

FIRST RECORD OF THE HIPPOLYTID SHRIMP GENUS *LEBBEUS* WHITE, 1847 (DECAPODA: CARIDEA) FROM TAIWAN, WITH THE DESCRIPTION OF THREE NEW SPECIES

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ABSTRACT

The hippolytid shrimp genus *Lebbeus* White, 1847 was previously unknown from Taiwan. However, recent deep-sea surveys off the island have collected numerous specimens comprising four species, three of which are new to science: *L. tosaensis* Hanamura and Abe, 2003, *L. brevirostris* n. sp., *L. formosus* n. sp., and *L. unguiculatus* n. sp. *Lebbeus brevirostris* belongs to the group bearing epipods only on the first two pereopods and is unique in having a short spiniform rostrum. *Lebbeus formosus* and *L. unguiculatus* bear epipods on the first three pereopods. The latter is characteristic in having the dactyli of the posterior pereopods terminating in a single elongate unguis. *Lebbeus formosus* is distinct in having a combination of rostral, antennular, telson, and pereopodal characters.

KEY WORDS: Caridea, Decapoda, deep sea, Hippolytidae, *Lebbeus*, Taiwan

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INTRODUCTION

The hippolytid genus *Lebbeus* White, 1847 is rather diverse, with about 50 species world wide (De Grave et al., 2009; Komai and Collins, 2009). Although species of this genus are well known from the North Pacific, i.e., Japan and Far Eastern Russia (see Komai et al., 2004) and found from shallow to deep waters, including hydrothermal vents, there are no previous records from Taiwan. The ongoing program of deep-sea cruises since the year 2000 [TAIWAN] have yielded numerous new species of decapods from Taiwanese waters (Komai and Chan, 2002, 2003, 2006, 2009, 2010; Chuang et al., 2003; Cleva, 2004; Ho et al., 2004; Ah Yong and Chan, 2004, 2010; Lin and Chan, 2005; Kim and Chan, 2005; Mitsunashi and Chan, 2006, 2009; Osawa et al., 2006a, b, 2008a, b; Lin, Osawa and Chan, 2007; Lin, Komai and Chan, 2007; Macpherson and Chan, 2008; Osawa and Chan, 2008, 2009; Komai et al., 2010). Amongst the carideans there are many specimens of *Lebbeus* collected between 266 and 1982 m in depth. Close examination on this material reveals four species to be present, three of which are new to science.

The specimens are deposited in the National Taiwan Ocean University, Keelung (NTOU), the Natural History Museum and Institute, Chiba (CBM), and the Oxford University Museum of Natural History (OUMNH). Carapace length (cl) is used as the standard measurement, expressed in mm, and measured dorsally from the postorbital margin to the posterior margin of the carapace. The station (stn) designation are preceded by a prefix indicating the actual type of collecting equipment, as follows: 4 m French beam trawl (CP), 2.5 m French beam trawl (PCP), 3 m ORE beam trawl (OCP), and the Le Drezen type solo hard bottom 12.4 m otter trawl (CD).

SYSTEMATICS

Lebbeus brevirostris n. sp.

Figs. 1-3, 10A-B

Material Examined.—Holotype: female cl 9.8 mm, TAIWAN 2001, stn CP71, 24°52.33'N, 122°03.10'E, 600 m, 6 May, 2001, NTOU M00243.

Paratypes: TAIWAN 2001, stn CP71, 24°52.33'N, 122°03.10'E, 600 m, 6 May, 2001, 2 males cl 5.5-7.5 mm, 2 females cl 7.2-7.4 mm, NTOU M00295, 2 males cl 4.6-4.8 mm, 1 female cl. 6.2 mm, OUMNH.ZC.2010-07-002, 003, 004; stn CP111, 24°52.24'N, 122°04.35'E, 540-700 m, 21 May, 2001, 1 female cl 7.3 mm, OUMNH.ZC.2010-07-001.

Description of Females.—Body moderately robust for genus; integument naked, glabrous, not particularly firm.

Rostrum (Fig. 1A-C) straight, directed forward, spiniform in lateral view (ventral blade not developed), failing to reach midlength of first segment of antennular peduncle, 0.30-0.35 times carapace length; dorsal margin armed with 0-1 teeth, ventral margin unarmed. Carapace with moderately high, blunt postrostral median carina extending to midlength of carapace and sloping toward rostral base, bearing 2 or 3 (usually 2) relatively large teeth but not forming crest, posteriormost tooth arising at 0.48-0.62 of carapace length; supraorbital tooth large, arising anteriorly from posterodorsal margin of orbit; orbital margin generally concave, with U-shaped notch below supraorbital tooth; suborbital lobe well developed, triangular, reaching to about 0.50 of antennal tooth; anterolateral margin between antennal and pterygostomial tooth weakly sinuous with shallow excavation below antennal spine.

Pleon (Fig. 1D) dorsally rounded. Second somite with shallow transverse groove on tergum. Pleura of anterior four somites broadly rounded, fifth pleuron with moder-

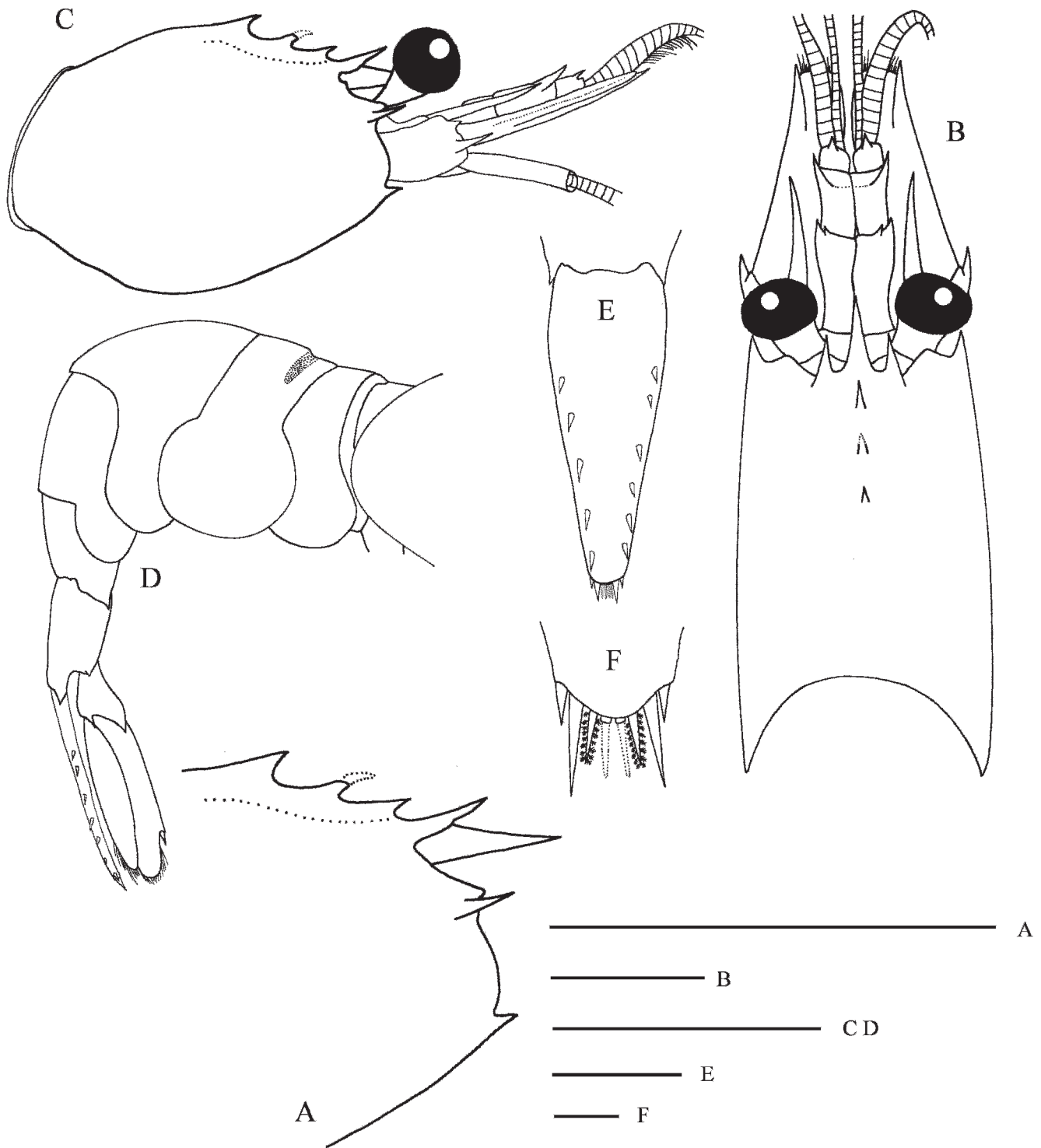


Fig. 1. *Lebbeus brevirostris* n. sp., holotype female cl 9.8 mm, TAIWAN 2001, stn CP71. A, anterior part of carapace, lateral view; B, carapace and anterior appendages, dorsal view; C, carapace and anterior appendages, lateral view; D, pleon, lateral view; E, telson, dorsal view; F, same, posterior margin, dorsal view. Scales: A, C, D = 10 mm; B, E = 5 mm; F = 0.5 mm.

ately strong posteroventral tooth. Sixth somite 1.21-1.42 times as long as fifth somite and 1.53-1.76 times as long as high, bearing small posteroventral tooth; posterolateral process terminating in small tooth. Telson 1.20-1.50 times as long as sixth somite, 2.52-2.81 times longer than anterior

width, tapering posteriorly to convex posterior margin, bearing 3-6 (usually 3-4) dorsolateral spines on each side (Fig. 1E); posterior margin (Fig. 1F) with 2 pairs of lateral spines (mesial pair longer) and 4 median spiniform plumose setae.

