

Agauae laeviunguis (Acari, Halacaridae), a New Species of Halacarid Mites from Korea

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Abstract: A new halacarid species, *Agauae laeviunguis* n. sp. from Youngil Bay, Pohang City, South Korea is described. In sharing the character combination of three dorsal setae on PE, lacking dorsal seta anterior to insertion of leg IV, three ventral setae on PE, female PGS adjacent to GF, telofemora devoid of fovea, well developed smooth cerotegumental lamella on all telofemora, presence of accessory process on all lateral claws, long gnathosoma, and a smooth seta on P₂ in both sexes, this species resembles *A. subglabra* Bartsch from Australia. The species, however, is clearly distinguished from *A. subglabra* by its larger body, claws of tarsi II-IV without ventral pecten, and much more PGS in female. Description of proto- and deutonymphs are also provided.

Keywords: Acari, Halacaridae, *Agauae*, new species, Korea

Representatives of genus *Agauae* (Acari: Halacaridae: Halacarinae) were found in all world oceans from intertidal shore to deep sea, mostly in sublittoral and bathyal zones. Among 42 species so far recorded, 13 species are known from the Northern Hemisphere. In the Northwest Pacific, the *Agauae* halacarids are still poorly known, and only two species have been recognized so far, viz. *A. kurilensis* Makarova from Kuril Islands (Makarova, 1977) and *A. gracilirostris* Sokolov from the Russian coast of the East Sea (Sea of Japan) (Sokolov, 1952). In the present paper, a new species of *Agauae* are described from Youngil Bay, east coast of South Korea. This is the first record of genus *Agauae* from Korea.

MATERIALS AND METHODS

Materials examined in the present study were collected from an algal bed at the intertidal rocky shore of Youngil Bay, South Korea. Samples were filtered through a nylon net (64 µm in pore diameter) after anaesthetizing halacarid mites with 7% MgCl₂ solution for about 30 minutes, or rinsed with freshwater for osmotic shock, and then fixed and stored in 80% ethanol.

Halacarids were cleared in lactic acid and mounted in glycerine jelly. Drawings were prepared using a camera lucida under a differential interference contrast microscope with Nomarski optics. The position of a seta is given in a decimal system, with reference to the length of a plate, from the anterior to posterior margin.

Materials for scanning electron microscopy were prefixed overnight at 4°C in 2.5% glutaraldehyde, and then followed by post fixation in 2% cold osmium tetroxide. After dehydration through a graded series of ethanol (50-100% at 10% interval) for 30 minutes each, the material was dried at the critical point dryer, and coated with gold-palladium in high evaporator, and then examined with a scanning electron microscope (Hitachi S-520) operated at 20 KV.

Type specimens will be deposited in the National Biological Resources Center (NBRC), Incheon, Korea, and are deposited in the Department of Biology (DB), Daegu University, Korea.

Abbreviations used in the text and figure legends: AD, anterior dorsal plate; AE, anterior epimeral plate; ds₁₋₆, dorsal setae 1-6 on idiosoma; GA, genitoanal plate; GF, genital foramen; GO, genital opening; mc, membranous cuticle between plates; OC, ocular plate; PAS, parambulacral setae; PD, posterior dorsal plate; PE, posterior epimeral plate; PGS, perigenital setae; P₁₋₄, first to fourth palpal segments; SGS, subgenital setae.

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DESCRIPTION

Family Halacaridae Murray, 1877
Subfamily Halacarinae Viets, 1927
Genus *Agauae* Lohmann, 1889

Agauae laeviuunguis n. sp.
(Figs. 1-5)

Materials examined: Holotype: female (DB50025), Masan-ri (35°41'30"N, 135°20'30"E), Pohang, Youngil Bay, South Korea, 4 November, 2004, C. Y. Chang and T. Chatterjee. Paratypes: 1 female (DB50026), and 2 males (DB50027, 50028), collection data same as in holotype. Additional material: 22 females, 12 males, 2 deutonymphs, 1 protonymph, collection data same as in holotype; 1 male, same locality, 4 December 2004, C. Y. Chang and H. W. Lim.

Female (holotype): Idiosoma of holotype female 738 μm long, 480 μm wide. Cerotegumental membranes present on anterior margin of AD; small and slightly rounded membrane on anterior half of AD, and inverted V-shaped one extending from middle over posterior margin of AD (Fig. 1A). AD 243 μm long, 227 μm width (ratio 1.07). Paired ds_1 situated at 0.32 level of AD, 22 μm long; ds_2 on mc between AD and OC, 77 μm long; ds_3 on mc between AD and PD, 75 μm long; ds_4 on mc between OC and PD, 82 μm long. Pair of gland pores near lateral margin posterior to ds_1 . Posterior to pores a group of canaliculi on either side.

