

***Copidognathus daguilarensis* (Acari: Halacaridae), a New Record of the *Copidognathus gibbus* Group from Korea**

Jimin Lee¹, Jong Hak Shin², Cheon Young Chang^{2,*}

¹Marine Ecosystem Research Center, Korea Institute of Ocean Science & Technology, Busan 49111, Korea

²Department of Biological Science, Daegu University, Gyeongsan 38453, Korea

ABSTRACT

A halacarid species of the genus *Copidognathus* is newly reported from Korea: *C. daguilarensis* Bartsch, 1997, which was described from Hong Kong. It is redescribed herein with detailed illustrations. Korean specimens coincide well with the original description, however, they showed two minor morphological discrepancies from it: quite shorter second palpal segment than the fourth and a modified dorsal seta on the second palpal segment. Korean specimens were rather smaller than the type specimens from Hong Kong, however, they did not show significant differences in the length to width ratios of important body parts. The number of perigenital setae was more variable in the Korean males, ranged 24–29 setae, versus 25–26 in Hong Kong's. *Copidognathus daguilarensis* is reported for the first time outside the type locality, and joins as the second member of the *gibbus* group in the northwest Pacific.

Keywords: *gibbus* group, marine, meiofauna, mite, northwest Pacific, taxonomy

INTRODUCTION

Genus *Copidognathus* is a representative and the most speciose halacarid genus, comprising 377 valid species, about 30% of all known species in the Halacaridae (WoRMS, 2020). *Copidognathus* mites are known to be distributed worldwide, and “found in a wide range of substrata, in sand, gravel, coral debris, bushy algae, colonial organisms, and amongst gills and eggs of decapods. A few species live in fresh water” (Bartsch, 2006).

In the northwest Pacific region (see Bartsch, 2009, fig. 1 for the outline of the marine biogeographical provinces), a total 44 species are recorded as yet: 35 species from the Aleutian Islands, Kuril Islands and its adjacent Russian waters of the East Sea (= Sea of Japan) (Sokolov, 1946, 1952; Newell, 1949, 1950, 1951a, 1951b; Viets, 1951; Makarova, 1972a, 1972b, 1974, 1977, 1978); one from Japan (Newell, 1984); and nine from South Korea. The nine species from South Korea are as follows: *C. koreanus* Chatterjee and Chang, 2003 (see Chatterjee and Chang, 2003); *C. laevisetosus* Chatterjee, Lee and Chang, 2004 and *C. cerberoideus* Bartsch, 1991 (see Chatterjee et al., 2004); *C. jejuensis* Chatterjee and Chang,

2004 and *C. polyporus* Bartsch, 1991 (see Chatterjee and Chang, 2004); *C. fistulosus* Chatterjee and Chang, 2005 (see Chatterjee and Chang, 2005); *C. quadriporosus* Chatterjee and Chang, 2006 and *C. tetrachachis* Chatterjee and Chang, 2006 (see Chatterjee and Chang, 2006); and *C. curtus* Hall, 1912 (see Chatterjee et al., 2012).

Recently we found one more *Copidognathus* species from the eastern and southern coasts of Korean peninsula. It has been identified as *C. daguilarensis* Bartsch, 1997, which was originally described from Hong Kong (Bartsch, 1997). Herein we conduct a taxonomic study of a redescription and detailed illustrations of the species, with brief systematic accounts on its morphological variabilities and zoogeographical distribution.

Collection was carried out mostly by gathering coralline algae on the intertidal rocks into plastic bags, and washing through a nylon net (64 µm in pore diameter), often after treating with same volume of a little hot (around 50–60°C) freshwater for about five minutes. Methods in the laboratory for microslide preparation, microscopy using a differential interference microscope, drawing and measurements are as written in the authors' latest papers (Lee and Chang, 2017;

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***To whom correspondence should be addressed**

Tel: 82-53-850-6454, Fax: 82-53-850-6459
E-mail: cychang@daegu.ac.kr

Shin and Chang, 2019).

Voucher specimens are kept in the Marine Interstitial fauna Resources Bank (MInRB) of the Korea Institute of Ocean Science & Technology (KIOST), Busan, Korea.

