spinose rim, short to high spire terminating in a small cluster of spines; some tables with perfectly smooth spire tapering to a pointed apex giving the table a tack-like appearance; and buttons that are few in number, simple to very nodulous, often irregular, perforated by numerous holes.

Currently fourteen species are regarded as being valid: *Holothuria (Theelothuria) aspertita* CHERBONNIER & FÉRAL, 1981; *H. (T.) foresti* CHERBONNIER & FÉRAL, 1981; *H. (T.) hamata* PEARSON, 1913; *H. (T.) klunzingeri* LAMPERT, 1885; *H. (T.) maculosa* PEARSON, 1913; *H. (T.) michaelseni* ERWE, 1913; *H. (T.) notabilis* LUDWIG, 1875; *H. (T.) paraprinceps* DEICHMANN, 1938; *H. (T.) princeps* SELENKA, 1867; *H. (T.) spinifera* THÉEL, 1886; *H. (T.) squamifera* SEMPER, 1868; *H. (T.) turriscelsa* CHERBONNIER, 1980 and *H. (T.) viridia* CHERBONNIER, 1980. Only *H. (T.) turriscelsa* CHERBONNIER, 1980 has been reported from the shallow-waters of Kenya (with Pemba Island). The records of MARSHALL *et al.* 2001 of *H. (T.) spinifera* are unconfirmable as no taxonomic description of this species is included in the latter's work. However, as MARSHALL *et al.* 2001 (p. 50) report the species as one of the four most wanted species in the trading business, it must be abundantly present in Kenyan waters and thus our extensive sampling effort should have exposed at least some individuals. Hence, it is here argued that MARSHALL *et al.*'s (2001) records undoubtedly are misidentifications and therefore the species most possibly does not belong to the Kenya fauna.

Holothuria (Theelothuria) turriscelsa CHERBONNIER, 1980.
(fig. 31A-G, fig. 54F)

Holothuria (Theelothuria) turriscelsa CHERBONNIER, 1980: 644, fig. 15A-L, pl.I E; MASSIN 1999: 53 (synonomy and records before 1999); SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 27, pl. 2A, B (colour pictures).

STATUS AND LOCATION TYPE – Holotype, PMNH.
TYPE LOCALITY – New Caledonia.
MATERIAL EXAMINED – TFun/9813 (one specimen); TFun/915 (one specimen); KKiun/9947 (two specimens).
GENERAL DESCRIPTION – The specimens at our disposition range from 155 to 200 mm in length and from 28 to 54 mm in width, after preservation. Body colour in life similar to colour in alcohol: yellow-green ventrally with numerous dark green to brown spots corresponding to the tube feet with white sucking discs; mottled dark green to yellow dorsally; the green patches correspond to the basis of the short, well developed dark brown conical papillae; the smaller yellow spots bear shorter dark brown papillae. Bivium clearly separated from the flattened trivium. Body wall several mm thick. Mouth ventral surrounded by 20 large, yellow to green tentacles. Anus dorso-terminal, guarded by dark-brown conical papillae. Tube feet spread evenly over the ambulacral and interambulacral areas of the trivium; papillae in the bivium spread over the total surface. Well developed white to almost translucent Cuvierian tubules, which were very readily ejected upon collection. Single club-shaped Polian vesicle. Single, segmented stone canal ending in an oval madreporic plate. MASSIN (1999) describes the calcareous ring as "stout composed of massive radial pieces characterized by a deep rounded anterior notch and two large posterior points; interradial pieces with a small anterior median tooth [Sic.]" (see also MASSIN 1999: 54, fig. 42a)

Ossicles: Tentacles with rods, 150-625 µm long, the longest rods are spined over the total surface; the smaller rods only moderately spined (fig. 31A). Ventral and dorsal body wall with tables, some knobbed buttons and ellipsoids (fig. 31B, C). Tables with rim of disc spinose, disc 65-80 µm across, disc perforated by four large central holes and numerous small peripheral holes which in the larger tables are arranged in concentric circles, spire relatively long consist of four pillars, united by a one to several cross beams and ends in a narrow spiny crown (fig. 31B). Ellipsoids with nodules on the lateral and median side, approximately 65 µm long, often irregular in outline (fig. 31C). Dorsal papillae with tables similar to those of the body wall, perforated plates and numerous rods (fig. 31D), no buttons nor ellipsoids. Ventral tube feet with tables similar to those in the body wall (fig. 31E); rods up to 400 µm long, perforated in the lateral extensions (fig. 31F); large perforated plates, 130-200 µm long (fig. 31G); ellipsoids and some knobbed buttons similar to those of the tube feet.