OC 120 μm long and 80 μm wide; length to width ratio of OC about 1.5; with 2 corneae; gland pore below posterior cornea, distance between gland pore and posterior cornea more than diameter of that cornea; pore canaliculus lateral to posterior cornea; cerotegumental membrane present longitudinally from anterior to posterior in middle of OC; canaliculi scattered beside cerotegumental membrane both medially and laterally.

PD (Fig. 1A) anteriorly truncate, 387 μm long, 240 μm wide (length to width ratio about 1.6). Pair of longitudinal cerotegumental membranes, 24-33 μm wide, anteriorly extending slightly beyond PD, posteriorly joining each other, extending a little behind posterior margin of PD. Pair of gland pores situated on posterior part of PD at 0.85 level of PD, near lateral margin of cerotegumental membranes; canaliculi present beside cerotegumental membranes both medially and laterally; ds_5 on PD just above the level of insertion of leg IV, at 0.49-0.53 level of PD; ds_6 on anal plate.

AE (Fig. 1B) 221 μm long with 3 pairs of setae. PE with 3 ventral setae (Fig. 1B) and 3 dorsal setae above insertion to leg III (Fig. 1A).

GA (Fig. 1B, C) 279 μm long, 195 μm wide. GO 92 μm

long, 86 μm wide; GF 163 μm long, 101 μm wide. PGS adjacent to GF, 15-16 setae on each side of GF, 8-11 setae in anterior half, 5-7 in posterior half. Ovipositor 85 μm long, extending far beyond GA. Genital sclerites devoid of SGS.

Gnathosoma (Fig. 1D) 314 μm long, 53 μm wide. Palp 4-segmented. Rostrum long, extending upto proximal third of P_4 . Rostral tip with a pair of small bidentate setae medially and a pair of small simple setae laterally; paired long setae (distal maxillary setae) at base of rostrum; paired basal maxillary setae on gnathosomal base. Tectum scaliform. Lengths of P_1 - P_4 23 μm , 184 μm , 30 μm , 61 μm , respectively; P_2 with smooth and pointed seta distally, 67 μm long; P_3 with a distal seta, 17 μm long; P_4 with 3 basal setae, 1 dorsal seta in the middle, 1 small apical seta and 2 spurs distally.

Cerotegumental lamella present on all telofemora dorsally and distoventrally (Fig. 2A-D), dorsal sides of basifemur III and trochanters III and IV. Small membranes also present on dorsal and ventral sides of patella IV, and on posterodorsal side of tibia IV. Cerotegumental membrane smooth and not sculptured. Dorsal membranes of telofemora I and II about 30 μm and 20 μm long, respectively, ventral membranes about 10-14 μm long. Chaetotaxy of legs (trochanter to tibia): trochanter 1-1-2-0; basifemur 2-2-2-2; telofemur 5-6-4-4(5); patella 4-4-4-4; tibia 12-11-10(5)-9(10). (The numbers in the parentheses mean those of the setae on the other side's leg.). Length to height ratios of telofemora I-IV about 2.9, 2.4, 2.5, 2.6, respectively; those of tibiae I-IV about 2.8, 2.7, 3.1, 3.1, respectively. Tarsus I with 3 dorsal setae, 1 solenidion, 1 ventral seta, and 10 pairs of PAS; tarsus II with 3 dorsal setae, 1 solenidion, about 7 pairs of PAS; tarsus III with 3 dorsal setae, 2-3 PAS; tarsus IV with 3 dorsal setae and 2 PAS. Tarsi with sclerites, minute median claw and 2 lateral claws; lateral claws ventrally smooth, and dorsally with 1 accessory process bearing about 6-7 minute teeth; dorsal edge of claws finely pectinated (Fig. 3E).

Male: Idiosoma 765 μm long. General appearance similar to females except for GA area (Figs. 1E, 3G). GA 360 μm long, 270 μm wide; GO 113 μm long; GF 126 μm long, 78 μm wide. Twenty-five PGS in inner ring adjacent to GO, about 130 PGS in outer ring. PGS branched. Five pairs of SGS present, 1st, 2nd, 3rd, and 5th pairs spur-type, while 4th pair thinner; all SGS closed to each other. Spermatopositor large, 279 μm long, 120 μm wide, a little surpassing anterior margin of GA. Distance between anterior end of GO to that of GA about 1.6 times of GO length. Three pairs of genital acetabulae present. Seta on P_2 similar to female.