Terminology and abbreviations used in the text are as follows: AD, anterior dorsal plate; AE, anterior epimeral plate; ds-1 to ds-6, dorsal setae 1 to 6 on the idiosoma; GA, genitoanal plate; GO, genital opening; OC, ocular plate; P, palp (P-2, second palpal segment); pas, parambulacral setae; PD, posterior dorsal plate; PE, posterior epimeral plate; pgs, perigenital setae; sgs, subgenital setae.

SYSTEMATIC ACCOUNTS

Subclass Acari Leach, 1817

Order Trombidiformes Reuter, 1909

Suborder Prostigmata Kramer, 1877

Superfamily Halacaroidae Murray, 1877

Family Halacaridae Murray, 1877

Genus *Copidognathus* Trouessart, 1888

***Copidognathus daguilaensis* Bartsch, 1997 (Figs. 1–3)**
Copidognathus daguilaensis Bartsch, 1997: 63, figs. 1, 2.

Material examined. Korea: 2♀♀ (MInRB-HI05-S003–4), 2♂♂ (MInRB-HI05-S005–6), Gyeongsangnam-do: Geoje Island, Deokwon Beach, 34°46'41"N, 128°34'42"E, 20 Mar 2018, Chang CY, Lee J; 3♀♀, 1♂, Gyeongsangbuk-do: Pohang, Masan-ri, Haseondae, 36°01'59"N, 129°28'58"E, 20 Jan 2019, Shin JH; 1♀, 1♂, Jeollanam-do: Geomun Island, Mogneomeo, 34°01'52"N, 127°18'55"E, 11 Jul 2019, Shin JH; 3♀♀ (MInRB-HI05-S007–9), Gyeongsangbuk-do: Yeongdeok, Gugye-ri, Namho Beach, 36°19'20"N, 129°22'55"E, 31 Aug 2019, Shin JH; 1♂, Yeongdeok, Jangsa, Jangsa Beach, 36°28'04"N, 129°37'40"E, 31 Aug 2019, Shin JH; 1♂, Pohang, Balsan-ri, Janggunbawi (General rock), 36°04'27"N, 129°51'43"E, 24 Sep 2019, Shin JH; 1♂, Pohang, Gupyeong-ri, Donginho quay, 35°94'27"N, 129°53'59"E, 24 Sep 2019, Shin JH; 1♀ (MInRB-HI05-S001), 1♂ (MInRB-HI05-S002), Gyeongju, Naa Beach, 35°69'74"N, 129°47'60"E, 25 Sep 2019, Shin JH. All samples mounted on H-S slides.

Description. Female: Idiosoma (Fig. 1A) 250 µm long, 162 µm wide, all dorsal plates divided with narrow membranous integument, partly contiguous between anterior OC and AE, and posterior OC and PE, respectively. AD (Fig. 1A) 106 µm long, 100 µm wide, slightly longer than wide (length to width ratio about 1.06); short frontal spine protruding forward; raised areola 'A'-shaped or invert 'V'-shaped anteriorly, convergent to frontal spine anteriorly, and extending

posteriorly to about 2/3–3/4 of AD; remaining portion of posterior 1/3–1/4 of AD faintly reticulated; a pair of first gland pores located anterolaterally near 1/3 of AD; posterior margin nearly straight.

OC distinct, narrowing posteriorly, 56 µm long (0.22 times as long as idiosoma, located at 0.26–0.53 level of idiosoma), 24 µm wide; with 2 corneae, the anterior slightly larger than the posterior; second gland pore behind posterior cornea laterally; porose areola present on anterior half. PD anterior margin weakly convex, 137 µm long, 119 µm wide, 0.55 times as long as idiosoma; with 2 medial costae extending anterolaterally towards each OC; each medial costae with 1 rosette pore wide in the middle, while 2–4 rosette pores wide anterior laterally; area (Fig. 1C) between 2 medial costae and both lateral sides of costae sculptured with panels coarsely reticulated and irregularly arranged; each mesh subdivided locating between medial costae; third gland pore located on lateral costae, at mid length of PD.

Dorsal setae (Fig. 1A): ds-1 (Fig. 3A) present just behind first gland pore, on anterolateral areola of AD; ds-2 on anterior corner of OC; ds-3 near anterior margin of PD; ds-4 and ds-5 on medial costae, each issuing at anterior 1/3 and 2/3 of PD, respectively; ds-6 on adanal plate.

