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**SHALLOW WATER AND DEEP-SEA BARNACLES
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COLLECTED DURING THE PHILIPPINE PANGLAO 2005 EXPEDITION,
WITH DESCRIPTIONS OF TWO NEW SPECIES**

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ABSTRACT. – The present study recorded the biodiversity of cirripedes collected in the Philippine Panglao 2005 Expedition, which yielded 20 species in 4 families of stalked barnacles and 3 families in sessile barnacles. All species were described using light microscopy and selected species which received lesser descriptions were studied using scanning electron microscope to illustrate the fine details including the setations of the mouth parts and cirri. The present study identified new *Arcoscalpellum* and *Paralepas* species and with new records in the Philippine waters including *Teloscalpellum ecaudatum*, *Trianguloscalpellum diota*, *Paralepas minuta* and *Adna anglica*.

KEY WORDS. – Philippines, biodiversity, barnacles, cirripedes, Panglao.

INTRODUCTION

The Philippines (containing > 7,100 islands) is a world biodiversity hotspot and being considered as one of the world's biologically richest country (Bouchet et al., 2002; Carpenter & Springer, 2005). Biodiversity of Philippine barnacles, however, has not been reported and studied extensively. Previous studies on the Philippine barnacles were mainly based on the collections in the “HMS Challenger Expedition” (1873–1876; Hoek, 1883), the “Albatross Expedition” (1907–1910; Pilsbry, 1907, 1912), the “HMS Siboga Expedition” (1899–1900; Hoek, 1907, 1913), the “Dr. Th. Mortensen's Pacific Expedition” (1914–1916; Broch, 1931), “MUSORSTOM 1 Expedition” (Rosell, 1981), “MUSORSTOM 2 Expedition” (Rosell, 1989) “MUSORSTOM 3 Expedition” (Rosell, 1991; Buckeridge, 1994) and the collections the U.P. Marine Biological Laboratory at Puerto Galera, Oriental Mindoro (Rosell, 1972).

The Philippine PANGLAO 2005 expedition is organised by the Museum of National d'Histores Naturelle, Paris, the National Fisheries Research and Development Institute, the Philippines Bureau of Fisheries and Aquatic Resources, the University of San Carlos, Cebu City, the Philippines, the National University of Singapore in Singapore and the National Taiwan Ocean University in Taiwan. The objectives of the expedition is based on the surrounding waters of the Panglao Island (located in the Boho Sea) to survey the

biodiversity of Philippine crustaceans, molluscs and fishes. The present study reports the biodiversity of barnacles collected in the PANGALAO 2005 expedition.

MATERIALS AND METHODS

Sampling methods in the PANGLAO 2005 expedition covered both shallow water and deep-sea habitats. Samples were collected using SCUBA diving (< 40 m depth), beam trawling (~ 200 m) and grab samples. Most specimens were dissected and studied based on light microscopy. Scanning Electron Microscopes were used to investigate the fine structure including the setal types (see Chan et al., 2008) of the lesser described species and new species discovered in the expeditions. Holotypes of the new *Arcoscalpellum* and *Paralepas* species identified in the present study were deposited in the National Museum of the Philippines, Manila (NMCR). Other specimens were deposited in the Biodiversity Research Museum, Academia Sinica (ASIZCR), National Museum of Natural Science, Taiwan (NMNS) and research collections in the Coastal Ecology Laboratory, Biodiversity Research Center, Academia Sinica (CEL). Capitulum length (CL) and Capitulum width (CW) of stalked barnacles and basal diameter (BD) of sessilian barnacles were measured using vernier callipers (± 0.01 mm). Systematics followed the latest revision in Buckeridge & Newman (2006), which separated the previous order Pedunculata into three new orders, the Ibloformis, Lepadoformis and Scalpelloformes.

The classification of the families inside Scalpelloformis followed the revision in Zevina (1981). The classification of sessilian barnacles basically followed Newman (1996) and Young (1998).

TAXONOMIC ACCOUNT

SCALPELLIFORMES Buckeridge & Newman, 2006

SCALPELLIDAE Pilsbry, 1907

Scalpellinae Pilsbry, 1907

Scalpellum Leach, 1817

Scalpellum stearnsii Pilsbry, 1890

(Figs. 1A, 3)

Scalpellum stearnsii Pilsbry, 1890: 441; Pilsbry, 1907: 14, Pl. 4: Figs. 1–5; Hoek, 1907: 69, Pl. VI: Fig. 1; Annandale, 1909b: 270; Krüger, 1911: 18, Pl. 2: Figs. 18, 19; Nilsson-Cantell, 1921: 175; Nilsson-Cantell, 1934: 33; Broch, 1922: 235, Fig. 6; Hiro, 1933: 22, Fig. 4, Pl. 1: Figs. 5, 5a; Hiro, 1939a: 237; Zevina, 1981: 98, Fig. 68; Rosell, 1991: 15; Liu & Ren, 2007: 226, Fig. 95.

Scalpellum stearnsii var *robusta* Hoek, 1907: 69, Pl. VI: Figs. 2, 3, 8–12.

Material examined. – Stn. CP2372 (8°38.7'N 123°16'E, sandy/muddy substratum, depth 231–255 m, 27 May 2005), CEL-Pangalo-001, 1 specimen, CL 51.74 mm, CW 32.61 mm. Stn. CP2349 (9°31.6'N 123°55.7'E, sandy/muddy substratum, depth 229–240 m, 24 May 2005), ASIZCR000209, 1 specimen, CL 25.6 mm, CW 15.72 mm.

Diagnosis. – Capitulum 14 valves, perfectly calcified. Upper latus pentagonal, carina strongly curved. Inframedian latus quadrilateral, umbo submedial. Carinal latus strongly curved, extended out of the carina. Cirrus I, rami unequal, outer rami oval shaped, inner rami long and slender.

Descriptions. – Capitulum almost square shaped, valves 14, perfectly calcified, covered by a yellow membrane (Figs. 1A, 3A). Tergum triangular, umbo apex (Fig. 3A), tergal margin slightly convex. Scutum quadrilateral (Fig. 3A), lateral margin concave (Fig. 3A). Upper latus pentagonal (Fig. 3A). Inframedian latus pentagonal and smaller than the upper latus, umbo submedial (Fig. 3A). Carinal latus strongly curved and horn shaped, extending beyond the carina, umbo apex (Fig. 3A). Rostral latus wider than high, narrow (Fig. 3A). Rostrum small. Carina strongly bowed, thick (Fig. 3A). Peduncle long, cylindrical, covered by calcified scales (Fig. 3A). Peduncle scales arranged in ring patterns (Fig. 3A).

Maxilla globular with fine setae. Maxillules without a clear notch, > 35 strong cuspidate setae on cutting edge (Fig. 3D). Mandibles have 5 major teeth, lower margin have fine denticles (Fig. 3E). Mandibulatory palps elongated and narrow (Fig. 3F), with serrulate type setae in the inferior margin. Labrum strongly V-shaped with > 30 fine teeth. Cirrus I, rami unequal, inner rami oval shaped (11 segments), outer rami

long and slender (14 segments; Fig. 3B). Cirri II–VI similar in morphology, rami almost equal in length, inner and outer rami 25–28 segmented (Fig. 3E). Caudal appendages short, with 5–6 segments.

Habitats. – Deep-sea species. Attached on the shells surface of gastropods, carapace surface of crabs and boulders.

Distribution. Indo-Pacific region.

Meroscalpellinae Zevina, 1978

Neoscalpellum Zevina, 1978

Neoscalpellum philippinensis (Rosell, 1981)

(Figs. 1B, 4)

Meroscalpellum dicheloplax philippiensis Rosell, 1981: 286, Pl. 1i–m, Pl. 2n, o.

Material examined. – Stn. CP2353 (9°25.6'N 124°2.1'E, muddy substratum, depth 233–255 m, 27 May 2005), ASIZCR000210, 3 specimens, CL 14.9–16.3 mm, CW 6.57–7.94 mm. Stn. CP2354 (9°26.0'N 124°6.5'E, muddy substratum, depth 1,773–1,775 m, 25 May 2005), CEL-PANGLAO-02, 8 specimens, CL 18.3–19.3 mm, CW 9.92–10.08 mm. Stn. CP2355 (9°24.3'N 124°10.7'E, muddy substratum, depth 1,764 m, 25 May 2005), CEL-PANGLAO-03, 3 specimens, CL 9.87–15.84 mm, CW 4.58–7.24 mm. CP2356 (9°20.9'N 124°8.7'E, muddy substratum, depth 1,764–1,756 m, 25 May 2005), CEL-PANGLAO-04, 7 specimens, CL 14.62–19.24 mm, CW 7.17–9.78 mm.

Diagnosis. – Capitulum 13 valves, imperfectly calcified. Tergum, and upper latus inverted V-shaped.

Descriptions. – Capitulum 13 valves, imperfectly calcified (Figs. 1B, 4A). Rostrum absent. Valves separated by narrow chitinous structure (Figs. 1B, 4A). Tergum inverted V-shaped, umbo apex. Scutum with long apicolateral arm, about 1/4 of the tergal margin, basal margin convex. Upper latus bifid, with long and thick depending arms. Inframedian latus vase-shaped, higher than wide, umbo submedial. Carinal latus elongated, higher than wide, umbo basicarinal angle. Rostral latus higher than wide, quadrilateral (Figs. 1B, 4A). Carina long, narrow and convex. (Figs. 1B, 4A). Peduncle covered by fine scales (Figs. 1B, 4A).

Maxilla triangular with dense serrulate setae (Fig. 4F, J). Maxillule narrow, not notched, with a few strong setae (Fig. 4E). Mandible with three teeth, without minor teeth on the major teeth (Fig. 4C). Lower margin of mandibles short and without spines (Fig. 4D). Mandibulatory palp elongated with setae on the tip (Fig. 4H). Labrum concaved and smooth, without any setae and teeth (Fig. 4B). Cirrus I, inner rami wide and flattered (5 segments), outer rami slender and long (9 segments; Fig. 4G). Cirrus II–VI, rami similar in length, cirrus II (inner rami 11 segments, outer rami 13 segments), cirrus III (13, 13), cirrus IV (17, 16) cirrus V (22, 21), cirrus VI (21, 21; Fig. 4I). All cirri with fine serrulate-type setae (Fig. 4K). Caudal appendages present, 8 segmented, 1/5 length of cirrus VI.



Fig. 1. Panglao cirripedes, general view: A, *Scalpellum stearnsii*; B, *Nesoscalpellum philippinensis*; C, *Welnerium poculum*; D, *Arcoscalpellum youngi*, new species; E, *Teloscalpellum ecaudatum*; F, *Amigdoscalpellum elegans*; G, *Trianguloscalpellum diota*; H, *Heteralepas japonica*; I, *Paralepas minuta*; J, *Paralepas laxus*, new species; H, *Glyptelasma hamatum*. Scale bars in mm.

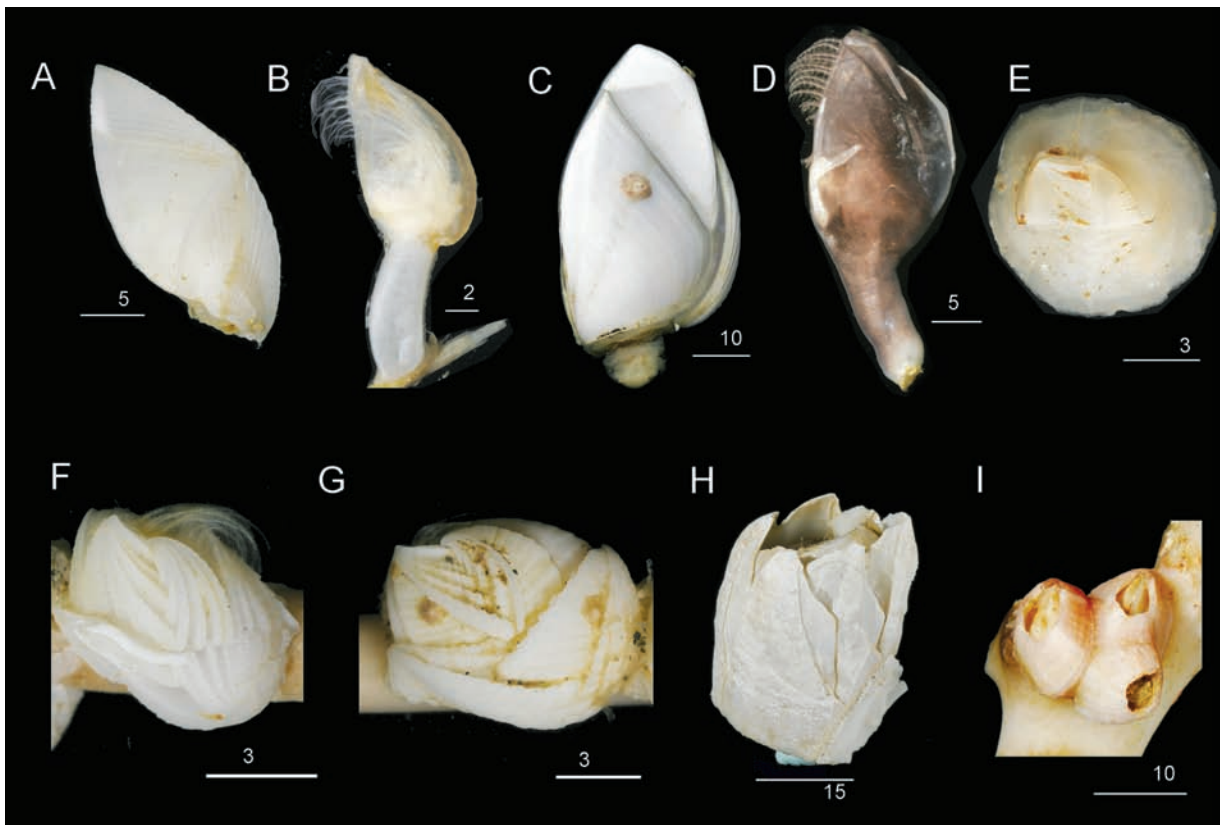


Fig. 2. Panglao cirripedes: A, *Megalasma striatum*; B, *Octolasma orthogonia*; C, *Lepas anatifera*; D, *Conchoderma hunteri*; E, *Metaverruca recta*; F, *Rostratoverruca intexta*; G, *Newmaniverruca albatrossiana*; H, *Striatobalanus tenuis*; I, *Adna anglica*. Scale bars in mm.

Habitats. – Attached on deep sea sponges.

Distribution. – Present records only in the Philippines.

Remarks. – *Neoscalpellum dicheloplax* was described by Pilsbry (1907) that consisting of two subspecies, *N. d. dicheloplax* and *N. d. benthophila*. Subsequently, Rosell (1981) added a subspecies, *N. d. philippinensis* (as *Meroscalpellum*), because *N. d. philippinensis* is

morphologically close to *N. d. benthophila* (Pilsbry, 1907). Except for the curved carina, *N. d. dicheloplax* had all valves biramous or V-shaped, whilst *N. d. philippinensis* had only tergum, scutum and upper lateral plates V-shaped. Comparing *N. d. philippinensis* and *N. d. benthophila*, the inframedian margin of the carinal latus of *N. d. philippinensis* is concave, whilst the one in *N. d. benthophila* is convex. *Neoscalpellum d. philippinensis* should be, therefore, considered as a separate species from *N. dicheloplax*.

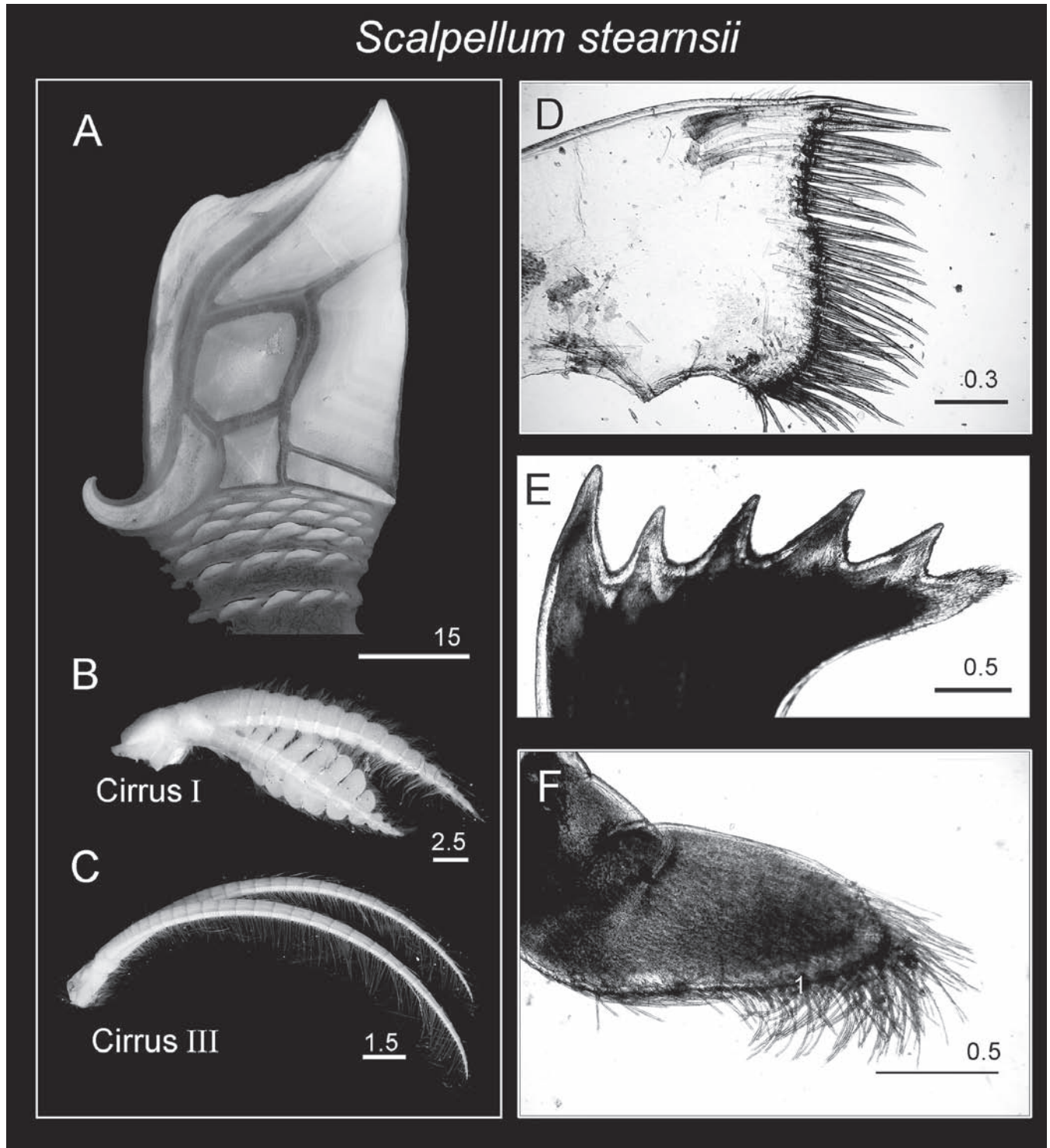


Fig. 3. *Scalpellum stearnsii*: A, side view showing the capitulum; B, cirrus I; C, cirrus III; D, maxillule; E, mandible; F, mandibulatory palp. Scale bars in mm.

Neoscalpellum philippinensis

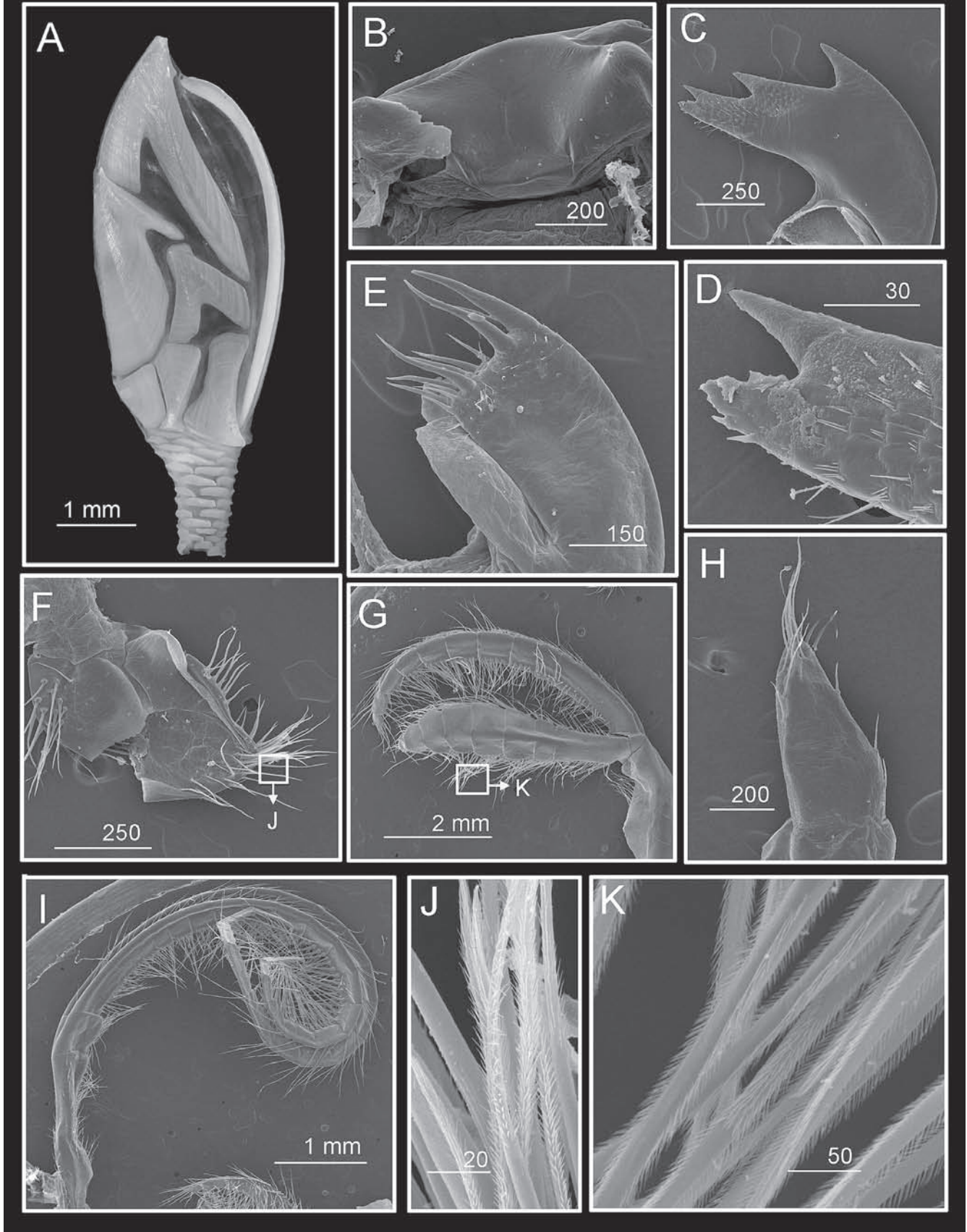


Fig. 4. *Neoscalpellum philippinensis*: A, dissected side view of the capitulum with somatic body removed, yellow covering membrane was removed using diluted commercial bleach solution to show the arrangement of opercular valves; scanning electron micrographs of: B, labrum; C, mandible; D, lower margin of mandible; E, maxillule; F, maxilla; G, cirrus I; H, mandibulatory palp; I, cirrus IV; J, serrulate setae on maxilla; K, serrulate setae on cirrus I. Scale bars: A, G, I in mm; B–F, H, J, K in μm .