DIAGNOSIS – See CHERBONNIER 1980: 644-646, fig. 15.

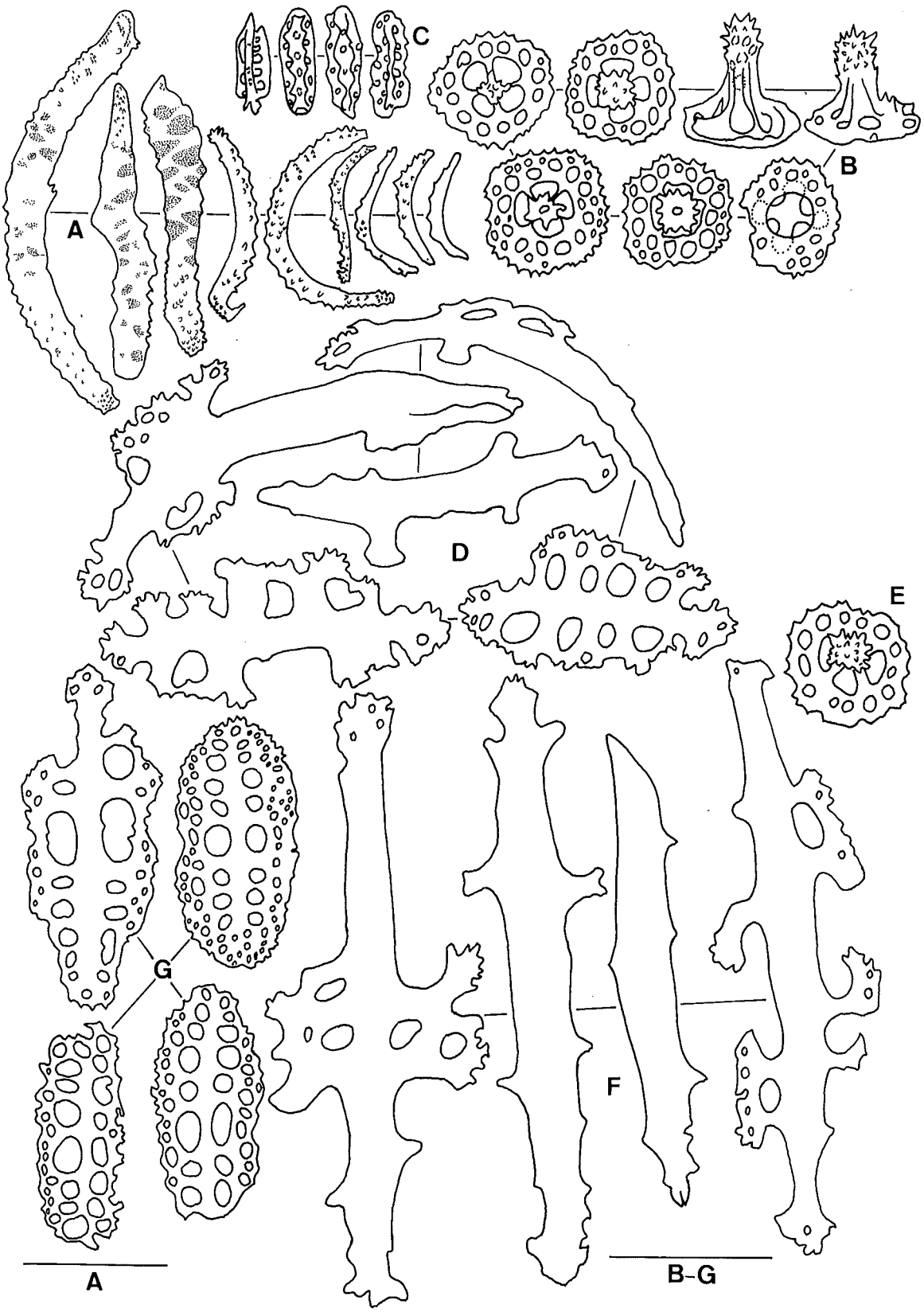

FIG. 31 – *Holothuria (Theelothuria) turriscelsa* CHERBONNIER, 1980. A. Rods of tentacles; B. Tables of body wall; C. Ellipsoids of body wall; D. Rods and plates of dorsal papillae; E. Table of ventral tube feet; F. Rods of ventral tube feet; G. Plate of ventral tube feet. Scale bar A represents 200 μm; scale bar B-G represents 100 μm.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
HH. (Theelothuria) hamata PEARSON, 1913	Gulf of Suez (Al Sayadh; Suez)	CHERBONNIER 1955; PEARSON 1913; DANIEL & HALDER 1974; PRICE 1982
	Seychelles (Aldabra[9])	SLOAN *et al.* 1979
H. (Theelothuria) klunzingeri LAMPERT, 1885	Gulf of Suez (unspecified)	CHERBONNIER 1955; PRICE 1982
	Red Sea (Beilul, Assab, Kosseir)	LAMPERT 1885; LUDWIG 1886; THÉEL 1886
	Gulf of Aden?	DANIEL & HALDER 1974
H. (Theelothuria) maculosa PEARSON, 1913	Madagascar (Nosy Bé; Tuléar)	CHERBONNIER 1988
	Seychelles (Aldabra)	PEARSON 1913; DANIEL & HALDER 1974; HUGHES & GAMBLE 1977; SLOAN *et al.* 1979; A.M. CLARK 1984
	Mozambique (Inhaca)	SLOAN et al. 1979?; CHERBONNIER 1988; MRAC records, pers. observ
	West Indian Ocean to West Pacific Ocean	ROWE & RICHMOND 1997
H. (Theelothuria) notabilis LUDWIG, 1874	Mozambique (South coast)	THANDAR 1984?
	South Africa (KwaZulu-Natal)	pers. observ.
H. (Theelothuria) spinifera THÉEL, 1886	Gulf of Suez (Sheikh Riyah)	CHERBONNIER 1955; PRICE 1982
	Red Sea (Hurghada)	MORTENSEN 1937; CLARK & ROWE 1971; PRICE 1982
	Persian Gulf (Kharg)	HEDING 1940b; PRICE 1982
	Kenya?	MARSHALL *et al.* 2001
	Tanzania?	MARSHALL *et al.* 2001
	Seychelles (Mahé)	MRAC record, pers. observ.
H. (Theelothuria) squamifera SEMPER, 1868	Gulf of Aqaba (Aqaba)	CHERBONNIER 1979a; PRICE 1982
	Gulf of Suez (Suez Bay)	CHERBONNIER 1955; PRICE 1982
	Red Sea (Kosseir)	LAMPERT 1885
	Gulf of Aden?	DANIEL & HALDER 1974

