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New records of Dendrochirotida (Echinodermata: Holothuroidea) from Papua New Guinea

by Claude MASSIN

Summary: This paper describes 12 Dendrochirotida from Papua New Guinea of which 11 are new local records. Five of them have been collected by dredging, the remaining 7 by hand-picking (diving and shore collecting). The present work also provides the first account of brooding behaviour in a tropical Dendrochirotida. Numbers of dendrochirotids to numbers of other species of holothuroids from Papua New Guinea is compared with different areas of the Indo-West-Pacific Ocean.

Key words: Echinodermata, Holothuroidea, Dendrochirotida, brooding, Papua New Guinea.

Introduction

Only few studies exist on the holothuroid fauna of Papua New Guinea. THÉEL (1886), LAMPERT (1885, 1889), H.L. CLARK (1921), LEVIN (1979) and MASSIN *et al.* (2002) reported several aspodichirotids from Papua New Guinea, but no dendrochirotids. BROUNS & HEIJS (1985) listed holothuroids living in a seagrass bed close to Port Moresby, where only a single species in a total of 15 belonged to the Dendrochirotida. The bulk of the works published on holothuroids from Papua New Guinea deals with trepang fisheries and take into account only the Aspidochirotida (see among others LONG & SKEWES, 1997: 12 species; KINCH, 2003: 15 species; DESURMONT, 2003: 20 species).
This work lists the Dendrochirotida from Papua New Guinea (mainly from the north coast, Madang Province) and discusses their importance in holothuroid diversity.

Material and methods

The material examined has been collected by shore collecting, by diving (between zero and 40 m depth) at Madang's Reefs and in Hansa Bay (Madang Province, Papua New Guinea) in 1983, 1987, 1989, 1990 and 1996, and by soft bottom dredging between 20-60 m depth in Hansa Bay in 1978. For the lettering of the collecting points around Laing Island (Hansa Bay) see the map in CLAEREBOUDT *et al.* (1990). For a detailed map of the collecting points in the Madang reefs see JEBB & LOWRY (1995).
Specimens collected by divers were anaesthetised in 3.5% $MgCl_2$ for a few hours, preserved in 10% buffered formalin (pH 8.2) and later transferred to 75% buffered alcohol for permanent storage. Dredged specimens were immediately preserved in 10% formalin and later transferred to 75% buffered alcohol for permanent storage.
Ossicles were prepared for light microscopy and scanning electron microscopy (SEM). Juveniles were dehydrated in two baths of Hexamethyl-Disilazane (Sigma) for more or less two hours. SEM observations of ossicles and juveniles were carried out using a JEOL JSM 5400 LV.

Results

Cucumariidae LUDWIG, 1894
Colochirinae PANNING, 1949
Leptopentacta H.L. CLARK, 1938
Leptopentacta imbricata (SEMPER, 1868)
Fig. 1A-G

Ocnus imbricatus SEMPER, 1868: 54, pl. 11 fig. 2, pl. 13, fig. 12-13, pl. 14, fig 12-13; LAMPERT, 1885: 130; THÉEL, 1886: 76.
Cucumaria imbricata; LUDWIG 1889-1892: 344, pl. 16, fig. 3; KOEHLER, 1895: 376; SLUITER, 1901: 79; PEARSON, 1903: 190; KOEHLER & VANEY, 1908: 29.
Trachythyone imbricata; PANNING, 1949: 42; A.M. CLARK & ROWE, 1971: 182.
Parocnus imbricatus; DEICHMANN 1941: 93.
Leptopentacta imbricata; H.L. CLARK, 1938: 453; DEICHMANN, 1941: 94; PANNING, 1966: 57, fig. 4-5; A.M. CLARK, 1982: 489; ROWE, 1983: 159; LIAO & A.M. CLARK, 1995: 476, pl. 23, fig. 16; LIAO, 1997: 166, fig. 96a-c; LANE *et al.*, 2000: 490; LANE & VANDENSPEGEL, 2003: 153.
Ocnus javanicus SLUITER, 1881: 342, pl. 4, fig. 1.
Leptopentacta javanicus; PRICE, 1982: 11.
Ocnus typicus THÉEL, 1886: 75 pl. 6, fig. 10, pl. 14, fig. 11.

TYPE LOCALITY

Bohol (Philippines).

MATERIAL EXAMINED

IRSNB IG 29848/11; Hansa Bay (Madang Province, Papua New Guinea); coll. B. TURSH & G. SEGHERS, 11.x.1978, dredging at 21 m on sandy-muddy bottom; 7 specimens.

DESCRIPTION

Specimens small, ranging from 23x3 mm to 53x5 mm. Body pentagonal in cross section; colour in alcohol whitish-grey. Body tapering at both ends, particularly at the anal end. Posterior part curved. Body wall thin, firm, gritty to the touch, translucent (intestinal content visible against light). Mouth and anus terminal; 5 valves closing the mouth opening; anus surrounded by numerous small overlapping calcareous plates. Tube feet large, conical, rigid, located in a single row along each ambulacrum; tube feet largely separated from each other, their number varying with body length: from 14 tube feet/row for a 23 mm long specimen to 37-38 tube feet/row for a 53 mm long specimen. Tentacles fully retracted, difficult to count; at least seven large bushy tentacles.

Calcareous ring narrow with radial and interradial plates nearly the same size (fig. 1A); radial pieces without posterior forked processes but with a posterior notch; retractor muscles of the calcareous ring short (1/10 of body length); longitudinal muscles inconspicuous. One short Polian vesicle. Gonad not observed.

Ossicles of dorsal and ventral body wall, large (up to 860 µm across), squarish or rounded (fig. 1B) densely crowded scales. Between the large scales, nodulous buttons (fig 1C), 25-60 µm across, and small basket-like ossicles (fig. 1D), 17-24 µm across. Tube feet with perforated plates (fig. 1E), 70-100 µm across, nodulous buttons (fig. 1F) with some bearing a long spine (fig. 1F), and a few irregular rod-like ossicles (fig. 1G); no end plate.

REMARKS

The fact that the species *imbricata* has been allocated to five different genera (*Ocnus*, *Cucumaria*, *Trachythyone*,

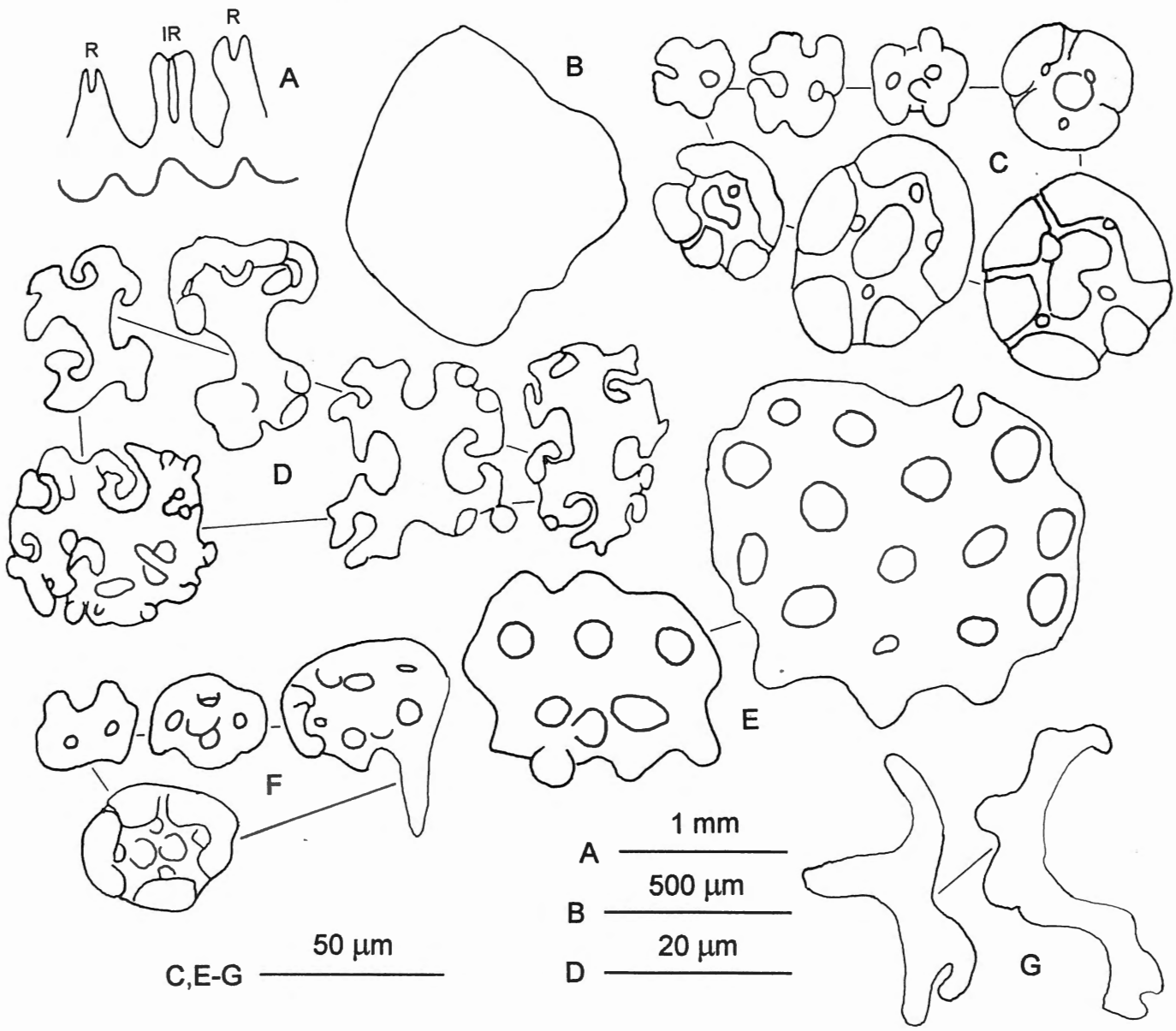


Fig. 1. *Leptopentacta imbricata* (SEMPER, 1868). A: calcareous ring (R: radial; IR: interradial); B: body wall scale; C: nodulous buttons from body wall; D: baskets from body wall; E: perforated plates from tube feet; F: nodulous buttons from tube feet; G: irregular rods from tube feet.