Arcoscalpellinae Zevina, 1978

***Weltnerium* Zevina, 1978**

***Weltnerium poculum* (Hoek, 1907)**

(Figs. 1C, 5)

Scalpellum poculum Hoek, 1907: 100, Pl. VIII: Fig. 4a; Rosell, 1989: 13, Pl. 2.

Weltnerium poculum Zevina, 1981: 209, Fig. 147.

Material examined. – Stn. CP2334 (9°37.5'N 123°40.2'E, sandy substratum, depth 631.2–659 m, 22 May 2005), CEL-PANGLAO-05, 1 specimen. Stn. CP2340 (9°29.4'N 123°44.4'E, sandy/muddy substratum, depth 291–318 m, 23 May 2005), ASIZCR000210, 3 specimens, CL 7.9–9.99 mm, CW 3.97–4.02 mm. Stn. CP2404 (9°39.4'N 123°43.3'E, rock/sand/coral/muddy substratum, depth 479–481 m, 1 Jun.2005), CEL-PANGLAO-06, 1 specimen, CL 17.3 mm, CW 9.07 mm.

Diagnosis. – Capitulum 14 valves, surface smooth. Inframedian latus large, pentagonal, umbo basal. Carino-latus did not extend beyond carina, umbo basicarinal angle.

Descriptions. – Capitulum white or pale yellow, elongated, 14 valves, surface smooth (Figs. 1C, 5A). Tergum quadrilateral, apex curved, occludent margin slightly convex. Scutum pentagonal, higher than wide, umbo apex (Fig. 5A), occludent margin straight, lateral margin convex, with a single short apicolateral arm (Fig. 5A). Upper latus pentagonal, umbo apex (Fig. 5A). Rostral latus quadrilateral (Fig. 5A). Inframedian latus large and pentagonal, umbo basal. Carinal latus elongated, higher than wide, umbo basicarinal angle, angle not exceeding beyond carina. Carina thick and curved. Peduncle cylindrical, surrounded by large scales (Fig. 5A).

Maxilla square shaped. Maxillule slightly notched (Fig. 5D), 3 strong setae on upper notch. Palp narrow and elongated (Fig. 5F). Mandibles with 3 major teeth, denticles on the third teeth (Fig. 5B), lower margin with 5 large sharp denticles (Fig. 5C). Mandibulatory palp elongated with short and sparse setae in the superior margin (Fig. 5F). Labrum strongly notched, V-shaped, 26 small teeth on the notch area (Fig. 5E). Inner rami of cirrus I oval and flattened, 8 segmented; outer rami slender, longer (10 segments). Cirri II–VI with equal length rami. Cirrus II (inner rami 12 segments, outer rami 13 segments), Cirrus III (18, 18), Cirrus IV (23, 23), Cirrus V (24, 26), Cirrus VI (26, 27). Caudal appendage 11-segmented, 1/5 length of the cirrus VI.

Distribution. – Indonesian and the Philippine waters.

Habitats. – Deep-sea species. Attached on the surface of deep-sea sponges, shell of molluscs or hydrozoans.

***Arcoscalpellum* Zevina, 1978**

***Arcoscalpellum youngi*, new species**

(Figs. 1D, 6)

Material examined. – Holotype: NMCR. Stn. CP2386 (8°49.3'N 123°1.9'E, sandy substratum, depth 2,149–2,217 m, 29 May 2005), CL 16.12 mm, CW 6.57 mm.

Diagnosis. – Capitulum elongated, higher than wide, 14 fully calcified valves. Inframedian latus very narrow and triangular, umbo apical. Rostral lateral quadrilateral, tall, higher than wide. Carinal latus pentagonal, higher than wide, umbo basicarinal angle, angle located at the mid region of the carinal margin and not extends beyond carina.

Descriptions. – Capitulum elongated, almost twice as long as wide, colour white, 14 fully calcified valves (Figs. 1D, 6A, G). Valves surface smooth (Fig. 6A, G). Tergum quadrilateral, umbo apex (Fig. 6A, G). Scutum quadrilateral, lateral margin is concave below the tergo-internal angle and become convex in the middle (Fig. 6A, G), occludent margin straight, umbo apical. Upper latus trapezoidal, scutal margin longest, concave. Other margin straight, the carinal margin shortest (Fig. 6A, G). An acute apex produced in a small triangle above and beyond the umbo, located on the scutal side. Rostral latus quadrilateral, higher than wide, basal margin short (Fig. 6A, G). Inframedian latus very narrow and triangular, touching the upper latus, umbo apical (Fig. 6A, G). Carinal latus pentagonal, higher than wide, umbo basicarinal angle which located at middle region of carinal margin, angle not exceeding beyond carina, carinal margin nearly straight. Peduncle fully covered by thick scales (Fig. 1D). Carina bowed (Fig. 6A, G).

Maxilla triangular. Maxillule not notched, with 8 strong setae (Fig. 6B). Mandibles with 3 major teeth (Fig. 6A), lower margin short, with five spines (Fig. 6B). Cirrus I with unequal length rami. Inner rami flattened with 7 segments (Fig. 6D), outer rami slender with 9 segments. Cirrus II – VI similar in morphology and length, with 17–22 segments (Fig. 6E). Caudal appendages short, within the length of the protopodite, 5 segmented (Fig. 6F).

Habitats. – Deep-sea species. Attached on crinoids.

Distribution. – Present records only covered in the Philippine Panglao waters.

Entymology. – Named for late Paulo S. Young (Universidade Federal do Rio de Janeiro, Brazil) for his contribution in barnacle taxonomy.

Remarks. – Only a single specimen of *Arcoscalpellum youngi*, new species, was collected but the preservation condition is not good and the soft tissue had dried out. As a result, labrum and palp was damaged during dissection and cannot be examined.

Weltnerium poculum

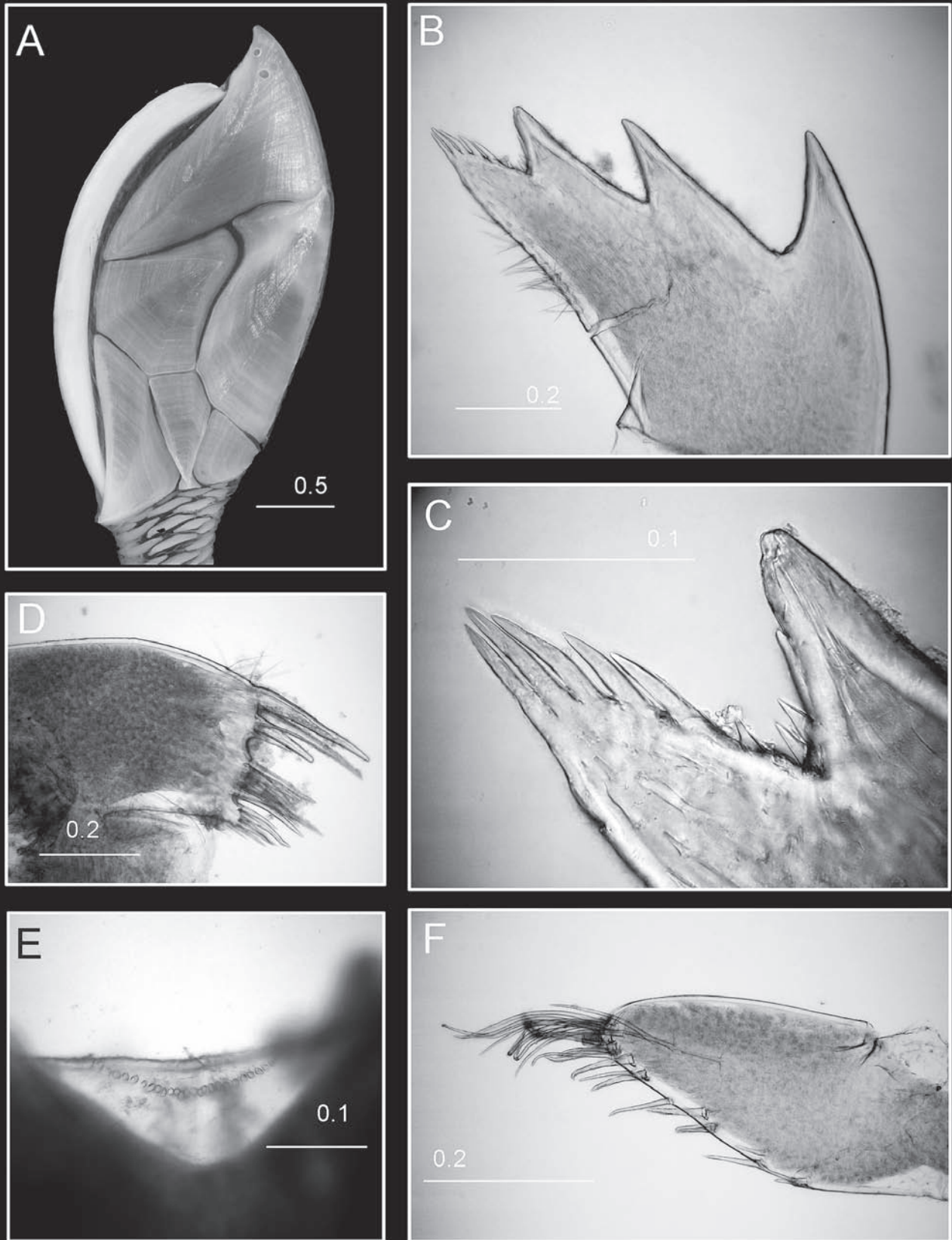


Fig. 5. *Weltnerium poculum*: A, dissected side view of the capitulum with somatic body removed, yellow covering membrane was removed using diluted commercial bleach solution to show the arrangement of opercular valves; B, mandible; C, lower margin of mandible; D, maxillule; E, labrum; F, mandibulatory palp. Scale bars in mm.

Arcoscalpellum youngi sp. nov.

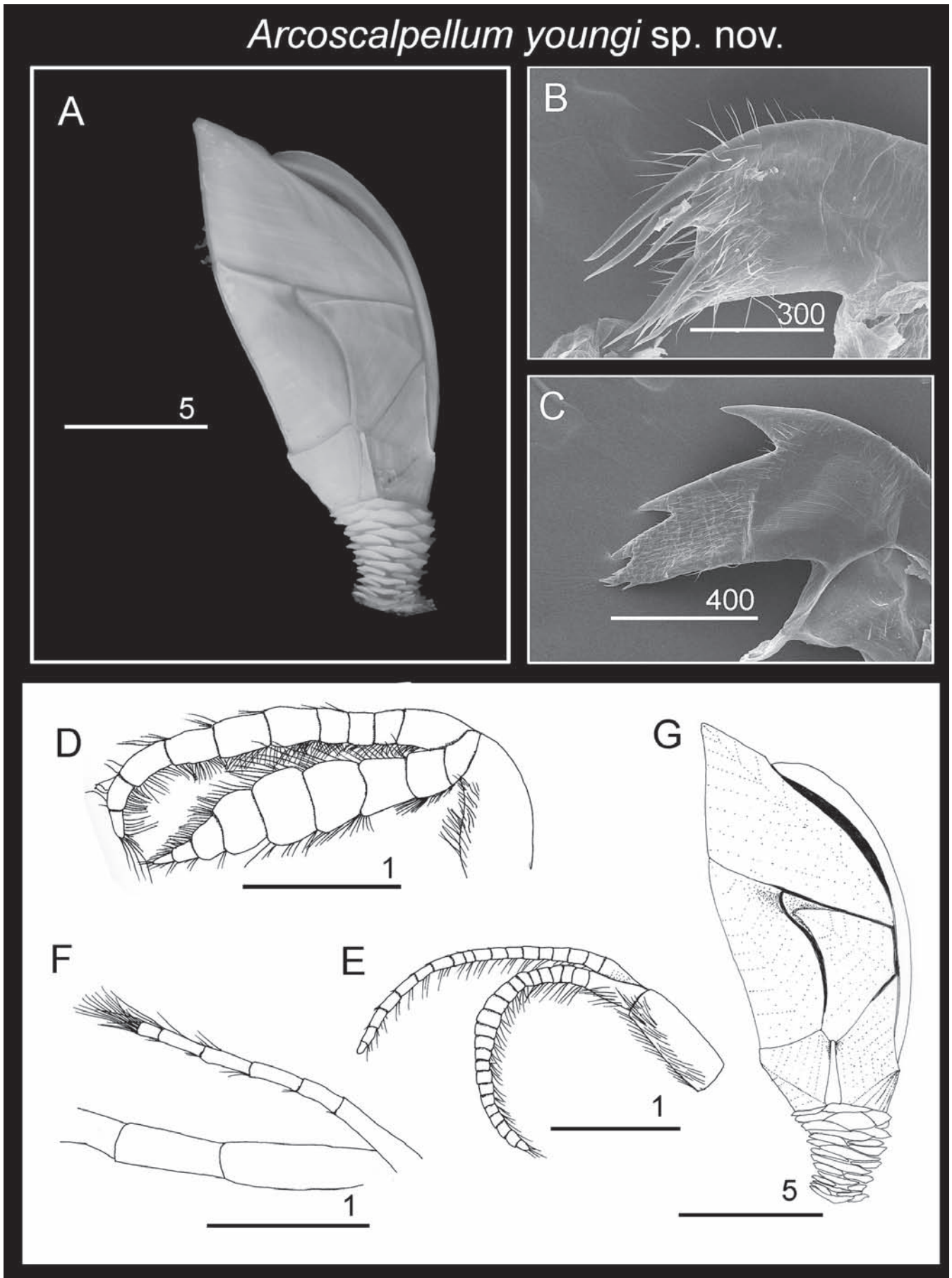


Fig. 6. *Arcoscalpellum youngi*, new species: A, side view showing the capitulum; Scanning electron micrographs of: B, maxillule; C, mandible; Drawing of D, cirrus I; E, cirrus IV; F, caudal appendage; G, side view of capitulum. Scale bars A, D, E, F, G in mm; B, C in μm.

Zevina (1981) revised the genus *Arcoscalpellum* which included 33 species. From those of the species, *Arcoscalpellum youngi*, new species, is morphologically close to *Arcoscalpellum pertosum* (Foster, 1978) in terms of the shapes of the tergum, scutum and upper latus. The upper latus of *A. pertosum* also produced an apex above and beyond the umbo, located on the scutal side. *Arcoscalpellum youngi*, new species, is different from *A. pertosum* in the shape of the inframedian latus. The inframedian latus on *A. youngi*, new species, is much narrower and triangular, while the inframedian latus in *A. pertosum* is much wider.

Teloscalpellum Zevina, 1978

Teloscalpellum ecaudatum (Calman, 1918)

(Figs. 1E, 7)

Scalpellum ecaudatum Calman, 1918: 106, text-fig. 2.
Teloscalpellum ecaudatum Zevina, 1981: 365, Fig. 282.

Material examined. – Stn. CP2335 (9°34.3'N 123°37.8'E, sandy/muddy substratum, depth 733–743 m, 22 May 2005), CEL-PANGLAO-07, 1 specimen, CL 13.26 mm, CW 7.3 mm. Stn. CP2398 (9°32.6'N 123°40.5'E, sandy substratum, depth 731–741 m, 31 May 2005), ASIZCR000212, 1 specimen, CL 9.52 mm, CW 7.7 mm.

Diagnosis. – Capitulum pale yellow, fully covered by 14 strongly sculptured valves, inframedian latus triangular, umbo protruded strongly at apex, carinal latus has umbo at basicarinal angle.

Descriptions. – Capitulum pale yellow, fully covered by 14 valves (Figs. 1E, 7A), valves surface rough, with strong striations (Fig. 7A); tergum large, triangular, umbo apex (Fig. 7A). Scutum quadrilateral, umbo apex, tergal margin straight, occludent margin slightly convex (Fig. 7A). Upper latus quadrilateral (Fig. 7A). Rostral latus triangular, flattened, wider than high (Fig. 7A). Inframedian latus narrow, triangular, umbo protruded strongly at apex (Fig. 7A). Carinal lateral curve pointed, umbo basicarinal angle, angle slightly extended beyond carina (Fig. 7A). Carina bowed (Fig. 7A). Peduncle covered by strong scales (Fig. 1E).

Maxilla globular (Fig. 7H), with serrulate setae (Fig. 7I). Maxillules slightly notched, with one large strong cuspidate setae on upper notch (Fig. 7B). Mandible with three major teeth, no minor teeth on major teeth (Fig. 7E), lower margin consists of 3–4 denticles (Fig. 7G). Mandible surface has serrulate setae (Fig. 7F). Mandibulatory palps elongated, serrulate setae on tip (Fig. 7C).

Habitats. – Deep-sea species. Attached on surface of gastropods.

Distribution. – Java Sea and the Philippines.

Remarks. – This species represent a new record in the Philippines.

Amigdoscalpellum Zevina, 1978

Amigdoscalpellum elegans (Hoek, 1883)

(Figs. 1F, 8)

Scalpellum elegans Hoek, 1907: 107, Pl. VIII: Fig. 14; Stubbings, 1936: 24; Zevina, 1981: 268, Fig. 201.

Amigdoscalpellum vitreum Rosell, 1991: 20, Fig. 2E. Non *A. vitreum* Hoek, 1883.

Material examined. – Stn. CP2384 (8°46.2'N 123°16.1'E, sandy, depth 613–647 m, 29 May 2005), CEL-Panglao-30, 1 specimen, CL 10.72 mm, CW 6.54 mm.

Diagnosis. – Capitulum 14 fully calcified striated valves (Fig. 8A). Inframedian latus triangular, umbo apex and not extended to upper latus. Tergum triangular with umbo apex.

Descriptions. – Capitulum white, 14 fully calcified valves (Fig. 8A). Valve surface finely striated (Fig. 8A). Tergum triangular, umbo apex (Fig. 8A). Scutum quadrilateral (Fig. 8A), umbo at a small apex at scutal margin (Fig. 8A), basal margin slightly convex. Upper latus trapezium (Fig. 8A). Inframedian latus triangular, small, umbo apex and apex not extended to the upper latus (Fig. 8A). Rostral latus pentagonal, wider than high (Fig. 8A). Carinal latus higher than wide, umbo at basicarinal angle, not extended beyond carina. (Fig. 8A). Carina narrow and slightly curved (Fig. 1F). Rostrum very small and narrow. Peduncle covered by series of scales (Fig. 1F).

Maxilla globular. Mandibles with 3 major teeth, no minor teeth on major teeth (Fig. 8B), lower margin have approximate 12 denticles (Fig. 8B). Mandibulatory palps elongated (Fig. 8C). Cirrus I separated from the other cirri. Cirrus I unequal rami, inner rami flattened and short, 7 segmented, outer rami slender, 10 segmented (Fig. 8E). Cirri II–IV has equal length rami, 14–18 segments in the inner and outer rami (Fig. 8E). Cirrus V–VI longest, 16–18 segments in both inner and outer rami.

Habitats. – Deep-sea species, attached on rocks.

Distribution. – Cosmopolitan.

Remarks. – This species is morphologically close to *Amigdoscalpellum vitreum* Hoek, 1883, by having white capitulum and finely striated valves. *Amigdoscalpellum elegans* differs from *A. vitreum* by having a convex basal margin in the scutum, instead of concave basal margin in *A. vitreum*. Tergum of *A. elegans* similar to a right-angled triangle, whilst tergum of *A. vitreum* is almost an equilateral triangle. The sides of the carina of *A. vitreum* is strongly sculptured (see Hoek, 1883). Rosell (1991) “*A. vitreum*” showed the scutum which has the basal margin of the scutum convex and the right angled tergum, and thus this species is probably *A. elegans*.