TABLE 18 – Other species within the holothurian subgenus *Theelothuria* known to occur in the shallow-waters of the WIO.

ECOLOGY – Strictly nocturnal species. *H. turriscelsa* was found on sandy patches between coral slabs. When disturbed numerous Cuvierian tubules are very readily ejected.
DISTRIBUTION IN THE STUDY REGION – Fundu (Pemba Island); Kiunga Marine Reserve.
GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific (not recorded from the Red Sea nor from the Persian Gulf) (see also SAMYN & VANDENBERGHE 2000). Figure 54F shows the known distribution in the WIO in detail.

Table 18 lists the other species within the holothurian subgenus *Theelothuria* that are known to occur in the shallow-waters of the WIO, but have for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record appeared.

Subgenus *Thymiosycia* PEARSON, 1914

DIAGNOSIS (after ROWE, 1969:145) [Type species: *Holothuria impatiens* FORSKÅL, 1775 by original designation].
Small to moderate species with cylindrical to vermiform body reaching lengths up to 350 mm; tube feet and papillae arranged more or less irregularly over the dorsal and ventral surface, though occasionally restricted to the ambulacral areas; mouth terminal, surrounded by 18-20 tentacles, surrounded by collar of papillae around the base; anus terminal mostly guarded by some kind of anal pedicels; body wall soft, thin, sometimes gritty to the touch; calcareous ring stout, radial

[9] SLOAN *et al.* (1979) report on two specimens that they label *Holothuria (Theelothuria)* sp. cf. *H. hamata* PEARSON 1913. It remains to be investigated whether these specimens are indeed *H. (T.) hamata*.

pieces up to three times the length of the interradial pieces. Ossicles comprise stout tables with flattened disc, rim smooth, circular to squarish in outline, four pillars forming a spire of moderate height ending in a cluster of small spines; buttons with three to four pairs of holes, mostly regular in outline.