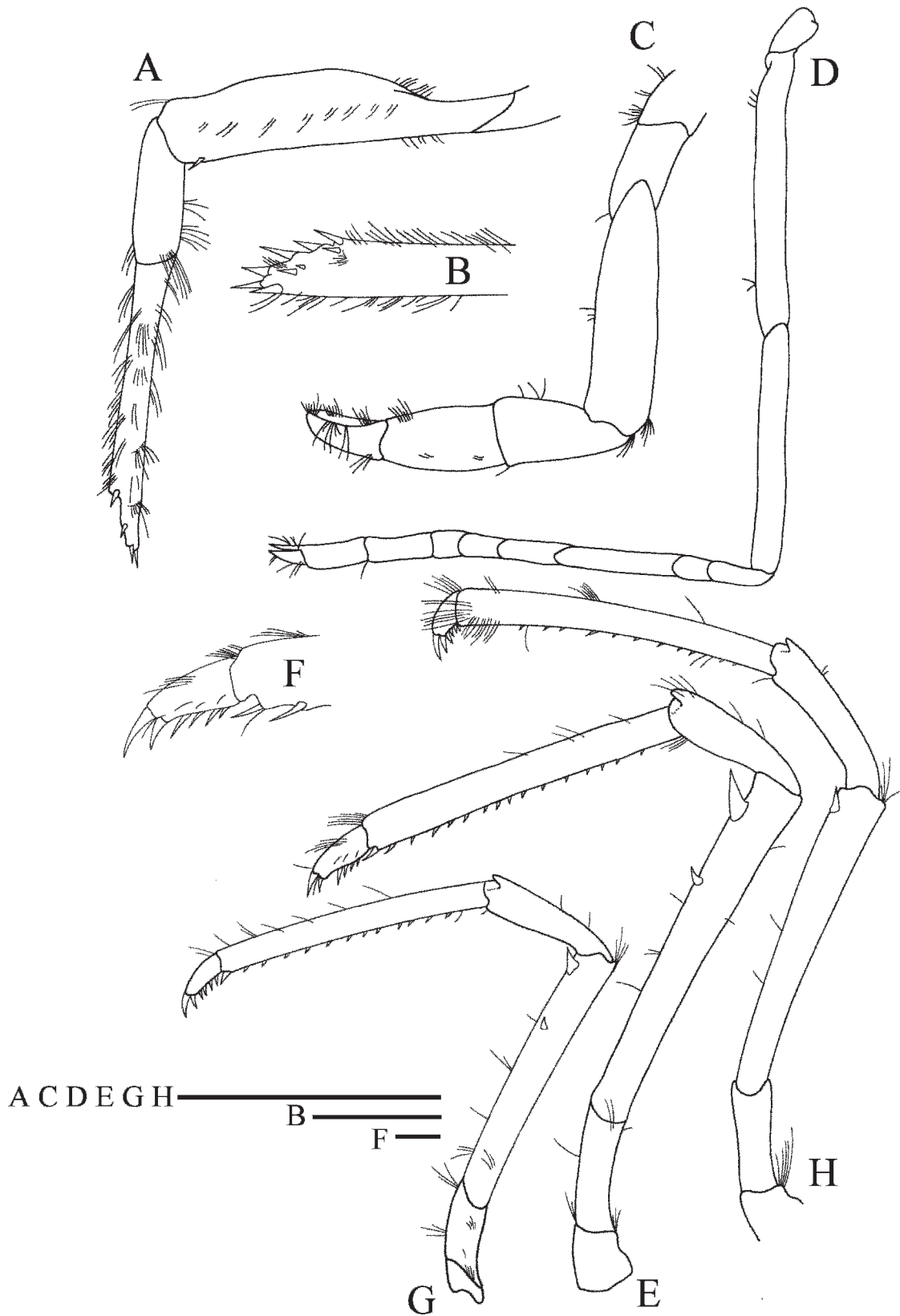


Fig. 2. *Lebbeus brevisrostris* n. sp., holotype female cl 9.8 mm, TAIWAN 2001, stn CP71, left appendages. A, third maxilliped, lateral view; B, same, distal part of ultimate segment, mesial view; C, first pereiopod, lateral view; D, second pereiopod, lateral view; E, third pereiopod, lateral view; F, same, dactylus and distal part of propodus, lateral view; G, fourth pereiopod, lateral view; H, fifth pereiopod, lateral view. Scales: A, C-E, G, H = 5 mm; B = 1 mm, F = 0.5 mm.

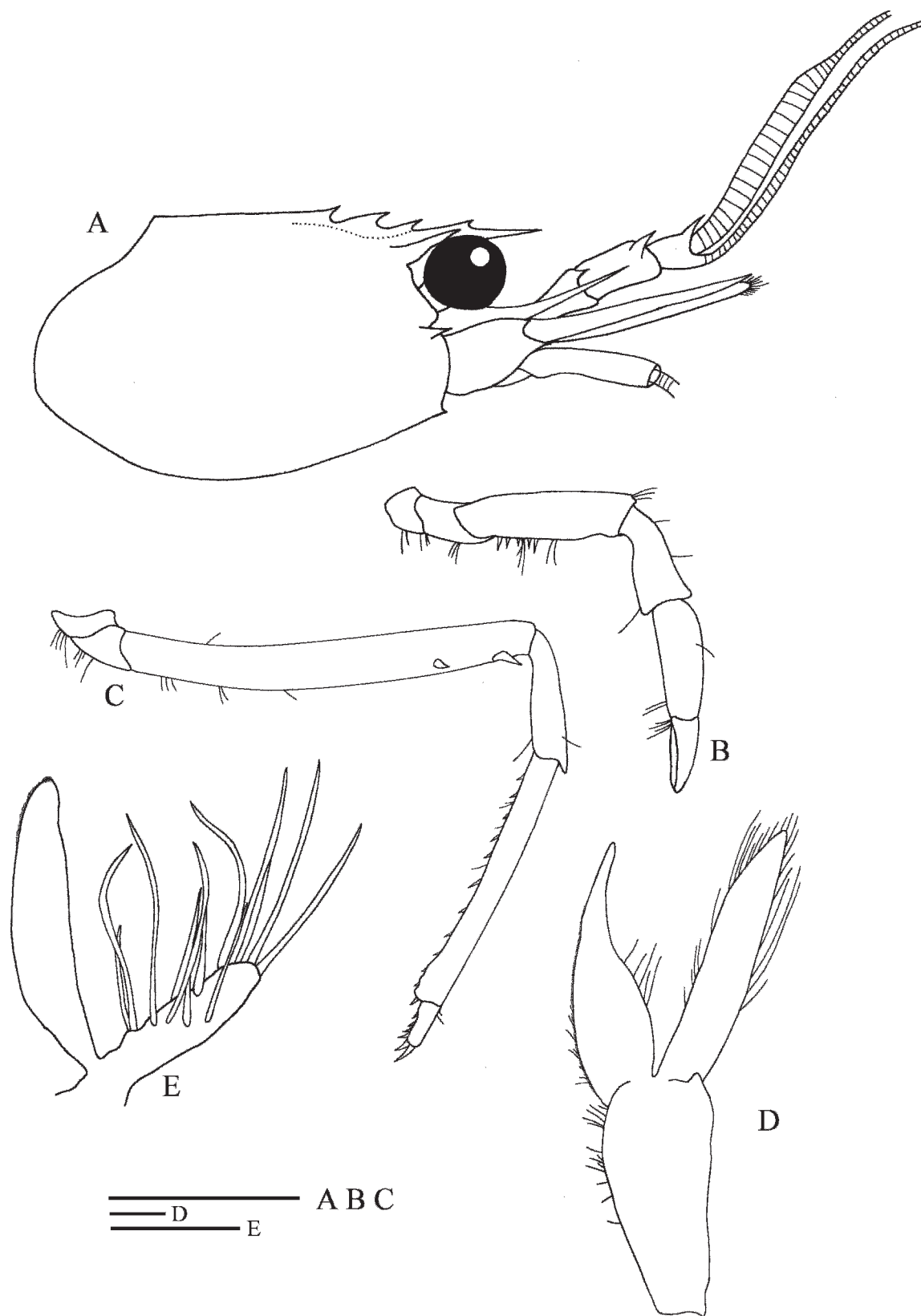


Fig. 3. *Lebbeus brevisrostris* n. sp., paratype male cl 7.5 mm, TAIWAN 2001, stn CP71. A, carapace and anterior appendages, lateral view; B, right first pereiopod, lateral view; C, right third pereiopod, lateral view; D, left first pleopod, ventral view; E, appendix interna and appendix masculina of second pleopod, dorsomesial view. Scales: A-C = 5 mm; D, E = 0.5 mm.

Eye subpyriform with cornea distinctly wider than eye-stalk; ocellus absent; maximum diameter of cornea 0.25–0.32 times carapace length.

Antennular peduncle (Fig. 1B, C) reaching 0.73–0.87 of antennal scale. First segment as long as distal two segments combined, falling short of midlength of antennal scale, dorsodistal margin armed with 1 strong lateral spine and 1–3 small additional spines; stylocerite from slightly falling short of distal margin of first segment (paratypes) to nearly reaching distal margin of second segment (holotype), not overlapping first segment, sharply pointed, mesial margin convex. Second segment 0.63–0.71 length of first segment, with 1 large spine at dorsolateral distal angle. Third segment short, about half as long as second segment, bearing 1 distinct dorsodistal spine. Lateral flagellum with thickened aesthetasc-bearing portion 0.40–0.46 times as long as carapace.

Antenna with basicerite bearing moderately small distolateral spine; carpocerite overreaching midlength of antennal scale. Antennal scale 0.62–0.81 times as long as carapace, 3.22–4.24 times as long as wide; lateral margin nearly straight or weakly concave; distolateral spine reaching rounded distal margin of lamella.

Mouthparts similar to those of other species of the genus. Third maxilliped (Fig. 2A, B) relatively long, overreaching antennal scale by 0.50–0.65 length of ultimate segment; ultimate segment 2.21–2.94 times as long as penultimate segment, tapering distally, with short row of darkly pigmented corneous spines distally; antepenultimate segment shorter than distal two segments combined; lateral surface bluntly ridged and bearing only 1 subdistal movable spine.

Strap-like, terminally hooked epipods present on third maxilliped to second pereopod and corresponding seto-branches on first to third pereopods.

First pereopod (Fig. 2C) moderately stout, almost reaching distal margin of antennal scale; dactylus 0.70–0.72 times as long as palm, terminating in 2 darkly pigmented corneous claws; merus 1.92–2.14 times as long as carpus, bearing row of slender spinules on proximal half of ventral surface. Second pereopod (Fig. 2D) overreaching antennal scale by length of chela and half of carpus; chela small with subcylindrical palm; palm 2.06–2.09 times longer than fingers; dactylus terminating in 2 small claws; carpus 1.65–1.70 times as long as merus, divided into 7 articles; ischium 1.14–1.16 times as long as merus. Third to fifth pereopods moderately long and slender, similar and slightly decreasing in length posteriorly. Third pereopod (Fig. 2E) overreaching antennal scale by length of dactylus and half of propodus; dactylus (Fig. 2F) 0.20–0.22 times as long as propodus, moderately stout, terminating in acute, darkly pigmented unguis, armed with 5 darkly pigmented accessory spinules on flexor margin, distalmost accessory spinule subterminal, distinctly larger than others, abutting base of unguis, making tip of dactylus appear biunguiculate; propodus with 1 spinule on ventrodistal margin and 9–16 spinules along ventral margin; carpus 0.48–0.52 times as long as propodus; merus armed with 2–6 ventrolateral spines in distal half. Fourth pereopod (Fig. 2G) overreaching antennal scale by length of dactylus; dactylus with 5 accessory spinules; propodus with 1 ventrodistal spinule and row of 9–12 spinules along ventral margin; merus with

2–6 ventrolateral spines. Fifth pereopod (Fig. 2H) almost reaching distal margin of antennal scale; dactylus with 5 accessory spinules; propodus with row of 6–11 ventral spinules; merus with 1 ventrolateral spine subdistally.