Parocnus and *Leptopentacta*) illustrates that the diagnoses of many dendrochirotid taxa need revision. Here, the specimens studied are allocated to the genus *Leptopentacta* because of their general aspect, position of their tube feet, presence of 5 oral valves and knobbed plates and irregular baskets in the body wall. However, the aspect of the calcareous ring of the material from Papua New Guinea is closer to the genus *Trachythyone* than *Leptopentacta*. *Leptopentacta grisea* CLARK, 1938, the type species of the genus *Leptopentacta*, has the radial plates of the calcareous ring indented by a deep posterior notch whereas *Trachythyone muricata* STUDER, 1876, the type species of the genus *Trachythyone*, presents radial plates of the calcareous ring with a shallow posterior notch. Several species currently classified in the genus *Leptopentacta* have their radial plates with only a shallow posterior notch, (e.g. *Leptopentacta ignava* (LUDWIG, 1875); *L. nova* DEICHMANN, 1941). It thus seems that the variation of the depth of the notch has value in separating species but not genera. In my opinion the presence of oral valves and small-knobbed perforated plates in the body wall are characteristics of the genus *Leptopentacta*.
The specimens from Papua New Guinea are very close to specimens from Hong-Kong illustrated by PANNING (1966, fig. 5). *L. imbricata* is a common species with a wide distribution from south-east Arabia to Indonesia and from the Philippines to China. The species is new to the fauna of Papua New Guinea.
Type of bottom and depth records are in accordance with published data on the species (SLUITER, 1901; LANE *et al.*, 2000).

Plesiocolochirus CHERBONNIER, 1946
Plesiocolochirus australis (LUDWIG, 1875)
Figs 2A-M, 3A-D

Colochirus australis LUDWIG, 1875: 88, pl. 6, fig. 15a-c.
Plesiocolochirus australis; ROWE & GATES, 1995: 278 (synonymy); MASSIN, 1999: 83, figs 68a-k, 69a-j, 70, 112 h (synonymy and list of records before 1999).
Cucumarid sp. 3; LANE & VANDENSPEGEL, 2003: 158.

TYPE LOCALITY

Bowen (Australia).

MATERIAL EXAMINED

IRSNB IG 27754/77, patch reef between Tabat and Wongat Islands (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 10.ix.1990, by diving, under an *Echinopora* sp. at 3 m depth, one specimen; IRSNB IG 27754/102, patch reef in front of Ruo Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 14.ix.1990, by diving, under a block of *Favites* sp. at 3 m depth, one specimen; IRSNB IG 28455/39, Durangit Reef (Hansa Bay, Madang Province, Papua New Guinea), coll. J.-C. BUSSERS 13.x.1996, by diving, among *Halimeda* sp., 5m depth, one specimen.

DESCRIPTION

Specimens small, 11.0x3.5 mm, 11.5x4.6 mm and 16.0x2.0 mm, quadrangular in cross section. Colour in alcohol beige; tentacles white with base and main stem speckled with black-brown. Mouth and anus terminal; mouth closed by 5 buccal valves; tentacles 10 (8 large + 2 ventral small); anus guarded by 5 anal teeth. Body wall gritty to the touch, thick, rigid because of the presence of numerous large scales. Tube feet only along ambulacra, in a single row along the 2 dorsal ambulacra and in a double row along the 3 ventral ambulacra (fig. 2A); in the slender specimen (2 mm across) tube feet in a single row in all the ambulacra. Dorsal tube feet few, small, sometimes difficult to see because of the body wall scales.

Calcareous ring without posterior processes but with posterior margin strongly undulating (fig. 2B) due to deeply notched interradial plates; radial and interrradial plates of similar size; anterior prolongation of the radial plates prominent; one short, pyriform Polian vesicle; one stone canal ending in a spherical madreporic plate located close to the calcareous ring; gonad made up of a few unbranched tubules; retractor muscles of the calcareous ring attached at mid-body.
Dorsal and ventral body wall with large multi-layered, round, oval or triangular scales, 230-670 µm long (fig. 2C, D), nodulous buttons with 4-6 holes, 60-85 µm across (fig. 2E, F) and nodulous-spiny baskets with (fig. 2G, H) or without (fig. 2J) a transverse bar, 45-65 µm across. Tube feet with perforated rods, 115-220 µm long (fig. 2K) and perforated plates, 70-125 µm long (fig. 2L); the latter located close to end plate which is 140-200 µm across (fig. 2M). Ossicles of tentacles highly variable according to the specimen; main ones large, irregular, perforated rods 125-260 µm long, located at the base of the tentacles (fig. 3A), small straight or curved perforated rods, 55-110 µm long (fig. 3B), small, branched rosettes, 20-40 µm long (fig. 3C), and rounded or elliptical rosettes, 25-50 µm long (fig. 3D); various perforated plates also present (fig. 3E).

REMARKS

The specimens of *Plesiocolochirus australis* from Papua New Guinea are very similar to the ones described by MASSIN (1999: figs 68-69) from Sulawesi. Ossicles of the tentacles present the same high variability.
The species was previously known from Australia, Indonesia and New Caledonia. It is new to the fauna of Papua New Guinea.

Phyllophoridae OSTERGREN, 1907
Thyoninae PANNING, 1949
Stolus SELENKA, 1867
Stolus rapax (KOEHLER & VANEY, 1908)
Fig. 4A-H

Cucumaria rapax KOEHLER & VANEY, 1908: 39, pl. 2, fig. 17-19; DANIEL & HALDER,1974: 419.
Stolus rapax; PANNING, 1949: 462; A.M. CLARK & ROWE,

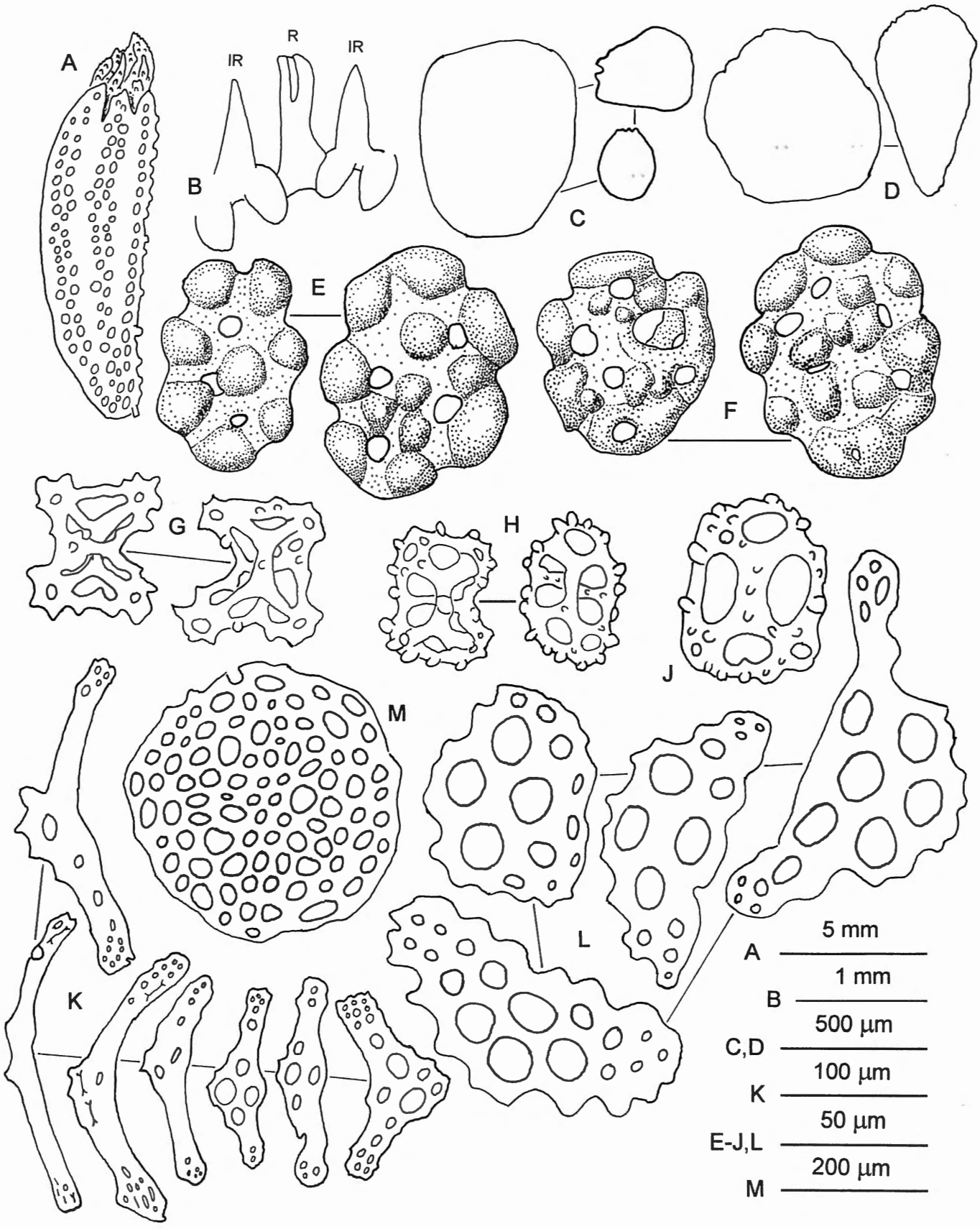


Fig. 2. *Plesiocolochirus australis* (LUDWIG, 1875). A: ventral view of a specimen; B: calcareous ring (R: radial; IR: interradial); C: large scales from dorsal body wall; D: large scales from ventral body wall; E: nodulous buttons from dorsal body wall; F: nodulous buttons from ventral body wall; G: baskets from dorsal body wall; H: baskets from ventral body wall; J: basket without transverse bar; K: perforated rods from tube feet; L: perforated plates from tube feet; M: tube feet end plate.