Deutonymph: Idiosoma 670-753 μm long (Fig. 4A). AD

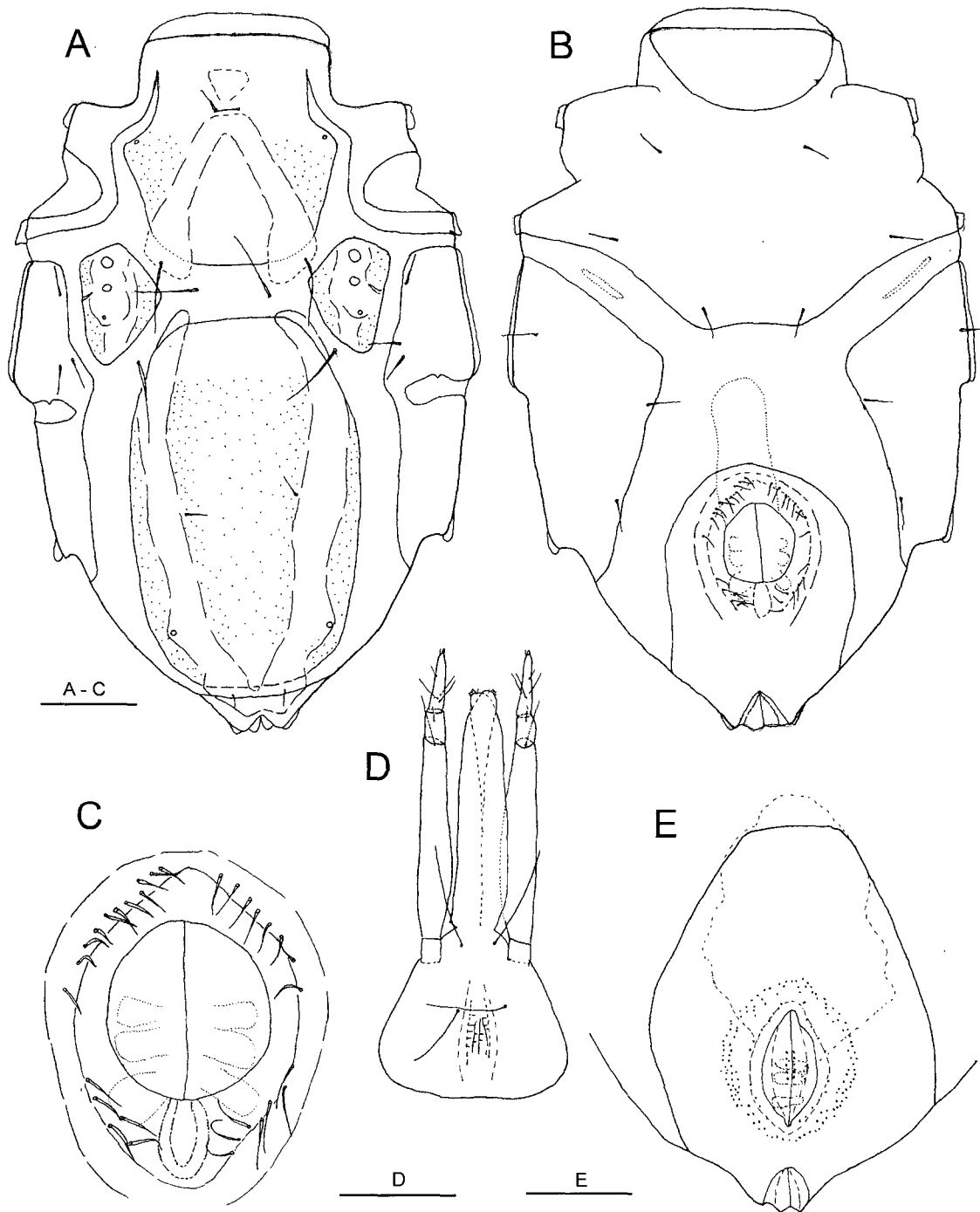


Fig. 1. *Agaue laeviunguis* n. sp. A-D, Holotype female. A, Idiosoma, dorsal. B, Idiosoma, ventral. C, GO area. D, Gnathosoma, ventral. E, GA, paratype male. Scales bars = 100 μm (A, B, D, E) and 50 μm (C).

170 μm long, with cerotegumental membrane a little rounded anteriorly and inverted V-shaped posteriorly. OC 99 μm long, 58 μm wide, with longitudinal cerotegumental membrane in the middle. PD 236 μm long, 157 μm wide, length to width ratio 1.5; 2 longitudinal cerotegumental membranes present along both lateral sides of PD. PD anteriorly truncated. Pair of dorsal setae at 0.37 level of PD;

pair of gland pores near posterolateral margin of PD.

PE with 3 ventral and 2 dorsal setae above insertion of leg III, lacking dorsal seta above insertion of leg IV. Genital plate separate from anal plate (Fig. 4B), 38 μm long, 36 μm wide; with 2 pairs of genital acetabula and 1 pair of setae. Seta on P_2 similar to adults.