Female pleopods typical of genus, without distinctive feature. Uropod with both rami reaching posterior margin of telson.

Male Characteristics.—Males generally similar to females but body less robust. Rostrum (Fig. 3A) more slender, 0.32–0.38 times as long as carapace; dorsal margin armed with 3–4 spines, including 1–2 (usually 1) spines on rostrum proper and 2–3 postrostral, posteriormost spine arising at 0.55–0.67 of carapace length; ventral margin unarmed. Carapace with gastric region not inflated, thus dorsal profile in lateral view nearly straight.

Fourth pleuron usually with small posteroventral tooth, but sometimes (rarely) rounded.

Antennular peduncle more elongate, slightly falling short of distal margin of antennal scale; outer flagellum elongate, flattened, 1.32–1.60 times longer than carapace, not abruptly tapering distal to aesthetasc-bearing portion; aesthetasc-bearing portion occupying proximal 0.42–0.48 of entire length; inner flagellum elongate, 1.33–1.52 times longer than carapace.

First pereopod similar to that of females, not showing notable sexual dimorphism (Fig. 3B). Third to fifth pereopods more elongate and slender. Third pereopod (Fig. 3C) overreaching distal margin of antennal scale by length of dactylus and 3/4 of propodus; merus with 2–5 (usually 2–3) ventrolateral spines in third and fourth pereopods, and 1–2 (usually 1) spines in fifth pereopod.

First pleopod (Fig. 3D) with endopod elongately subtriangular; appendix interna terminal, elongate and well-developed, length about half of endopod. Second pleopod with appendix masculina about 0.50 times as long as appendix interna (Fig. 3E), bearing 12–15 long setae.

Color.—Body generally pale pink, pleon and tailfan with wide orange-red bands, third maxilliped and pereopods also with orange-red bands. Bands often prominent, but occasionally faded and giving the body an overall pale pink appearance. Eyes dark brown. Antennular and antennal flagella orange-red to orange-pink. Internal organs (probably representing mature oocytes) visible inside carapace light yellow.

Distribution.—Only known from northeastern Taiwan at depths of 540–700 m.

Remarks.—Subgeneric groups within *Lebbeus* according to the number of pereopodal epipods were first discussed by Rathbun (1904) and are followed by many authors (Holthuis, 1947; Butler, 1980; Wicksten, 1990; Hayashi, 1992; Komai et al., 2004). Whether these groups reflect the phylogenetic relationships among the species is still not known. However, it remains useful for differentiation of species groups in this morphologically disparate genus. This new species belongs to the species group characterized by the possession of epipods on the first and second pereopods only. Among the 16 known species in the group (see Komai et al., 2004; Jensen, 2006), the new species shares with *L. laevirostris* Crosnier, 1999 from Indonesia a spiniform rostrum lacking ventral teeth. The latter species

is still only known by the ovigerous female holotype. In view of the sexual dimorphism frequently exhibited in species of *Lebbeus*, the following comparison is limited to females. Comparison with the original description of *L. laevirostris* (cf. Crosnier, 1999) reveals the following morphological differences: 1) the rostrum is distinctly shorter in the new species than in *L. laevirostris*, i.e., reaching only the midlength of the first segment of the antennular peduncle vs. extending to the midlength of the second segment of the antennular peduncle; 2) the postrostral teeth of the new species are not particularly enlarged vs. very large and forming a distinct postrostral crest in *L. laevirostris*; 3) the antennal and pterygostomial teeth on the carapace are moderate in size in the new species vs. fairly elongate in *L. laevirostris*; 4) the fourth pleuron is rounded in the new species vs. with a sharp posteroventral tooth in *L. laevirostris*; 5) the antennular stylocerite falls short of or nearly reaches to the distal margin of the second segment of the antennular peduncle in *L. brevirostris* vs. reaching to the distal end of the antennular peduncle in *L. laevirostris*; 6) the distolateral spine of the antennal scale just reaches the distal margin of the lamella in *L. brevirostris*, rather than exceeding beyond it in *L. laevirostris*; and 7) the antepenultimate segment of the third maxilliped bears one subdistal movable spine in this new species vs. none in *L. laevirostris*.

A short spiniform rostrum is also present in two East Pacific species, *L. lagunae* (Schmitt, 1921) and *L. catalepsis* Jensen, 1987. However, the rostrum is much more reduced and subequal to the supraorbital spine in the latter two species. Furthermore, in both these species epipods are present on the anterior three pereopods. The carapace and pleon are scattered with tufts of short setae in *L. lagunae* and *L. catalepsis*, but naked in *L. brevirostris*. The antepenultimate segment of the third maxilliped bears a row of dorsal spines in *L. lagunae* and *L. catalepsis*, but unarmed dorsally in *L. brevirostris*. The third maxilliped and the posterior pereopods are also much stouter in the former two species than in the latter species.

It is remarkable that two of the four male specimens of *L. brevirostris* bear a tiny posterolateral tooth at each of the fourth pleura, while another male has the left fourth pleuron also being pointed. This suggests that the armament of the fourth pleonal pleuron is variable in this species, at least in males. Similar variations in the shape of the fourth pleonal pleuron were also found in the other three species reported here from Taiwan (see below). The presence or absence of a posteroventral tooth on the fourth pleuron has been considered diagnostic in species of *Lebbeus* (Hayashi, 1992; Franssen, 1997; Komai, 2001; Komai et al., 2004; Jensen, 2006), but perhaps should be used cautiously.

Etymology.—The name “*brevirostris*” refers to the short rostrum of this new species.

***Lebbeus formosus* n. sp.**
Figs. 4-5, 10C

Material Examined.—Holotype: female cl 9.5 mm, TAIWAN 2006, stn CP364, 22°06.3345'N, 121°08.2237'E, 1260-1275 m, 24 August 2006, NTOU M00483.

Paratypes: TAIWAN 2000, Stn CP39, 21°57.05'N, 121°03.02'E, 1316-1317 m, 1 August 2000, 1 female cl 11.0 mm, NTOU M00565; TAIWAN 2001, stn CP126, 22°13.82'N, 121°01.80'E, 1222-1226 m, 21 August 2001, 1 female cl 9.5 mm, NTOU M00568; TAIWAN 2002, stn CP189, 21°39.91'N, 118°20.94'E, 1629-1649 m, 27 August 2002, 1 female cl 11.0 mm, OUMNH.ZC.2010-07-005; stn CP190, 21°35.01'N, 118°15.02'E, 1650-1665 m, 28 August 2002, 1 female cl 12.4 mm, OUMNH.ZC.2010-07-006; TAIWAN 2003, stn CD203, 22°00.02'N, 120°28.94'E, 635-868 m, 29 May 2003, 1 female cl 8.3 mm, NTOU M00807; TAIWAN 2005, stn CD325, 20°40.281'N, 118°03.598'E, 1794-1982 m, 20 August 2005, 1 female cl 13.7 mm, NTOU M00872; stn PCP332, 22°17.145'N, 120°00.318'E, 961-1026 m, 5 October 2005, 1 female cl 12.4 mm, CBM-ZC; TAIWAN 2008, stn PCP438, 22°15.359'N, 121°3.311'E, 1206-1222 m, 12 July 2008, 1 female cl 9.8 mm, 2 females with damaged carapace, NTOU M00883.

Description of Females.—Body moderately robust for genus; integument naked, glabrous, not particularly firm.

Rostrum (Fig. 4A, B) straight, directed forward, reaching nearly or slightly overreaching distal margin of first segment of antennular peduncle, 0.31-0.54 times carapace length; dorsal rostral series consisting of 3-5 teeth, including 1-3 teeth on rostrum proper and 2 postrostral teeth, ventral margin armed with 2-4 (usually 3) teeth. Carapace with moderately high, blunt postrostral median carina extending to at least midlength (usually to two-thirds) of carapace, sloping toward rostral base; 2 postrostral teeth relatively large, but not forming crest, posteriormost tooth arising at 0.21-0.44 of carapace length; supraorbital tooth large, arising anterior to level of posterior margin of orbit, far falling short of tip of suborbital lobe or antennal tooth; orbital margin generally concave, but with distinct U-shaped notch below base of supraorbital spine; suborbital lobe well developed, triangular, reaching distal margin of antennal tooth; anterolateral margin between antennal and pterygostomial teeth strongly sinuous with deep excavation below antennal spine.

Pleon (Fig. 4C) dorsally rounded. Second somite with shallow transverse groove on tergum. Pleura of anterior three somites broadly rounded; fourth pleuron rounded or with small posteroventral tooth; fifth pleuron with moderately strong posteroventral tooth. Sixth somite 1.25-1.56 times as long as fifth somite, bearing small posteroventral tooth; posterolateral process terminating in small tooth. Telson (Fig. 4D) 1.29-1.64 times as long as sixth somite, tapering posteriorly to convex posterior margin, bearing 3-4 dorsolateral spines on each side; posterior margin (Fig. 4E) with 2 pairs of lateral movable spines (mesial pair longer) and 6 median spiniform plumose setae.

Eye subpyriform with cornea distinctly wider than eye-stalk; ocellus absent; maximum diameter of cornea 0.12-0.17 times carapace length.