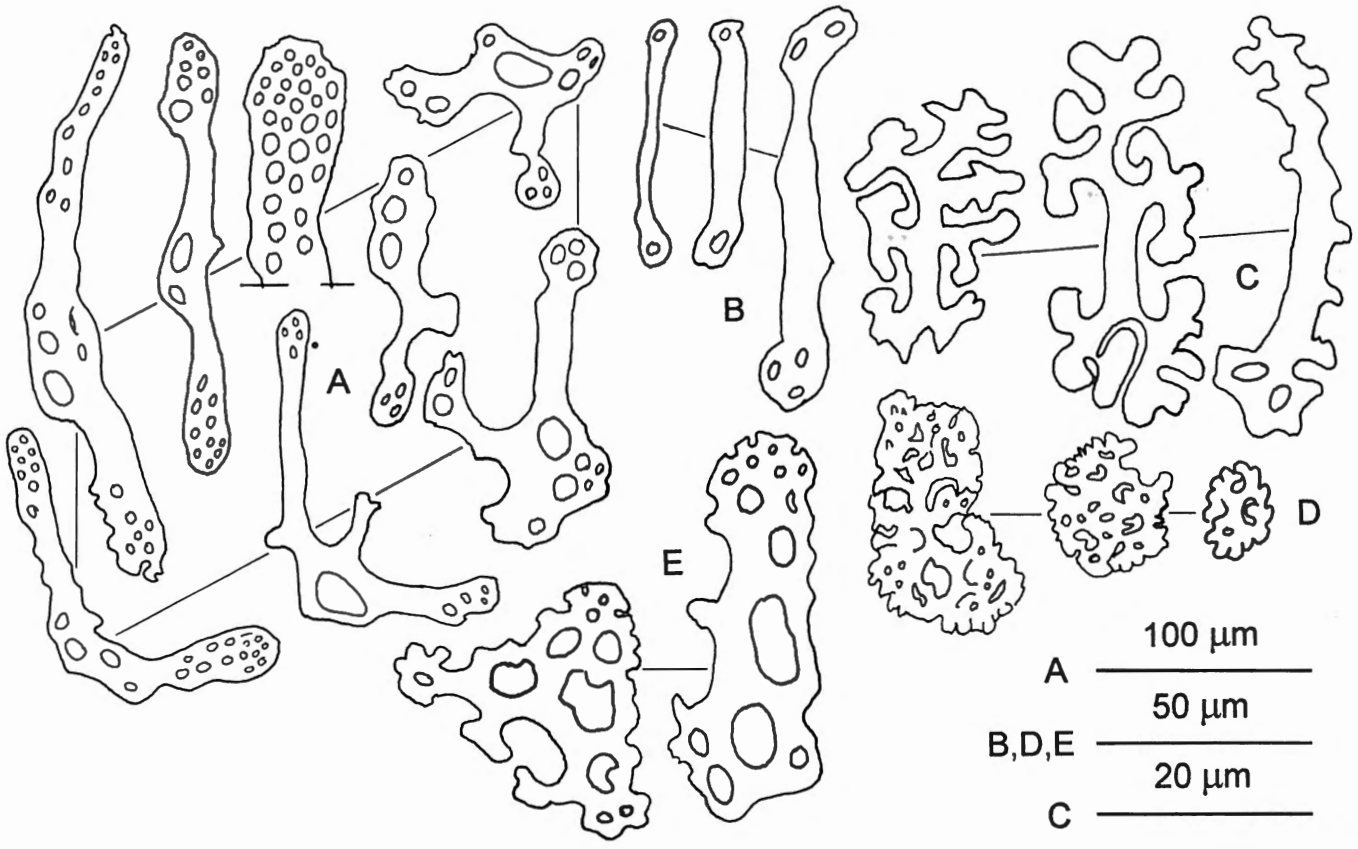


Fig. 3. *Plesiocolochirus australis* (LUDWIG, 1875). Ossicles from the tentacles. A: large perforated rods; B: small perforated rods; C: small rosettes; D: large rosettes; E: perforated plates.

1971: 182; RAJPAL & THANDAR, 1999: 131; THANDAR (in press).

TYPE LOCALITY

Bay of Bengal

MATERIAL EXAMINED

IRSNB IG 29848/10; Hansa Bay (Madang Province, Papua New Guinea); coll. B. TURSH & G. SEGHERS, 17.x.1978, dredging at 40-60 m on sandy-muddy bottom; 2 specimens.

DESCRIPTION

Specimens small, 32x6.0 mm and 38x6.5 mm, width measured at mid-body. Body U-shaped, tapering strongly toward both ends; near to mouth, the body is only 2.5 to 3 mm across. Mouth and anus terminal. Body wall very thin, soft, translucent, gritty to the touch because of the numerous large scales clearly visible to the naked eye. Colour in alcohol whitish. Tube feet restricted to ambulacra; close to the mouth and the anus they are short, in a zigzag row; mid-ventrally they are longer and more numerous (in 2-3 rows). Tentacles not observed because aquapharyngeal bulb fully retracted.
Radial plates of the calcareous ring with subdivided, long, narrow posterior processes (fig. 4A) and an anterior groove for the insertion of retractor muscle; interradial plates in a mosaic of pieces and with an anterior tooth (fig. 4A). One Polian vesicle, 1/10 of body length. Stone canal not observed. Longitudinal muscles inconspicuous. Gonad consisting of a few unbranched tubules.
Ossicles of body wall, both dorsally and ventrally, numerous large, multi-layered plates, 150-500 µm across (fig. 4B-C), and few small, simple perforated plates, 80-100 µm across (fig. 4D). In the tube feet, multi-layered plates at the base, 125-160 µm across, similar to those of body wall (fig. 4E); at the tip, small perforated plates, some with 2 short pillars (fig. 4F), and curved tables with 2 central pillars (fig. 4G); the latter arranged in concentric circles around end plate (fig. 4H).

REMARKS

The specimens fit very well with description of *Stolus rapax* (KOEHLER & VANEY, 1908), a species known up to now only from the Bay of Bengal (at mouth of the Hughli River). *S. rapax* can be easily separated from nearly all the other species at present included in the genus *Stolus* [*S. albescens* LIAO in LIAO & CLARK, 1995; *S. buccalis* (STIMPSON, 1856); *S. canescens* (SEMPER, 1868); *S. cognatus* (LAMPERT, 1885); *S. conjungens* (SEMPER, 1868); *S. crassus* LIAO & PAWSON,

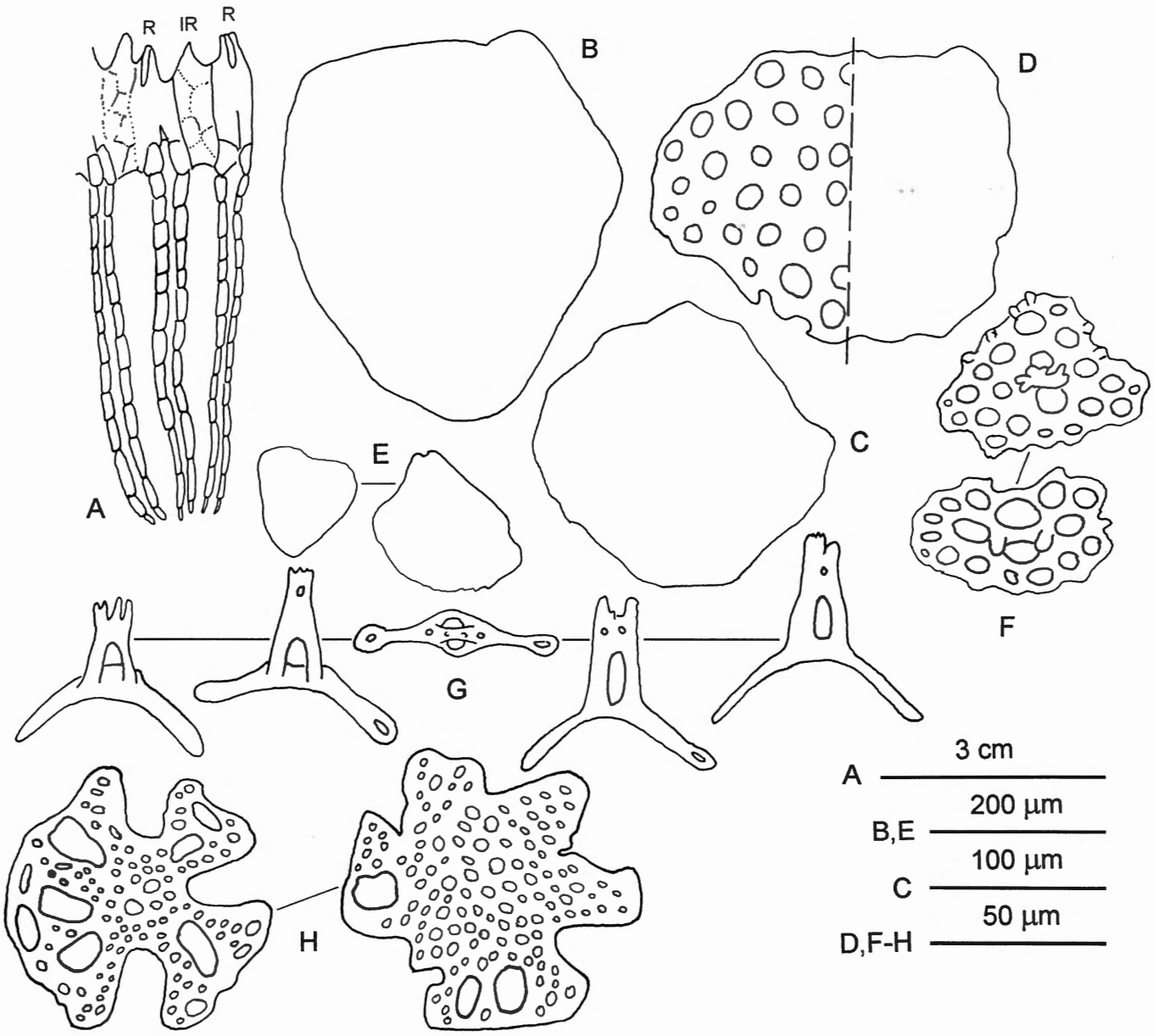


Fig. 4. *Stolus rapax* (KOEHLER & VANEY, 1908). A: calcareous ring (R: radial; IR: interradial); B: large plate from dorsal body wall; C: large plate from ventral body wall; D: small perforated plate from body wall; E: multi-layered plate from tube feet; F: small perforated plates from tube feet; G: curved tables from tube feet; H: end plates from tube feet.

2001; *S. dentatus* THANDAR (in press); *S. micronodosus* LIAO & PAWSON, 2001; *S. minutus* H.L. CLARK, 1938; *S. papillatus* (SLUITER, 1887); *S. pseudoalbescens* THANDAR (in press); *S. punctata* (OHSHIMA, 1915)] due to the absence of nodulous buttons and the presence of thick multi-layered plates in the body wall and the tube feet. Only *S. kilberti* RAJPAL & THANDAR, 1999 is also characterised by large multi-layered plates and the absence of nodulous buttons. However, *S. kilberti* is readily separated from *S. rapax* by the size and the shape of the large plates (RAJPAL & THANDAR, 1999; THANDAR in press). As already noted by KOEHLER & VANEY (1910) and RAJPAL & THANDAR (1999) *S. rapax* is also very close to *Pseudothyone mosaica* (KOEHLER & VANEY, 1910). The main differences between both species is the presence of divided or undivided plates of the calcareous ring, respectively. This is an example of two species that have a remarkably similar ossicle assemblage but at the same time different calcareous rings. By their calcareous ring they have been placed in separate families (Phyllophoridae and Sclerodactylidae)! This questions again (cf supra *Leptopentacta imbricata*) the importance of the calcareous ring in dendrochirote taxonomy, and the definition of several dendrochirote genera which are in need of revision. In the meantime, I will adopt the point of view of RAJPAL & THANDAR (1999) and refer the species *rapax* to the genus *Stolus*.

The species is new to the fauna of Papua New Guinea.

Phyllophorinae ÖSTERGREN, 1907
Phyllophorus GRUBE, 1840
Phyllothuria HEDING & PANNING, 1954
Phyllophorus (Phyllothuria) hypsipyrga (MARENZELLER, 1881)
Fig. 5A-H

Orcula hypsipyrga MARENZELLER, 1881: 135, pl. V, fig. 10.
Phyllophorus hypsipyrgus; CHANG & LIAO, 1964: 30, text fig.
Phyllophorus (Phyllothuria) hypsipyrga; HEDING & PANNING, 1954: 151, fig. 64a-c, fig. 65a-e (synonymy and records before 1954); CLARK & ROWE, 1971: 184, pl. 29, fig. 19; RHO & WON, 1993: 127, pl. 3, figs 1-9; LIAO, 1997: 211, fig. 126a-j; LANE *et al.* 2000: 491.