All ventral plates marginally with rosette pores (Fig. 1B). AE 84 µm long, 151 µm wide (length to width ratio 0.56); partly separated medially from GA by striated integument, about half as broad as AE; with 3 pairs of ventral setae and a pair of epimeral pores; numerous canaliculi scattered irregularly on medial and anterolateral surface of AE, aggregating more densely in posterolateral area, grouped with 8–14 canaliculi each. PE clearly separated, with 1 dorsal and 3 ventral setae. GA 127 µm long, 109 µm wide (length to width ratio 1.16) with 3 pairs of pgs, foremost seta to level of leg IV; second seta slightly ahead of GO; last one positioned near posterolateral margin of GO. GO elliptical, biased backwards, extending to anal sclerite; 41 µm long, 34 µm wide, about 1/3 times as long as GA, with 1 pair of sgs anteriorly. Ovipositor present, its anterior tip extending to level of leg IV.

Gnathosoma (Fig. 3A–D) short, about 75 µm long, 61 µm wide; with a pair of basirostral setae; ventral surface of gnathosomal base covered with 2–4 rows of small pores medially and 3–4 rows of large one with canaliculi on both ventrolateral sides. Rostrum about 33 µm long, 0.79 times as long as gnathosomal base; narrow apex of rostrum reaching to end of P-2; with 3 pair of rostral setae: small protorostral and deutorostral setae placed at tip dorsolaterally and laterally, respectively; long tritrostrals at anterior half. Palp (Fig. 3D) clearly 4 segmented; P-1 and P-3 lacking setae; P-2 enlarged with 1 dorsal pinnate seta; P-4 slender and longest, 1.3 times as long as P-2, with 3 long basal and 1 short dis-