Antennular peduncle (Fig. 4A, B) reaching 0.61-0.82 of antennal scale. First segment as long as or slightly shorter than distal two segments combined, reaching 0.31-0.42 of antennal scale, dorsodistal margin armed with 1 strong

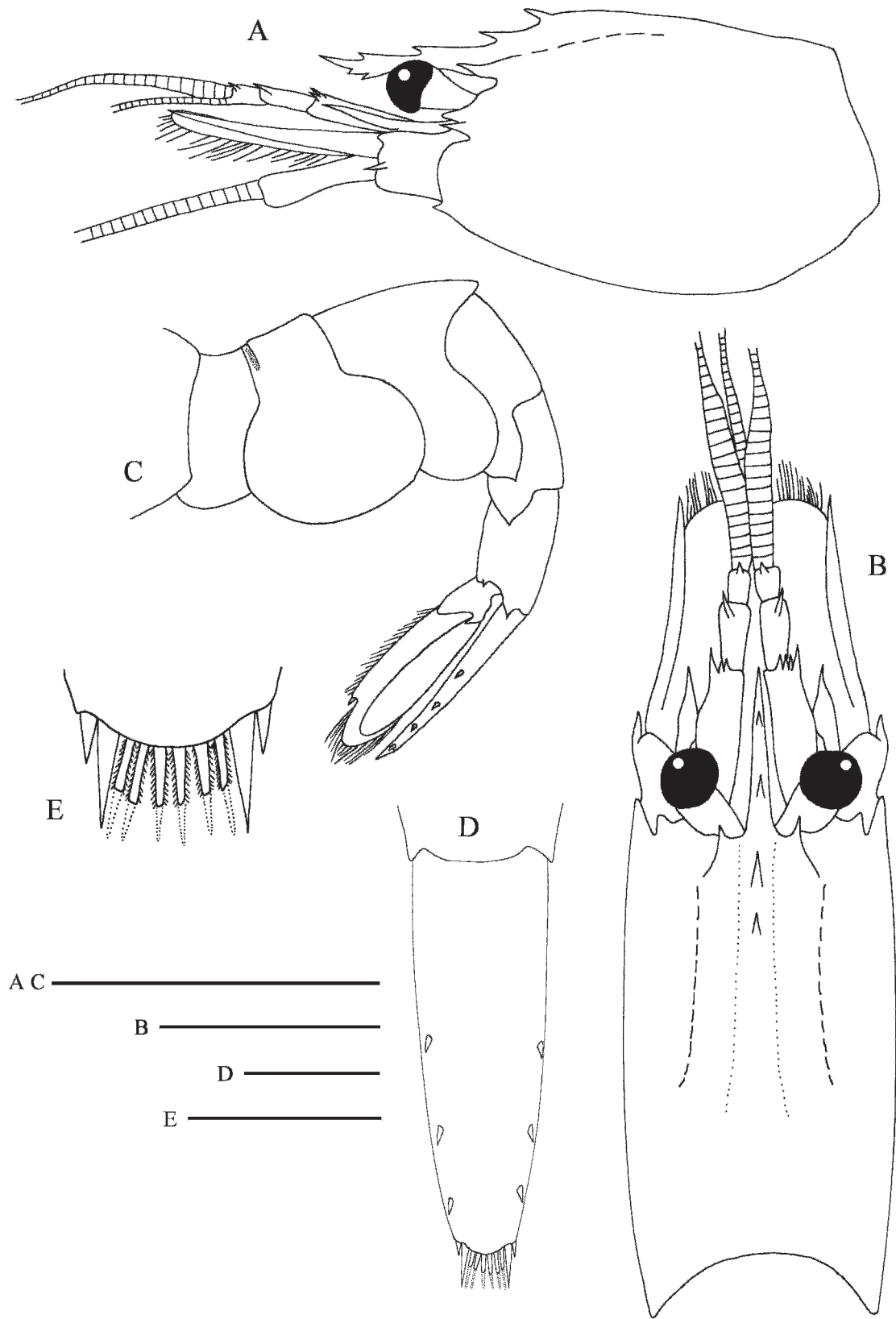


Fig. 4. *Lebbeus formosus* n. sp., holotype female cl 9.5 mm, TAIWAN 2006, stn CP364. A, carapace and anterior appendages, lateral view; B, carapace and anterior appendages, dorsal view; C, pleon, lateral view; D, Telson, dorsal view; E, same, posterior margin, dorsal view. Scales: A, C = 10 mm; B = 5 mm; D, E = 1 mm.

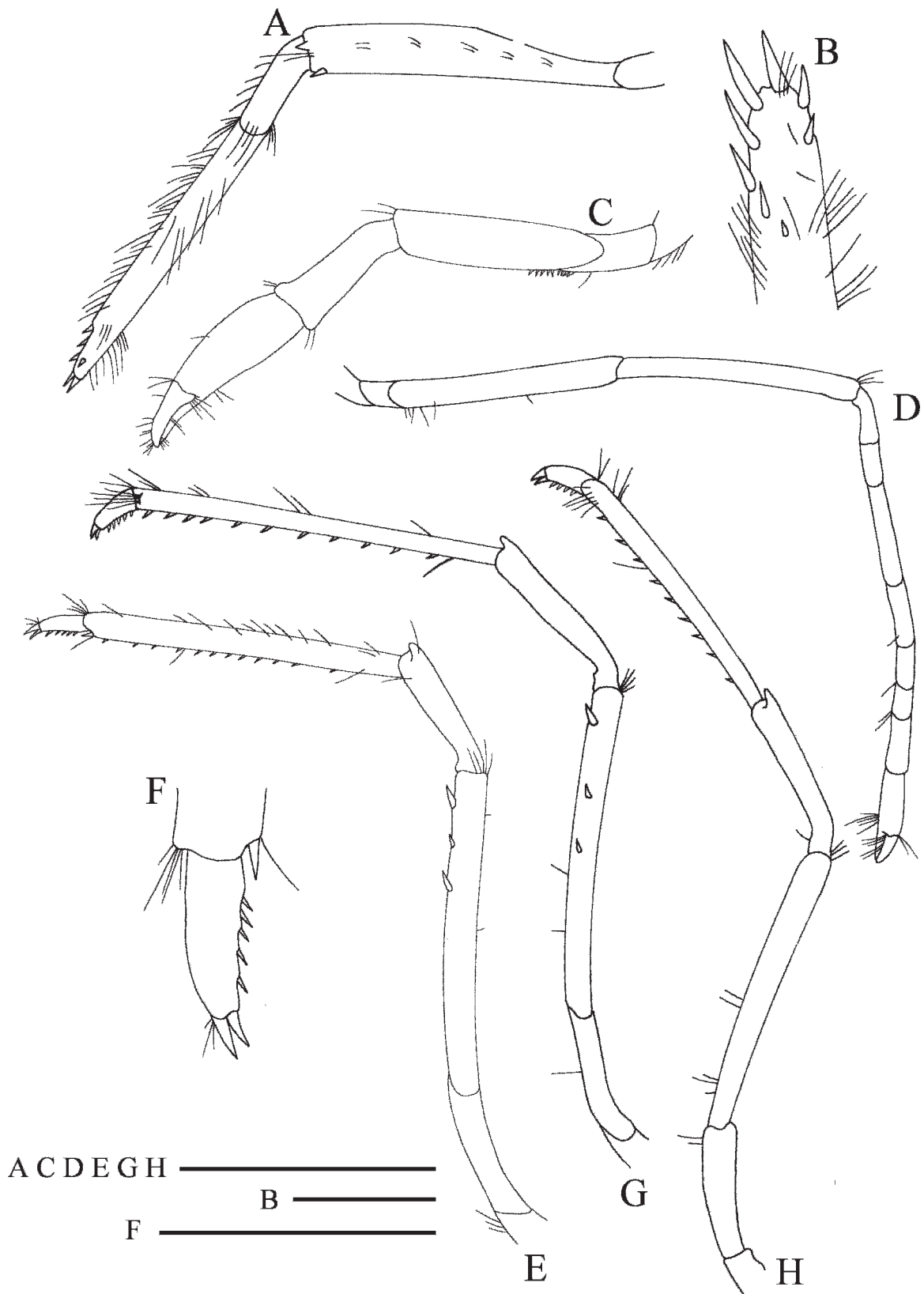


Fig. 5. *Lebbeus formosus* n. sp., A-D, G-H, holotype female cl 9.5 mm, TAIWAN 2006, stn CP364; E-F, paratype female cl 8.3 mm, stn TAIWAN 2003, stn CD203. A, left third maxilliped, lateral view; B, same, distal part of ultimate segment, mesial view; C, right first pereiopod, lateral view; D, right second pereiopod, lateral view; E, right third pereiopod, lateral view; F, same, dactylus and distal part of propodus, lateral view; G, left fourth pereiopod, lateral view; H, left fifth pereiopod, lateral view. Scales: A, C-E, G-H = 5 mm; B, F = 1mm.

lateral spine and 2-3 (usually 3) small additional spines; stylocerite almost reaching or just overreaching distal margin of first segment, not overlapping first segment, sharply pointed, mesial margin convex. Second segment 0.41-0.54 length of first segment, with 1 large dorsolateral distal spine. Third segment short, about half as long as second segment, bearing 1 distinct dorsodistal spine. Lateral flagellum with thickened aesthetasc-bearing portion 0.35-0.41 times as long as carapace.

Antenna with basicerite bearing relatively small distolateral tooth; carpcerite reaching 0.51-0.56 of antennal scale. Antennal scale 0.56-0.65 times as long as carapace and 2.43-2.97 times longer than wide; lateral margin nearly straight or weakly concave; distolateral spine reaching rounded distal margin of lamella.

Mouthparts similar to those of other species of the genus. Third maxilliped (Fig. 5A, B) overreaching antennal scale by 1/3 length of ultimate segment; ultimate segment 2.62-3.31 (usually 2.62-2.69) times as long as penultimate segment, tapering distally, with short row of darkly pigmented corneous spines distomesially; antepenultimate segment shorter than distal two segments combined; lateral surface bluntly ridged and bearing only 1 subdistal movable spine and 1 fixed distolateral spine.

Strap-like, terminally hooked epipods present on third maxilliped to third pereopod, corresponding setobranchs present on first to third pereopods.

First pereopod (Fig. 5C) moderately stout, extending to tip of antennal scale; dactylus 0.56-0.66 times as long as palm, terminating in 2 darkly pigmented corneous claws; merus 1.63-1.75 times as long as carpus, bearing row of slender spinules on proximal half of ventral surface. Second pereopod (Fig. 5D) overreaching antennal scale by length of chela and 0.33-0.48 of carpus; palm subcylindrical, 1.89-1.95 times longer than fingers; dactylus terminating in 2 small claws; carpus 1.76-1.85 times as long as merus, usually divided into 7 articles; ischium 1.05-1.11 times as long as merus. Third to fifth pereopods moderately long and slender, similar and slightly decreasing in length posteriorly. Third pereopod (Fig. 5E) overreaching antennal scale by length of dactylus and half of propodus; dactylus (Fig. 5F) 0.14-0.16 times as long as propodus, moderately stout, terminating in acute, darkly pigmented unguis and armed with 4-6 darkly pigmented accessory spinules on flexor margin, distalmost accessory spinule subterminal, distinctly larger than others, abutting base of unguis, making tip of dactylus appear biunguiculate; propodus with 1 ventrodistal spinule and 9-14 spinules along ventral margin; carpus 0.50-0.55 times as long as propodus; merus armed with 3-6 ventrolateral movable spines at most in distal half. Fourth pereopod (Fig. 5G) overreaching antennal scale by length of dactylus and about 0.25 of propodus; dactylus with 5-6 accessory spinules on flexor margin; propodus with 1 ventrodistal spinule and row of 10-15 spinules along ventral margin; merus with 2-4 ventrolateral movable spines. Fifth pereopod (Fig. 5H) overreaching distal margin of antennal scale by dactylus; dactylus with 3-6 accessory spinules on flexor margin; propodus with row of 8-12 ventral spinules; merus with 1-2 ventrolateral movable spines subdistally.

Female pleopods typical of genus, without distinctive feature.

Eggs large and few, 1.34-1.38 mm in diameter.