MATERIAL EXAMINED

IRSNB IG 29848/3, Hansa Bay (Madang Province, Papua New Guinea); coll. B. TURSH & G. SEGHERS, 12.x.1978, dredging at 46 m on sandy-muddy bottom; 4 specimens; IRSNB IG 29848/8, Hansa Bay (Madang Province, Papua New Guinea); coll. B. TURSH & G. SEGHERS, 17.x.1978, dredging at 40-60 m on sandy-muddy bottom; 2 specimens.

TYPE LOCALITY

Japan.

DESCRIPTION

Specimens small, ranging from 18x5 mm to 104x20 mm. Body cylindrical, with a short narrow tail distally. Mouth and anus terminal, anus surrounded by 5 anal papillae. Body wall gritty to the touch. Colour in alcohol from white to grey-beige with brown areas. Calcareous ring and ossicles visible through transparent body wall. Tube feet large, sparsely distributed over the whole body surface, more numerous ventrally.
Calcareous ring 1/7 to 1/6 of body length; radial plates with posterior processes, each made up of 5-7 pieces, the last ones (4-7) very narrow (fig. 5A); anterior part of radial plate with a deep groove for the attachment of prominent retractor muscles; interradial plates each with a strong anterior tooth (fig. 5A); retractor muscles attached at 1/4 to 1/3 of body length. Polian vesicle, single, short; stone canal single.
In the body wall and tube feet, tables only. Table bases with one large central hole and 8-24 peripheral ones (fig. 5B-E); majority with 8 large, regular peripheral holes (fig. 5B, D). In the largest specimen the 8 peripheral holes of the tables are smaller (fig. 5E) than in tables from small specimens. One specimen (49 mm long) has a mixture of table bases with large and narrow holes; rim of disc smooth or with few short blunt spines; table discs 60-120 µm across, table height 50-150 µm; the smaller the specimen the taller the tables; spire of the tables with 4 pillars united by 2-6 cross beams, and ending in a small crown of short spines. End plates of tube feet 110-240 µm across (fig. 5F), larger ventrally. Introvert with, miliary granules, round or elliptical, 40-80 µm across (fig. 5G). Tentacles with numerous very narrow rods, 50-95 µm long (fig. 5H).

REMARKS

The calcareous ring and the tables with a high spire are characteristic of the genus *Phyllophorus* and the subgenus *Phyllothuria* (see HEDING & PANNING, 1954). The specimens are very close to the *Phyllophorus (Phyllothuria) hypsipyrga* (MARENZELLER, 1881) reported by OHSHIMA (1912). They also present some affinities with *Phyllophorus (Phyllothuria) discrepans* (SLUITER, 1901) but are distinct by the presence of more numerous and narrower subdivisions of the posterior processes of the radial plates, by the regular tables, and by the very tall spire of the tables.
The species was previously known from Korea, Japan, China and Indonesia and is new to the fauna of Papua New Guinea.

Semperiellinae HEDING & PANNING, 1954
Massinium SAMYN & THANDAR, 2003
Massinium magnum (LUDWIG, 1882)
Fig. 6A-K

Thyonidium magnum LUDWIG, 1882: 132.
Neothyonidium magnum; HEDING & PANNING, 1954:197, fig. 98A-M; MASSIN, 1999: 88, figs. 72a-k, 73, 113a (synonymy).
Massinium magnum; SAMYN & THANDAR: 2003: 136.

TYPE LOCALITY

Ambon (Indonesia).

MATERIAL EXAMINED

IRSNB IG 28455/51, Laing Island H1H2 (Hansa Bay, Madang Province, Papua New Guinea), coll. C. MASSIN, 16.x.1996, by diving at 5 m depth in coarse sand, one specimen (tentacles + introvert); IRSNB IG 28455/54, Laing Island H1H2 (Hansa Bay, Madang Province, Papua New Guinea), coll. C. MASSIN, 17.x.1996, hand picking 6 m depth in coarse sand, one specimen (tentacles + introvert + a piece of body wall).

DESCRIPTION

Large species with tentacle crown up to 30 cm across when fully extended Colour of large tentacles of living specimen: at base, alternation of beige and black-brown bands, at tip uniform black; introvert beige with two rows of black-brown tube feet along each ambulacrum; colour in alcohol same but faded; body wall beige. Twenty tentacles in 2 circles: external circle of 10 large tentacles, inner circle of 10 small tentacles.
Calcareous ring similar to specimens from Sulawesi (see MASSIN, 1999: fig. 72a-b).
Body wall with only rosettes, 15-35 µm long (fig. 6A). Tube feet with similar rosettes to those from body wall, 15-40 µm long (fig. 6B), in addition, irregular rods, 80-130 µm long

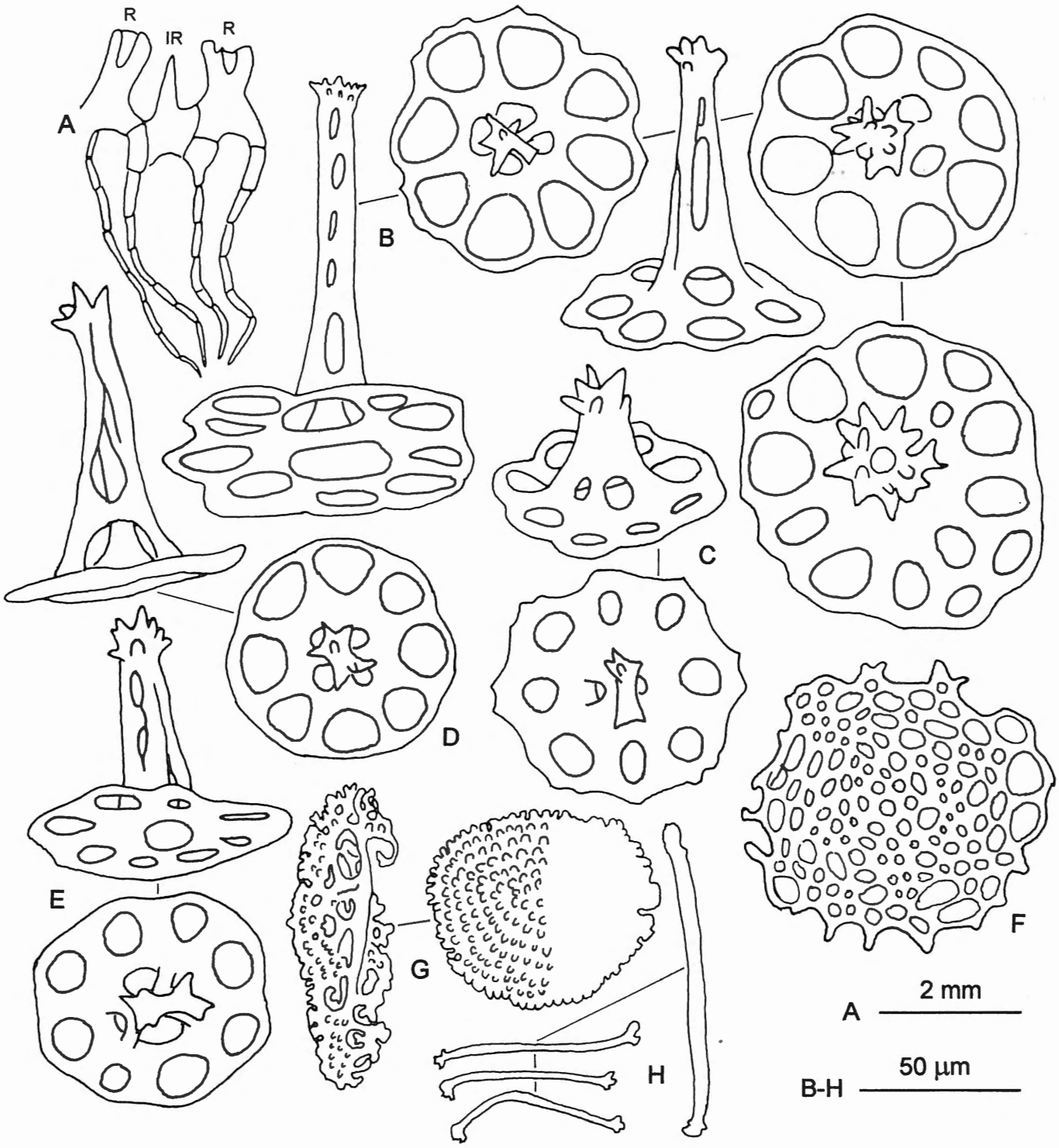


Fig. 5. *Phyllophorus (Phyllothuria) hypsipyrga* (MARENZELLER, 1881). A: calcareous ring (R: radial; IR: interradial); B: tables from dorsal body wall; C: tables from ventral body wall; D: tables from dorsal tube feet; E: tables from ventral tube feet; F: tube feet end plate; G: miliary granules from introvert; H: rods from tentacles.

(fig. 6C) located close to end plate (fig. 6D) which is 300-320 µm in diameter, and a few tables reduced to discs, perforated by 4 holes. Introvert with tables only (fig. 6E), spires 40-50 µm high, discs 80-100 µm across, perforated by 4 large central holes and 10-45 small peripheral holes. In tube feet of introvert, irregular perforated rods, 30-155 µm long (fig. 6F), numerous rosettes, 30-65 µm long (fig. 6G) and tables (fig. 6H); disc of tables round or ovate with smooth margin, 4 large central holes and 12-30 small, peripheral holes; spire 20-25 µm high, made of 2 pillars ending in a bundle of blunt spines; end plates 600-630 µm across. In the tentacles, rosettes only, large at base (fig. 6J), small in secondary branches and close to extremities (figs. 6K, L); in the distal extremities, no ossicles.

HABITS

Body always buried in the sand, only tentacles and introvert visible; tentacles coming out at sunset and at night.

REMARKS

The specimens of *Massinium magnum* from Papua New Guinea are similar to those specimens from Sulawesi described by MASSIN (1999, fig. 72). They differ slightly by the height of the spire of the introvert tables (shorter for the specimens from Papua New Guinea) and by the perforated rods of the tube feet of the introvert (rods perforated by a few large holes for specimens from Papua New Guinea versus numerous small holes for specimens from Sulawesi).
The species is new to the fauna of Papua New Guinea.

Thyoninae PANNING, 1949
Thyone JAEGER, 1833
Thyone bicornis OHSHIMA, 1915
Fig. 7A-E

Thyone bicornis OHSHIMA, 1915: 270, pl. 10, fig. 24a-d; CHANG & LIAO, 1964: 26, text fig.; LIAO & A.M. CLARK, 1995: 503, fig. 305a-e; LIAO, 1997: 198, fig. 117a-e; WON & RHO, 1998: 9, fig. 2A-H; LANE *et al.*, 2000: 491.
Non *Thyone bicornis*; YANG, 1937: 6, fig. 3a-g.