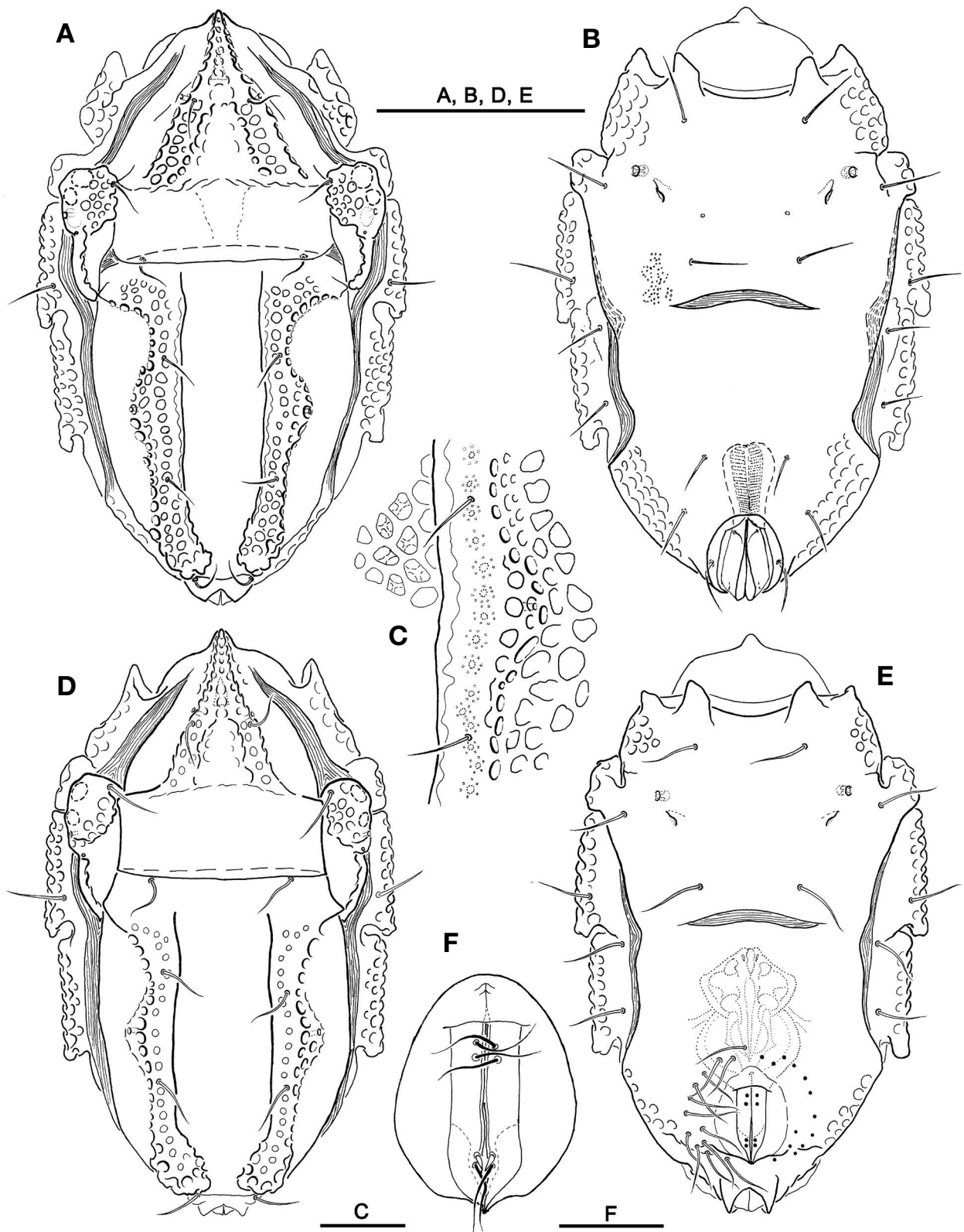


Fig. 1. *Copidognathus daguilarensis*. A-C, Female (MInRB-HI05-S001): A, Idiosoma, dorsal; B, Idiosoma, ventral; C, Costa on PD between ds-5 and ds-6. D-F, Male (MInRB-HI05-S005): D, Idiosoma, dorsal; E, Idiosoma, ventral; F, GO. ds, dorsal setae on idiosoma; GO, genital opening; PD, posterior dorsal plate. Scale bars: A, B, D, E = 100 µm, C, F = 20 µm.