Size.—Largest female cl 13.7 mm. The only ovigerous female is the holotype of cl 9.5 mm.

Color.—Body generally pale pink, appendages and sometimes also the ventrolateral part of the carapace darker pink. Eyes dark brown. Internal organ visible inside carapace dark green.

Distribution.—Only known from southern Taiwan to near Pratas (Dongsha) in the South China Sea, at depths of 635-1982 m.

Remarks.—This new species belongs to the group with epipods on the first to third pereopods only. About 30 species are currently known in this group (see Komai et al., 2004; Jensen, 2006; Komai and Komatsu, 2009; Ah Yong, 2009). Amongst them, this Taiwanese form is most similar to *Lebbeus africanus* Fransen, 1997 (Banc d'Arguin, off Mauritania, West Africa, 1500 m); *L. antarcticus* Hale, 1941 (restricted to the Indian Ocean Sector of the Antarctic, 450-650 m, see Ward, 1985; Komai et al., 1996); *L. bidentatus* Zarenkov, 1976 (only known from off Chile, southeastern Pacific, 680 m); *L. carinatus* Zarenkov, 1976 (only known from off Peru, eastern Pacific, 1680-1860 m); *L. microceros* (Krøyer, 1841) (southern Greenland to Newfoundland, Nova Scotia and New Brunswick, 8-80 m, see Leim, 1921; Squires, 1990); *L. polyacanthus* Komai, Hayashi and Kohtsuka, 2004 (only known from off Noto Peninsula and Toyama Bay, Sea of Japan, 250-400 m); *L. similior* Komai and Komatsu, 2009 (only known from the Kashima Sea, northeastern Japan, 1196 m); *L. uschakovi* Kobjakova, 1936 (only known from the Sea of Okhotsk, 182 m); *L. wera* Ah Yong, 2009 (only known from the hydrothermal vents on the Kermadec Ridge, New Zealand, 1208-1324 m); *L. washingtonianus* Rathbun, 1902 (known with certainty only from the northeastern Pacific from Queen Charlotte Islands to the Guaymas Basin, Gulf of California, 820-1808 m, see Rathbun, 1904; Butler, 1980; Wicksten and Hendrickx, 2003; Komai and Komatsu, 2009); and *L. zebra* (Leim, 1921) (same distribution as *L. microceros*, Rathbun, 1929; Squires, 1965, 1990 suggested that *L. zebra* and *L. microceros* may belong to the same species). Their shared characters include: the rostrum being styliform rather than spiniform, bearing both dorsal and ventral teeth, and nearly reaching or slightly overreaching the distal margin of the first segment of the antennular peduncle; two or more postrostral teeth; a deep notch below the base of the supraorbital tooth; a distinct concavity on the anterolateral margin of the carapace just below the antennal tooth; first segment of the antennular peduncle usually armed with more than one spine on the dorsodistal margin; and the dactyli of the third to fifth pereopods appearing biunguiculate, i.e., distalmost accessory spinule on the flexor margin subequal or only slightly smaller than terminal claw. The differences between this new species and the 11 allied taxa are discussed below.

Lebbeus africanus differs from *L. formosus* in the proportionally longer rostrum reaching to the distal margin

of the second segment of the antennular peduncle vs. reaching or slightly overreaching the distal margin of the first segment, and the short stout plumose setae on the posterior margin of the telson being distinctly shorter than the mesial pair vs. subequal in the length. In *L. antarcticus*, the stylocerite falls far short of the distal margin of the first segment of the antennular peduncle (Hale, 1941; Zarenkov, 1968; Ward, 1985; Komai et al., 1996). Furthermore, the third to fifth pereopods seem to be proportionally longer in *L. antarcticus* than in *L. formosus*, whilst the meral spines on the fourth pereopod number six in *L. antarcticus* vs. 2-4 in *L. formosus*. *Lebbeus bidentatus* is only known from the holotype, which has a damaged rostrum (Fransen, 1997). Nevertheless, the remaining part of the rostrum clearly suggests that the rostrum nearly reaches the distal margin of the second segment of the antennular peduncle. Furthermore, the supraorbital spine on the carapace is elongate in *L. bidentatus* reaching to the base of the cornea of the anteriorly extended eye-stalk vs. reaching only to the midlength of the eye-stalk in *L. formosus*. *Lebbeus carinatus* is only known from the holotype with a damaged telson (Fransen, 1997), and it is very similar to the present new species. Nevertheless, the three ventral teeth of the rostrum are clustered on the rostral apex vs. rather widely separated in *L. formosus*. The cornea also seems to be relatively larger in *L. carinatus* than in *L. formosus*. According to the figure of Fransen (1997, Fig. 33), the corneal diameter is slightly greater than the depth of the antennal basicerite vs. distinctly smaller in *L. formosus*. In *L. microceras* and *L. zebra*, the telson is armed only with one pair of spines on the posterior margin mesial to the two pairs on the posterolateral angle vs. six plumose setae on the posterior margin of the telson in addition to the two pairs of spines; and the stylocerite is elongate (Leim, 1921; Squires, 1990) reaching the distal margin of the second segment of the antennular peduncle vs. extending to the distal margin of the first segment. In *L. polyacanthus* the dorsal rostral series consists of 6-7 teeth vs. 4-5 in *L. formosus*. Equally, the meral spines on the third and fourth pereopods number 9-13 and 8-11 vs. 3-6 and 2-4 in *L. formosus*. Further, the color in life is very different between the two species. In *L. polyacanthus*, the carapace has a reticulate pattern of red on a transparent background; the pleon is reddish orange with five or six transverse bands on the anterior four somites, each band extending obliquely anteriorly. Such markings are absent in *L. formosus*. In *L. similior*, the dorsal rostral series consists of seven teeth, including four on the rostrum proper; whilst the stylocerite does not reach the distal margin of the first segment of the antennular peduncle vs. reaching or slightly overreaching it in *L. formosus*. Furthermore, the six plumose setae on the posterior margin of the telson are distinctly shorter than the mesial pair of posterolateral spines in *L. similior*. *Lebbeus uschakovi* harbors nine teeth in the dorsal rostral series, including six on the rostrum proper, and four ventral rostral teeth; whilst the rostrum slightly overreaches the distal margin of the third segment of the antennular peduncle (Kobjakova, 1937; Fransen, 1997). In *L. wera*, eight teeth are present in the dorsal rostral series, including three on the rostrum proper; whilst the rostrum falls slightly short of

the distal margin of the antennular peduncle and the telson is armed with 6-7 pairs of dorsolateral spines (Ahyong, 2009). The short stylocerite of *L. washingtonianus* has the stylocerite not reaching the distal margin of the first segment of the antennular peduncle, easily distinguishes both species (Butler, 1980). Further, the distolateral spine of the antennal scale falls short of the lamella vs. reaching it in *L. formosus*, and the telson is only armed with 4-6 pairs of dorsolateral spines in *L. washingtonianus*.

The armature of the fourth pleuron is rather variable in this new species. Of the 11 female specimens examined, six specimens, including the holotype, have a small posteroventral tooth on the fourth pleuron on either side, whereas the other five specimens lack the tooth. Furthermore, a single specimen (NTOU M00565) has eight carpal articles in its left second pereopod (the right second pereopod is missing). This is unusual as the genus is characterized by having seven carpal articles.

Etymology.—This new species is named after the older name for Taiwan (Formosa), the type-locality of the species.

Lebbeus tosaensis Hanamura and Abe, 2003

Fig. 6

Lebbeus tosaensis Hanamura and Abe, 2003: 17, figs. 1-5; Komai and Takeda, 2004: 84, figs. 1B, 4B-C.

Material Examined.—TAIWAN 2005, stn OCP273, 24°47.77'N, 122°00.20'E, 266-348 m, 13 Jun 2005, 1 male cl 4.8 mm, 1 female cl 6.3 mm, NTOU M00888.

Diagnosis.—Rostrum (Fig. 6A, C) straight, directed forward, not reaching distal margin of first segment of antennular peduncle; dorsal margin armed with 3 teeth, including 2 postrostral; ventral margin armed with 1 small, subdistal tooth. Carapace with strong supraorbital tooth, accompanied by deep U-shaped notch below its base; suborbital lobe well-developed, almost reaching distal margin of antennal tooth; antennal tooth relatively large; pterygostomial angle with minute spinule in male, slightly larger in female. Anterior three pleura (Fig. 6B) rounded; second tergum with shallow transverse groove; fourth pleuron with tiny posteroventral tooth in male, but rounded in female. Telson with 3 pairs of dorsolateral spines. First segment of antennular peduncle with 3-4 spines on dorsodistal margin, stylocerite almost reaching distal margin of first segment of antennular peduncle. Epipods only present on first to third pereopods. Third to fifth pereopods long and slender; dactyli appearing biunguiculate, each armed with 4-6 accessory spinules; meri armed with 5 on third, 5-6 on fourth (fig. 6D) and 2-3 spines on fifth pereopod respectively.

Distribution.—Previously only known from the Pacific side of Japan, Tosa Bay (Hanamura and Abe, 2003) and Sagami Sea (Komai and Takeda, 2004), at depths of 250-344 m. The present specimens extend the geographical range of this species to off northeastern Taiwan, at depths of 266-348 m.