TYPE LOCALITY

Suruga Bay, south mid-Japan

MATERIAL EXAMINED

IRSNB IG 25848/9, Hansa Bay (Madang Province, Papua New Guinea), coll. B. TURSH & G. SEGHERS, 17.x.1978, dredging at 40-60 m on sandy-muddy bottom; one specimen.

DESCRIPTION

Specimen small, 23,5x9 mm; body curved, banana-shaped, with mouth and anus slightly dorsal; tube feet narrow, cylindrical, sparsely scattered all over the body wall. Skin thin, soft, translucent; colour in alcohol greyish. Calcareous ring tubular, 9 mm long with long posterior processes (fig. 7A) made up of a mosaic of pieces; radial plates with an anterior slit for the attachment of the retractor muscle; interradial plates with an anterior notch; retractor muscles 5 mm long; tentacles fully retracted. Polian vesicle 3.8 mm long. Madreporic plate and gonad not observed.
Ossicles sparse in body wall and tube feet. Body wall with tables only, discs 70 µm across, perforated by 4 large central holes and 4 small peripheral holes (fig. 7B); rim of disc smooth; no pillar or 2 pillars united by a single cross beam and ending in 2 diverging spines, sometimes bifurcate distally (fig. 7B). Tube feet with tables with curved, perforated discs and a spire made up of 2 pillars fused at apex in a single point (fig. 7C); end plates small, 45-50 µm across, some star-shaped (fig. 7D). Introvert with numerous rosettes, 20-50 µm long (fig. 7E).

REMARKS

The specimen collected in Papua New Guinea presents many affinities with *Thyone bicornis* OHSHIMA, 1915 as reported from China (LIAO & CLARK, 1995). It differs mainly in the form of the tables from the tube feet. The ones from China have a spire made of 2 separate pillars whereas the one from Papua New Guinea has a spire made of 2 fused pillars (tack-like). Since tables of the tube feet in some *Thyone* species may present both forms of spire (*T. comata* CHERBONNIER, 1988, *T crebrapodia* CHERBONNIER, 1988) this difference cannot be retained at the specific level.
The specimen observed shows also affinities with *T. crebrapodia* (particularly the specimens described by LIAO & PAWSON, 2001) and *T. longicornis* CHERBONNIER, 1988. However, in the original description of *T. crebrapodia*, CHERBONNIER mentioned tables in the introvert whereas in the specimen from Papua New Guinea only rosettes are present. The specimen observed differs from *T. longicornis* by the much smaller size of the two points of the body wall table spires and by the greater number of small holes in the tube feet end plates. The species is new to the fauna of Papua New Guinea.

Sclerodactylidae PANNING, 1949
Cladolabinae HEDING & PANNING, 1954
Cladolabes BRANDT, 1835
Cladolabes acicula (SEMPER, 1868)

Cucumaria acicula SEMPER, 1868: 54, pl.15, fig. 11.
Cladolabes acicula; MASSIN, 1996: 42, fig. 29A-D, 30A-C (synonymy and list of records);
Cladolabes aciculus; LIAO & A.M. CLARK, 1995: 489, fig. 295a-d; LIAO, 1997: 181, fig. 105a-d; LANE *et al.*, 2000: 490.

TYPE LOCALITY

Viti Island (Fiji)

MATERIAL EXAMINED

IRSNB IG 26700/199, Durangit Reef (Hansa Bay, Madang

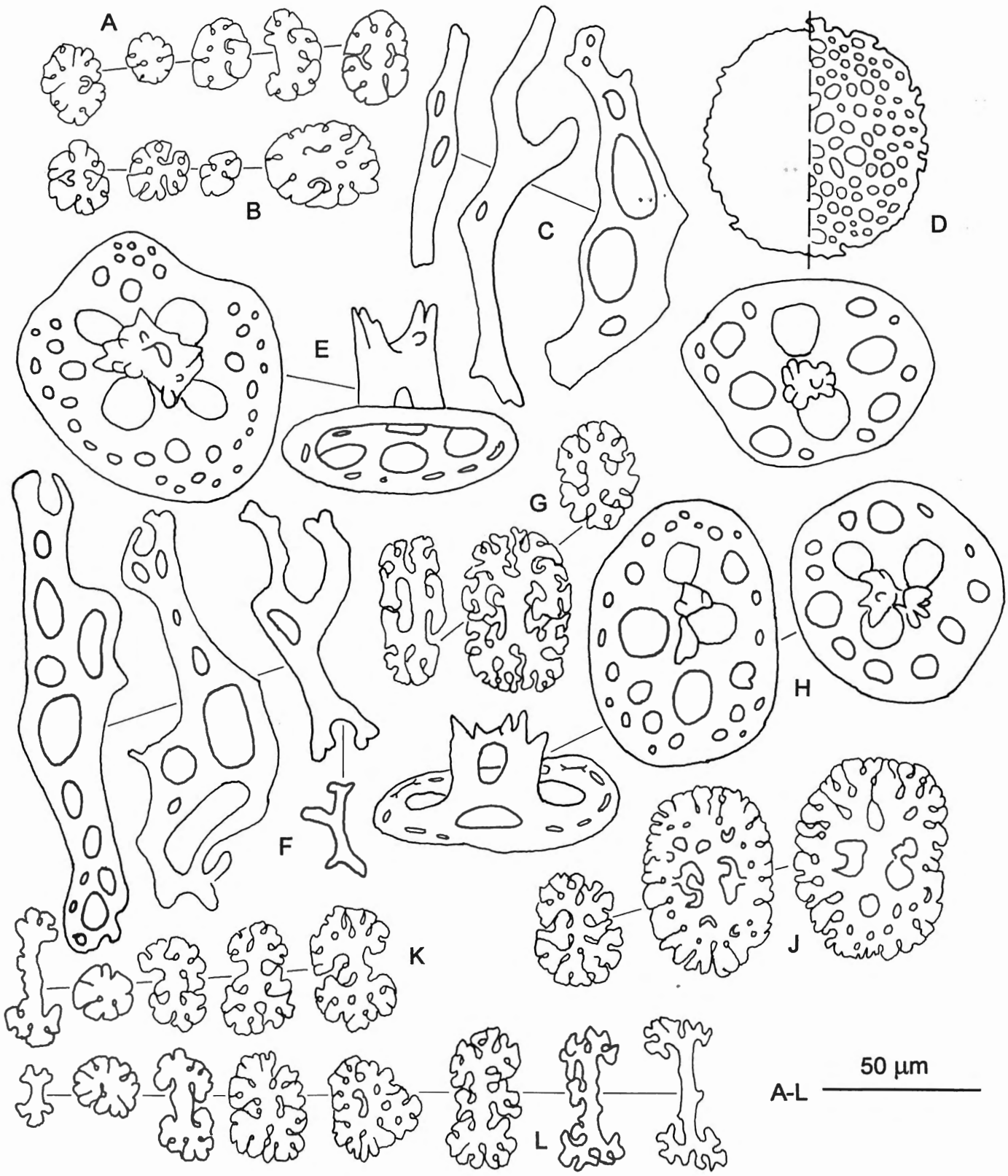


Fig. 6. *Massinium magnum* (LUDWIG, 1892). A: body wall rosettes; B: tube feet rosettes; C: rods from tube feet; D: tube feet end plate; E: tables from introvert; F: irregular rods from introvert tube feet; G: rosettes from introvert tube feet; H: tables from introvert tube feet; J: rosettes from tentacle base; K: rosettes from tentacle secondary shaft; L: rosettes close to the smallest ramifications of the tentacles.

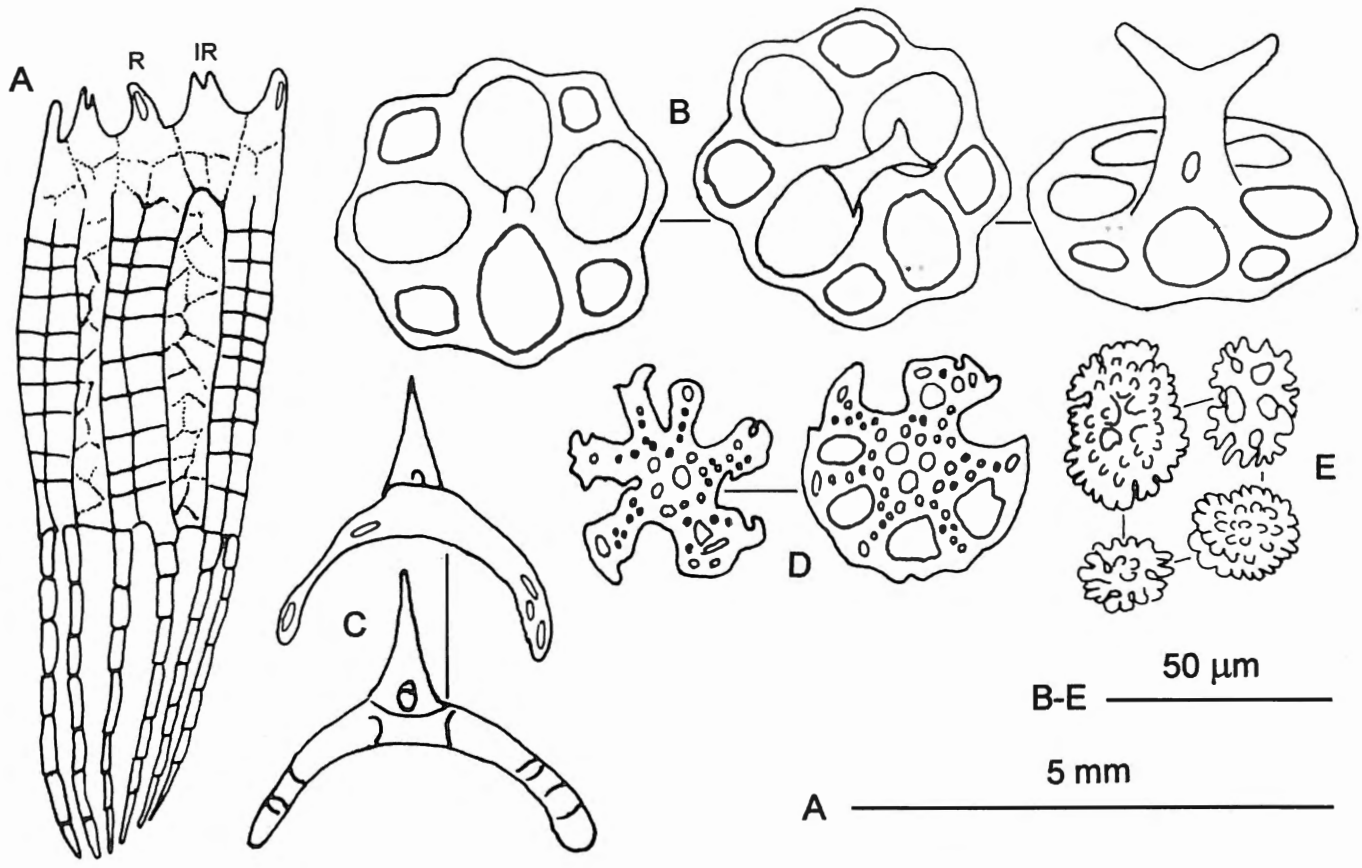


Fig. 7. *Thyone bicornis* OHSHIMA, 1915. A: calcareous ring (R: radial; IR: interradial); B: tables from body wall; C: curved tables from tube feet; D: tube feet end plates; E: rosettes from introvert.