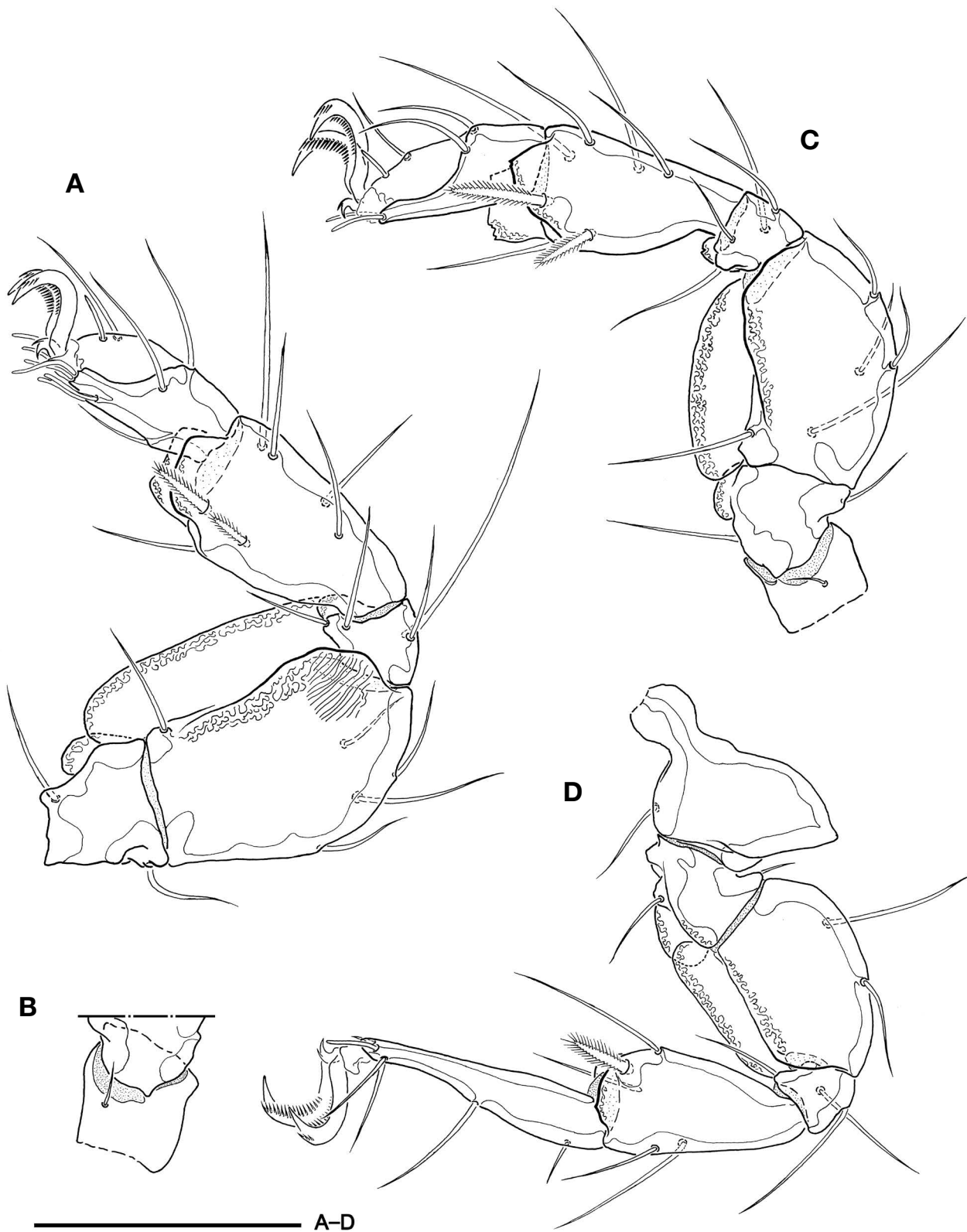


Fig. 2. *Copidognathus daguilarensis*, female (MInRB-HI05-S001). A, Leg I, excluding trochanter; B, Trochanter of Leg I; C, Leg II; D, Leg III. Scale bars: A-D = 50 μ m.