Legs I-IV with 6 segments. Legs with thin cerotegumental

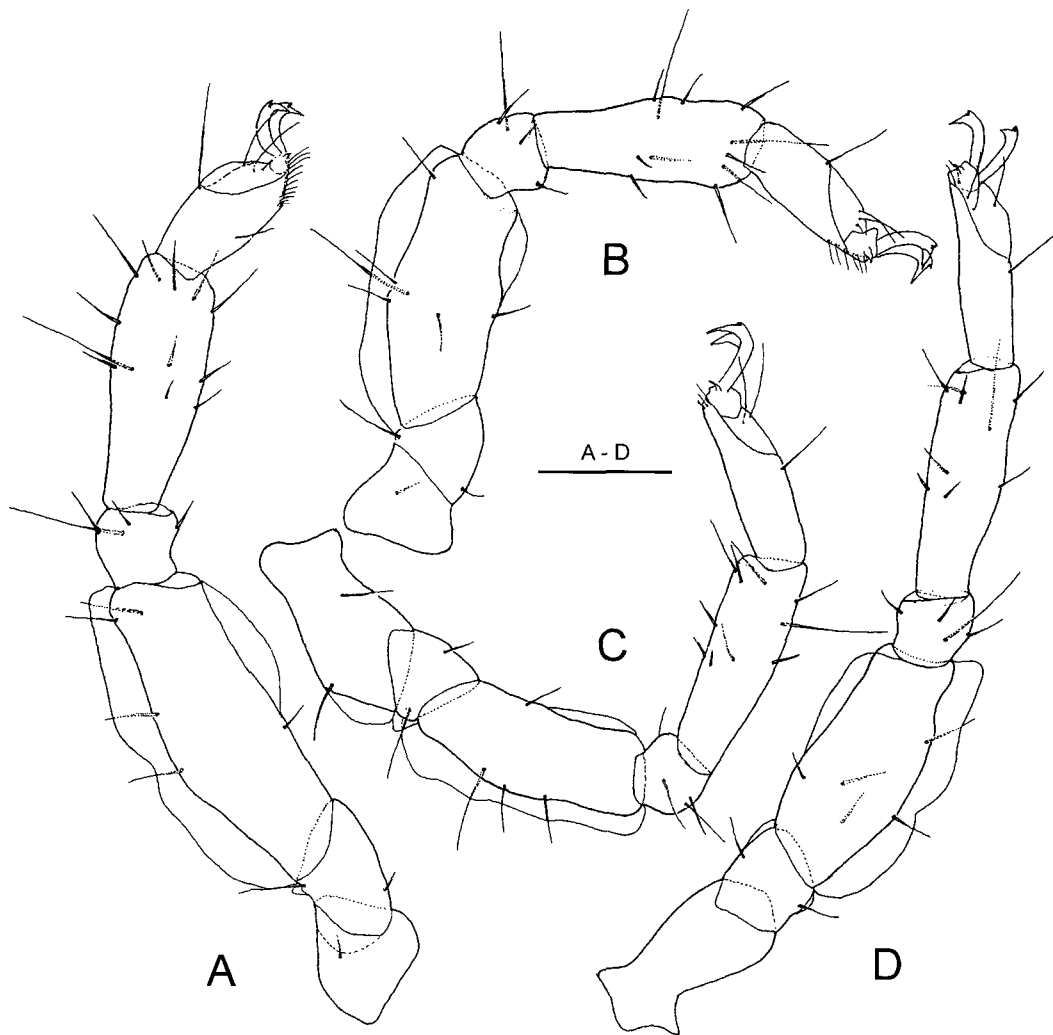


Fig. 2. *Agaue laeviunguis* n. sp., holotype female. A-D, Legs I-IV. Scale bar = 100 μ m.

membranes on dorsal and distoventral side of telofemora (Fig. 4C-F). Chaetotaxy of legs (trochanter to tibia): trochanter 1-1-2-0; basifemur 2-2-2-2; telofemur 4-5-3-3; patella 4-3-3-3; tibia 9-8-6-5. Tarsus I with about 20 PAS (Fig. 3H). Lateral claws smooth ventrally, with an accessory process dorsally; accessory process with about 6-7 fine teeth.

Protonymph: Idiosoma 477 μ m, 294 μ m wide (Fig. 5A). AD 141 μ m long, 123 μ m wide. OC 72 μ m long, 34 μ m wide. PD anteriorly truncated, 159 μ m long, 93 μ m wide. PE dorsally and ventrally each with only 1 seta anterior to insertion of leg III. Genital plate separate from anal plate (Fig. 5B), with 1 pair of genital acetabula, lacking seta. Legs with thin cerotegumental membranes on dorsal and ventrodistal side of telofemora (Fig. 5C-F). Legs I-III with 6 segments; leg IV with telofemur and basifemur not divided. Lateral claws smooth ventrally, with an accessory process dorsally, accessory process with about 6 fine teeth.