Province, Papua New Guinea), coll C. MASSIN, 05.xi.1983, by diver under a block of *Leptoria phrygia* (ELLIS & SOLANDER, 1786) at 7 m depth, one specimen; IRSNB IG 27598/36, Tab Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 18.ix.1989, by diver under a block of *Leptoria phrygia* at 3 m depth, one specimen.

DESCRIPTION

Living specimens bright orange with brown-black tentacles; in alcohol completely white; body cylindrical, 74x30 mm and 68x20 mm. Tube feet in rows along ambulacra only, densely crowded ventrally, sparse dorsally; mouth and anus terminal. Ossicles identical to the ones illustrated by MASSIN (1996: fig. 29, 30) for a specimen from Ambon.

REMARKS

Throughout its wide distribution area (from Mauritius to Fiji and Hawaii) *Cladolabes acicula* is very constant in its colour pattern and ossicle assemblage. The species is new to the fauna of Papua New Guinea.

Cladolabes schmeltzii (LUDWIG, 1875)

Thyonidium Schmeltzii LUDWIG, 1875: 94, fig. 20a-b.
Cladolabes schmeltzii; LIAO & A.M. CLARK, 1995: 490, fig. 296a-b; LIAO, 1997: 183, fig. 107a-b; MASSIN, 1999: 96, fig; 80a-e, 81, 113d (synonymy and list of records); LANE *et al.*, 2000: 490.

TYPE LOCALITY

Bowen (Great Barrier Reef, Australia)

MATERIAL EXAMINED

IRSNB IG 27598/61, patch reef NW of Guzem Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 23.ix.1989, by diver under a block of *Hydnophora exesa* (PALLAS, 1766), 3 m depth, one specimen.

DESCRIPTION

Specimen small, 21x8 mm, cylindrical with mouth and anus

terminal. Colour in alcohol whitish yellow; tube feet in rows along the ambulacra only, more numerous ventrally than dorsally. Tentacles partly withdrawn, only the outer circle of 10 tentacles visible; anus without anal teeth. Ossicles identical to the ones figured by MASSIN, 1999 (fig. 80).

REMARKS

Cladolabes schmeltzii is very constant in its ossicles composition throughout its distribution area (see illustrations of HEDING & PANNING 1954, CLARK & ROWE 1971, CANNON & SILVER 1987, LIAO & CLARK 1995, MASSIN 1999). The species is new to the fauna of Papua New Guinea.

Afrocucumis DEICHMANN, 1944
Afrocucumis africana (SEMPER, 1868)

Cucumaria africana SEMPER, 1868: 53, pl. 15, fig. 16.
Afrocucumis africana; MASSIN, 1999: 96, fig. 79 (synonymy and list of records); SAMYN, 2003: 8, fig. 1A-C, fig. 51A.

MATERIAL EXAMINED

IRSNB IG 26700/110, Laing Island K3-4-5 (Hansa Bay, Madang Province, Papua New Guinea), coll. C. MASSIN, 18.x.1983, by hand on the reef flat at low tide, under stones, 4 specimens.

TYPE LOCALITY

Querimba Island (Mozambique)

DESCRIPTION

Specimens small, from 7x9 mm to 124x14 mm, barrel-shaped; living specimens brown-black dorsally as well as ventrally; in alcohol, completely white, translucent; large body wall ossicles visible in the translucent body wall. Tube feet large, in 2 rows on each ambulacrum. Mouth and anus terminal. Ossicles identical to those illustrated by MASSIN (1996; fig. 27) from a specimen from Ambon. Large lenticular plates 200-290 µm across.

REMARKS

The size of the large lenticular plates and the absence of miliary granules in the tube feet are characteristic of *Afrocucumis africana* and readily separates *A. africana* from *A. stracki* MASSIN, 1996. Up to now *A. africana* has mainly been found intertidally (see among others OHSHIMA 1916; ROWE & DOTY 1977; SLOAN *et al.* 1979; CHERBONNIER 1988; LIAO & CLARK 1995; MASSIN 1996; LANE *et al.* 2000; SAMYN 2003, present study) whereas *A. stracki* lives in shallow waters (1-5 m depth). The species is new to the fauna of Papua New Guinea.

Afrocucumis stracki MASSIN, 1996
Fig. 8A-E, pl. 1

Afrocucumis stracki MASSIN, 1996: 40, fig. 28A-G.
Pseudocucumis africanus; ENGEL, 1933: 16, fig. 15a-b, 16a-d.

TYPE LOCALITY

Ambon (Indonesia).

MATERIAL EXAMINED

IRSNB IG 27598/31, Tab Islands (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 18.ix.1989, by diver under a block of *Symphyllia radians* EDWARDS & HAIME, 1849 at 3 m depth, 2 specimens; IRSNB IG 27598/45, patch reef on the left side of Guzem Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 21.ix.1989, by diver under a block of *Hydnophora microconos* (LAMARCK, 1816) at 2 m depth, 4 specimens; IRSNB IG 27598/53, patch reef N.W. of Guzem Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 22.ix.1989, by diver under a block of *Favites flexuosa* (DANA, 1846) at 3 m depth, 2 specimens; IRSNB IG 27598/76, patch reef in front of Guzem Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 28.ix.1989, by diver under a block of *Cyphastrea microphthamla* (LAMARCK, 1816), 5 m depth, one specimen; IRSNB IG 27754/101, patch reef in front of Riwo Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 14.ix.1990, by diver under a block of *Goniastrea* sp. at 5 m depth, one specimen; IRSNB IG 27754/103, patch reef in front of Riwo Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 14.ix.1990, by diver under a block of Agariciidae at 3 m depth, one specimen; IRSNB IG 27754/104, patch reef in front of Riwo Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 14.ix.1990, by diver under a block of *Pavona clavus* (DANA, 1846) at 4 m depth, one specimen; IRSNB IG 27754/118, patch reef in front of Guzem Island (Madang's Reef, Madang Province, Papua New Guinea), coll. C. MASSIN, 19.ix.1990, by diver under a block of *Platygyra* sp. at 3 m depth, 3 specimens.

DESCRIPTION

Specimens from 23 to 55 mm long and 7 to 14 mm wide at mid-body; cylindrical, tapering mainly distally; colour of living specimens brown; colour in alcohol brown-beige with white close to the mouth and the anus which are both terminal; tube feet large, long, numerous, scattered all over the body wall at mid-body; rows (2) visible close to the mouth and the anus for most specimens; only few specimens with rows visible over the whole length. In most specimens, anal papillae surround anus. Tentacles fully withdrawn; genital papillae not observed. Contrary to the type material, posterior processes of calcareous ring fragmented (fig. 8A). Retractor muscles prominent, attached at 1/3 of body length

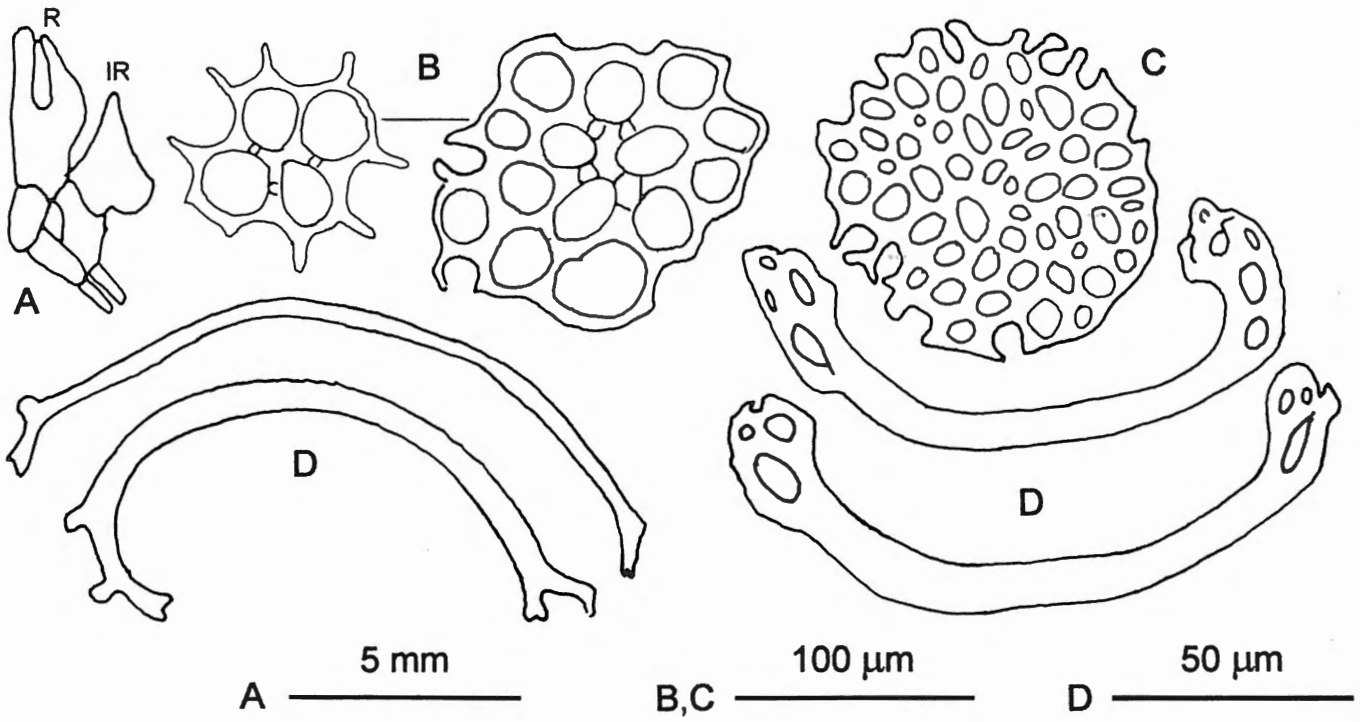


Fig. 8. *Afrocucumis stracki* MASSIN, 1996. A: calcareous ring (R: radial; IR: interradial); B: perforated plates from body wall and tube feet; C: tube feet end plate; D: C-shape rods from tentacles. A: adult; B-D: juvenile.

from anterior end; Polian vesicle, single, large; stone canal single.