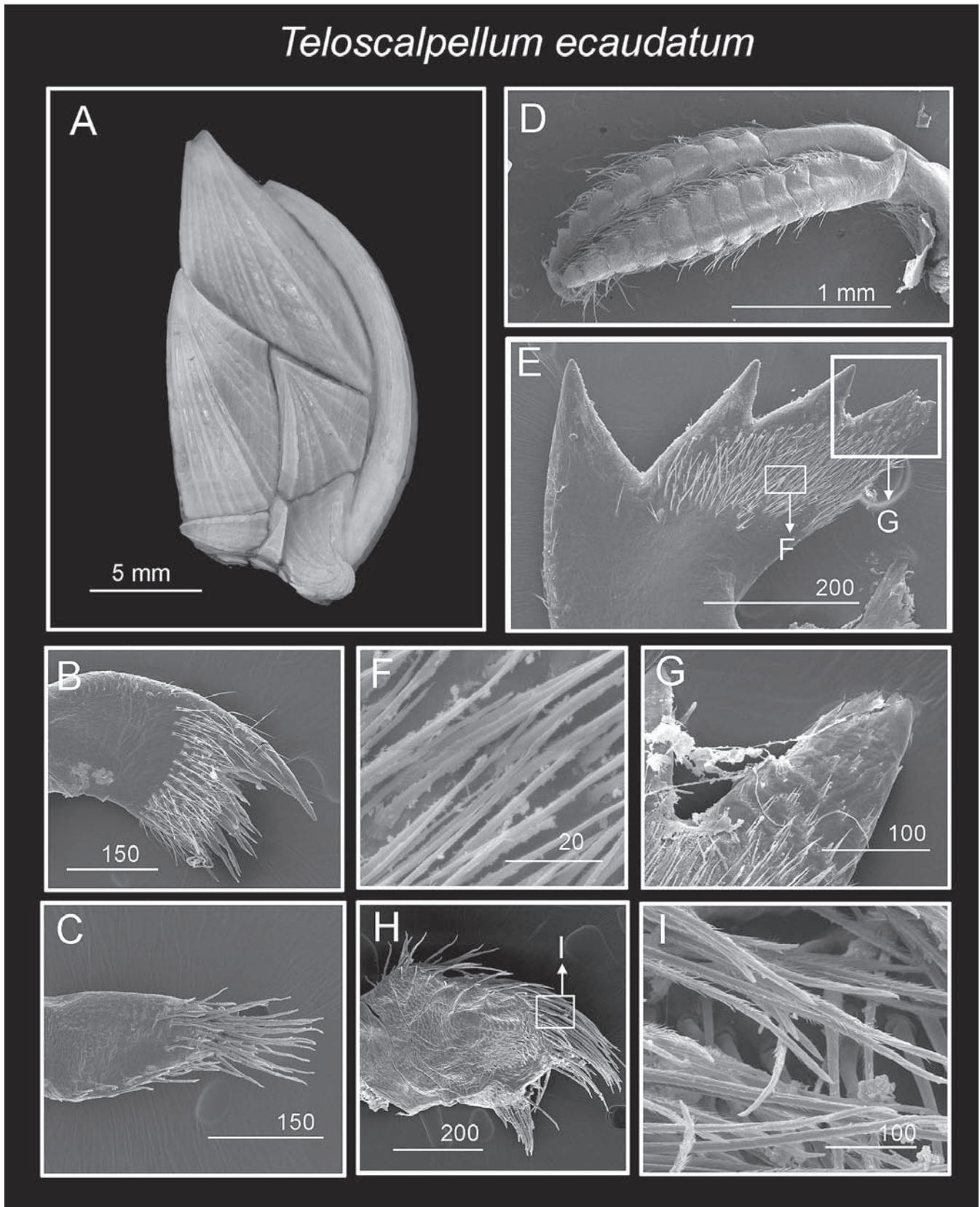


Fig. 7. *Teloscalpellum ecaudatum*: A, dissected capitulum with somatic body removed, yellow covering membrane was removed using diluted commercial bleach solution to show the arrangement of opercular valves. Scanning electron micrographs of: B, maxillule; C, mandibulatory palp; D, cirrus I; E, mandible; F, setae on mandible; G, lower margin of mandible; H, maxilla; I, serrulate setae on maxilla. Scale bars: A, D in mm; B, C, E-I in µm.

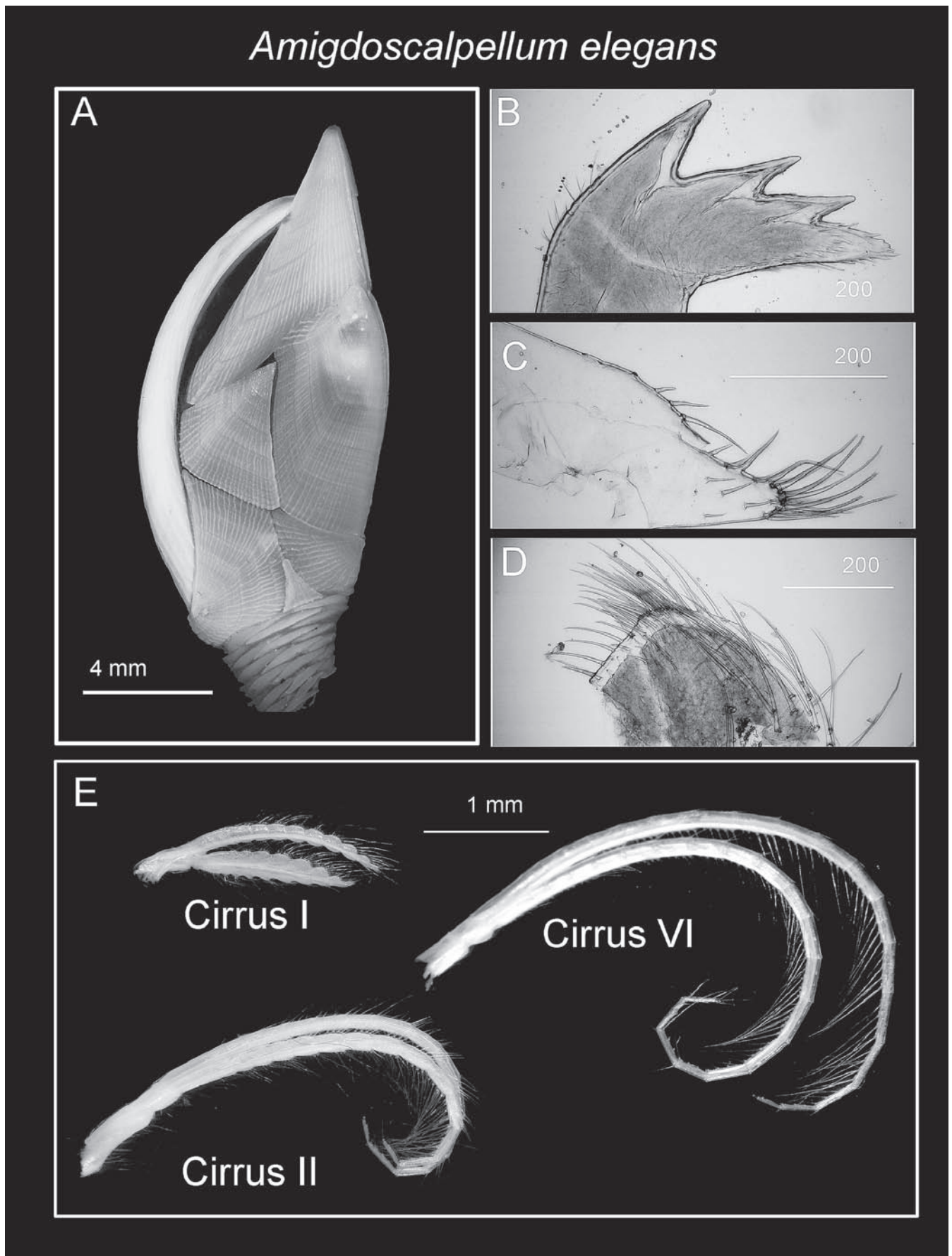


Fig. 8. *Amigdoscalpellum elegans*: A, dissected capitulum with somatic body removed; B, mandible; C, mandibulatory palp; D, maxilla; E, cirrus I, II and VI. Scale bars: A–D in µm; E in mm.

***Trianguloscapellum* Zevina, 1978**

***Trianguloscapellum diota* (Hoek, 1907)**

(Figs. 1G, 9)

Scapellum diota Hoek, 1907: 87, 88, Pl. VII: Fig. 15, 15a. Stubbings, 1936: 22, Fig. 9.

Trianguloscapellum diota Zevina, 1981: 315, Fig. 239.

Material examined. – Stn. CP2340 (9°29.4'N 123°44.4'E, sandy/muddy substratum, depth 291–318 m, 23 May 2005), CEL-PANGLAO-20, CL 6.73 mm, CW 4.11 mm.

Diagnosis. – Capitulum diffused pink, elongated, 14 valves. Carinal lateral margin strongly convex, curved apex. Inframedium latus small and narrow.

Descriptions. – Capitulum diffused light pink (Figs. 1G, 9A), elongated, 14 valves, covered by hairy membrane (Fig. 9A). Tergum triangular, occludent margin straight, apex pointed (Fig. 9A). Scutum quadrilateral, occludent margin straight, apex produced and slightly overlapped with the tergum (Fig. 9A). Upper latus quadrilateral (Fig. 9A). Carinal strongly convex and apex produced, umbo apex (Fig. 9A). Inframedian latus triangular, umbo apex (Fig. 9A). Rostral latus quadrilateral, flattened, wider than high (Fig. 9A). Carina bowed (Fig. 9A).

Maxillule not notched (Fig. 9A), cutting edge with cuspidate and serrulate setae (Fig. 9B). Mandible 3 teeth, 10 denticles on the lower margin (Fig. 9D, E). Mandibulatory palp narrow and elongated with slightly serrulated setae (Fig. 9F, G) on tip. Labrum slightly concaved with small denticles in a straight row (Fig. 9). Serrulate setae on penis tip (Fig. 9K, L). Cirrus I short, inner rami flattened, 5 segments, outer rami longer, 7 segments (Fig. 9J). Cirrus II–VI long and slender, similar in length (Fig. 9C). Caudal appendages short, one segmented, tip with setae (Fig. 9K).

Habitats. – Attached on deep-sea crinoids.

Distribution. – The Philippines and South Pacific water and Indian Ocean (Zanzibar).

Remarks. – This species is a new record in Philippine waters.

LEPADIFORMES Buckeridge & Newman, 2006

HETERALEPADOMORPHA Newman, 1987

HETERALEPADIDAE Nilsson-Cantell, 1921

***Heteralepas* Pilsbry, 1907**

***Heteralepas cantelli* Chan, Tsang & Shih 2009**

(Figs. 1H, 10)

Heteralepas cantelli Chan, Tsang & Shih 2009: 86, figs. 2, 3, 6.

Material examined. – Holotype: NMCR. Stn. CP2331 (9°39.2'N 123°47.5'E, muddy substratum, 22 May 2005), CL 11.68 mm, CW 10.08 mm. Paratypes: NMNS-6006-001 > 50 specimens, CL 7.97–14.5 mm, CW 4.78–11.78 mm, data same as holotype. Stn. CP2391 (9°30.3'N 123°43.0'E, sandy substratum), ASIZCR000213, 1 specimen, CL 13.02 mm, CW 8.03 mm. Stn. CP2331 (9°39.2'N 123°47.5'E, muddy substratum), ASIZCR000214 > 50 specimens, CL 7.97–14.5 mm, CW 4.78–11.78 mm. Stn. CP2332 (9°38.8'N 123°45.9'E, muddy substratum), CEL-PANGLAO-08, > 100 specimens, CL 7.97–14.5 mm, CW 4.78–11.78 mm. Stn. 2362 (8°56.5'N 123°32.7'E, sandy substratum), CEL-PANGLAO-09, > 100 specimens, CL 5.3–18.1 mm, CW 3.6–9.80 mm. Stn. CP2372 (8°38.7'N 123°16.0'E, sandy/muddy substratum), CEL-PANGLAO-10, > 10 specimens, CL 7.62–14.7 mm, CW 5.07–10.08 mm. Stn. CP2381 (8°43.3'N 123°19.0'E, sandy substratum), CEL-PANGLAO-11, > 100 specimens, CL 10.29–17.90 mm, CW 5.88–12.5 mm.

Diagnosis. – Capitulum without any valves. Carinal margin of capitulum and peduncle have 1–3 crests. Outer rami of cirrus V and VI shorter than the inner rami. Capitulum wall thin and semi-transparent.

Descriptions. – Capitulum without any valves (Figs. 1H, 10A). Shape of the capitulum and peduncle length variable. Orifice crenulated (Figs. 1H, 10A). Carinal margin of capitulum and peduncle had 1–3 crests (Fig. 10A, indicated by arrows). Maxilla bilobed, with dense serrulate setae (Fig. 10G, H). Maxillule strongly notched, two strong setae on the upper notch (Fig. 10F), blade shaped cuspidate setae on the cutting margin. Mandible with 4 large teeth, denticles blade shaped (Fig. 10B, C). Labrum concave, with 28 small teeth (Fig. 10E). Cirrus I maxillipeds, unequal rami, inner rami shorter, 6 segmented, outer rami longer, 12 segmented (Fig. 10I). Setae of cirrus I are bidentate serrulate type (Fig. 10J). Base of cirrus I had 1 filamentous appendages. Cirrus II–IV long and slender, with serrulate type setae (Fig. 10K, J). Cirrus V and VI had unequal length rami, inner rami obviously longer than the outer rami. Cirrus II (inner rami, segment 24, outer rami segment 26), cirrus III (47, 46), cirrus IV (47, 47), cirrus V (50, 19), cirrus VI (49, 18). Each segment of cirrus II–VI has a pair of long spine (Fig. 10L). Caudal appendage present, 6 segmented, 1/4 length of cirrus outer rami of cirrus VI.

Habitats. – Deep-sea species. Attached on ropes and shell surface of gastropods.

Distribution. – At present, records only covered in the Philippines.

***Paralepas* (Pilsbry, 1907)**

***Paralepas minuta* (Darwin, 1851)**

(Figs. 1I, 11)

Alepas minuta Darwin, 1851.

Heteralepas (*Paralepas*) *minuta* Hiro, 1933: 51, text-fig. 15.

Paralepas minuta Stubbings, 1967: 240.

Trianguloscalpellum diota

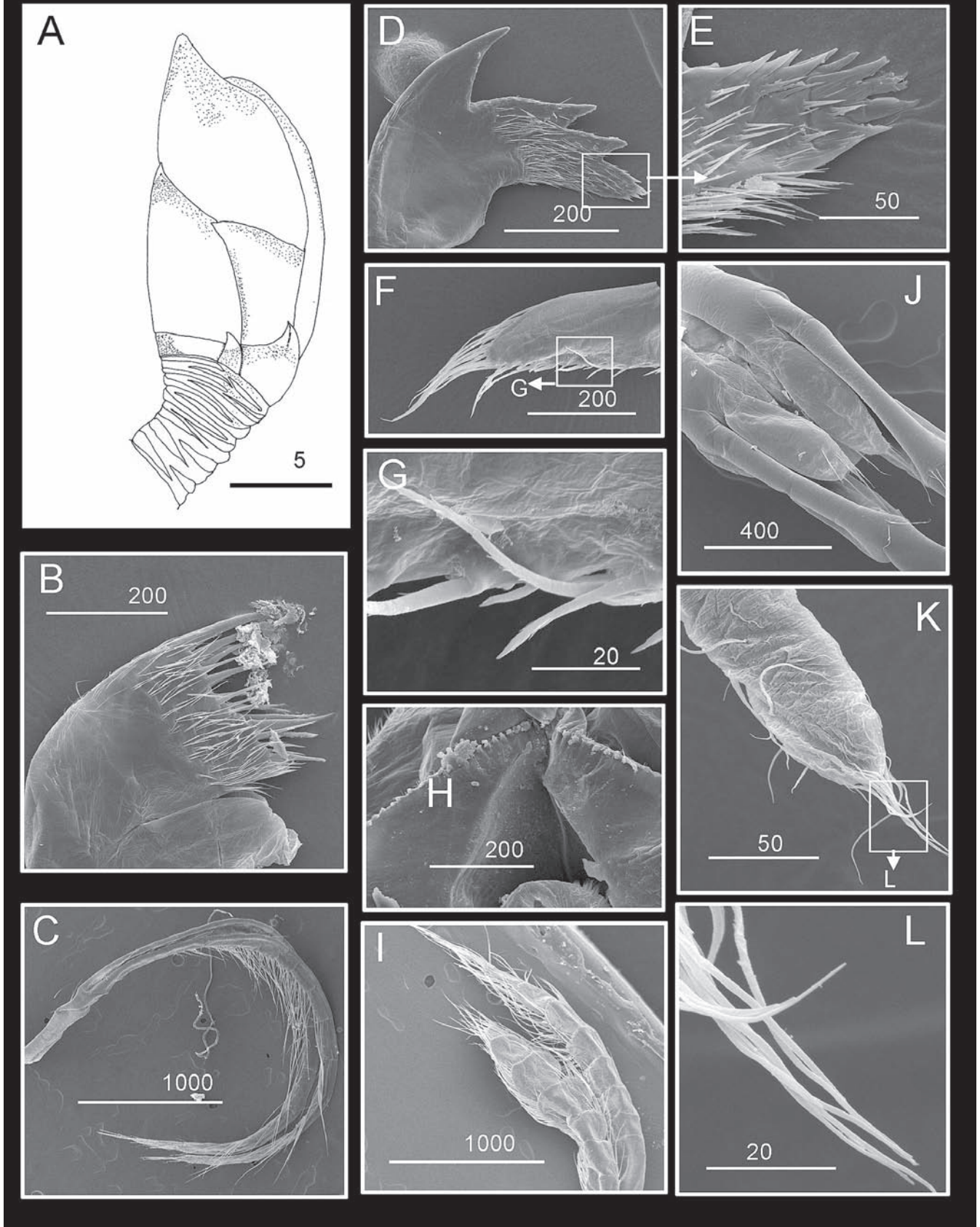


Fig. 9. A, *Trianguloscalpellum diota*, schematic drawings of the capitulum, shading indicate the pink colourations in the specimen; scanning electron micrographs of: B, maxillule; C, cirrus VI; D, mandible; E, lower margin of mandible; F, mandibulatory palp; G, serrulate setae on mandibulatory palp; H, labrum; I, cirrus I; J, caudal appendage; K, penis; L, serrulate setae on penis tip. Scale bars in μm .

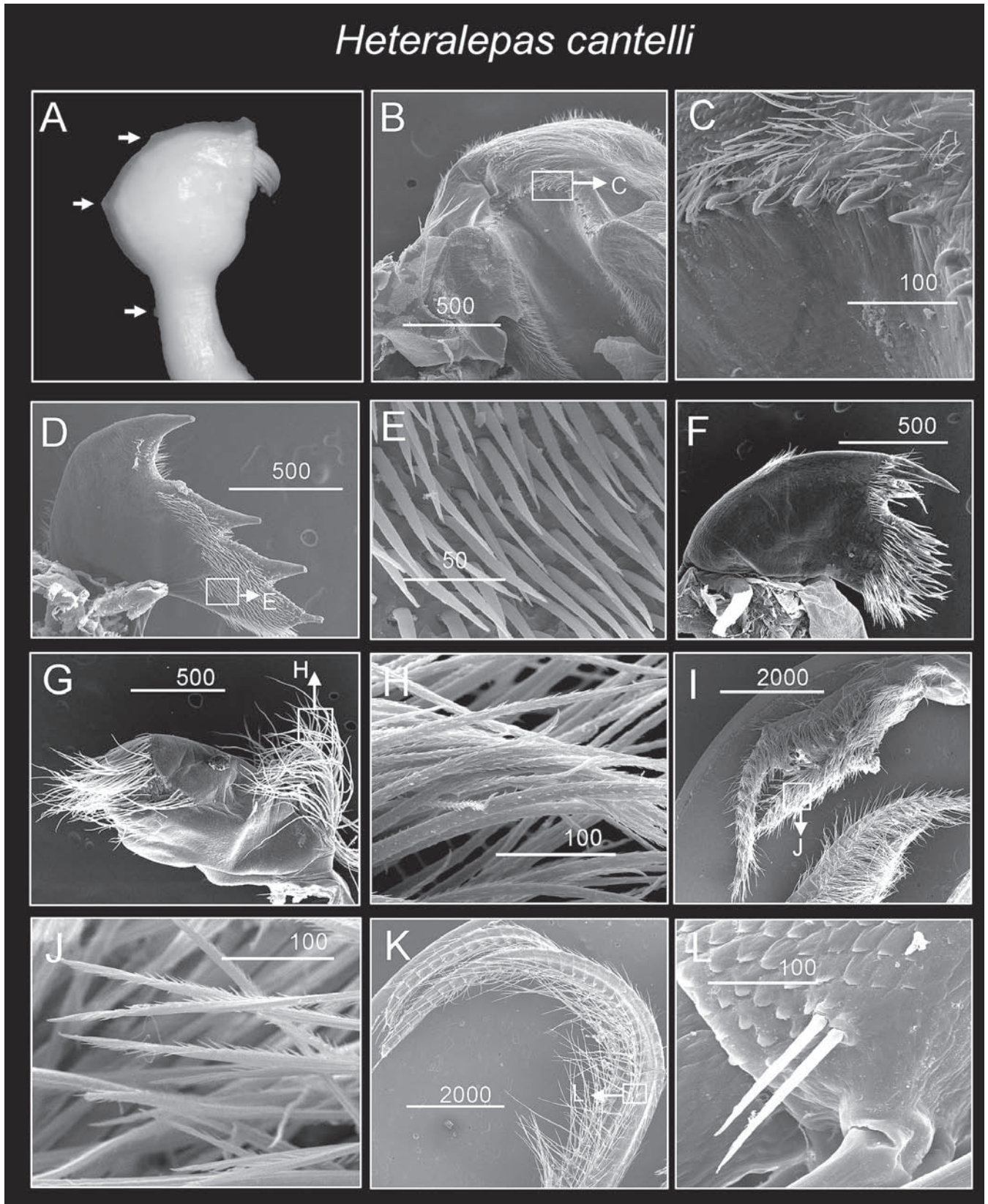


Fig. 10. *Heteralepas cantelli*: A, side view showing capitulum, arrows indicate the crests on the carinal margin of the capitulum; B, labrum; C, teeth on labrum; D, mandible; E, blade shaped setae on mandible; F, maxillule; G, maxilla; H, serrulate setae on maxilla; I, cirrus I; J, serrulate setae on cirrus I; K, cirrus IV; L, paired setae on segment of cirrus IV. Scale bars in μm .