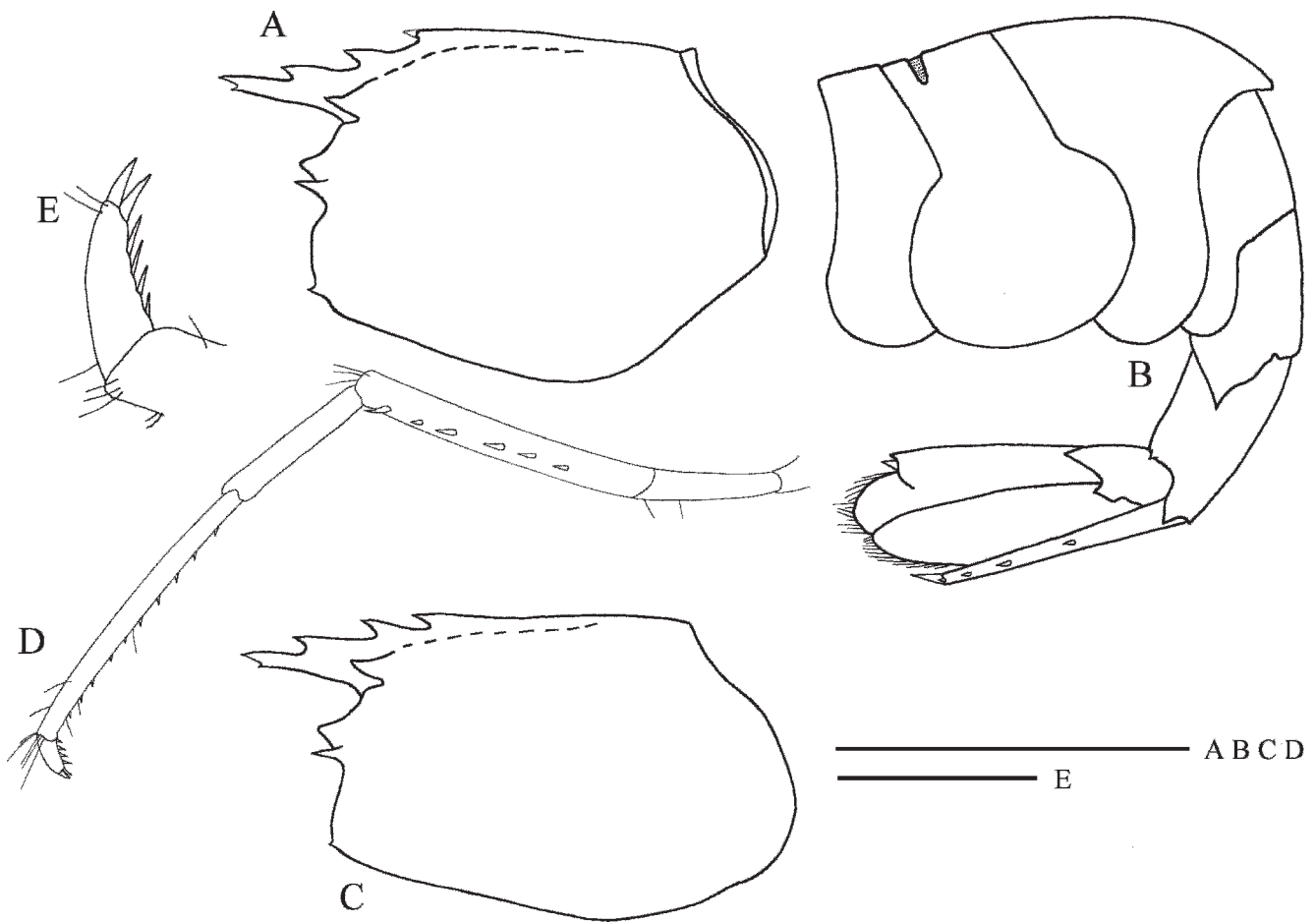


Fig. 6. *Lebbeus tosaensis* Hanamura and Abe, 2003, A-B, D, female cl 6.3 mm, TAIWAN 2005, stn OCP273; C, E, male cl 4.8 mm, same station. A, carapace, lateral view; B, pleon, lateral view; C, carapace, lateral view; D, right fourth pereopod, lateral view; E, right third pereopod, dactylus and distal propodus, lateral view. Scales: A-D = 5 mm, E = 1 mm.

Remarks.—The two specimens from Taiwan exhibit some differences from the Japanese material. The telson has only three pairs of dorsolateral spines in the Taiwanese material, rather than four or five pairs in the Japanese specimens. The fourth pleonal pleuron is rounded in the Taiwanese female specimen, but the females of this species from Japan always bear a small posteroventral tooth at the fourth pleuron. As the shape of the fourth pleonal pleuron could be rather variable in the species of this genus, more material from Taiwan and Japan will be necessary to determine if the present specimens represent another species.

***Lebbeus unguiculatus* n. sp.**

Figs. 7-9, 10D

Material Examined.—Holotype: ovigerous female cl 11.9 mm, Taiwan 2006, stn PCP358, 22°09.556'N, 121°07.174'E, 1257-1262 m, 3 June 2006, NTOU M00889.

Paratypes: TAIWAN 2003, stn CD203, 22°00.02'N, 120°28.94'E, 635-868 m, 29 May 2003, 1 female cl 11.2 mm, NTOU M00890; TAIWAN 2005, stn CP277, 24°23.57'N, 122°14.12'E, 1222-1261 m, 14 June 2005, 1 male cl 11.8 mm, CBM-ZC; stn PCP333, 22°16.502'N,

120°02.242'E, 889-1037 m, 5 October 2005, 1 male cl 10.6 mm, 1 ovigerous female cl 12.4 mm, NTOU M00891; TAIWAN 2006, stn PCP353, 22°14.675'N, 121°03.935'E, 1204-1217 m, 2 June 2006, 1 female cl 11.8 mm, OUMNH.ZC.2010-07-007; stn PCP366, 22°02.8724'N, 121°10.787'E, 1301-1302 m, 24 August 2006, 1 female cl 14.8 mm, OUMNH.ZC.2010-07-008; TAIWAN 2008, stn PCP437, 22°18.736'N, 121°4.335'E, 1179-1203 m, 11 July 2008, 1 ovigerous female cl 12.2 mm, NTOU M00892.

Description of Females.—Body moderately robust for genus; integument naked, glabrous, not particularly firm.

Rostrum (Fig. 7A, B) straight, directed forward, slightly falling short of distal margin of first segment of antennular peduncle, 0.42-0.49 times carapace length; dorsal margin armed with 3-4 (usually 4) teeth, including 1-2 on rostrum proper and 2-3 postrostral teeth; ventral margin armed with 3-4 (usually 3) teeth. Carapace with moderately high, blunt postrostral carina extending nearly to posterior margin of carapace; posteriormost postrostral tooth arising at 0.20-0.29 of carapace length; supraorbital tooth large, arising anterior to level of posterior margin of orbit, not reaching tips of suborbital lobe or antennal tooth; orbital margin generally concave, but with deep U-shaped notch below base of supraorbital tooth; suborbital lobe well developed,

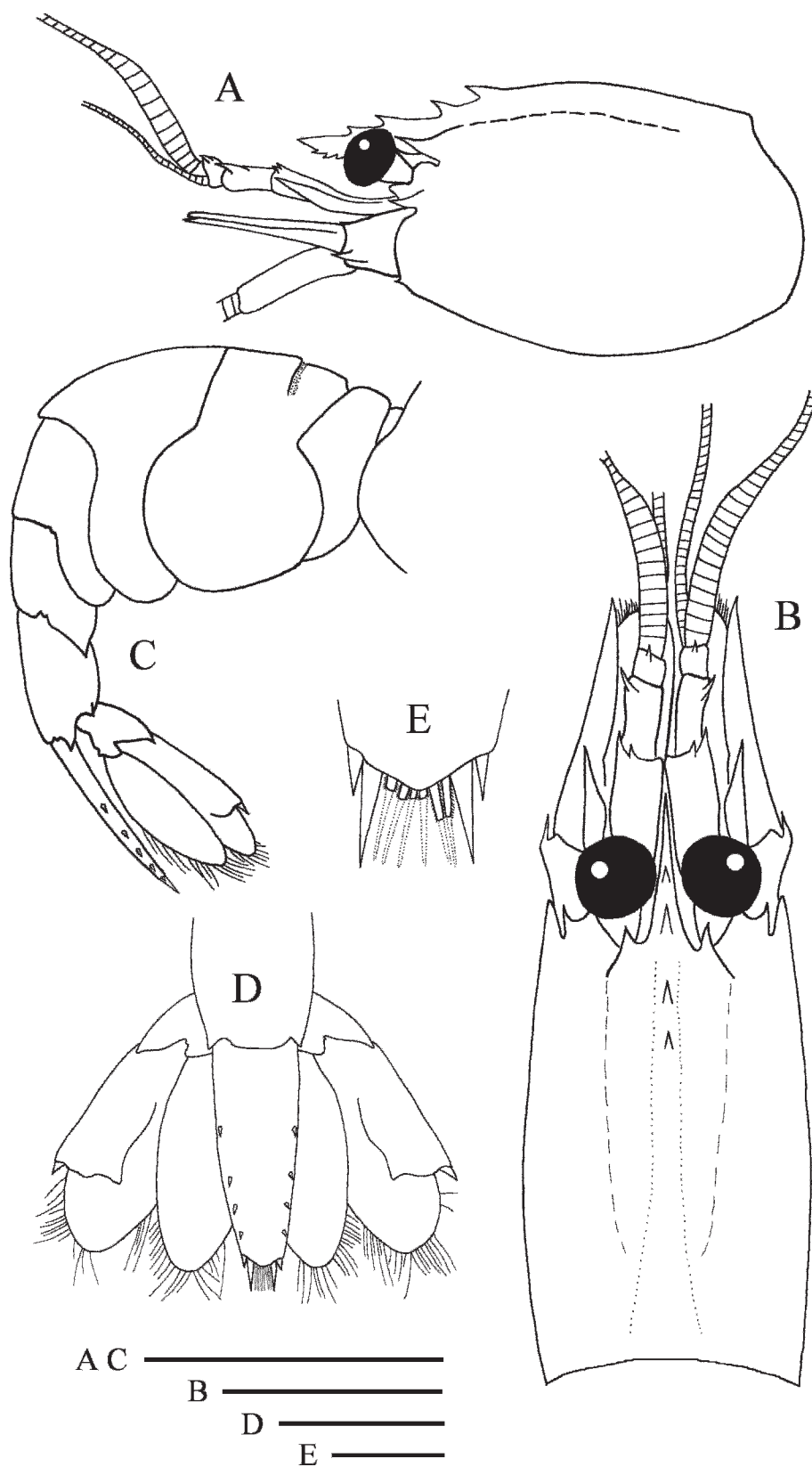


Fig. 7. *Lebbeus unguiculatus* n. sp., holotype ovigerous female cl.11.9 mm, TAIWAN 2006, stn PCP358. A, carapace and anterior appendages, lateral view; B, carapace and anterior appendages, dorsal view; C, pleon, lateral view; D, Telson, dorsal view; E, same, posterior margin, dorsal view. Scales: A, C = 10 mm; B, D = 5 mm; E = 1 mm.