Typical ossicles as large lenticular plates, 300-375 µm across, in the body wall; miliary granules in the tube feet; rods with numerous perforations at their extremities in the tentacles. The number of miliary granules in tube feet highly variable within the species and not related to size of specimen.

Four females with gonad well developed containing very large oocytes (nearly one mm across) and one female with doliolaria larvae in the gonad. One female with brooding juveniles, 1.6-1.8 mm long,, approximately 80 free in the coelomic cavity and about 30 still in the gonads. All the oocytes, doliolaria larvae or juveniles are at the same stage of development in the gonad of a female. All the material was collected in September (1989 & 1990) .

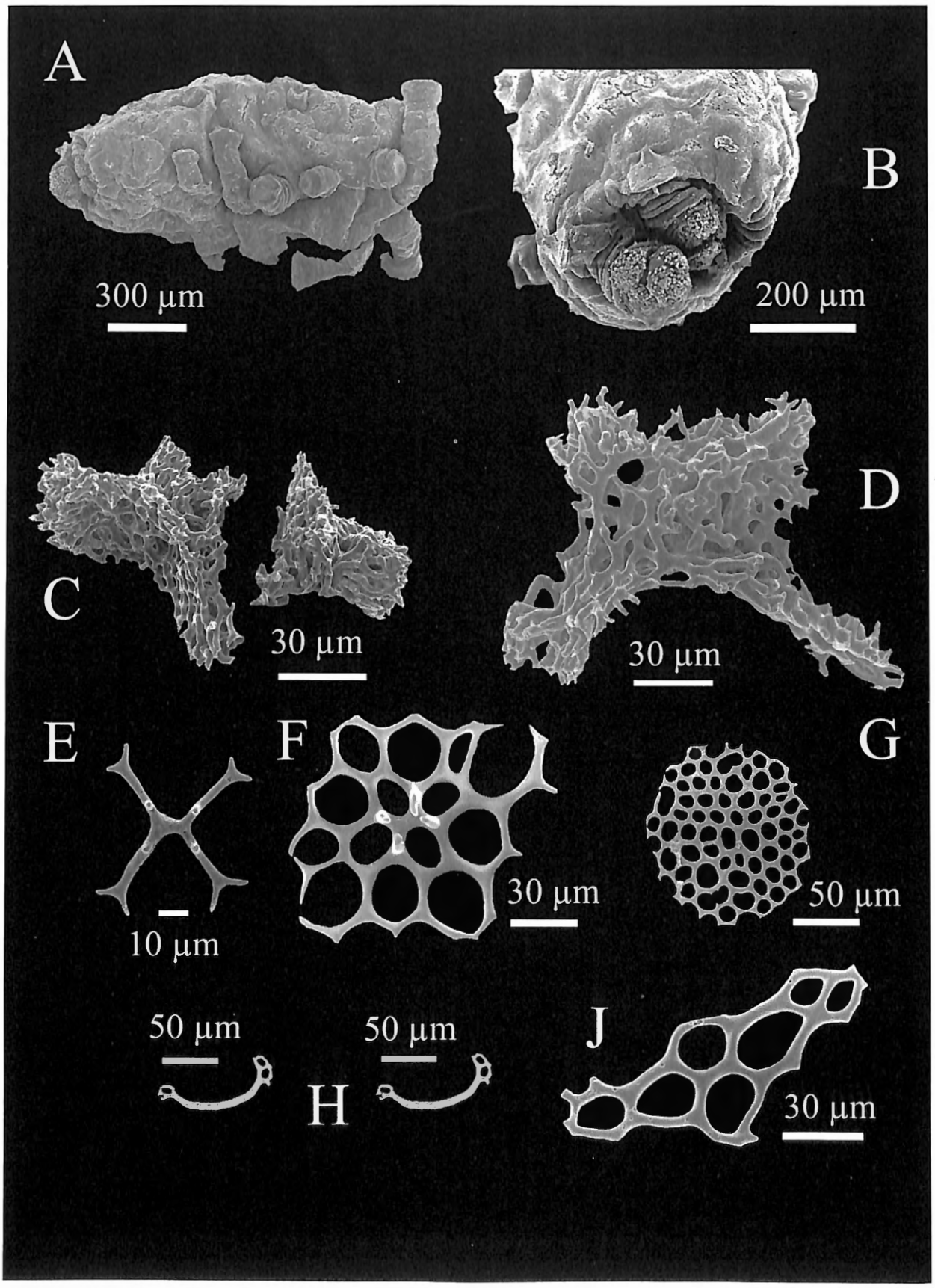
Juveniles with 10-25 tube feet in 3 rows ventrally (the 2 posterior tube feet particularly large: pl. 1A) and 2-4 tentacles (pl. 1B); calcareous ring reduced to a narrow ribbon, visible through the transparent body wall, of 10 pieces: 5 radial (pl. 1C, left piece, 1D) and 5 interradial (pl. 1C, right piece) made up of irregularly branching rods forming a tridimensional mesh (pl. 1C, D); contrary to the adults, radial plates of juveniles have anterior projections and no posterior processes; ossicles of the body wall and tube feet are plates (fig. 8B, pl. 1E-F), 100-160 µm across with large perforations; developing plates with 4 centrally located knobs (pl. 1E), large plates with 4 knobs or 4 short pillars (Fig. 8B, pl. 1F) sometimes united by a crown; close to the tube feet end plate, perforated plates are rod-like (Pl. 1J); end plates (fig. 8C, pl.1G), 110-140 µm across. In tentacles a few C-shaped rods (fig. 8D, E, pl. 1H), 100-135 µm long, with or without perforated extremities. In the brooding female retractor muscles of the calcareous ring reduced.

REMARKS

By their size and form of the ossicles the 15 specimens from Papua New Guinea are identical to the holotype and paratype (MASSIN, 1996, fig. 28A-G) from Ambon.

Brooding is a well-known phenomenon among Dendrochirotida. O'LOUGHLIN (1994) and ALCOCK & O'LOUGHLIN (2001) mentioned 32 cucumariid species, all inhabiting cold or temperate waters, with this behaviour. Some phyllophorids, a sclerodactylid and many psolids are also known to brood (O'LOUGHLIN, 1994); nearly all brooding species inhabit cold or temperate waters. *Afrocucumis africana* has been mentioned by OHSHIMA (1916) as a brooding species in the temperate waters of Ushibuka (Kyushu, Japan). This brooding activity has never been mentioned for specimens of *A. africana* from tropical waters where the species is very common. (MASSIN, 1999; SAMYN 2003) The closely related species *A. stracki* is the first tropical brooding Dendrochirotida reported in the literature.

Release of the juveniles from the coelomic cavity has never been observed but is supposed to occur through the anus or through a tear of the body wall. The synchronism in the development of the juveniles and the very reduced retractor muscles of the incubating female suggest that it could also happen by autotomy of the aqua-pharyngeal bulb.



Pl. 1. *Afrocucumis stracki* MASSIN, 1996. 1.6 mm long juvenile. A: ventral view; B: frontal view with two tentacles visible; C: calcareous ring, radial (R) and interradial (IR) pieces; D: calcareous ring, radial piece; E and F: ossicles from body wall; G: end plate from tube feet; H: ossicles from tentacles; J: ossicles from tube feet.

Ossicles of the juveniles are rather different from those of the adults, a well known phenomenon among holothurians (MASSIN *et al.*, 2000). The calcareous ring is also very different between juveniles and adults. The tridimensional mesh of the calcareous ring of the juveniles is very similar to the one illustrated by CHERBONNIER (1953: pl. 1i) for *Leptosynapta minuta* (BECHER, 1906), by BILLET (1988: fig. 18A-E) for *Ypsilothuria bitentaculata attenuata* (R. PERRIER, 1902) and by MASSIN *et al.* (2000: Fig. 2A for *Holothuria (Metriatyla) scabra* JAEGER, 1833. This structure of the early calcareous ring, present in three of the main holothurian orders (Aspidochirotida, Dendrochirotida and Apodida), must be considered a plesiomorphic character.

The specimens were all found in shallow waters (2-5 m depth) under coral blocks or in crevices located in the dead part of the coral. At Ambon they have been collected at similar depth: 1-3 m (MASSIN 1996). They are not linked to a particular coral species.

The species is new to the fauna of Papua New Guinea. Its distribution is restricted to the eastern part of Indonesia (Ambon, Misool) and Papua New Guinea.

Placothuridae PAWSON & FELL, 1965

Placothuria PAWSON & FELL, 1965

Placothuria cf. *molpadioides* (SEMPER, 1868)

Fig. 9A-N

Ocnus molpadioides SEMPER, 1868: 55, pl. 15, fig. 13; LAMPERT, 1885: 133; THÉEL, 1886: 118.

Cucumaria molpadioides; LUDWIG, 1889-1892: 344.

Stolus molpadioides; PANNING, 1949: 463; A.M. CLARK & ROWE, 1971: 182; LIAO & A.M. CLARK, 1995: 497, fig. 302a-c, pl. 23, fig. 2.

Placothuria molpadioides; LIAO, 1997: 224, fig. 134a-e; LANE *et al.*, 2000: 491; LIAO & PAWSON, 2001: 83.

TYPE LOCALITY

China.

MATERIAL EXAMINED

IRSNB IG 25848/1, Hansa Bay (Madang Province, Papua New Guinea), coll. B. TURSH & G. SEGHERS, 15.x.1978, dredging at 50 m on sandy-muddy bottom, one specimen. IRSNB IG 25848/4, Hansa Bay (Madang Province, Papua New Guinea), coll. B. TURSH & G. SEGHERS, 17.x.1978, dredging at 50 m on sandy-muddy bottom, 4 specimens.

DESCRIPTION

Specimens small, from 14x3 mm to 30x4.5 mm (width measured at mid-body). Body U-shaped, tapering at both ends, pentagonal in cross section (fig. 9A). Skin tough, gritty to the touch. Colour in alcohol: body whitish, tube feet yellowish. Tube feet restricted to the ambulacra, in a single row along the bivium and in 2 rows along the trivium (up to 3 rows at mid-body); base of the tube feet conical, rigid as body wall, tip of the tube feet cylindrical, soft. Mouth and anus terminal, mouth without valves; anus surrounded by 5 anal papillae. Tentacles 10, ventral 2 smaller. Calcareous ring 1/4 of body length with paired long posterior processes (fig. 9B); radial plates with an anterior groove for the insertion of retractor muscle; posterior processes long, narrow, made of numerous pieces (fig. 9B); interradial plates, with an anterior notch, made up of a mosaic of pieces extending to 1/3 of the length of the radial plates (fig. 9B). Gonad present in a 21 mm long specimen, made up of a few undivided, thick tubules.