Variability: Idiosoma ranging from 720 to 800 μ m long in 14 males examined, 715 to 775 μ m long in 13 females examined. Among the females examined, three females had a seta out of ring anteriorly, not on periphery. Chaetotaxy of telofemora and tibia was variable: telofemur II with 5-6 setae; telofemora III and IV 4-5; tibia I 12-13; tibia II 11-12; tibiae III and IV 9-10, respectively. In holotype female, tibia III had only 5 setae on one side. Position of setae on tibiae often varied depending individuals, even among between right and left tibia of an individual. Number of ventral setae (ventromedial and ventrolateral) on tibiae varied according to the number of total setae. Some specimens also had the cerotegumental membrane on the lateral side of gnathosoma. Length of genital plate of two deutonymphs measured 38 μ m and 47 μ m each. One deutonymph showed 3 ventral setae on right side of PE while 2 ventral setae on left side under SEM observation. In deutonymph, length to width ratio of OC ranged from 1.37-1.54.

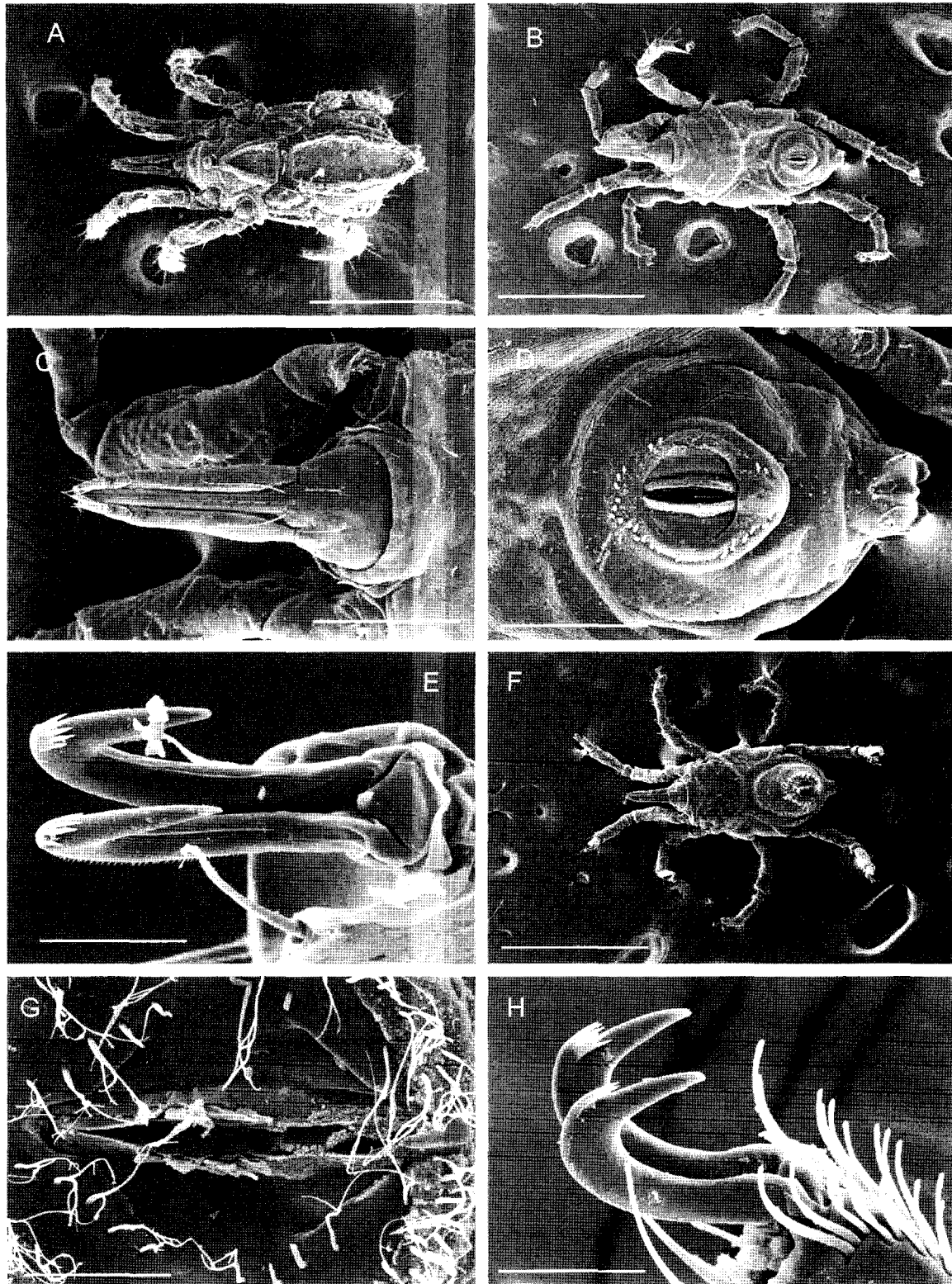


Fig. 3. *Agauae laeviunguis* n. sp. (SEM figures). A-E, Female. A, Idiosoma, dorsal view. B, Idiosoma, ventral view. C, Gnathosoma, ventral view. D, GA, Ventral view. E, Claw of leg 3. F-G, male. F, Habitus, ventral view. G, GO area. H, Claw of leg 1, deutonymph. Scale bars = 100 μ m (A, B, C, E) and 50 μ m (D).

Posterior tip of OC varied from slightly pointed to round. Position of setae ds_4 varied from mc to margin between mc

and PD. Cerotegumental membrane on AD in some individuals extending posteriorly beyond posterior margin

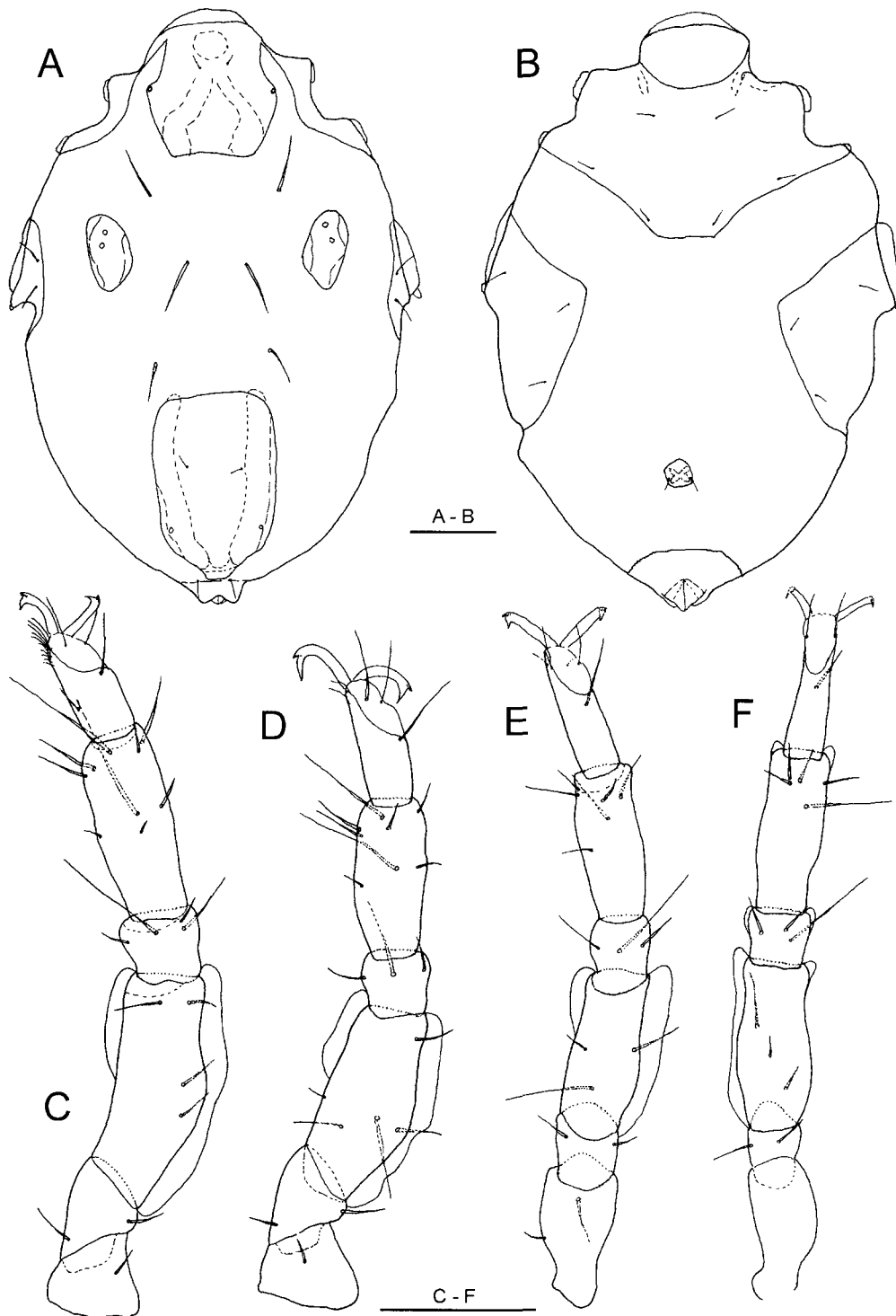


Fig. 4. *Agae laeviunguis* n. sp., deutonymph. A, Idiosoma, dorsal. B, Idiosoma, ventral. C-F, Legs I-IV. Scale bars = 100 μ m.

of AD, while in others restricted to AD.