Material examined. – Stn. CP2393 (9°30.1'N 123°41.6'E, sandy/muddy substratum, depth 396–414 m, 30 May 2005), CEL-PANGLAO-12, 3 specimens, CL 4.62–5.48 mm, CW 3.81–3.87 mm.

Diagnosis. – Capitulum globular, yellow, without valves. Inner and outer rami of cirrus V and VI similar in length.

Descriptions. – Small sized. Capitulum globular, yellow, without valves, surface slightly wrinkled (Fig. 1I). Orifice crenulated (Fig. 1I). Maxilla globular (Fig. 11C). Maxillule notched, with two large setae and one small setae on upper notch (Fig. 11E). Mandibles with 3 major teeth, second and third teeth with large denticles (Fig. 11A, B). Mandibulatory palp elongated (Fig. 11D), with setae on upper side. Labrum concave, with small sharp denticles (Fig. 11G). Inner rami of cirrus I flattened, 7 segmented, outer rami slender, 8 segmented (Fig. 11F). Cirri II–VI similar in length. Segments of inner and outer rami ranged from 11–13. Caudal appendages present, narrow, 1/2 length of cirrus VI, 7 segmented.

Habitats. – This species often found on the spine of the sea urchin *Stylocidaris* spp.

Distribution. – Mediterranean Sea, Japan and the Philippines.

Remarks. – External morphology of *Paralepas* spp. are similar to each other. Rosell (1991) sampled *Paralepas scutiger* in Philippine waters but without descriptions on the mouth parts and cirri. Diversity of *Paralepas* in the Philippine waters should be studied by investigating the soft part morphology and DNA sequence divergence patterns. This is the first record of *P. minuta* in the Philippines.

***Paralepas laxus*, new species,**
(Figs. 1J, 12, 13)

Material examined. – Holotype: Stn. CP2343 (9°24.7'N 123°49.4'E, sandy/muddy substratum, depth 273–302m, 23 May 2005). NMCR, 1 specimen, CL 12.3 mm, CW 10.07 mm. Paratypes: ASIZCR000215, 2 specimens, CL 14.2–15.23, CW 8.45–9.00 mm, data same as holotype, NMNH 6006-002, 2 specimens, CL 14.3–15.5 mm, CW 8–9 mm, data same as holotype.

Diagnosis. – Capitulum smooth, without any valves. Orifice widely opened.

Descriptions. – Capitulum white or pale yellow, smooth, without any valves (Figs. 1J, 12A, B, C) and crests on the carinal margin (Fig. 1C). Orifice oval and widely opened, orifice margin thick (Figs. 1J, 12A, B). Peduncle smooth and length up to 10 mm (Fig. 1J). Cirrus I separated from other cirri. Cirrus I had unequal rami. Inner rami flattened, 5 segmented, outer rami slender, 7 segmented (Fig. 12D). Cirrus II–VI had equal length rami, all with 12–16 segments (Fig. 12E, F, G). Caudal appendages present, narrow and 5 segmented, 1/2 length of cirrus VI (Fig. 12H). Maxillule slightly notched (Fig. 13A), with 3 strong setae on the upper edge. Mandible with three major teeth, 5–6 minor teeth on each major tooth (Fig. 13B, C). Labrum concaved (Fig. 13F)

not notched, 15 teeth on the cutting edge (Fig. 13F, I). Dense serrulate setae on outer and inner side of the labrum (Fig. 13L). Mandibular palps elongated (Fig. 13H), with dense serrulate setae on tip (Fig. 13K), surface with fan-shaped denticles (Fig. 12J).

Habitats. – Attached on the shell of gastropods.

Distribution. – Present record only in Philippine waters.

Entymology. – The Latin word *laxus* resembles wide. This species is named for its wide orifice.

Remarks. – This species is morphologically close to *Paralepas (Alepas) intermedia* (Hoek, 1907). *Paralepas intermedia* has a narrow orifice which opened in a fine slit (Hoek, 1907). *Paralepas laxus*, new species, is different from *P. intermedia* by having a widely opened orifice in the capitulum, which has not been recorded in other *Paralepas* species.

LEPADOMORPHA Pilsbry, 1916

POECILASMATIDAE Annandale, 1909

***Glyptelasma* Pilsbry, 1907**

***Glyptelasma hamatum* (Calman, 1919)**
(Figs. 1H, 14, 15)

Megalasma (Glyptelasma) hamatum Calman, 1919: 370, Figs. 5–7; Nilsson-Cantell, 1927: 770, Fig. 12; Nilsson-Cantell, 1928: 23, Fig. 11; Nilsson-Cantell, 1931: 10; 1934: 49; Nilsson-Cantell, 1955: 219; Pl. 5: Fig. 1, 2, Pl. 14: Fig. 3; Zevina, 1982: 93, Fig. 83; Liu & Ren, 1985: 262, Fig. 49, Pl. 12: 10–13.

Megalasma carinatum Foster, 1978: 26, Fig. 12, Pl. 3b (not Hoek).

Glyptelasma hamatum Liu & Ren, 2007: 157: Fig. 57.

Material examined. – Stn. CP2335 (9°34.3'N 123°37.8'E, sandy/muddy substratum, depth 733–743 m, 22 May 2005), CEL-PANGLAO-14, 1 specimen, CL 15.57 mm, CW 7.85 mm.

Diagnosis. – Capitulum fully covered by five smooth white valves. Base of carina is wide and expanded horizontally.

Descriptions. – Capitulum fully covered by 5 smooth white valves (Figs. 1K, 14A). Scutum large with long occludent margin, lateral margin curved (Fig. 14A). Tergum triangular (Fig. 14A). Carina short and curved (Fig. 1I). Base of carina is wide and expanded horizontally. Maxilla spherical with fine setae (Fig. 14C). Maxillule strongly notched, 2 strong setae on the upper notch (Fig. 14B). Mandibles 4 major teeth, without any multi-dentations (Fig. 14F). Third teeth covered by thick and large setae (Fig. 14F). Mandibulatory palp elongated, upper margin with dense setae (Fig. 14E). Labrum slightly concave with dense small teeth (Fig. 14D). Dense setae along the penis (Fig. 15A), tip of which with bundle of smooth setae (Fig. 15B). Cirrus I with equal rami, both inner and outer rami six-segmented (Fig. 15C). Cirrus I with serrulate setae (Fig. 15F) at distal region of rami.

Paralepas minuta

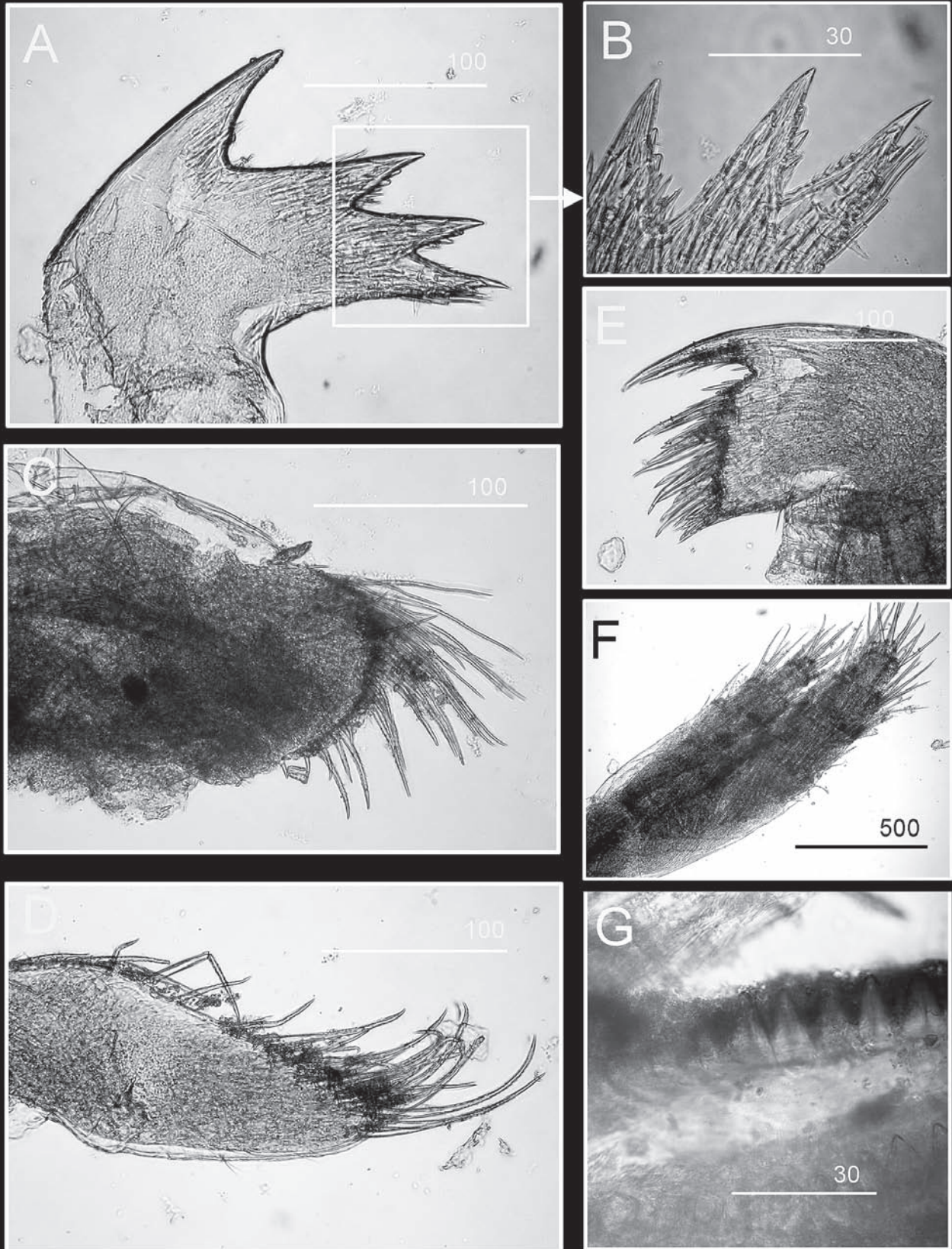


Fig. 11. *Paralepas minuta*: A, mandible; B, magnified view on the teeth of mandible; C, maxilla; D, mandibulatory palp; E, maxillule; F, cirrus I; G, teeth on labrum. Scale bars in µm.

Paralepas laxus sp. nov.

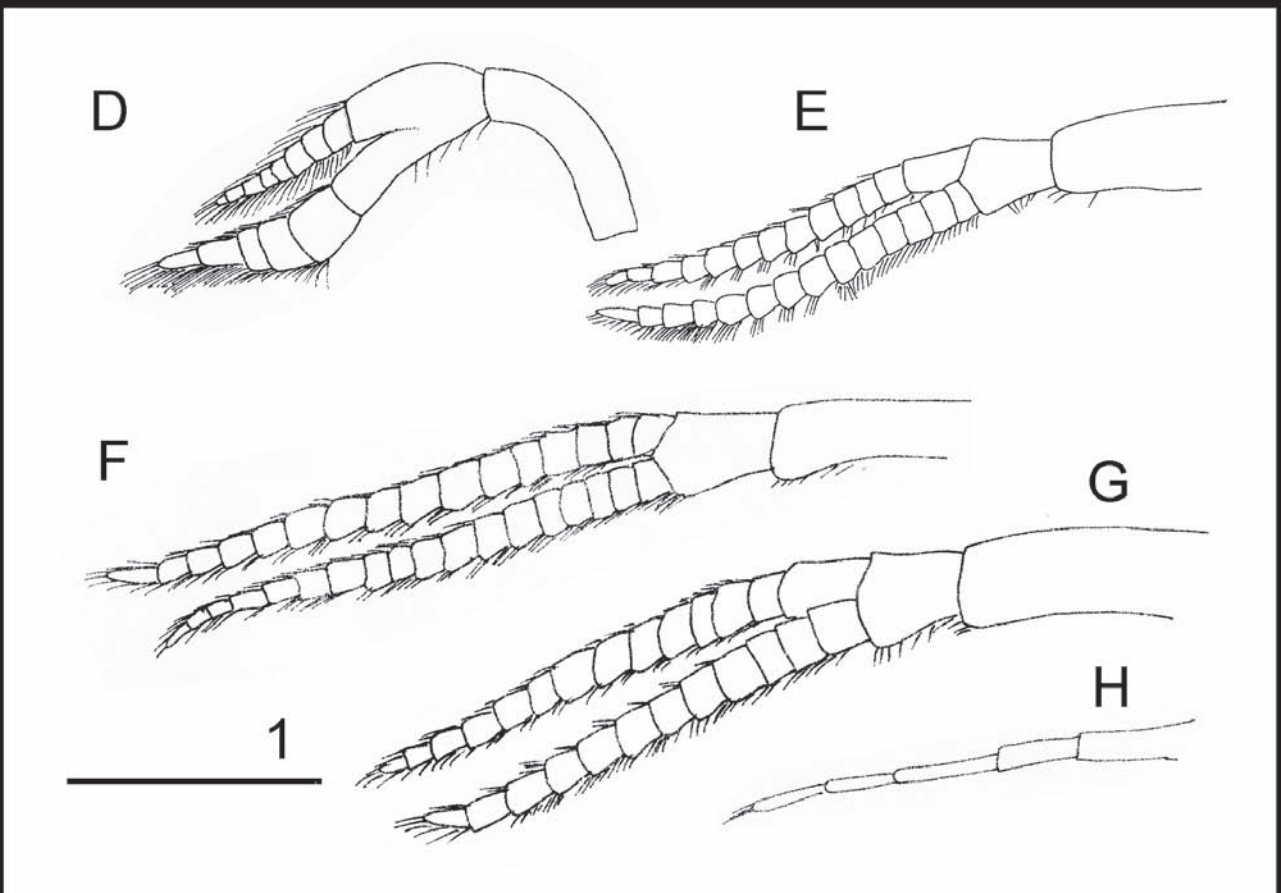


Fig. 12. *Paralepas laxus*, new species: A, capitulum of an adult; B, C, capitulum of an juvenile; Drawings of: D, cirrus I; E, cirrus II; F, cirrus V; G, cirrus VI; H, caudal appendage. Scale bars in mm.

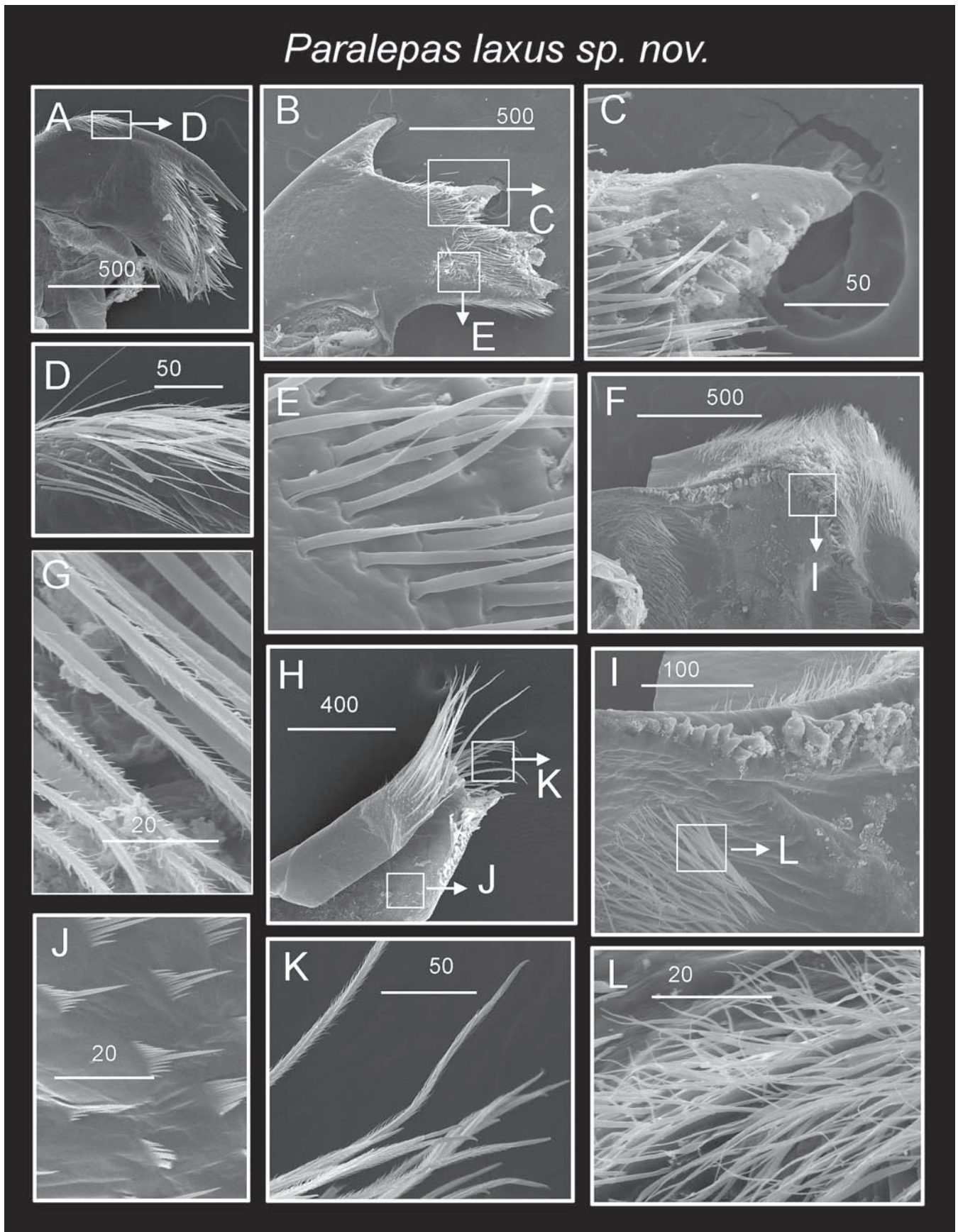


Fig. 13. *Paralepas laxus*, new species: scanning electron micrographs of: A, maxillule; B, mandible; C, second teeth on mandible; D, setae on maxillule; E, serrulate setae on mandible; F, labrum; G, serrulate setae on cirrus I; H, mandibulatory palp; I, teeth on labrum; J, fan-shaped denticles on mandibulatory palp; K, serrulate setae of mandibulatory palp; L, setae on labrum. Scale bars in μm .

Glyptelasma hamatum

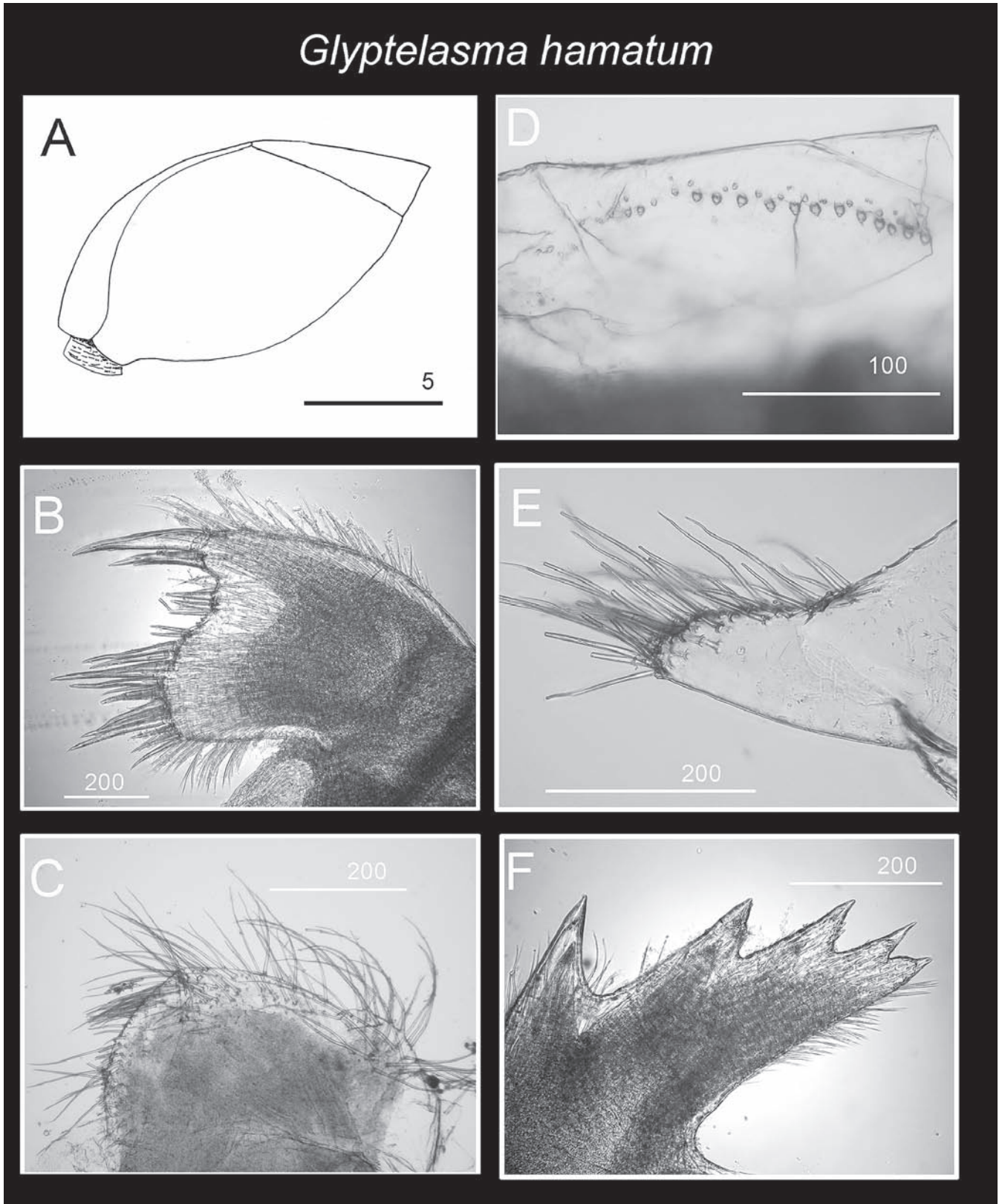


Fig. 14. *Glyptelasma hamatum*: A, drawing of capitulum; B, maxillule; C, maxilla; D, labrum; E, mandibulatory palp; F, mandible. Scale bars in µm.

