromorphs except in the basal part, 5) conspicuous linear structure on the middle part of the genital plates, 6) adanal lyrifissure *iad* in level anterior to adanal setae *ad*₃.

5. Discussion

Some conspicuous sculptures on the notogaster and pteromorphs were tested whether they are cerotegumental or cuticular structures. Comparative structures were suspected to be made from ceroteguments (Ermilov et al. 2015). Ermilov & Friedrich (2016) mentioned the sculptures on the notogaster as a 'cerotegumental ridge'. Specimens were tested repeatedly in heated lactic acid in an attempt to remove the particular structures if they were cerotegumental. Since the conspicuous structures (1) distinctive pattern suggestive of a neural network on notogastral surface, (2) several nodules or singular nodule on the notogastral porose areas, and (3) granular ornamentation on the surface of pteromorphs, could not be removed absolutely, the structures must be derived from the cuticula.

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