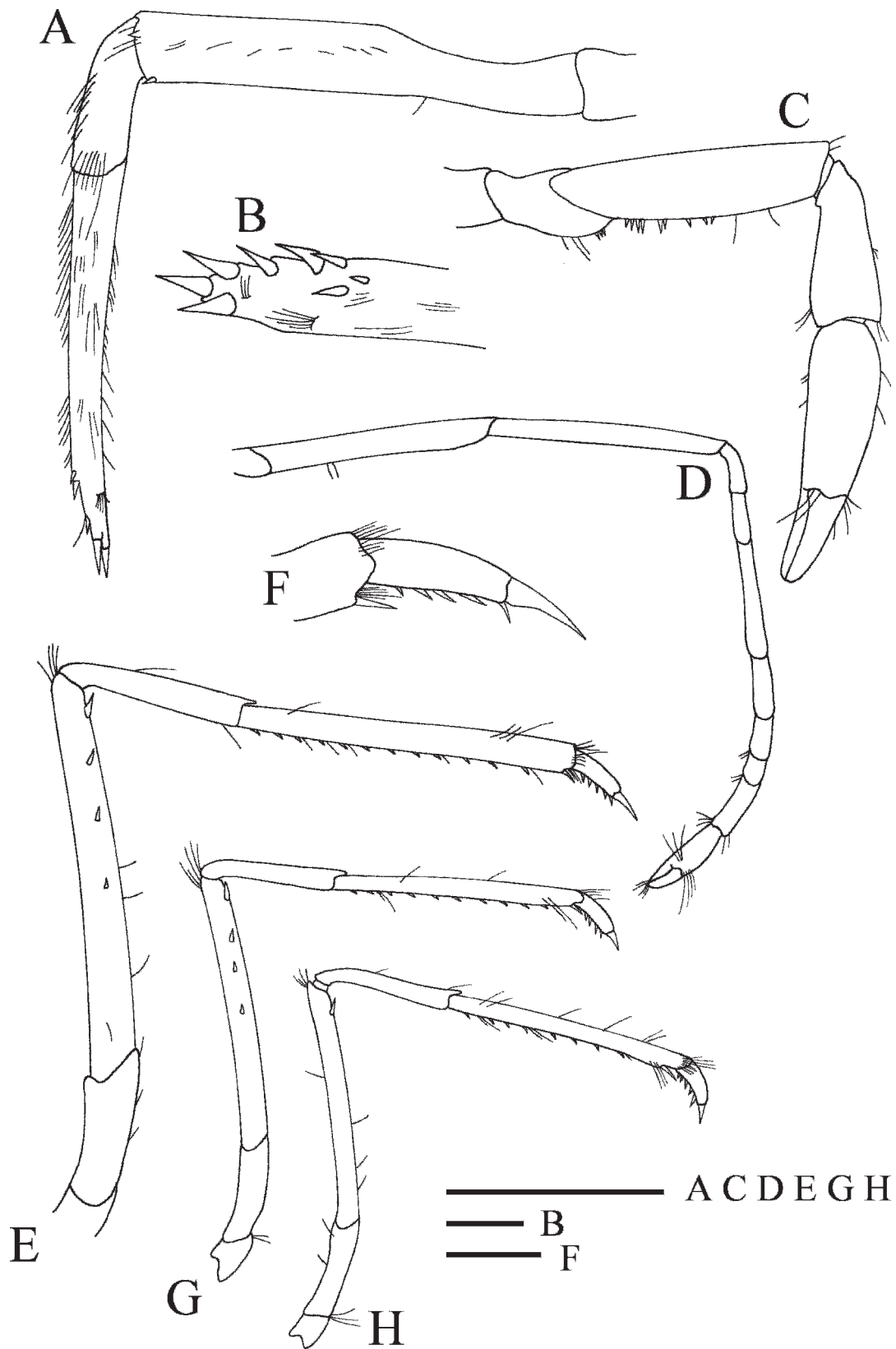


Fig. 8. *Lebbeus unguiculatus* n. sp., paratype ovigerous female cl 12.4 mm, TAIWAN 2006, stn PCP333. A, left third maxilliped, lateral view; B, same, distal part of ultimate segment, mesial view; C, right first pereiopod, lateral view; D, right second pereiopod, lateral view; E, right third pereiopod, lateral view; F, same, dactylus and distal part of propodus, lateral view; G, right fourth pereiopod, lateral view; H, right fifth pereiopod, lateral view. Scales: A, C-E, G-H = 5 mm; B, F = 1 mm.

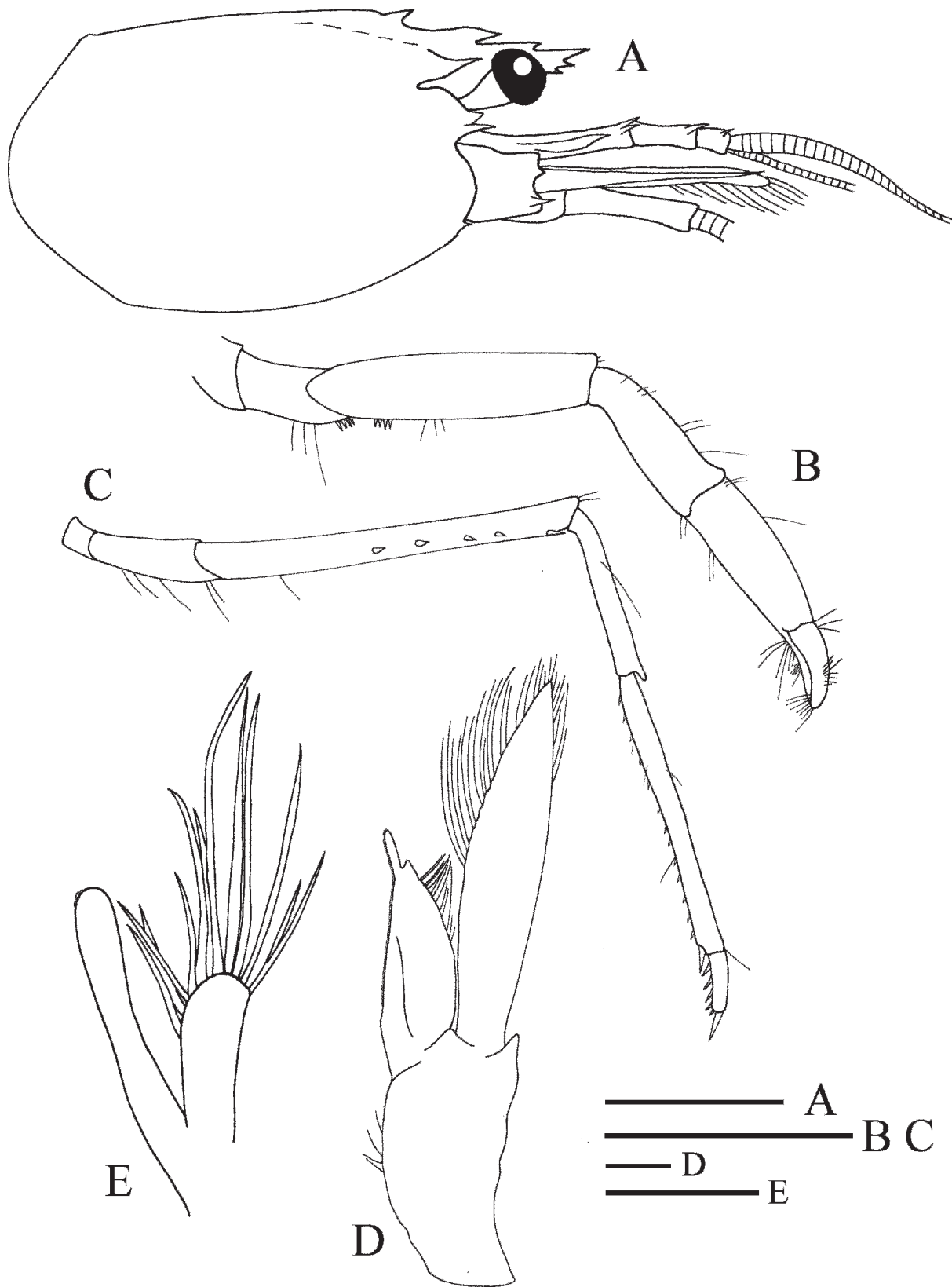


Fig. 9. *Lebbeus unguiculatus* n. sp., paratype male cl 11.8 mm, TAIWAN 2005, stn CP277. A, carapace and anterior appendages, lateral view; B, right first pereiopod, lateral view; C, right third pereiopod, lateral view; D, left first pleopod, ventral view; E, appendix interna and appendix masculina of second pleopod, dorsomesial view. Scales: A-C = 5 mm; D, E = 0.5 mm.

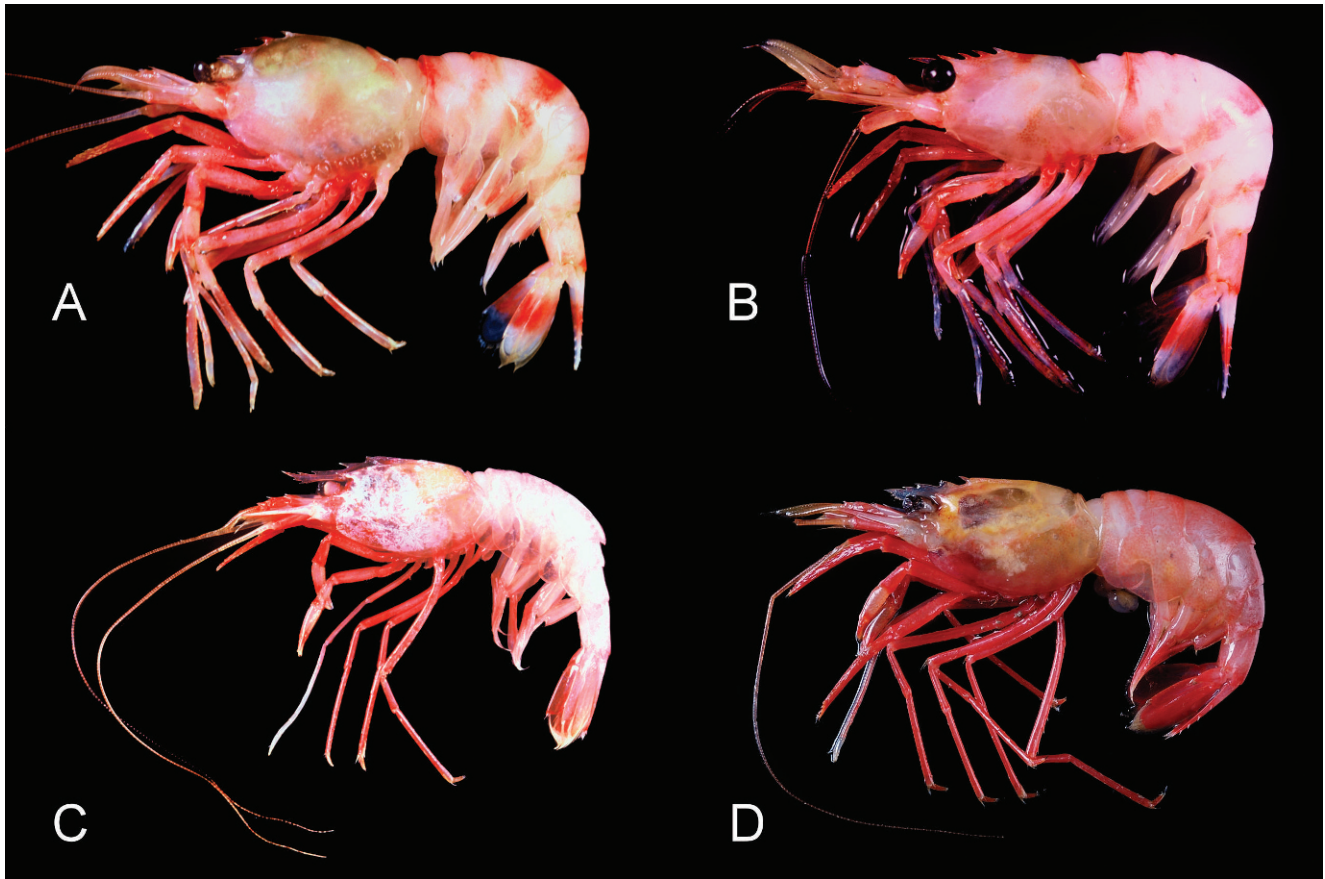


Fig. 10. A, *Lebbeus brevisrostris* n. sp., holotype female cl. 9.8 mm, TAIWAN 2001, stn CP71; B, *Lebbeus brevisrostris* n. sp., paratype male 7.5 mm, same station; C, *Lebbeus formosus* n. sp., paratype female, cl 9.5 mm, TAIWAN 2001, stn CP126; D, *Lebbeus unguiculatus* n. sp., paratype ovigerous female, cl 12.4 mm, TAIWAN 2006, stn PCP333.

triangular, reaching or slightly overreaching distal margin of antennal tooth; anterolateral margin between antennal and pterygostomial teeth strongly sinuous with deep excavation just inferior of antennal tooth.