Pappose setae present at base of outer rami of cirrus I (Fig. 15I). Cirrus II–VI were similar, with 13–15 segments in both rami (Fig. 15D). Setae serrulate-type (Fig. 15E). Segment of cirri II–VI with fan-shaped denticles (Fig. 15G, H).

Distribution. – Indo-Pacific waters

Remarks. – External morphology of *G. hamatum* is similar to *G. carinatum* (Hoek, 1883). *Glyptelasma carinatum* can be distinguished from *G. hamatum* by having numerous filamentous appendages on the dorsal side of the somatic body (see Calman, 1919; Young, 2001).

***Megalasma* Hoek, 1883**

***Megalasma striatum* Hoek, 1883**

(Figs. 2A, 16)

Megalasma striatum Hoek, 1883: 51, Pl. II: Figs. 5-9, Pl. VII: Figs. 8, 9; Hoek, 1907: 31; Gruvel, 1905: 112, Fig. 126; Broch, 1922: 271, Figs. 2930; Hiro, 1937a: 99, Fig. 81; Nilsson-Cantell, 1938: 29; Utinomi, 1958: 292, Fig. 4; Foster, 1978: 27, Pl. 3c; Dong et al., 1980: 125; Zevina, 1982: 80, Fig. 71; Liu & Ren, 1985: 258, Fig. 47, Pl. 9: 13–20; Rosell, 1991: 28; Jones et al., 2000: 239; Liu & Ren, 2007: 160, Fig. 59.

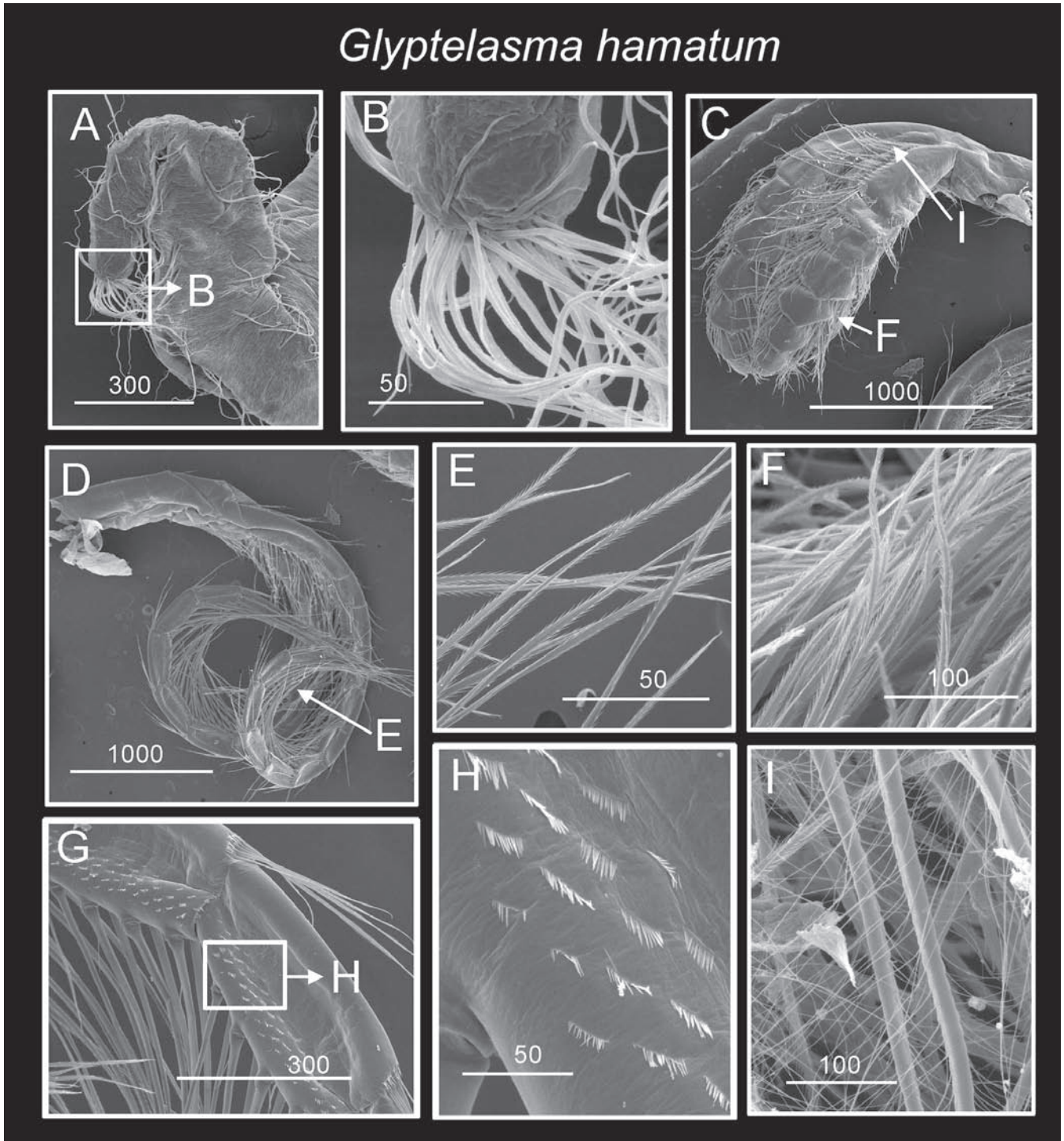


Fig. 15. *Glyptelasma hamatum*: scanning electron micrograph of: A, penis; B, tip of penis, showing the serrulate setae; C, cirrus I; D, cirrus IV; E, serrulate setae on cirrus IV; F, serrulate setae on cirrus IV; G, enlarged segment of cirrus IV; H, fan-shaped denticles on cirrus IV; I, pappose setae on cirrus I. Scale bars in µm.

Megalasma striatum

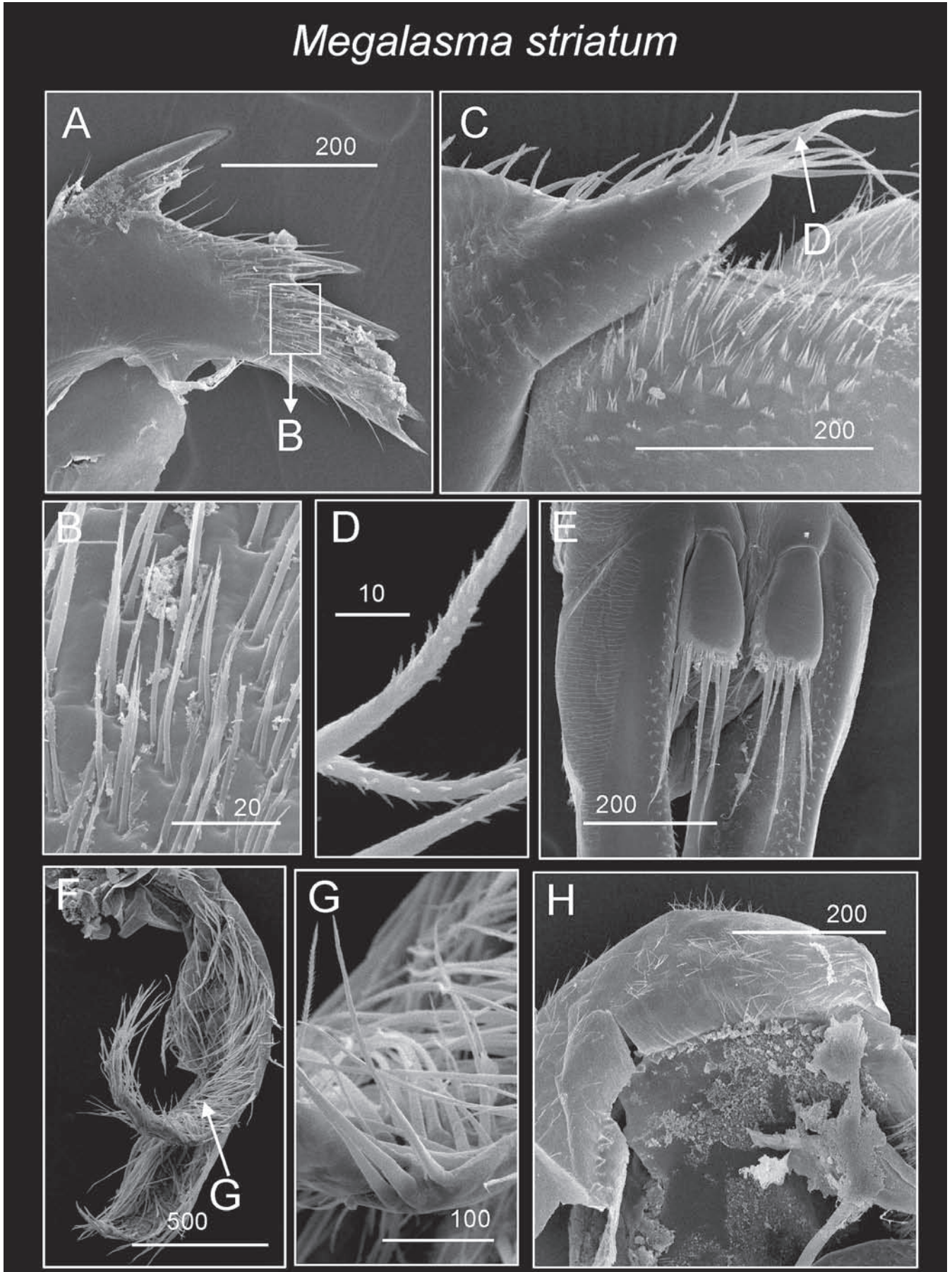


Fig. 16. *Megalasma striatum*, scanning electron micrographs: A, mandible; B, blade-shaped setae on mandible; C, mandibulatory palp; D, serrulate setae on mandibulatory palp; E, caudal appendages; F, cirrus I; G, serrulate setae on cirrus I; H, labrum. Scale bars in µm.

Material examined. – Stn. CP2343 (9°27.4'N 123°49.4'E, sandy/muddy substratum, depth 273–302 m, 23 May 2005), CEL-PANGLAO-15, 2 specimens, CL 10.28–11.34 mm, CW 4.91–5.34 mm, ASIZCR000216, 1 specimen, CL 10.26 mm, CW 4.78 mm.

Diagnosis. – Capitulum 5 strongly striated valves. Peduncle short. Carina spoon shaped, basal region slightly horizontally expanded.

Descriptions. – Capitulum 5 valves (Fig. 2A). Valves thick and white (Fig. 2A). External surfaces of valves strongly sculptured with striations (Fig. 2A). Internal surfaces of valves smooth. Scutum and tergum triangular (Fig. 2A). Carina spoon shaped, basal region slightly horizontally expanded (Fig. 2A). Peduncle short, yellow. Maxillule notched with 3 strong setae on upper notch and 8–9 large setae on lower notch. Mandibles 4 major teeth (Fig. 16A), surface with serrulate type setae (Fig. 16B). All major teeth in mandibles without multi-dentations (Fig. 16A). Labrum concave with fine sharp teeth (Fig. 16H). Mandibulatory palps elongated, with serrulate type setae (Fig. 16C, D). Cirrus I, outer rami 12 segments, inner rami swollen and 8 segmented, with serrulate type setae (Fig. 16F, G). Caudal appendage present, short, 1 segmented (Fig. 16E).

Habitats. – Deep-sea species, on sea urchin spines.

Distribution. – Indo-Pacific region.

Octolasmis Gray, 1825

***Octolasmis orthogonia* (Darwin, 1851)**

(Figs. 2B, 17)

Dichelaspis orthogonia Darwin, 1851: 130, Pl. 2: Fig. 10; Weltner, 1922: 81; Gruvel, 1905: 138, Fig. 163; Hoek, 1907: 25, Pl. 2: Figs. 14–18, Pl. 3: Figs. 1, 1a, b, 10b.

Dichelaspis versluysi Hoek, 1907: 28, Pl. III: Figs. 8–13.

Dichelaspis weberi Hoek, 1907: 26, Pl. III: Figs. 2–7.

Octolasmis weberi Krüger, 1911: 42, Pl. 3: Fig. 27; Barnard, 1924: 60; Hiro, 1933: 58, Fig. 17, Pl. 2: Figs. 6–8; Hiro, 1937a: 92, Fig. 75; Hiro, 1939b: 206.

Octolasmis orthogonia Broch, 1922: 279; Broch, 1931: 28; Nilsson-Cantell, 1925: 21, Fig. 8; 1928: 18, Fig. 8; 1938: 29; Hiro, 1933: 55, Fig. 16, Pl. 2: Figs. 5a, 5; Hiro, 1937a: 91, Fig. 71; 1937b: 415; Zevina, 1968: 36; 1982: 61, Fig. 53; Utinomi, 1970: 342; Liu & Ren, 1985: 249, Fig. 40, Pl. 9: 3–10; Rosell, 1991: 26; Fig. 3a; Liu & Ren, 2007: 177, Fig. 69.

Material examined. – Stn. CP2349 (9°31.6'N 123°55.7'E, muddy substratum, depth 229–240 m, 24 May 2005), CEL-PANGLAO-16, 9 specimens, CL 6.70–7.17 mm, CW 3–3.2 mm. Stn. CP2377 (8°40.6'N 123°20.3'E, sandy substratum, depth 82.4–85.3 m, 28 May 2005), ASIZCR000217, 14 individuals, CL 1.03–2.05 mm, CW 0.93–2.83 mm.

Diagnosis. – Capitulum oval shaped, 5 valves, orange yellow coloured. Scutum narrow and L-shaped. Tergum triangular, with three prominent ridges at the scutal margin.

Descriptions. – Capitulum oval shaped, 5 valves, orange yellow coloured (Figs. 2B, 17A). Scutum narrow and L-shaped (Figs. 2B, 17A). Tergum triangular, with 3 prominent

ridges at the scutal margin (Figs. 2B, 17A). Third ridge longest (Figs. 2B, 17A). Carina smooth, base oval shaped (Figs. 2B, 17A). Peduncle yellow and smooth. Maxilla globular (Fig. 17B). Maxillule notched, 2 large setae on upper notch and 5–6 spines on lower notch (Fig. 17C). Mandible with 4 major teeth, without any double dentations (Fig. 17D). Labrum concaved, with > 11 small sharp teeth (Fig. 17F). Mandibulatory palp elongated with fine setae (Fig. 17E). Cirrus I unequal rami, inner rami 5 segmented, outer rami 3 segmented. Cirri II–VI with similar length rami, 7–8 segmented.

Habitats. – Attached on gorgonians, sea urchin spines and on the surface of the stalked barnacle *Heterlepas japonica*.

Distribution. – Tropical to subtropical oceans.

LEPADIDAE Darwin, 1851

***Lepas* Linnaeus, 1758**

***Lepas anatifera* Linnaeus, 1758**

(Figs. 2C, 18)

Lepas anatifera Linnaeus, 1758: 668; Darwin, 1851: 73, Pl. 1: Fig. 1; Hoek, 1883: 38, Pl. I: Figs. 1, 2; Gruvel, 1905: 108; Annandale, 1909a: 73; Stebbing, 1910: 563; Krüger, 1911: 23, Figs. 36–41; Jennings, 1918: 57; Nilsson-Cantell, 1921: 236; Hiro, 1937a: 56, Fig. 46; Utinomi, 1949: 20; 1958: 287; 1970: 341; Tarasov & Zevina, 1957: 104, Figs. 14, 24, 26, 28; Stubbings, 1967: 237; Zevina, 1968: 35; Zevina, 1982: 17, Fig. 8; Gordon, 1970: 28, Fig. 9; Foster, 1978: 29, Fig. 14.

Lepas anatifera anatifera Newman, 1972: 36; Arnaud, 1973: 157; Liu & Ren, 1985: 218, Fig. 19, Pl. 5: Fig. 10.

Material examined. – Stn. CP2331 (9°39.2'N 123°47.5'E, muddy substratum, depth 255.6–262.8 m, 22 May 2005), ASIZCR000218, 1 specimen, CL 37.03 mm, CW 22.38 mm.

Diagnosis. – Capitulum five valves, external plate surface smooth. Carina forked below umbo, right scutum has an internal umbonal teeth.

Descriptions. – Capitulum five valves, external plate surface smooth, white and some variety with radiating spots (Figs. 2C, 18A). Carina forked below umbo, right scutum with internal umbonal tooth (Figs. 18B, C). Peduncle dark brown, with vertical striated lines in some individuals. Maxilla elongated (Fig. 18L). Maxillule notched (Fig. 18F), with 2 strong setae on upper notch. Mandible narrow, with 3 major teeth, without any minor teeth on surface of major teeth, lower margin long and smooth (Fig. 18I). Mandibulatory palp oval, with dense setae (Fig. 18M). Labrum concaved, with long and sharp teeth (Fig. 18G, J). Labral margin with dense setae (Fig. 18J). Coxa of cirrus I with 2 filamentary appendages (Fig. 18D). Cirrus I shorter than other cirri, outer rami 7 segmented, inner rami 7 segmented (Fig. 18E), rami with serrulate type setae (Fig. 18K). Cirrus II similar with Cirrus III–VI in their shape (Fig. 18H), all with serrulate type setae (Fig. 18K).

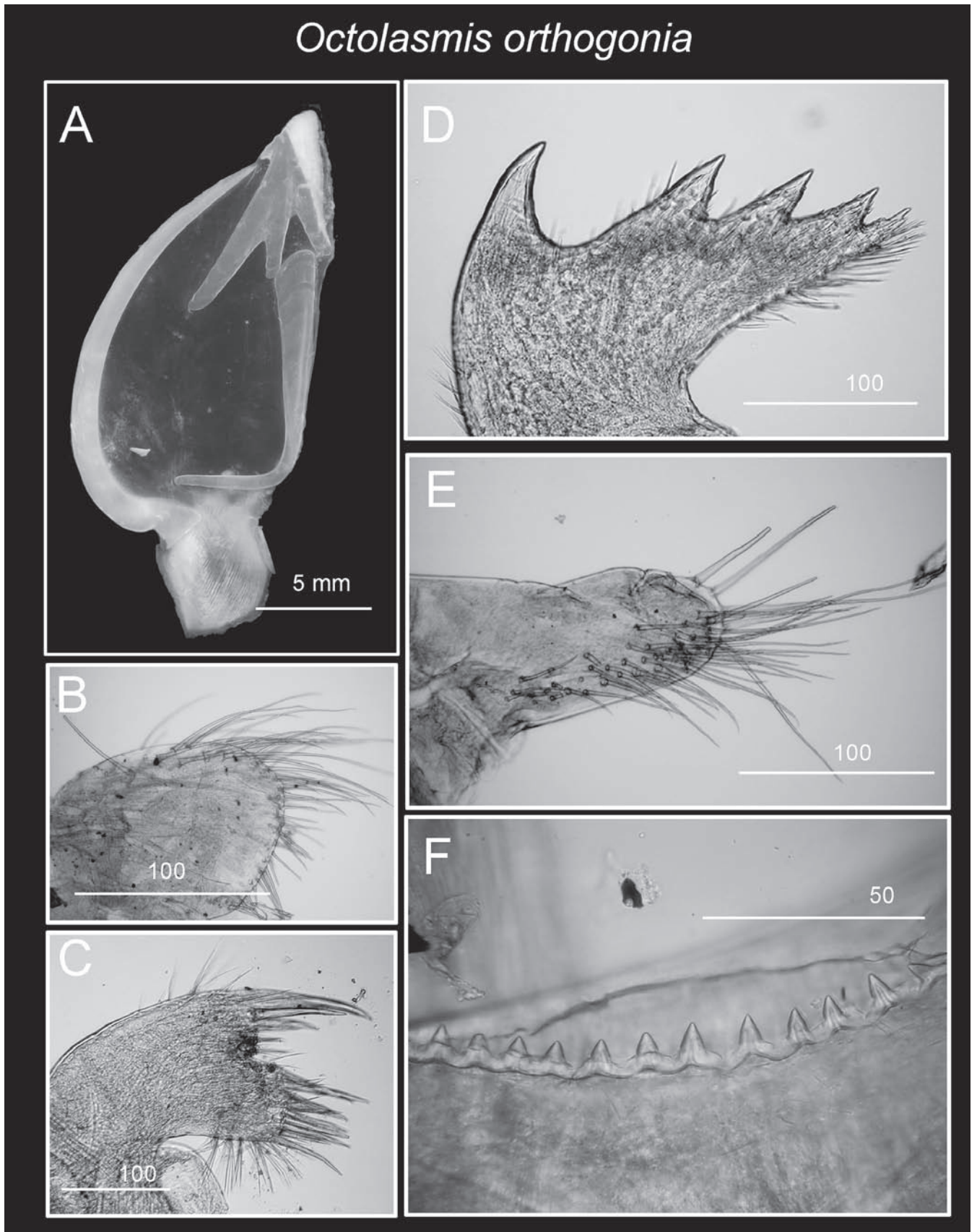


Fig. 17. *Octolasmis orthogonia*: A, dissected capitulum, bleached with diluted commercial bleach solution to show the arrangement of valves; B, maxilla; C, maxillule; D, mandible; E, mandibulatory palp; F, teeth on labrum. Scale bars: A in mm; B-F in μm .