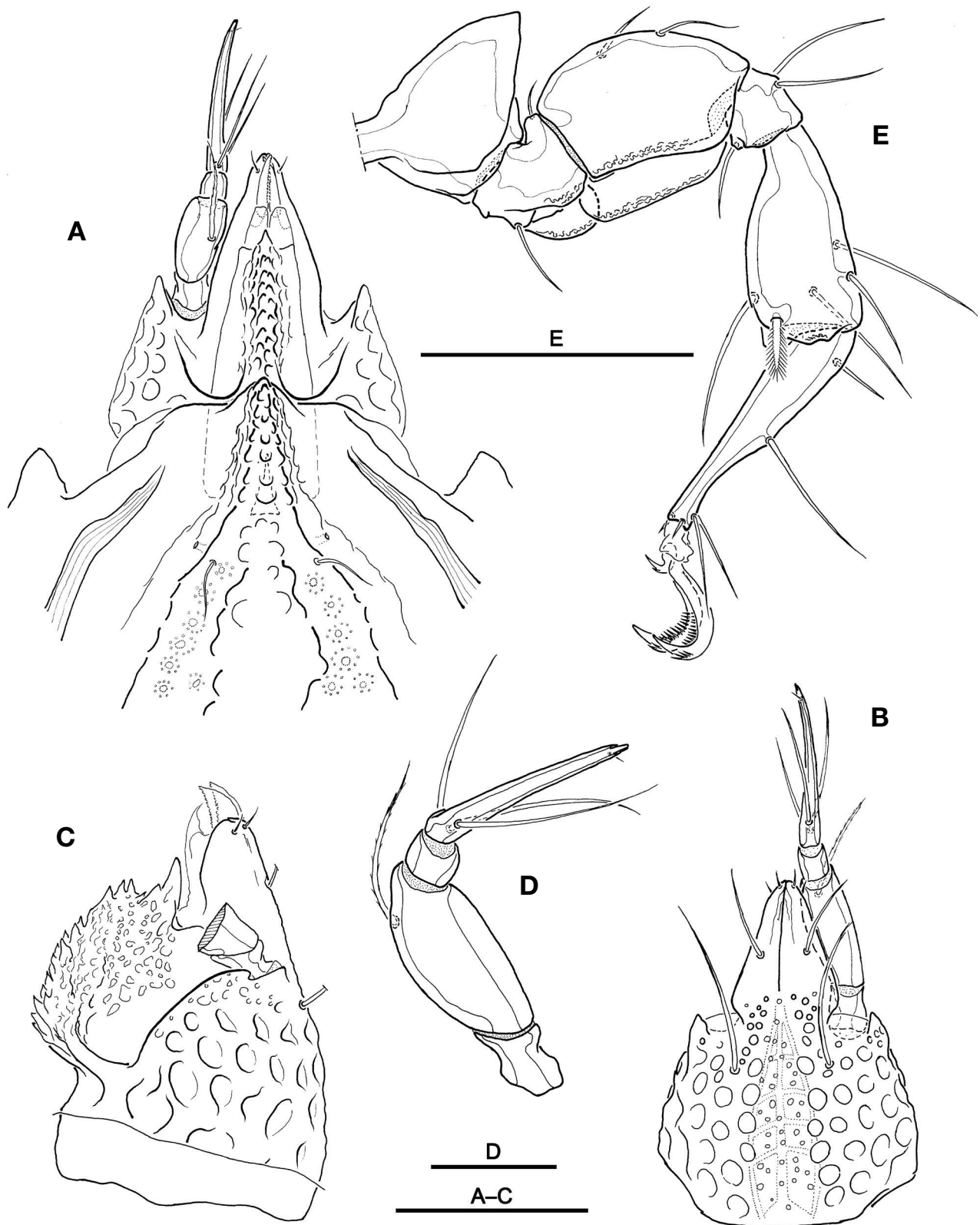


Fig. 3. *Copidognathus daguilarensis*, female. A, Anterior part of gnathosoma and AD, dorsal (MInRB-HI05-S001); B, Gnathosoma, ventral (MInRB-HI05-S007); C, Gnathosoma, lateral (MInRB-HI05-S008); D, Palp, lateral (MInRB-HI05-S001); E, Leg IV (MInRB-HI05-S001). AD, anterior dorsal plate. Scale bars: A-C, E=50 µm, D=20 µm.

tal setae. Tectum (Fig. 3C) representing strong crest-shaped process.

Chaetotaxy of legs (excluding tarsi) (Figs. 2A–C, 3E) as follows: trochanters 1-1-1-0; basifemora 2-2-2-2; telofemora 5-5-2-2; genua 4-4-3-3; tibiae 7-7-5-5. Trochanters III and IV with large triangular protrusion dorsally (Figs. 2D, 3E). Lateral lamella on basifemora of legs I to IV developed. Telofemora of all legs with well-developed lateral and medial membranes; medial lamella less advanced than lateral one; all lamellae bearing fine reticulation on surfaces; surface of medial membrane in telofemur I with detailed stripes anteriorly. Genua I and II with small lateral lamella; articular lamellae in genua III and IV lacking. Tibiae I and II with lateral and medial lamellae; lateral articular lamella larger than medial one; tibia I with smooth and truncated lateral and medial lamellae; tibia II with slightly dentate on distal corner edge of lateral membrane; tibiae III and IV with weakly developed articular lamellae; tibiae I to IV with 2-2-1-1 bipectinate setae, respectively. Tarsi I and II stubby and each segments short than previous tibiae I and II; tarsi of legs I and II with large claw fossae, 1 solenidion and 3 dorsal setae; tarsus I with 1 ventromedial seta, 6 pas (2 pairs of doublets on both lateral sides, 2 singles on medial surface); tarsus II with 2 eupathid pas; tarsi III and IV slender, each segments longer than previous tibiae III and IV, and 4.4 and 4.1 times longer than high, respectively; tarsi of legs III and IV with 4 dorsal setae; tarsus III with 1 short and 1 long pas; tarsus IV with 2 short pas. All tarsi of legs with median claws bearing accessory process and paired lateral claws; lateral claws each with pecten consisting of numerous spinules.

Male: Almost similar to female, except for genital region. Idiosoma (Fig. 1D, E) 248 μ m long, 153 μ m wide (length to width ratio 1.62), slightly broader than in female. GA

(Fig. 1E) 129 μ m long, 112 μ m wide; anterior tip of spermatophore extending to level of leg III, with 26 pgs around GO. GO (Fig. 1E) 40 μ m long, 32 μ m wide, about 1/3 times as long as GA; 4 pairs of sgs (Fig. 1F) present, fore group consisting of 2 pairs of long filiform setae, rear group comprising 1 pair of short spiniform elements anteriorly and 1 pair of long filiform setae posteriorly; posterior end of GO noticeably apart from anal sclerite.

Remarks. Among several species groups in the genus *Copidognathus*, *C. daguilaensis* is definitely assigned to the *gibbus* group in having the characteristics as follows: a big, triangular protrusion on the ventral surface of basifemora III and IV; large articular lamellae on telofemora I–IV; and slender tarsi III and IV, slightly longer than their nearby tibiae (see Bartsch, 1994, 1997; Otto, 2000; Chatterjee and De Troch, 2003 for the key characters of the *gibbus* group).