Pleon (Fig. 7C) dorsally rounded. Second somite with shallow transverse groove on tergum. Pleura of anterior three somites broadly rounded; fourth pleuron usually rounded, rarely with small posteroventral tooth; fifth pleuron with moderately strong posteroventral tooth. Sixth somite 1.40-1.51 times as long as fifth somite, bearing small posteroventral tooth; posterolateral process terminating in small tooth. Telson (Fig. 7D) 1.50-1.71 times as long as sixth somite, tapering posteriorly to convex posterior margin, bearing 4-5 dorsolateral spines on each side; posterior margin (Fig. 7E) with 2 pairs of lateral spines (mesial pair longer) and 6 median spiniform plumose setae.

Eye subpyriform with cornea distinctly wider than eye-stalk; ocellus absent; maximum diameter of cornea 0.13-0.14 times carapace length.

Antennular peduncle (Fig. 7A, B) reaching 0.77-0.86 of antennal scale. First segment longer than distal two segments combined, reaching 0.44-0.52 of antennal scale, dorsodistal margin armed with 1 strong lateral spine and 1-2 small additional spines; stylocerite almost reaching or slightly overreaching distal margin of first segment, not overlapping first segment, sharply pointed, mesial margin

convex. Second segment about half-length of first segment, with 1 large distal dorsolateral spine. Third segment short, about half as long as second segment, bearing 1 distinct dorsodistal spine. Lateral flagellum with thickened aesthetasc-bearing portion 0.51-0.54 times as long as carapace.

Antenna with basicerite bearing moderately large distolateral spine; carapocerite reaching 0.63-0.85 of antennal scale. Antennal scale 0.53-0.60 times as long as carapace and 2.21-2.84 times longer than wide; lateral margin nearly straight or faintly concave; distolateral spine reaching rounded distal margin of lamella.

Mouthparts similar to those of other species of the genus. Third maxilliped (Fig. 8A, B) overreaching antennal scale by half of ultimate segment; ultimate segment 2.93-4.13 (usually 3.13-3.45) times as long as penultimate segment, tapering distally, with short row of darkly pigmented corneous spines; antepenultimate segment shorter than distal 2 segments combined; lateral surface bluntly ridged and bearing only 1 subdistal movable spine and 1 fixed distolateral tooth.

Strap-like, terminally hooked epipods present on third maxilliped to third pereiopod, corresponding setobranchs present on first to third pereiopods.

First pereiopod (Fig. 8C) moderately stout, extending to tip of antennal scale; dactylus 0.45-0.62 times as long as palm, terminating in 2 darkly pigmented corneous claws;

merus 1.49-1.78 times as long as carpus, bearing row of slender spinules on proximal half of ventral margin. Second pereopod (Fig. 8D) overreaching antennal scale by length of chela and 0.45-0.48 of carpus; chela small with subcylindrical palm; palm 1.22-1.68 times longer than fingers; dactylus terminating in 2 small claws; carpus 1.67-1.79 times as long as merus, divided into 7 articles; ischium as long as merus. Third to fifth pereopods moderately long and slender, similar, but slightly decreasing in length posteriorly. Third pereopod (Fig. 8E) overreaching antennal scale by length of dactylus and propodus; dactylus (Fig. 8F) 0.28-0.29 times as long as propodus, moderately stout, terminating in darkly pigmented unguis and armed with 4-5 darkly pigmented accessory spinules on flexor margin; unguis considerably elongate, 0.24-0.29 times as long as total length of dactylus, distalmost accessory spinule subequal to others and much smaller than unguis, thus not appearing biunguiculate; propodus with 1 ventrodiscal spinule and 9-12 spinules along ventral margin; carpus 0.56-0.57 times as long as propodus; merus armed with 4-6 ventrolateral spines at most in distal half. Fourth pereopod (Fig. 8G) overreaching antennal scale by length of dactylus and about 0.60 of propodus; dactylus with 4-6 accessory spinules on flexor margin; propodus with 1 ventrodiscal spinule and row of 9-12 spinules along ventral margin; merus with 3-4 ventrolateral spines. Fifth pereopod (Fig. 8H) overreaching distal margin of antennal scale by dactylus and 0.25 of propodus; dactylus with 5-6 accessory spinules on flexor margin; propodus with row of 7-13 ventral spinules; merus with 0-1 ventrolateral spine subdistally.

Female pleopods and uropod typical of genus, without distinctive feature.

Eggs large and few, 1.29-1.37 mm in diameter.

Male Characteristics.—Males generally similar to females but body less robust. Rostrum (Fig. 9A) relatively short, 0.35 times as long as carapace; dorsal margin armed with 3 or 4 teeth, including 2 on rostrum proper and 1-2 teeth on carapace posterior to level of orbital margin, posteriormost tooth arising at 0.18-0.26 of carapace length; ventral margin armed with 2 or 3 teeth. Carapace with gastric region not inflated, thus dorsal profile in lateral view nearly straight.

Fourth pleonal pleuron rounded or with small postero-ventral tooth.

Antennular peduncle more elongate, reaching 0.90-0.92 of distal margin of antennal scale; lateral flagellum elongate, flattened, 1.35 times as long as carapace, not abruptly tapering distal to aesthetasc-bearing portion; aesthetasc-bearing portion occupying proximal 0.79 of entire length.

First pereopod similar to that of female, not showing sexual dimorphism (Fig. 9B). Third pereopod (Fig. 9C) overreaching distal margin of antennal scale by length of dactylus, propodus and 0.20 of carpus. Meri armed with 5-6 on third, 2-3 on fourth, and 0-1 ventrolateral spines on fifth pereopod, respectively.

First pleopod (Fig. 9D) with endopod elongate subtriangular; appendix interna terminal, elongate, and well developed, about 0.80 length of endopod proper. Second

pleopod with appendix masculina about 0.75 length of appendix interna (Fig. 9E), bearing 13 long setae.

Color.—Body generally pinkish red, somewhat whitish translucent along dorsal half of carapace. Eyes dark brown. Internal organs visible inside carapace, light yellow. Eggs translucent whitish.

Distribution.—Only known from southern Taiwan, at depths of 635-1302 m.

Remarks.—*Lebbeus unguiculatus* belongs to the species group with epipods on the first to third pereopods only, but it is very characteristic in having the ungui of the dactyli of the third to fifth pereopods greatly elongated and attaining half or more than the length of the corpus. Elongated ungui on the third to fifth pereopods are also found in *L. acudactylus* Jensen, 2006 (Aleutian Islands to Gulf of Alaska; Jensen, 2006) and *L. scrippsi* Wicksten and Méndez, 1982 (southern Gulf of California to off Arica, Chile; Wicksten and Méndez, 1982; Wicksten and Hendrickx, 2003), though it is still unclear if the unguis is basally demarcated in the latter species. Other than lacking an epipod on the third pereopod in *L. acudactylus* and *L. scrippsi*, *L. unguiculatus* differs from these two species in bearing a deep notch just below the base of the supraorbital tooth. *Lebbeus acudactylus* further differs from *L. unguiculatus* in the longer rostrum (distinctly overreaching first antennular segment vs. falling short) and the presence of a single distolateral spine on the distal margin of the first antennular segment vs. 1-2 accessory spines in addition to the distolateral spine in *L. unguiculatus*. *L. scrippsi* can also be readily separated from *L. unguiculatus* in having only one postrostral spine vs. 2-3, fewer dorsolateral spines on the telson with 3 pairs vs. 4-5, and the proportionally longer dactylus of the third pereopod some 0.4 times vs. 0.28-0.29 times as long as the propodus.

Superficially, this new species is rather similar to *L. formosus* and the other 11 species mentioned above (see Remarks under *L. formosus*), but the unusual feature of the dactyli of the third to fifth pereopods immediately distinguishes *L. unguiculatus* from these species. Furthermore, the short rostrum separates *L. unguiculatus* from *L. africanus*, *L. bidentatus*, and *L. uschakovi*. The relatively longer stylocerite is useful to distinguish this new species from *L. antarcticus*, as in the latter species the stylocerite far falls short of the distal margin of the first segment of the antennular peduncle. The presence of only 3-4 teeth in the dorsal rostral series distinguishes *L. unguiculatus* from *L. polyacanthus* (6-7), *L. similior* (7), *L. uschakovi* (9), and *L. wera* (8). This new species differs from *L. microceras* and *L. zebra* in the length of the stylocerite, reaching or slightly overreaching the distal margin of the first antennular segment vs. reaching the distal margin of the second antennular segment, and the possession of six plumose setae, instead of one pair of spines, on the posterior margin of the telson. The rostrum is slightly shorter in *L. unguiculatus* than in *L. formosus*, falling short of distal margin of first antennular segment vs. almost reaching or slightly overreaching first antennular segment, but the carpocerite of the antenna of the former is longer than in the latter some 0.63-0.85 vs. 0.52-0.56 of the length of the

antennal scale. Moreover, the palm of the second pereopod is relatively shorter in *L. unguiculatus* than in *L. formosus*, about 1.22-1.68 vs. 1.89-1.95 times as long as dactylus.

The armature of the fourth pleonal pleuron is also variable in *L. unguiculatus*. Of the eight specimens examined, four specimens lack a posteroventral tooth on the fourth pleuron. However, one male (NTOU M00891) and one female (OUMNH.ZC.2010-07-007) have small posteroventral teeth on both sides and two females (NTOU M00890, M00892) have a small tooth on either side.

Etymology.—The name *unguiculatus* refers to the unusually elongated unguis of the third to fifth pereopods in this new species.

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