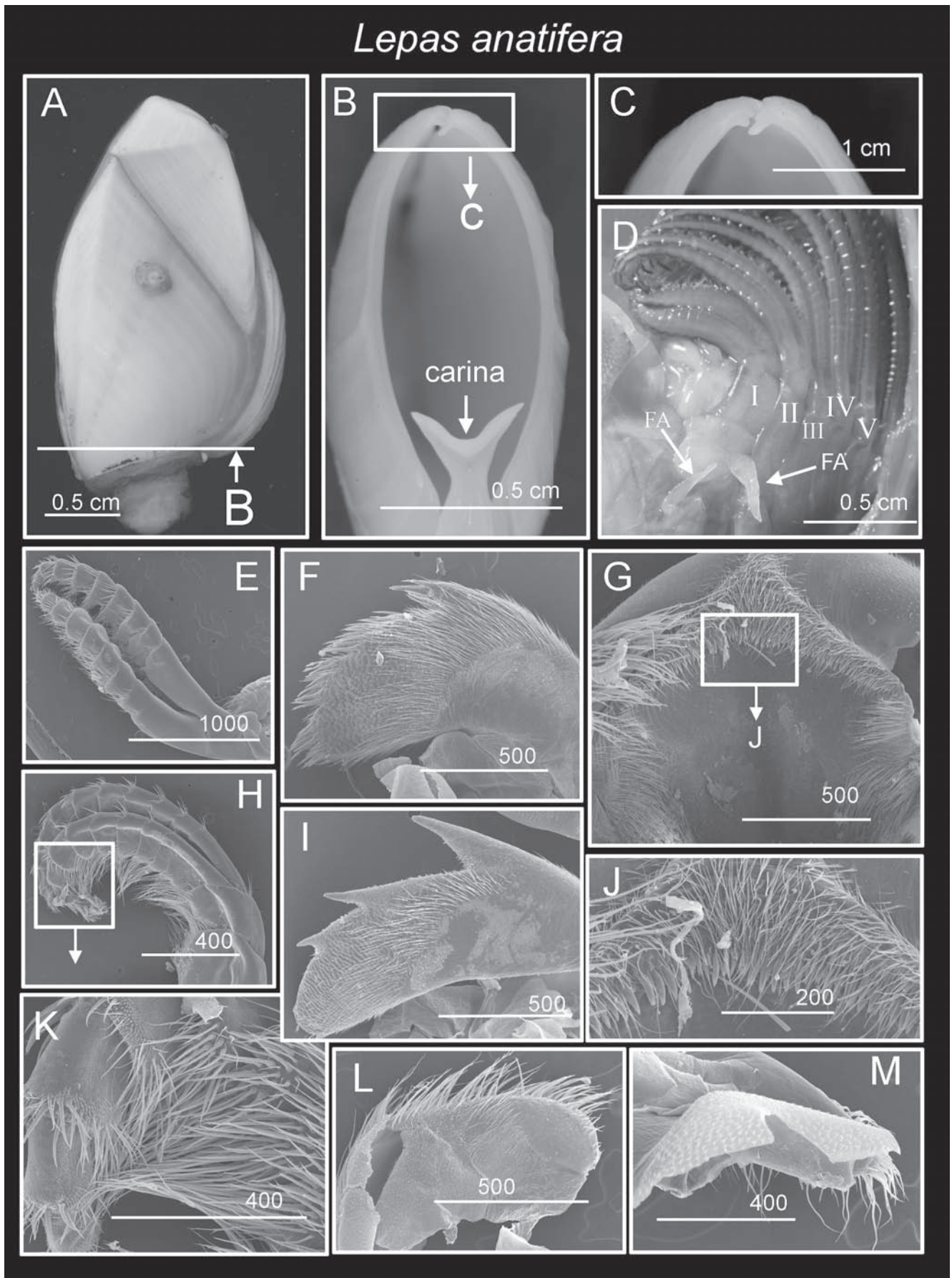


Fig. 18. *Lepas anatifera*: A, capitulum showing valve arrangement; B, base view of the capitulum, showing the umbo of the scutum and the forked carina; C, umbo of scutum; D, somatic body showing cirri I-V and the filamentary appendages (FA); scanning electron micrographs of: E, cirrus I; F, maxillule; G, labrum; H, cirrus II; I, mandible; J, teeth of labrum; K, magnified view of cirrus II; L, maxilla; M, mandibulatory palp. Scale bars: A-D in mm; E-K in μm .

Habitats. – Attached on floating objects.

Distribution. – Cosmopolitan.

Conchoderma Olfers, 1814

Conchoderma hunteri (Owen, 1830)

(Figs. 2D, 19)

Cineras hunteri Owen, 1830. Cat. Mus. Coll. of Surgeons Invert. Part 1: 71 (not seen).

Conchoderma hunteri Darwin, 1851: 153, Pl. 3: Fig. 3; Gruvel, 1905: 145, Fig. 169; Barnard, 1955: 247.

Conchoderma virgatum var. *hunteri* Annandale, 1909a: 82; Krüger, 1911: 26, Pl. 3, Figs. 20–22.

Conchoderma virgatum var. *japonica* Krüger, 1911: 27, Pl. 3: Fig. 23.

Conchoderma virgatum forma *hunteri*: Broch, 1931: 28; Nilsson-Cantell, 1938: 27.

Conchoderma virgatum hunteri Hiro, 1937b: 402, Fig. 6; Hiro, 1937a: 63, Fig. 53; Hiro, 1939b: 205; Utinomi, 1968: 167; Utinomi, 1970: 341; Gordon, 1970: 21, Fig. 6; Dong et al., 1980: 125; Zevina, 1982: 27, Fig. 16; Liu & Ren, 1985: 227, Fig. 25, Pl. 6: Figs. 12–16. Liu & Ren, 2007: 201, Fig. 83.

Material examined. – Stn. CP2362 (8°56.5'N 123°32.7'E, sandy substratum, depth 679–684 m, 26 May 2005), ASIZCR000219, 1 specimens, CL 22.2 mm, CW 14.30 mm, CEL-PANGLAO-18, 3 specimens, CL 17.44–20.3 mm, CW 10.6–13.47 mm.

Diagnosis. – Capitulum deep-purple, five valves, valves narrow and loosely separated. Scutum tri-lobed and Y-shaped.

Descriptions. – Capitulum deep-purple, five valves, valves narrow and loosely separated (Figs. 2D, 19A). Scutum tri-lobed and Y-shaped, lateral lobe does not wider than the lower lobe (Figs. 2D, 19A). Terga and carina narrow and bended (Figs. 2D, 19A). Base on cirrus I-IV had a single filamentary appendages (Fig. 19B). Peduncle cylindrical and smooth (Figs. 2D, 19A). Maxilla globular (Fig. 19H). Maxillule not notched, grown with fine setae on the cutting edge, a single strong seta on the top (Fig. 19G). Mandible with four major teeth and with sharp setae on their surfaces (Fig. 19D, E, F). Mandibulatory palp triangular, with setae on its superior margin (Fig. 18J). Labrum slightly concave, with numerous fine teeth (Fig. 19I). The base of cirrus I with two filamentary appendages, all other cirri with single filamentary appendage except in cirrus II. Cirrus I (inner rami 17 segments, outer rami 9 segments), II (9, 9), III (14, 13), IV (10, 12), V (11, 12), VI (10, 13) (Fig. 19C).

Habitats. – Shallow water species. Attached on sub-tidal ropes, sea snakes and buoys.

Distribution. – Indo-Pacific Ocean including the Philippines.

Remarks. – Liu & Ren (2007) described that the major teeth of the mandibles of *C. hunteri* are equipped with minor teeth. As a result of observations using high power magnifications

light microscopes in the present study, these minor teeth were indeed sharp setae instead. Zevina (1982) considered *C. hunteri* as a variety of *C. virgatum* (Spengler). Chan (unpublished) revealed there are clear genetic divergence in COI gene between *C. hunteri* and *C. virgatum*. The present study regards *C. hunteri* and *C. virgatum* as a separate species. The taxonomic identity of *C. hunteri* and *C. virgatum* should be evaluated using molecular analysis on their DNA sequence divergence.

SESSILIA Lamarck, 1818

VERRUCOMORPHA Pilsbry, 1916

VERRUCIDAE Darwin, 1854

Metaverruca Pilsbry, 1916

Metaverruca recta (Aurivillius, 1898)

(Figs. 2E, 20)

Verruca recta Aurivillius, 1898: 195.

Verruca sculpta Aurivillius, 1898: 197; Gruvel, 1905: 175; Gruvel, 1920: 41, Pl. 5: Figs. 26, 27. Nilsson-Cantell, 1929: 461, Fig. 1; Nilsson-Cantell, 1938: 12; Broch, 1931: 41; Ren, 1984: 166.

Verruca cookei Rosell, 1981: 299, Pl. 11: Figs. r, s, u, v; Rosell, 1991: 33. Non *Verruca cookei* Pilsbry, 1927.

Metaverruca recta Buckeridge, 1994: 116, 117, Fig. 13.

Material examined. – Stn. DW2376 (8°40.7'N 123°16.1'E, sandy/muddy substratum, depth 212–219 m, 28 May 2005), CEL-PANGLAO-19, 1 specimen, BD 8.65 mm.

Diagnosis. – Parietes white, smooth, low conic, operculum D-shaped, sub-parallel to base. Carina and rostrum apex at margin, interlocked with 8 ribs. Fixed scutum quadrangular, with clear single myophore.

Descriptions. – Parietes white, smooth, low, conic, operculum sub-parallel to base, D-shaped (Fig. 2E). Carina and rostrum apex at opercular margin (Fig. 2E). Rostrum and carina interlocked with 8 ribs. Fixed scutum quadrangular, with clear single myophore. Movable tergum square shaped (Fig. 20A), with 2 prominent articular ridges (Fig. 20A). Movable scutum triangular with 3 articular ridges (Fig. 20A). Mandible with 3 teeth (Fig. 20B), lower margin long, with 2 groups of large denticles, one group with 5 denticles, another group with 4 denticles, placed closer to tip (Fig. 20C). Maxillule not notched, cutting edge straight, with 8 large setae (Fig. 20D). Labrum slightly concave with small sharp teeth (Fig. 20E, G). Maxilla globular (Fig. 20F). Caudal appendages short, about 1 segment length of the cirrus VI.

Habitats. – Deep-sea species. On rocks.

Distribution. – Cosmopolitan.

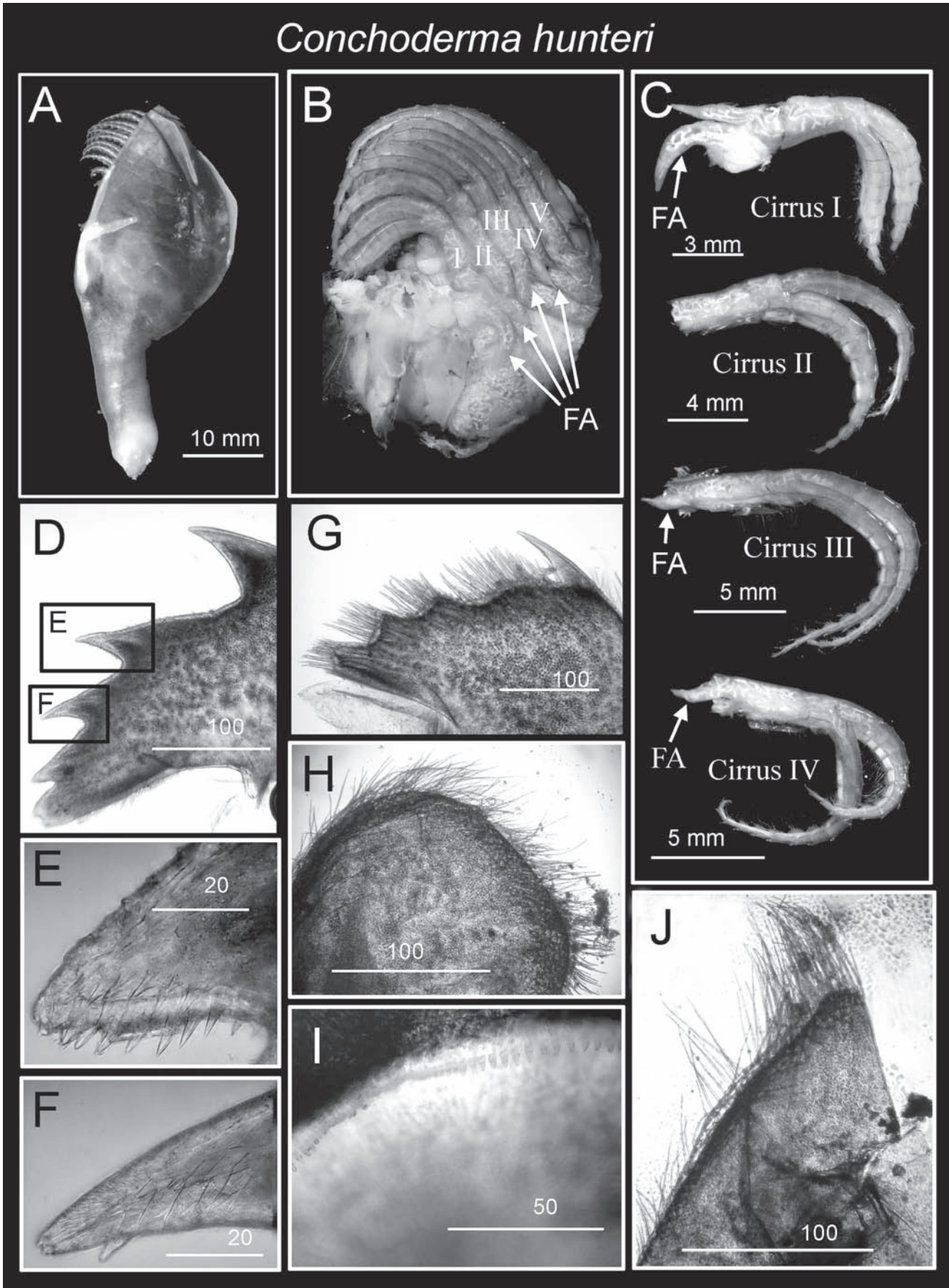


Fig. 19. *Conchoderma hunteri*: A, capitulum showing valve arrangement; B, somatic body showing filamentary appendages (FA) on the base of cirri, except cirrus II, V, VI; C, dissected cirri, showing filamentary appendages on cirrus I, III and IV; D, mandible; E, magnified view of the second teeth of mandible, showing sharp setae on major teeth; F, magnified view of the third teeth of mandible, showing sharp setae on major teeth; G, maxillule; H, maxilla; I, teeth on labrum; J, mandibulatory palp. Scale bars: A–C in mm; D–J in μm .

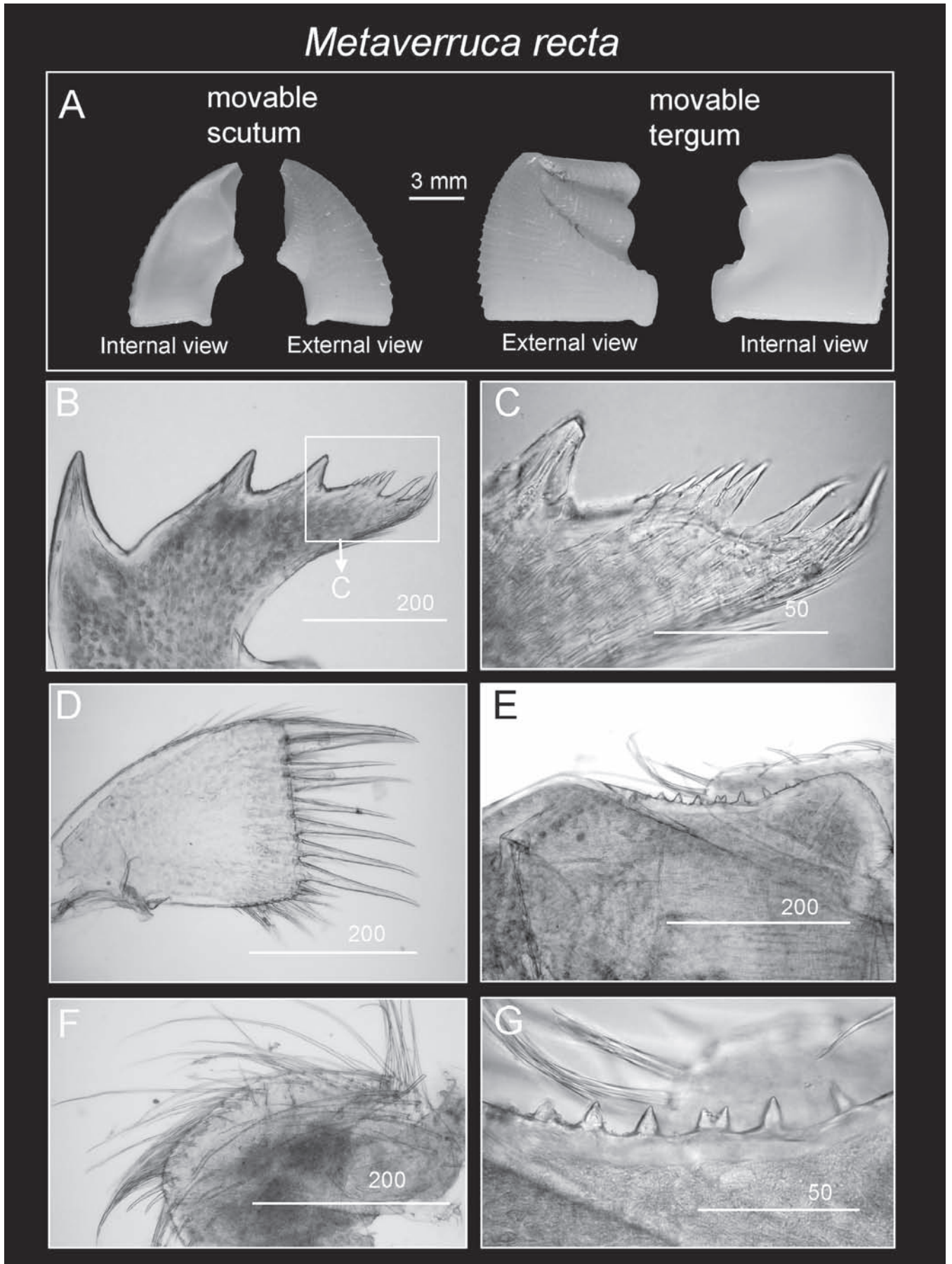


Fig. 20. *Metaverruca recta*: A, external and internal view of movable scutum and tergum; B, mandible; C, lower margin of mandible; D, maxillule; E, labrum; F, maxilla; G, teeth on labrum. Scale bars: A in mm; B–G in μm .

Rostratoverruca Broch, 1922

***Rostratoverruca intexta* (Pilsbry, 1912)**

(Figs. 2F, 21)

Verruca intexta Pilsbry, 1912: 292; 1916: 47; Nilsson-Cantell, 1927: 774; 1929: 468, Fig. 3. Stubbings, 1940: 389.

Verruca conchula Hoek, 1913: 146, Pl. XI: Figs. 14, 15.

Verruca (Rostratoverruca) intexta Rosell, 1986: 26, Pl. 7 f, g; Rosell, 1989: 26, Pl. 7F, G; Rosell, 1991: 33.

Rostratoverruca intexta Buckeridge, 1994: 119, Fig. 14.

Material examined. – Stn. CP2343 (9°27.4'N 123°49.4'E, sandy/muddy substratum, depth 273–302 m, 23 May 2005), CEL-PANGLAO-21, > 40 specimens, BD 4.28–5.80 mm. Stn. CP2393 (9°30.1'N 123°41.6'E, sandy/muddy substratum, depth 396–414 m, 30 May 2005), ASIZCR000220, 4 specimens, BD 4.1–6.0 mm.

Diagnosis. – Parietes cream white, surface with rounded ribbings. Carina apex marginal. Rostrum apex removes apart from the opercular margin. Rostrum patelliform.

Descriptions. – Parietes cream white, surface with rounded ribbings (Figs. 2F, 21A). Rostrum patelliform (Fig. 21A), apex removed from opercular margin. Carina apex marginal, elongated with distinct apex (Fig. 21A). Fixed scutum lacking myophore (Fig. 21F). Both of fixed scutum and tergum with curved beaks (Fig. 21F). Movable scutum triangular, with three diagonal ribs (Fig. 21B). Movable tergum quadrilateral, with 3 ribs, apex curved towards scutal margin (Fig. 21B). Maxilla wide and triangular (Fig. 21H). Maxillule notched, two large setae on upper notch (Fig. 21G, I). Mandibles with 3 major teeth, without any minor teeth on major teeth, lower margin long, with 5 large denticles (Fig. 21C, D, E). Mandibulatory palp narrow and pointed and setae on the superior margin (Fig. 21K). Labrum concave, with fine teeth (Fig. 21J).

Habitats. – Attached on urchin spines.

Distribution. – Indo-Pacific waters.