In this relatively small natural group (see Bartsch, 1997), 49 members are currently recognized. *Copidognathus daguilaensis* is most similar to *C. areolatus* Bartsch, 1989 from Hawaii and *C. bistriatus* Bartsch, 1994 from Australia in sharing the combination of characters: separated dorsal plates of AD and PD, partly fused AE and GA, medial costae on PD with one rosette pore wide, short frontal spine, and ds-1 positioned slightly posterior to first gland pore. However, it differs from *C. areolatus* by ‘A’-shaped areola with a transverse bar on the anterior AD (vs. with an additional, second transverse bar in *C. areolatus*), and the gland pore on PD present (vs. lacking in *C. areolatus*). *Copidognathus daguilaensis* is also discernible from *C. bistriatus* by four dorsal setae on tarsus IV (vs. three in *C. bistriatus*), the gland pore situated medially on PD between ds-4 and ds-5 (vs. much closer to ds-4 in *C. bistriatus*), and much longer tarsi III and IV (over 4 times as long as wide, versus about 2.8 times in *C. bistriatus*).

Table 1. Comparison of variabilities between specimens from Hong Kong and Korea

	Female		Male	
	Hong Kong (holotype)	Korea (n=10)	Hong Kong (n=?)	Korea (n=4)
Idiosoma	310/– (–)	234–279/147–182 (1.60)	290–300/– (–)	248–263/153–174 (1.53)
AD	125/111 (1.13)	95–115/80–106 (1.12)	–	99–111/88–100 (1.12)
OC	100/35 (2.86)	53–78/20–27 (2.75)	–	42–78/16–27 (2.95)
PD	167/135 (1.24)	142–158/98–126 (1.31)	–	136–147/111–128 (1.20)
AE	97/182 (0.53)	80–90/132–170 (0.56)	–	84–93/143–162 (0.58)
GA	152/130 (1.17)	121–147/100–118 (1.24)	140/130 (1.08)	129–135/112–130 (1.12)
GN	91/– (–)	70–83/54–58 (1.35)	–	73–82/55–60 (1.33)
No. of pgs	6	6	25–26	24–29
No. of sgs	1 Pair	1 Pair	4 Pairs	4 Pairs

Values are presented as length and width ranges in μ m with their ratios (medium values) in parentheses.

AD, anterior dorsal plate; OC, ocular plate; PD, posterior dorsal plate; AE, anterior epimeral plate; GA, genitoanal plate; GN, gnathosoma; pgs, perigenital setae; sgs, subgenital setae.

Korean specimens fit well with the original description, based upon the specimens from Hong Kong (Bartsch, 1997), excluding only two minor morphological discrepancies: P-4 is about 1.3 times longer than P-2 (versus P-4 almost as long as P-2 in the original description); and the dorsal seta on P-2 is noticeably modified to a pinnate seta in both sexes, while that was drawn apparently as a slender smooth seta in the original description (Bartsch, 1997, fig. 1E, G). Furthermore, there exists a size difference between the two populations, that is, Korean specimens were somewhat smaller than those from Hong Kong: lengths of idiosoma ranged 234–279 µm (mean 260 µm, $n=10$) versus 275–315 µm (holotype 310 µm) in the female, and 248–263 µm long (mean 256 µm, $n=4$) versus 290–300 µm in the male. Accordingly, proportional to the body size, other body parts also showed the similar tendency (Table 1). However, considering probable measurement errors supposedly caused by different measuring methods, different conditions of specimens and mounting mediums, etc., the length to width ratios of every body parts did not show significant differences between the two populations. Variability in the number of male pgs should also be noteworthy: more variable in the Korean males, ranged 24–29 setae, than in Hong Kong's (25–26 setae).

Copidognathus daguilaensis is reported for the first time outside the type locality, Hong Kong. It was collected from several localities in the eastern and southern coasts of the Korean peninsula, which are presumably affected by the Tsushima Current, a branch of the Kuroshio Current. This study also reveals that *C. daguilaensis* has joined as the second member of the *gibbus* group in the northwest Pacific after *C. lamelliger* Sokolov, 1952 from Russian waters of the East Sea.

Distribution. Hong Kong, Korea (East Sea, South Sea).

ORCID

Jimin Lee: <https://orcid.org/0000-0001-9004-8275>

Jong Hak Shin: <https://orcid.org/0000-0002-1889-4212>

Cheon Young Chang: <http://orcid.org/0000-0001-5557-7120>

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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