Etymology: The specific name, *laeviunguis* (*L. laevis*, smooth or bare; *unguis*, claw), refers to the character state of claws without ventral pectines in the present new species.

Remarks: In having character combination of 3 dorsal setae on PE, lacking dorsal seta anterior to insertion of leg IV, 3 ventral setae on PE, female PGS adjacent to GF, telofemora devoid of fovea, well developed smooth cerotegumental lamella on all telofemora, presence of accessory process on all lateral claws, long gnathosoma, and a smooth seta on P₂

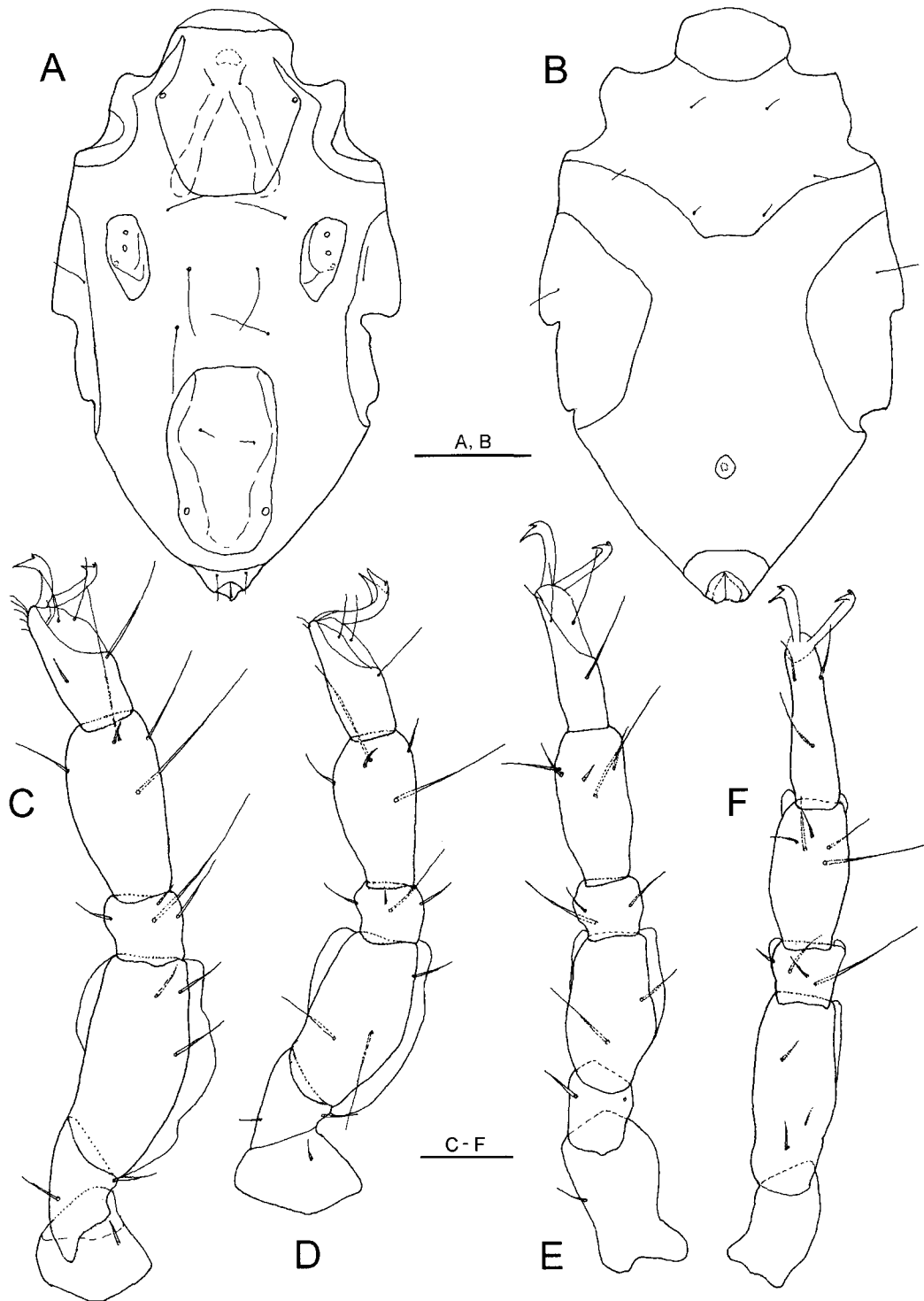


Fig. 5. *Agaue laeviunguis* n. sp., protonymph. A, Idiosoma, dorsal. B, Idiosoma, ventral. C-F, Legs I-IV. Scale bars = 100 μ m (A, B) and 50 μ m (C-F).

in both sexes, the present new species resembles *A. subglabra* Bartsch from Rottnest Island, Australia (Bartsch, 1999). However, *A. laeviunguis* n. sp. differs from *A. subglabra* by larger body, claws of tarsi II-IV without ventral pecten, 30 PGS in female (against 13 PGS in *A. subglabra*), and much longer $ds_{2,4}$ (about 71-82 μ m long,

while 10-12 μ m long in *A. laeviunguis*).