Newmaniverruca Young, 1998

***Newmaniverruca albatrossiana* (Pilsbry, 1912)**

(Figs. 2G, 22)

Verruca albatrossiana Pilsbry, 1912: 292; 1916: 47; Broch, 1922: 290, Figs. 39–40; Zullo, 1968: 218, Figs. 3a–c; 4a–d. Ren, 1984: 168, Fig. 2, Pl. 13: Figs. 11–13.

Verruca grex Hoek, 1913: 142, Pl. XI: Figs. 7–13, Pl. XIII: Figs. 11–13.

Verruca albatrossiana Broch, 1931: 45.

Newmaniverruca albatrossiana Young, 1998: 77; Jones et al., 2000: 256; Liu & Ren, 2007: 268–270, Fig. 117.

Material examined. – Stn. CP2341 (9°24.5'N 123°49.7'E, sandy/muddy substratum, depth 712–888 m, 23 May 2005), CEL-PANGLAO-22, 4 specimens, BD 5.29–6.22 mm, Stn. CP2358 (8°52.1'N 123°37.1'E, sandy substratum, depth 569–597 m, 26 May 2005), CEL-PANGLAO-23, 4 specimens, BD 3.51–5.32 mm. Stn. CP2384 (8°46.2'N 123°16.1'E, sandy substratum, depth 613–647 m, 29 May 2005), 1 specimen, ASIZCR000221, BD 6.5 mm.

Diagnosis. – Parietes white, surface ribbed vertically, skewed towards the carina. Rostrum and Carina apex marginal. Rostrum low. Fixed scutum larger than fixed tergum.

Descriptions. – Parietes white, surface ribbed vertically, skewed towards the carina (Fig. 2G). Rostrum low. Fixed scutum larger than fixed tergum. Movable tergum quadrilateral, with 4 secondary ribs (Fig. 22B). Movable tergum triangular, apex slightly curved, with 4 diagonal ribs (Fig. 22B). Maxilla slightly globular (Fig. 22H). Maxillule notched, with 2 large setae on the upper notch and five setae on the lower notch (Fig. 22G). Mandible with 3 major teeth, lower margin long, with 3 large denticles (Fig. 22A). Mandibulatory palp triangular with setae on the superior margin (Fig. 22I). Labrum concave, with 22 small sharp teeth and numerous fine setae (Fig. 22E). Cirrus I with unequal rami, inner rami 15 segments, outer rami 9 segments, rami with serrulate type of setae (Fig. 22C, D). Cirrus II (outer rami 8, inner rami 16), cirrus III (10, 17), cirrus IV (17, 20), cirrus V (17, 19), cirrus VI (20, 23). Caudal appendage long, 22 segments (Fig. 22F).

Habitats. – On urchin spines.

Distribution. – Indo-Pacific region.

BALANOMORPHA Pilsbry, 1916

BALANOIDEA Leach, 1817

ARCHAEOBALANIDAE Newman & Ross, 1976

Archaeobalaninae Newman & Ross, 1976

***Striatobalanus* Hoek, 1913**

***Striatobalanus tenuis* (Hoek, 1883)**

(Figs. 2H, 23)

Balanus tenuis Hoek, 1883: 154, Pl. 13: Figs. 29–33; Hoek, 1913: 190, Pl. XVII: Figs. 14–19; Pilsbry, 1916: 216; Barnard, 1924: 74; Nilsson-Cantell, 1925: 34, Fig. 14, Pl. 1: Figs. 5, 6; Nilsson-Cantell, 1927: 785; Nilsson-Cantell, 1938: 46; Broch, 1931: 70; Hiro, 1937b: 439, Fig. 24; Utinomi, 1968: 174; Utinomi, 1969: 88; Fig. 6; Ren & Liu, 1978: 161, Fig. 22, Pl. 7; Liu & Ren, 2007: 363, Fig. 161.

Balanus albus Hoek, 1913: 185, Pl. XVI: Figs. 12, 13, Pl. XVII, Figs. 1–6. Stubbings, 1936: 41, Fig. 18.

Chirona tenuis Newman & Ross, 1976: 50; Rosell, 1989: 33, Pl. 10g.

Striatobalanus tenuis Liu & Ren, 2007: 363, Fig. 161.

Material examined. – Stn. CP2372 (8°38.7'N 123°16.0'E, sandy/muddy substratum, depth 231–255 m, 27 May 2005), ASIZCR000222, 1 specimen, BD 34.60 mm. Stn. CP2358 (8°52.1'N 123°37.1'E, sandy substratum, depth 569–597 m, 26 May 2005), CEL-PANGLAO-25, 1 specimen, BD 31.34 mm. Stn. CP2404 (9°39.4'N 123°43.3'E, rocky/sandy/corals/muddy substratum, depth 479–481 m, 1 Jun 2005), CEL-PANGLAO-26, 1 specimen, BD 23.69 mm. Stn. CP2380 (8°41.3'N 123°18.7'E, sandy/muddy substratum, depth 163–271 m, 28 May 2005), 3 specimens, BD 20.9–23.64 mm.

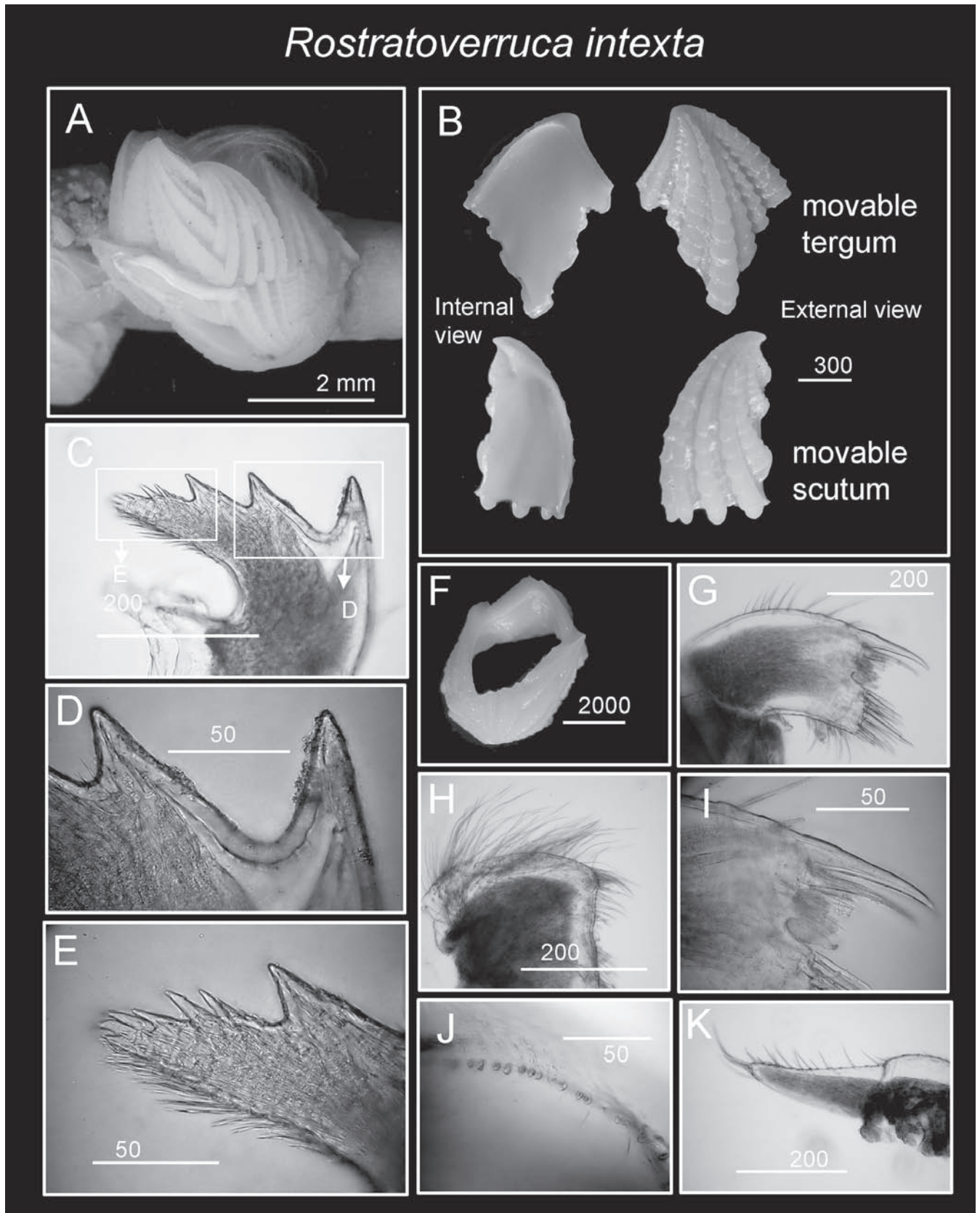


Fig. 21. *Rostratoverruca intexta*: A, general view; B, external and internal view of scutum and tergum; C, mandible; D, first and second teeth of mandible; E, lower margin of mandible; F, shell showing fixed scutum and tergum; G, maxillule; H, maxilla; I, upper notch of maxillule; J, labrum; K, mandibulatory palp. Scale bars: A, B in mm; C–K in μm .

Newmaniverruca albatrossiana

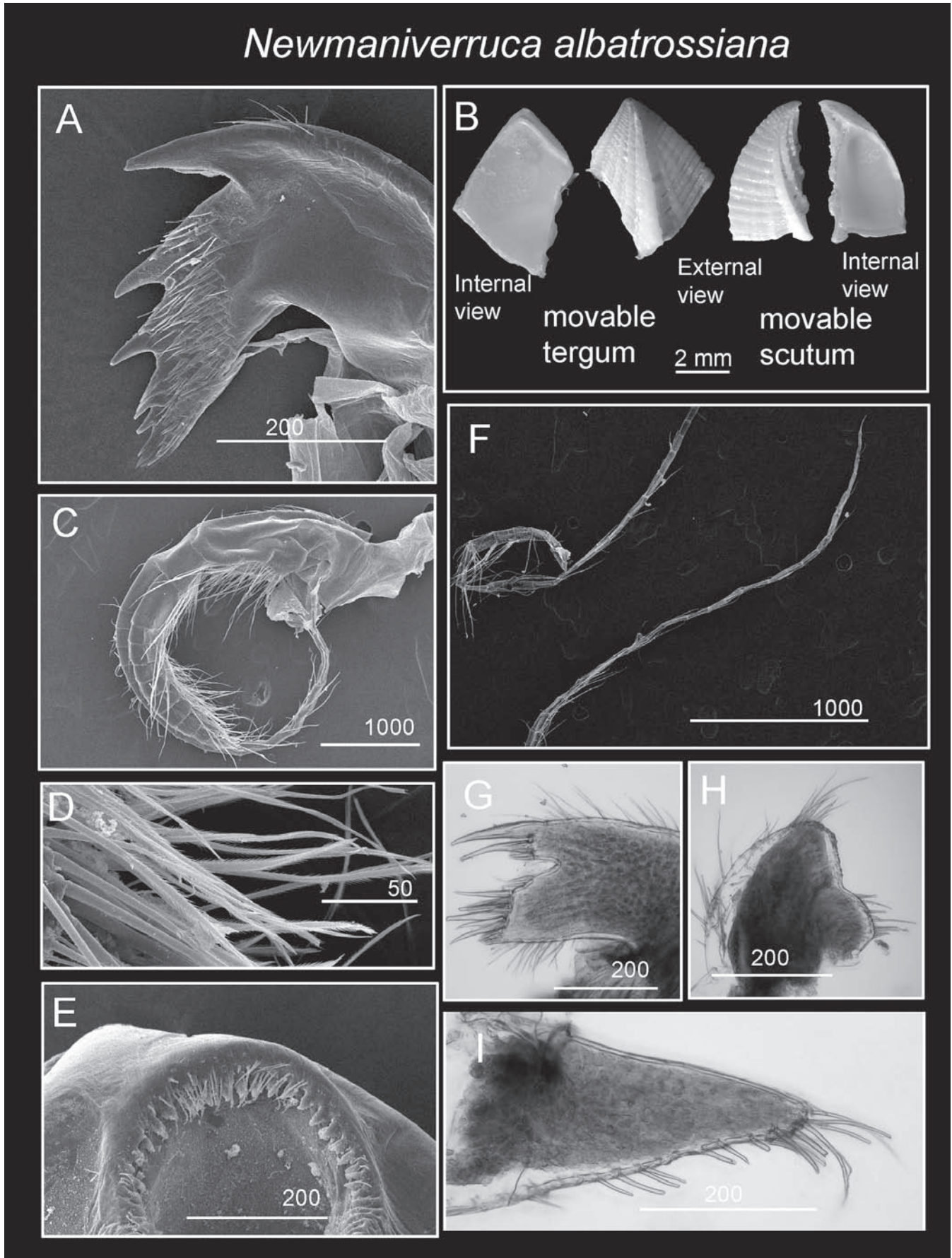


Fig. 22. *Newmaniverruca albatrossiana*: A, mandible; B, external and internal view of movable scutum and tergum; C, cirrus I. D, serrulate setae of cirrus I; E, labrum; F, caudal appendages; G, maxillule; H, maxilla; I, mandibulatory palp. Scale bars: A, C-I in µm; B in mm.

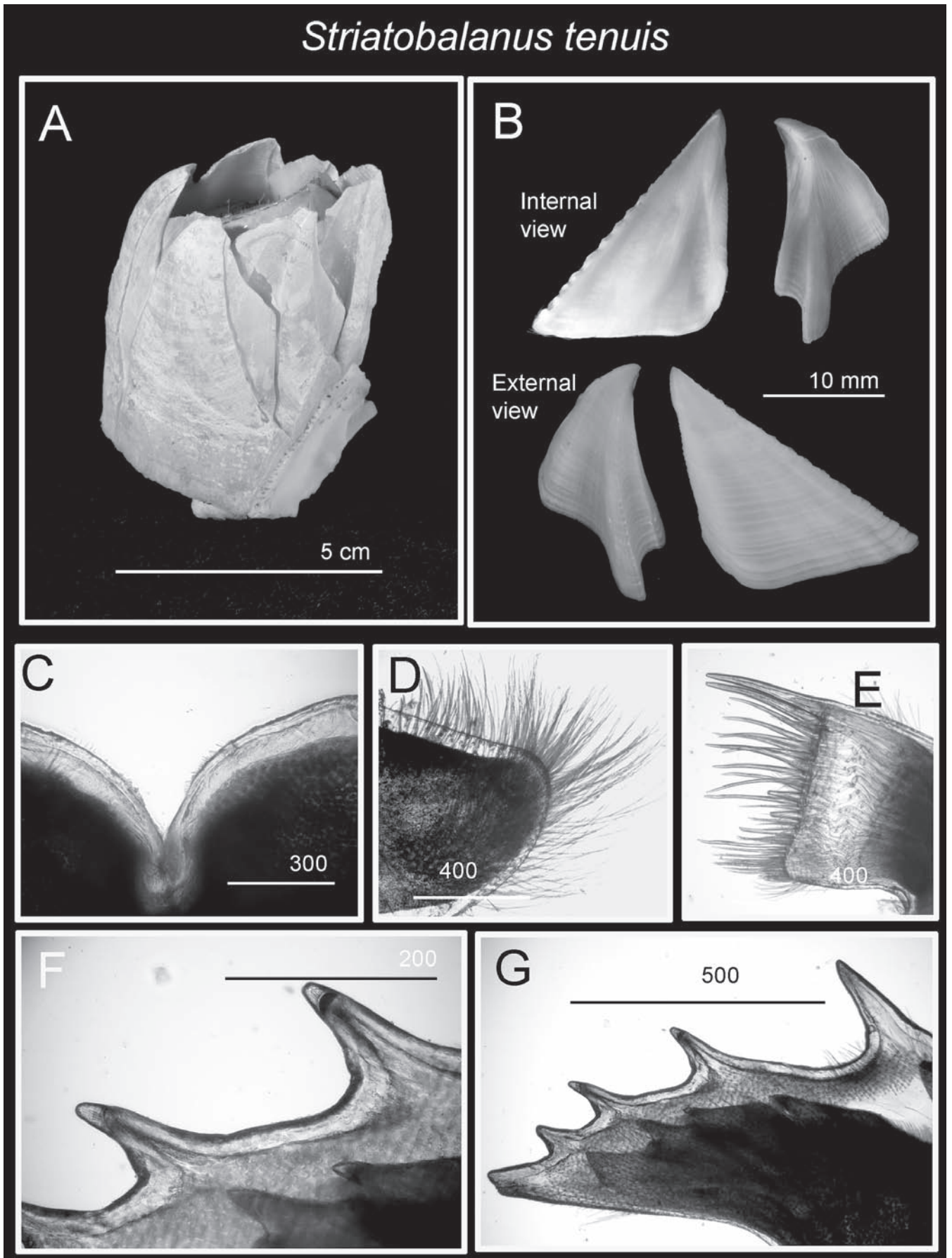


Fig. 23. *Striatobalanus tenuis*: A, general view; B, external and internal view of scutum and tergum; C, labrum; D, maxilla; E, maxillule; F, enlarged view of mandible; G, mandible. Scale bars: A, C-G in μm ; B in mm.

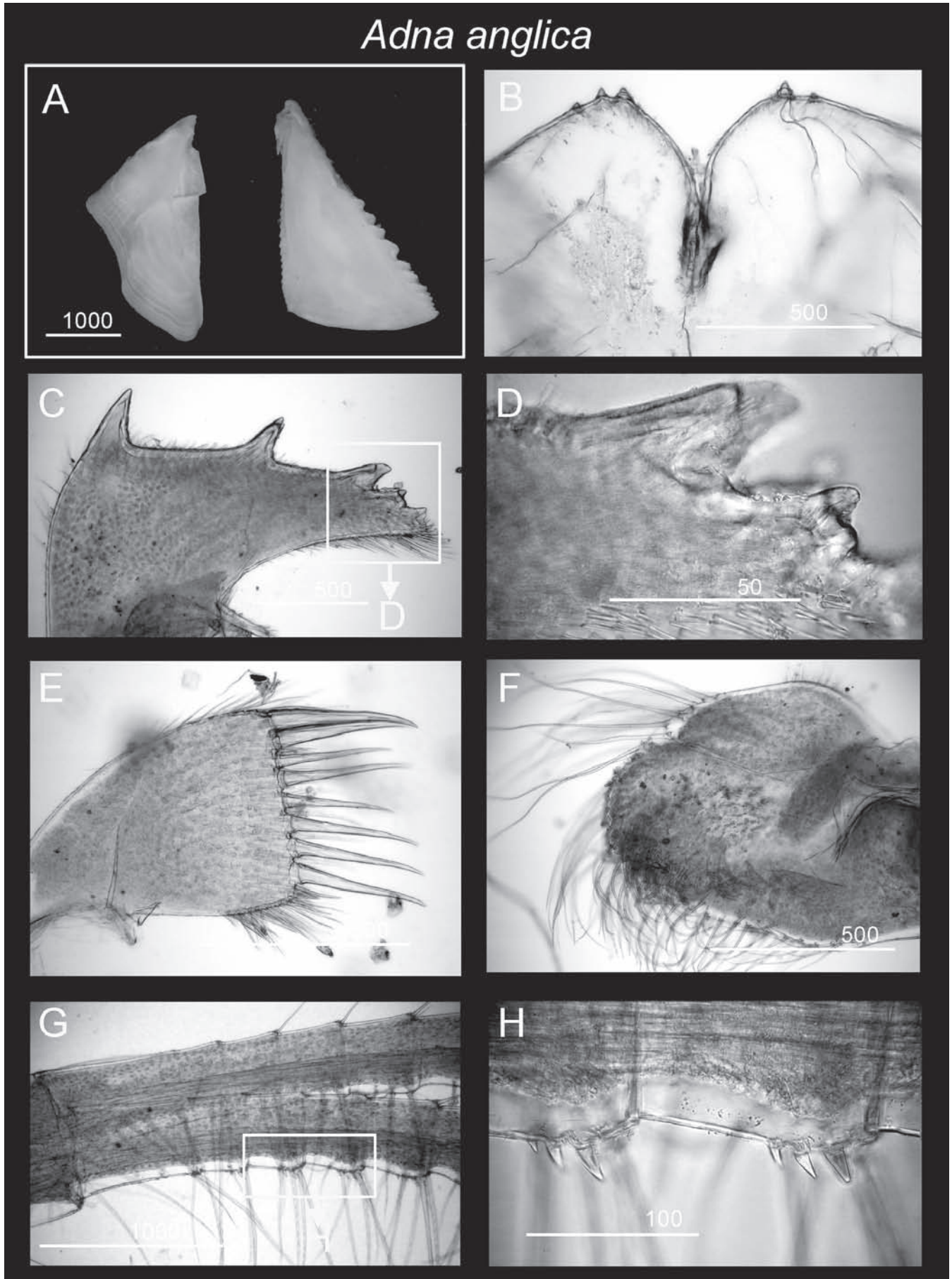


Fig. 24. *Adna anglica*: A, internal view of scutum and tergum; B, labrum; C, mandible; D, lower margin of mandible; E, maxillule; F, maxilla; G, H, basal segments of cirrus IV, showing spines. Scale bars: A in mm; B–H in µm.

Diagnosis. – Shell consisted of six plates, base calcareous, white in colour; orifice deeply toothed. Raddii narrow and with oblique and concave summits.

Descriptions. – Shell consisted of six plates, white in colour; orifice deeply toothed (Figs. 2H, 23A). Raddii narrow and with oblique and concave summits (Fig. 23A). Base calcareous. Scutum and tergum white (Fig. 23B). Scutum triangular, tergal margin straight and with teeth on the occludent margin (Fig. 23B). Tergum slightly curved and with long, wide spur (Fig. 23B). Outer surface of scutum and tergum striated longitudinally (Fig. 23B). Mandible with 4 major teeth (Fig. 23G), second and third teeth being bi-dentate, third and fourth teeth are closer each other (Fig. 23F). Maxillule not notched, cutting edge straight, with 2 large setae on upper region (Fig. 22E). Maxilla covered with long, slender setae (Fig. 23D). Mandibulatory palp long, with long and slender setae. Labrum with distinct and deep notch (Fig. 23C). Cirri: Cirri I–III are maxillipeds. Cirrus I with unequal rami (inner rami 17 segments, outer rami 13 segments), rami on cirrus II–VI subequal. Cirrus II (inner rami 13 segments, outer rami 16 segments), cirrus III (17, 17), cirrus IV (33, 34), cirrus V (35, 37), cirrus VI (35, 34).