Body wall packed with perforated, rounded calcareous plates, 20-60 µm across (fig. 9C); the majority smooth , only some are nodulous, with perforations partly obscured (fig. 9D). Tube feet with 2 kind of ossicles: elongated, perforated plates (up to 165 µm long)(fig. 9E), smallest ones often nodulous (fig. 9F); arched rods with a central spire-like perforated process 45-55 µm high (fig. 9G); end plates more or less 60 µm across (fig. 9H). Tentacles with fine, straight rods, 25-50 µm long with forked and/or perforated extremities (fig. 9J). In one specimen, tentacle deposits also include a few X-shaped or Y-shaped ossicles (fig. 9K), irregular rods (fig. 9L), nodulous rods (fig. 9M) and rosettes (fig. 9N).

REMARKS

The specimens present many affinities with *Placothuria molpadioides* (SEMPER, 1868) in their general aspect, the position of the tube feet, the calcareous ring, the ossicles of the tube feet and tentacles. However, the very large, thick body wall plates (250-800 µm across) described by LIAO & A.M. CLARK (1995) and illustrated by LIAO (1997) were not observed. This could be linked to the size of the specimens as the present specimens range from 14 to 30 mm in length while those from China were 50 to 136 mm long (see SEMPER, 1868; LIAO & A.M. CLARK, 1995). It is known that ossicles do change with advancing age, becoming more spiny or nodulous (MASSIN, 1994) so that the absence of large plates in the specimens from Papua New Guinea could be explained by their small size. Because of the uncertainty in the identification the specimens are reported as *Placothuria* cf. *molpadioides* until a complete growth series of this species becomes available.

This species was only known from China (LIAO & A.M. CLARK, 1995; LANE *et al.*, 2000) and is new to the fauna of Papua New Guinea.

Discussion

The Dendrochirotida of Papua New Guinea now include 12 species (see table 1): 11 of them in the present work and *Pentacta quadrangularis* (LESSON, 1830) cited by BROUNS & HEIJS (1985). If we assume that in Papua New Guinea the Aspidochirotida are represented by at least 30 species (estimation based on surrounding areas: 35 for the Torres Strait, CLARK, 1921; 32 species for Sulawesi, MASSIN, 1999) and the Apodida by 13 species (13 for the Torres Strait, CLARK, 1921; 15 species for Sulawesi, MASSIN, 1999), the Dendrochirotida, with 12 species, represent 22% of the holothuroid diversity along the coast of Papua New Guinea. It is well known that Aspidochirotida are characteristic of

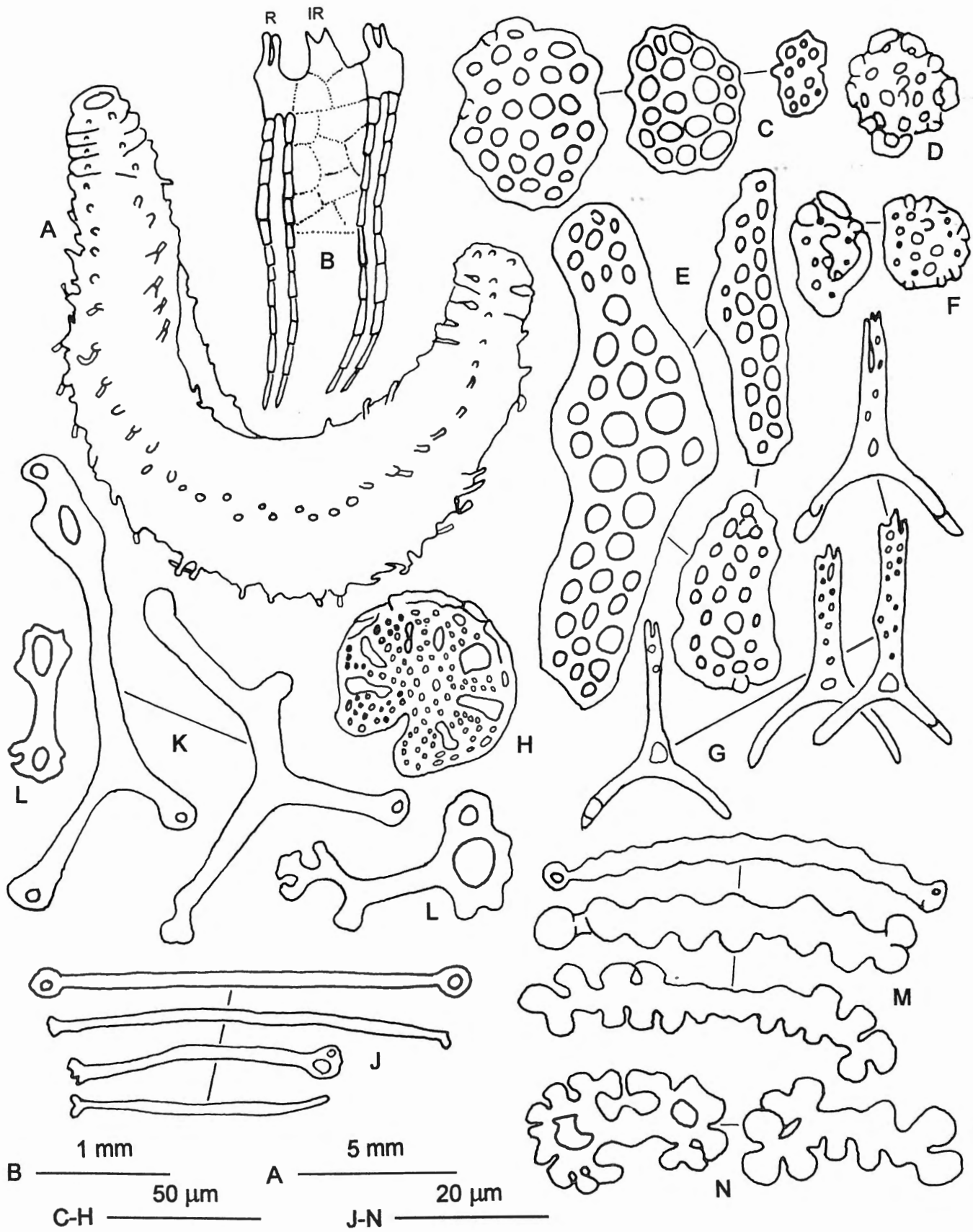


Fig. 9. *Placothuria* cf *molpadioides* (SEMPER, 1868). A: dorsal view of a specimen; B: calcareous ring (R: radial; IR: interradial); C: smooth perforated plates from body wall; D: nodulous perforated plates from body wall; E: smooth perforated plates from tube feet; F: nodulous perforated plates from tube feet; G: arched rods from tube feet; H: tube feet end plate; J: rods from the tentacles; K: X- or Y-shaped rods from tentacles; L: irregular rods from tentacles; M: nodulous rods from tentacles; N: rosettes from tentacles.

Taxon in current assignment	*Taxon in original assignment*	*Family*
Leptopentacta imbricata (SEMPER, 1868)	*Ocnus imbricatus* SEMPER, 1868	Cucumaridae
Colochirus quadrangularis (LESSON, 1830)	*Holothuria quadrangularis* LESSON, 1830	Cucumariidae
Plesiocholodhirus australis (LUDWIG, 1875)	*Colochirus australis* LUDWIG, 1875	Cucumariidae
Stolus rapax (KOEHLER & VANEY, 1908)	*Cucumaria rapax* KOEHLER & VANEY, 1908	Phyllophoridae
Phyllophorus (Phyllothuria) hypsipyrga (MARENZELLER, 1881)	*Orcula hypsipyrga* MARENZELLER, 1881	Phyllophoridae
Massinium magnum (LUDWIG, 1882)	*Thyonidium magnum* LUDWIG, 1882	Phyllophoridae
Thyone bicornis OHSHIMA, 1915	*Thyone bicornis* OHSHIMA, 1915	Phyllophoridae
Cladolabes acicula (SEMPER, 1868)	*Cucumaria acicula* SEMPER, 1868	Sclerodactylidae
Cladolabes schmeltzii (LUDWIG, 1875)	*Thyonidium* Schmeltzii LUDWIG, 1875	Sclerodactylidae
Afrocucumis africana (SEMPER, 1868)	*Cucumaria africana* SEMPER, 1868	Sclerodactylidae
Afrocucumis stracki MASSIN, 1996	*Afrocucumis stracki* MASSIN, 1996	Sclerodactylidae
Placothuria cf. molpadioides (SEMPER, 1868)	*Ocnus molpadioides* SEMPER, 1868	Placothuridae

Table 1: List of the Dendrochirotida known from Papua New Guinea

clear tropical waters whereas Dendrochirotida prefer temperate and cold waters (BAKUS, 1973). In tropical Indo-West Pacific shallow-waters (± 20° N to 20° S) Dendrochirotida represent from 0 to 35 % of the shallow-waters holothuroid diversity (see table 2).

The very low proportion or absence of Dendrochirotida around remote islands as Aldabra, Cocos Islands, Ashmore Reef, Cartier Island, Rowley Shoals, Scott Reef, Christmas Island, Kosrae Island and Guam is most probably linked to their weak dispersion capacity and also to the rarity or absence of appropriate biotopes around these remote islands to harbour Dendrochirotida .

The low proportion of Dendrochirotida along the tropical east coast of Africa is related, according to SAMYN & TALLON (in press), not only to their weak dispersion capacity but also to the prevalent currents and to the presence of

Area	*% Dendrochirotida*	*Authors*
Christmas Island	0	MARSH 2000
Kenya and Pemba Island	2	SAMYN 2003
Cocos Islands	3	MARSH 1994
Ashmore Reef & Cartier Isl	4	MARSH *et al.* 1993
Kosrae Isl (Eastern Caroline Islands)	4	KERR 1994
Guam (Mariana Islands)	5	ROWE & DOTY 1977, KERR *et al.* 1992
Somalia	6	TORTONESE 1980
Aldabra (Seychelles)	6	SLOAN *et al.* 1979
Rowley Shoals & Scott Reef	7	MARSH 1986
South Vietnam	18	LEVIN 1999
Sulawesi (Indonesia)	18	MASSIN 1999
Madagascar	20	CHERBONNIER 1988
Arabian Sea	21.4	SAMYN 2003
Papua New Guinea	22	Present study
Gulf of Aden	23.7	SAMYN 2003
Torres Strait	24	H.L. CLARK 1921
Northern Australia	35	CANNON & SILVER 1987

Table 2: Percentage of Dendrochirotida amongst holothurian species in tropical Indo-West Pacific shallow-waters (±20°.N to 20°.S).

downwellings.
Sampling techniques may also be taken into account to explain, at least partly, the low proportion of Dendrochirotida observed in some areas. In Papua New Guinea 42% (5/12) of the dendrochirotids have been obtained by dredging sandy-muddy bottoms between 40-60 m depth. The data, among others, of SLOAN *et al.* (1979), TORTONESE (1980), MARSH (1986), MARSH (2000) and SAMYN (2003) are based on diver and/or shore collecting only and very often in shallow-waters (0-20 m depth). Sampling through dredging of the above mentioned areas will possibly increase their dendrochirotid diversity.

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