Agaue laeviunguis is also similar to *A. hypertrophica* (Lohmann) from Zanzibar, Tanzania (Lohmann, 1893), *A. hamiltoni* Womersley from Macquarie Island (Womersley, 1937), *A. maglanica* Newell and *A. heterunguis* Newell from Chile (Newell, 1971, 1984). The Idiosoma size (720-

775 µm long in female, 715-800 µm in male) of the present new species is much larger than those of *A. hypertrophica* (488-535 µm), *A. magellanica* (435-522 µm in female, 444-505 µm in male), *A. heterunguis* (496 µm in male) and *A. hamiltoni* (540 µm in male) (Newell, 1971, 1984; Womersley, 1937). Lateral claws are armed with pectines ventrally in *A. magellanica* (7-14 pectines), *A. heterunguis* (3-4 very coarse pectines) and *A. hamiltoni* (about 18 pectines), while ventrally smooth in *A. laeviunguis*, as suggested in the specific name. *Agauae heterunguis* lacks accessory process on lateral claws and lamella on telofemora.

Agauae laeviunguis resembles *A. kurilensis* Makarova from the Kurile Islands, Russia, however, the present new species is distinguished from it by the following points: *A. laeviunguis* has a smaller body than *A. kurilensis* (1,564 µm long in female); GF of female locates at 0.06 level of GA in *A. laeviunguis*, while GF is apart from the anterior margin of GA, i.e., at about 0.20 level of GA in *A. kurilensis* (cf. Makarova, 1977, Fig. 9-ga); GA of female is rounded anteriorly in *A. laeviunguis*, while somewhat triangular in *A. kurilensis*; female of *A. laeviunguis* has 8-11 setae on each side of GF in the anterior half closed to GF and 5-7 setae on each side of GF in the posterior half closed to GF, while female of *A. kurilensis* has 3 or 4 setae on each side of GF on the anterior half closed to GF and a pair of peripheral PGS near the anterior margin of GA and 7 or 8 on each side of GF in the posterior half closed to GF; ventromedial sides of claws are furnished with well developed pectines (from middle to distal part of claws near accessory process) in *A. kurilensis* (see Makarova, 1977, p. 140, fig. 9-I: tip of tarsus and claws), while claws smooth ventrally and accessory process bearing 6-7 minute teeth in *A. laeviunguis*. The cerotegumental lamellae on telofemora are well developed in *A. laeviunguis*, while they were neither mentioned in the description of *A. kurilensis* nor figured (cf. Makarova, 1977, Fig. 9-I).

Sokolov (1952) described *A. gracilirostris* from the Russian coast of the East Sea (Sea of Japan) based on only nymphs and larvae. In the deutonymph of *A. gracilirostris*, cerotegumental lamella on leg I is not conspicuous, while the lamella is well developed in the nymph of *A. laeviunguis*; PD is nearly triangular anteriorly in *A. gracilirostris*, while truncated in the deutonymph of *A. laeviunguis*; PD is slender (length to width ratio about 2.5) in the deutonymph of *A. gracilirostris* (cf. Sokolov, 1952, Fig. 74-1), while much wider in the deutonymph of *A. laeviunguis* (length to width ratio about 1.5).

The morphological differentiations between nymphs and adults were observed as follows. Increase in the number of setae on PE are shown during the development: only one

dorsal seta on PE anterior to insertion of leg III at protonymph stage, two setae at deutonymph and then three setae at adult stage. The protonymph has only one ventral seta on PE (Fig. 5B), while both deutonymphs and adults have three setae (Figs. 1B, 4B).

Chaetotaxy on legs of nymphs shows less number of setae than in adult (especially prominent at tibia segment). Arrangements of pectines on claws do not show any significant dissimilarities through two nymphal stages and adult stage.

Both proto- and deutonymph have the genital plate separated from anal plate. Protonymph has single pair of genital acetabula, while deutonymph has two pairs of genital acetabulae (Figs. 4B, 5B). At the protonymph stage the setae on genital plate is entirely lacking (Fig. 5B), and there are only a pair of setae at the deutonymph stage (Fig. 4B).

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