Habitats. – Deep-sea habitats > 200 m depth. Often epibiont on molluscan shells or crab carapace.

Distribution. – East China Sea, South China Sea, Japan, the Philippines, Indonesia Indian Ocean.

PYRGOMATIDAE Gray, 1825

MEGATREMATINAE Holthuis, 1982

Pyrgomini Ross & Pitombo, 2002

Adna Sowerby, 1823

Adna anglica Sowerby, 1823

(Figs. 2I, 24)

Pyrgoma anglica Sowerby, 1823 [no pagination].

Pyrgoma anglicum Darwin, 1854: 360, Pl. 12: Fig. 4a–c; Gruvel, 1905: 302, Fig. 324; Hiro, 1935: 53, Fig. 4; Hiro, 1937b: 467; Nilsson-Cantell, 1938: 66, Fig. 24; Stubbings, 1967: 294, Fig. 22.

Boscia anglicum Ross & Newman, 1973: 164, Fig. 23a, b.

Boscia anglicum Newman & Ross, 1976: 59; Ren, 1986: 150, Fig. 13, Pl. 5: Figs. 20–25.

Adna anglica Ross & Pitombo, 2002: 58.

Material examined. – Stn. DW2376 (8°40.7'N 123°16.1'E; sandy/muddy, depth 212–219 m, 28 May 2005), CEL-PANGLAO-28, 5 specimens, BD 5.80–6.32 mm. Stn. CP2392 (9°29.0'N 123°41.1'E, sandy/muddy substratum, depth 400–436 m, 30 May 2005), CEL-PANGLAO-29, 3 specimens, BD 5.28–6.11 mm on stony corals.

Diagnosis. – Parietes smooth, rose red, orifice small and oval. Base slightly convex.

Descriptions. – Parietes smooth, rose red, orifice small and oval (Fig. 2K). Base slightly convex (Fig. 2K). Scutum triangular, large teeth on occludent margin, tergal margin vertical straight (Fig. 24A). Tergum wide, scutal margin vertical straight, basi-scutal angle absent. Labrum V-shaped with two large teeth on each side (Fig. 24B). Maxilla globular (Fig. 24F). Maxillule not notched, with 8 large setae on straight cutting edge (Fig. 24E). Mandible 5 major teeth, second, third and fourth teeth each with one addition tooth on the cutting edge, lower margin short with a few setae (Fig. 24C, D). Cirri I–II are maxillipeds; outer rami 9 segments, inner rami 7 segments. Cirrus II (outer rami 11 segments, inner rami 9 segments), Cirri III (20, 20), cirrus IV (25, 27), cirrus V (28, 29), cirrus VI (29, 29). outer rami of cirrus IV with spines on the last 5 segments (Fig. 24G, H). Spines absent on outer rami of cirrus IV.

Habitats. – Attach on corals.

Distribution. – South China Sea, Japan, Madagascar, Atlantic Ocean and the Philippines.

Remarks. – First record in the Philippine waters.

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LITERATURE CITED

- Annandale, N., 1909a. An account of the Indian Cirripedia Pedunculata Part 1. Family Lepadidae (sensu stricto). *Records of the Indian Museum*, 2(2): 61–137.
- Annandale, N., 1909b. Description of a barnacle of the Genus *Scalpellum* from Malaysian. *Records of the Indian Museum*, 3: 267–270.

- Arnaud, P. M., 1973. Le genre *Lepas* Linne, 1758, dans les Terres Australes et Antarctiques Françaises (Cirripedia). *Crustaceana*, **24**(2): 157–162.
- Aurivillius, C. W. C., 1898. Cirripedes nouveaux provenant des Campagnes de S. A. S. le Prince de Monaco. *Bulletin de la Societe Zoologique de France*, **23**: 189–198.
- Barnard, K. H., 1924. Contributions to the crustacean fauna of South Africa. 7. Cirripedia. *Annals of the South Africa Museum*, **20**: 1–103.
- Barnard, K. H., 1955. An addition to the faunal list of South African barnacles. *Annals and Magazine of the Natural History Museum London*, **13**(2): 247.
- Bouchet, P., P. Lozouet, P. Maestrati & V. Heros, 2002. Assessing the magnitude of species richness in tropical marine environments: exceptionally high numbers of molluscs at a New Caledonia site. *Biological Journal of the Linnean Society*, **75**: 421–436.
- Broch, H., 1922. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–1916, X. Studies on Pacific Cirripedes. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kobenhavn*, **73**: 215–358.
- Broch, H., 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–1916, LVI. Indomalayan Cirripedia. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kobenhavn*, **91**: 1–146.
- Buckeridge, J. S., 1994. Cirripedia Thoracica: Verrucomorpha of New Caledonia, Indonesia, Wallis and Futuna Islands. In Crosnier, A. (Ed), Résultats des Campagnes MUSORSTOM, Volume 12. *Mémoires du Muséum national d'Histoire naturelle, Paris*, **161**: 87–125.
- Buckeridge, J. S. & W. A. Newman, 2006. A revision of the Iblidae and the pedunculate barnacles (Crustacea: Cirripedia: Thoracica), including new ordinal, familial and generic taxa, and two new species from New Zealand and Tasmanian waters. *Zootaxa*, **1136**: 1–38.
- Calman, W. T., 1918. On barnacles of genus *Scalpellum* from deep-sea telegraph-cable. *Annals and Magazine of the Natural History Museum, London series 9*, **1**: 96–124.
- Calman, W. T., 1919. On barnacles of the genus *Megalasma* from deep-sea telegraph cables. *Annals and Magazine of the Natural History Museum, London series 9*, **4**: 361–374.
- Carpenter, K. E. & V. G. Springer, 2005. The center of the center of marine shore fish biodiversity: the Philippine Islands. *Environmental Biology of Fishes*, **72**: 467–480.
- Chan, B. K. K., A. Garm & J. T. Høeg, 2008. Setal morphology and cirral setation of thoracican barnacle cirri: adaptations and implications for thoracican evolution. *Journal of Zoology (London)*, **275**: 294–306.
- Chan, B. K. K., Tsang, L. M. & F-L. Shih, 2009. Morphological and genetic differentiations of the stalked barnacle *Heteralepas japonica* Aurivillius, 1892, with description of a new species of *Heteralepas* Pilsbry, 1907, from the Philippines. *Raffles Bulletin of Zoology*, Supplement No. **20**: 83–95.
- Darwin, C., 1851. *A monograph on the sub-class Cirripedia with figures of all species. The Lepadidae: or pedunculated barnacles.* Ray Society, London. 400 pp.
- Darwin, C., 1854. *A monograph on the sub-class Cirripedia with figures of all species. The Balanidae, Verrucidae, etc.* Ray Society, London. 684 pp.
- Dong, Y.-M., Y.-S. Chen & R.-X. Cai, 1980. Preliminary study on the Chinese cirripedian fauna (Crustacea). *Acta Oceanologica Sinica*, **2**: 124–131.
- Foster, B. A., 1978. The marine fauna of New Zealand: Barnacles (Cirripedia: Thoracica). *New Zealand Oceanographic Institute Memoir*, **69**: 1–143.
- Gordon, J. A., 1970. An annotated checklist of Hawaiian barnacles (Class Crustacea: Subclass Cirripedia) with notes on their nomenclature, habitats and Hawaiian localities. *Hawaii Institute of Marine Biology Technical Report*, **19**: 1–130.
- Gray, J. E., 1825. A synopsis of the genera of Cirripedes arranged in natural families, with a description of some new species. *Annals of Philosophy*, **10**: 97–107.
- Gruvel, A., 1905. *Monographie des Cirrhipèdes ou thecostracés.* Masson et Cie, Paris, 472 pp.
- Gruvel, A., 1920. Cirrhipèdes provenant des campagnes Scientifiques de S. A. S. le Prince de Monaco (1855-1913). *Résultats des Campagnes Scientifiques accomplies sur son yacht par Albert Ier, Prince Souverain de Monaco*, **53**: 1–88.
- Hiro, F., 1933. Report on the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. *Records of the Oceanographic Works in Japan*, **5**: 11–84.
- Hiro, F., 1935. A study of cirripeds associated with corals occurring in Tanabe Bay. *Records of the Oceanographic Works in Japan*, **7**: 45–72.
- Hiro, F., 1937a. Order Thoracica I. (Cirripedia Pedunculata) Subclass Cirripedia (Class Crustacea). *Fauna Nipponica*, **9**: 1–116. [In Japanese]
- Hiro, F., 1937b. Studies on Cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. *Memoirs of the College of Science, Kyoto University Series B*, **12**: 385–478.
- Hiro, F., 1939a. Studies on the Cirripedian fauna of Japan. III. Supplementary notes on the Cirripeds found in the Vicinity of Seto. *Memoirs of the College of Science, Kyoto University Series B*, **15**: 237–244.
- Hiro, F., 1939b. Studies on the Cirripedian fauna of Japan. V. Cirripeds of the northern part of Honshu. *Report of the Tohoku University Series 4 (Biology)*, **15**: 201–218.
- Hoek, P. P. C., 1883. Report on the Cirripedia collected by H.M.S. Challenger during the years 1873–76. *Report of the Scientific Results from the Exploratory Voyages of H.M.S. Challenger, Zoology*, **8**: 1–169.
- Hoek, P. P. C., 1907. Pedunculata. The Cirripedia of Siboga Expedition. *Siboga Expeditie, Monograph*, **31a**: 1–127.
- Hoek, P. P. C., 1913. The Cirripedia of the Siboga Expedition. B. Cirripedia sessilia. *Siboga-Expeditie, Monograph*, **31b**: 129–275.
- Holthuis, L. B., 1982. The nomenclature of some coral inhabiting barnacles of the family Pyrgomatidae (Cirripedia. Balanomorpha). *Crustaceana*, **43**(3): 316–320.
- Jennings, L. S., 1918. Art. III. Revision of the Cirripedia of New Zealand. *Transactions of the Proceedings of the New Zealand Institute*, **50**: 56–63.
- Jones, D. S., M. A. Hewitt & A. Sampey, 2000. A checklist of the Cirripedia of the South China Sea. *The Raffles Bulletin of Zoology 2000 Supplement*, **8**: 233–307.
- Krüger, D. P., 1911. Beiträge zur Cirripedenfauna Ostasiens. *Beiträge zur Naturgeschichte Ostasiens herausgegeben von F. Doflein. Konglige Bayerische Akademie der Wissenschaften, Munich Mathematische-physikalische Klasse. Abhandlungen Supplement Band*, **2**: 1–72.
- Lamarck, J. B. P. A. de M., ch. De, 1818. *Histoire naturelle des animaux sans vertèbres. Volume 5*, Deterville, Paris, 612 pp.

- Leach, W. E., 1817. Distribution, systematique de la class Cirripedes. *Journal de Physique de Chimie et d'Histoire Naturelle, Paris*, **85**: 67–69.
- Linnaeus, C., 1758. *Systema Naturae. Homiae. Editio Decima, Reformata Volume 1*. 824 pp.
- Liu, R.-Y. & X.-Q. Ren, 1985. Studies on Chinese Cirripedia (Crustacea). VI. Suborder Lepadomorpha. *Studia Marina Sinica*, **25**: 179–281.
- Liu, R.-Y. & X.-Q. Ren, 2007. *Fauna Sinica. Invertebrata. Vol. 42 Crustacea Cirripedia Thoracica*. Science Press, Beijing, China. 633 pp.
- Newman, W. A., 1987. Evolution of Cirripedes and their major groups. In: Southward, A. (ed.). *Barnacle Biology. Crustacean Issues 5*. Rotterdam: Balkema. Pp. 3–42.
- Newman, W. A., 1972. Lepadids from the Caroline Islands. *Crustaceana*, **22**(1): 31–38.
- Newman, W. A., 1996. Sous-Classe des Cirripèdes (Cirripedia Burmeister, 1834) Super- Ordres des Thoraciques et des Acrothoraciques (Thoracica Darwin, 1854-Acrothoracica Gruvel, 1905). In: J Forest (ed.), *Traité de Zoologie, Anatomie, Systématique, Biologie, 7, Crustacés, Fasc. 2 Généralités (suite) et Systématique*. 453-540. Masson/Paris.
- Newman, W. A. & A. Ross, 1976. A revision of the balanomorph barnacles: including a catalog of the species. *Memoirs of the San Diego Society of Natural History*, **9**: 1–108.
- Nilsson-Cantell, C. A., 1921. Cirripeden-Studien. Zur Kenntnis der Biologie, Anatomie und Systematic dieser Gruppe. *Zoologiska Bidrag Fran Uppsala*, **7**: 75–390.
- Nilsson-Cantell, C. A., 1925. Neue und wening bekannte Cirripeden aus den Musseen zu Stockholm und zu Uppsala. *Arkiv för Zoologi, Stockholm*, **18A**(3): 1–45.
- Nilsson-Cantell, C. A., 1927. Some barnacles in the British Museum (Natural History). *Proceedings of the Zoological Society of London*, **1927**: 743–790.
- Nilsson-Cantell, C. A., 1928. Studies on cirripeds in the British Museum. *Annals and Magazine of the Natural History Museum*, (10) **2**: 1–39.
- Nilsson-Cantell, C. A., 1929. Cirripeden des genus *Verruca* der Deutschen Tiefsee- Expedition au dem Dampfer “Valdivia” 1898-1899. *Zoologische Jahrbucher (Abtheilung fur Systematik, Geographie und Biologie der Thiere)*, **58**(4): 459–480.
- Nilsson-Cantell, C. A., 1931. Cirripedes from the Indian Ocean and Malay Archipelago in the British Museum (Natural History) London. *Arkiv för Zoologi, Stockholm*, **23A**(18):1–12.
- Nilsson-Cantell, C. A., 1934. Indo-Malayan cirripeds in the Raffles Museum, Singapore. *Bulletin of the Ruffles Museum*, **9**: 42–73.
- Nilsson-Cantell, C. A., 1938. Cirripeds from the Indian Ocean in the collection of the Indian Museum, Calcutta. *Memoirs of the Indian Museum*, **13**(1): 1–81.
- Nilsson-Cantell, C. A., 1955. Cirripedia. *Rept. Swedish Deep-sea Expedition. Vol. 2. Zoology*, **17**: 215–220.
- Olfers, J. F., 1814. *Magazin der Gessels. Naturforsh Ferunde, Berlin* (not seen).
- Owen, R. (1830) Cat. Mus. Coll. Of Surgeons, Invertebrate Part I. p. 71.
- Pilsbry, H. A., 1890. Description of a new Japanese *Scalpellum*. *Proceedings of the Academy of the Natural Sciences, Philadelphia*, **42**: 441–443.
- Pilsbry, H. A., 1907. The barnacles (Cirripedia) contained in the collections in the U. S. National Museum. *Bulletin of the United States National Museum*, **60**: 1–122.
- Pilsbry, H. A., 1912. Diagnoses of new barnacles from the Philippine archipelago and China Sea. *Proceedings of the United States National Museum*, **42**: 291–294.
- Pilsbry, H. A., 1916. The sessile barnacles (Cirripedia) collected in the collections of the U. S. National Museum: Including a monograph of the American species. *Bulletin of the United States National Museum*, **93**: 1–366.
- Pilsbry, H. A., 1927. Littoral barnacles of the Hawaiian islands and Japan. Proceedings of the Academy of Natural Science of Philadelphia, **79**: 305–317.
- Ren, X. Q., 1984. Studies on Chinese Cirripedia (Crustacea) IV. Family Verrucidae. *Studia Marina Sinica*, **23**: 165–179.
- Ren, X. Q., 1986. Studies on Chinese Cirripedia (Crustacea) VII. Family Pyrgomatidae. *Studia Marina Sinica*, **26**: 129–158.
- Ren, X. Q. & R. Y. Liu, 1978. Studies on Chinese Cirripedia (Crustacea) I. Genus *Balanus*. *Studia Marina Sinica*, **13**: 119–196.
- Rosell, N. C., 1972. Some barnacles (Cirripedia Thoracica) of Puerto Galera found in the vicinity of the U.P. Marine Biological Laboratory. *National Applied Science Bulletin*, **24**: 143–285.
- Rosell, N. C., 1981. Crustacea: Cirripedia. Résultats des campagnes MUSORSTOM I PHILIPPINES (18-28 MARS 1976) ditions de 1 Office de la Recherche Scientifique et Technique Outre-Mer avec le concours du Muséum National d'Histoire Naturelle Collection Mémoires ORSTOM n° 91 Paris. pp. 278–307
- Rosell, N. C., 1986. *Philippine Barnacles. Guide to Philippine Flora & Fauna. Vol. VII*. Natural Resources Management Center, Ministry of Natural Resources & University of the Philippines.
- Rosell, N. C., 1989. Thoracic Cirripeds from the MUSORSTOM 2 Expedition. In: Forest, J. (ed.) Resultats des Campagnes MUSORSTOM, Volume 5. *Mémoire du Muséum national d'Histoire naturelle (A)*, **144**: 9–35.
- Rosell, N. C., 1991. Crustacea Cirripedia Thoracica: MUSORSTOM 3 Philippine collection. In: Crosnier, A. (ed.) Resultats des Campagnes MUSORSTOM. Volume 9. *Mémoire du Muséum national d'Histoire naturelle (A)*, **152**: 9-61.
- Ross, A. & F. B. Pitombo, 2002. Notes on the coral-inhabiting Megatrematinae and the description of a new tribe, new genus and three species (Cirripedia: Sessilia: Pyrgomatidae). *Sessile Organisms*, **19**: 57–68.
- Ross, A. & W. A. Newman, 1973. Revision of the coral-inhabiting barnacles (Cirripedia: Balanidae). *Transactions of the San Diego Society of Natural History*, **17**(12): 137–174.
- Sowerby, G. B., 1821–1836. *The genera of recent and fossil shells, for the use of students in conchology and geology*. London. 265 plates with unnumbered text.
- Stebbing, T. R. R., 1910. General catalogue of South African Crustacea. *Annals of the South Africa Museum*, **6**(4): 563–575.
- Stubbings, H. G., 1936. Cirripedia. Scientific Reports of the John Murray Expedition 1933-34. *British Museum (Natural History)*, **4**(1): 1–70.
- Stubbings, H. G., 1940. Cirripedia (additional part). Scientific reports of the *John Murray Expedition 1933-34. British Museum (Natural History)*, **7**(3): 384–399.
- Stubbings, H. G., 1967. West African Cirripedia fauna of tropical West African. *Bulletin of the British Museum (Natural History) Zoology*, **15**(6): 229–319.
- Tarasov, N. E. & G. B. Zevina, 1957. Cirripedia Thoracica of the Seas of USSR. *Fauna Russian Natural Science*, (69) **6** (1): 1–267. [In Russian]

- Utinomi, H., 1949. Studies on the cirripedian fauna of Japan. VI. Cirripeds from Kyushu and Ryukyus Island. *Publications of the Seto Marine Biology Laboratory*, **1**(2): 19–37.
- Utinomi, H., 1958. Studies on the cirripedian fauna of Japan. VII. Cirripeds from Sagami Bay. *Publications of the Seto Marine Biology Laboratory*, **6**(3): 281–311.
- Utinomi, H., 1968. Pelagic shelf and shallow-water cirripedia from the Indo-west Pacific. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kobenhavn*, **131**: 161–186.
- Utinomi, H., 1969. Cirripedia of the Iranian Gulf. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kobenhavn*, **132**: 79–94.
- Utinomi, H., 1970. Studies on the cirripedian fauna of Japan. 9. Distributional survey of the thoracic cirripeds in the southeastern part of Japan Sea. *Publications of the Seto Marine Biology Laboratory*, **17**(5): 339–372.
- Weltner, W., 1922. Cirripedia der deutschen Tiefsee-Expedition. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1895–1899*, **23**: 59–112
- Young, P. S., 1998. Cirripedia (Crustacea) from the 'Campagne Biacore' in the Azores region, including a generic revision of Verrucidae. *Zoosystema*, **20**: 31–92.
- Young, P. S., 2001. Deep-sea Cirripedia Thoracica (Crustacea) from the northeastern Atlantic collected by French expeditions. *Zoosystema*, **23**(4): 705–756.
- Zevina, G. B., 1968. New species of Lepadomorpha (Cirripedia, Thoracica) from the Bay of Tonkin. *Crustaceana*, **15**: 35–40.
- Zevina, G. B., 1978. A new system of the family Scalpellidae Pilsbry (Cirripedia, Thoracica). 2. Subfamilies Arcoscalpellinae and Meroscalpellinae. *Zoologicheskyy Zhurnal*, **57**(9): 1343–1352. [In Russian]
- Zevina, G. B., 1981. Barnacles of the Suborder Lepadomorpha (Cirripedia, Thoracica) of the world Oceans. I: Family Scalpellidae. *Fauna SSSR*, **127**:1–398. [in Russian]
- Zevina, G. B., 1982. Barnacles of the Suborder Lepadomorpha (Cirripedia, Thoracica) of the world Oceans II. *Fauna SSSR*, **133**:1–223. [in Russian]
- Zullo, V., 1968. Catalogue of the Cirripedia named by Henry, A. Pilsbry. *Proceedings of the Academy of the Natural Sciences, Philadelphia*, **120**: 209–235.