Currently thirteen species are recognised as being valid: *Holothuria (Thymiosycia) arenicola* SEMPER, 1868; *H. (T.) conusalba* CHERBONNIER & FÉRAL, 1984; *H. (T.) decorata* VON MARENZELLER, 1882; H. *(T.) gracilis* SEMPER, 1868; *H. (T.) hartmeyeri* ERWE, 1913; *H. (T.) impatiens* (FORSKÅL, 1775); *H. (T.) milloti* CHERBONNIER, 1988; *H. (T.) marginata* SLUITER, 1901; *H. (T.) minax* THÉEL 1886; *H. (T.) remollescens* LAMPERT, 1885; *H. (T.) strigosa* SELENKA, 1867; *H. (T.) thomasi* PAWSON & CAYCEDO, 1980; *H. (T.) truncata* LAMPERT, 1885. It must however be stressed that this subgenus is in urgent need of revision and that it cannot be excluded that several of these species will prove to be synonyms or will need to be allocated to a different subgenus (SAMYN, MASSIN & ROWE in prep.). This observation is further evidenced by a recent revision of the subgenus *Mertensiothuria* (SAMYN & MASSIN in press) in which *H. aphanes* LAMPERT 1885 and *H. hilla* LESSON, 1830 were transferred form *Thymiosycia* to *Mertensiothuria.* ROWE (*in* ROWE & GATES 1995) further referred the recently described *H. (T.) altaturricula* CHERBONNIER & FÉRAL, 1984 to the synonymy of *H. (P.) samoana* LUDWIG, 1874, *H. macroperona* H.L. CLARK, 1938 to the synomy of *H. (T.) hartmeyeri* ERWE, 1913, *H. truncata* LAMPERT, 1885 and the different colour forms of *H. impatiens* (*H. impatiens* var. *concolor* H.L CLARK, 1921; *H. impatiens* var. *pulchra* H.L. CLARK, 1921; *H. impatiens* var. *lutea* H.L. CLARK, 1921; *H. impatiens* var. *bicolor* H.L. CLARK, 1921) to the synonymy of *H. (T.) impatiens* (FORSKÅL, 1775). In my opinion ROWE's decision on *H. (T.) truncata* needs reconsideration for the tables depicted by CHERBONNIER (1974) have a spinier crown as those normally found in *H. (T.) impatiens*. Even so, *H. (T.) milloti* needs careful re-examination, for it most probably is but a synonym of *H. arenicola* (SAMYN, MASSIN & ROWE unpublished data).

Only *H. (T.) arenicola* and *H. (T.) impatiens* have been reported from the shallow-waters of Kenya (with Pemba Island), they are keyed hereunder.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND).

1. Bivium yellow to beige with a row of dark brown spots on each ambulacral area. Cuvierian tubules absent. . . . . ***Holothuria (Thymiosycia) arenicola* SEMPER, 1868**

1'. Bivium beige with irregular brown to dark brown blotches. Cuvierian tubules present. . ***Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775)**

Holothuria (Thymiosycia) arenicola
SEMPER, 1868
(fig. 32A-E, fig. 54G)

Holothuria arenicola SEMPER, 1868: 81, pls. 20, 30 fig. 13, 35 fig. 4; TORTONESE 1936a: 234; PANNING 1944: 69; TORTONESE 1953a: 44; MACNAE & KALK 1962: 108, 112; CHERBONNIER 1967: 56; JAMES 1969: 61; JAMES & PEARSE 1969: 105; DANIEL & HALDER 1974: 426; HICKMAN 1998: 44 (colour pictures); CONAND 1999: 12, 21, 39.

Sporadipus (Acolopos) maculatus BRANDT 1835: 46.

Holothuria maculata; DANIEL & HALDER 1974: 428.

Actinopyga maculata; DANIEL & HALDER 1974: 426.

Holothuria boutani HÉROUARD 1893: 132, pl. 7 fig. A.

Holothuria arenicola var. *boutani*; CHERBONNIER 1955: 153.

Holothuria fusco-punctata; VANEY 1905: 187; DANIEL & HALDER 1974: 417.

Holothuria (Thymiosycia) arenicola; SLOAN *et al.* 1979: 123; PRICE 1981: 9; PRICE 1982: 11; A.M. CLARK 1984: 99; CANNON & SILVER 1986: 25; CHERBONNIER 1988: 82 (synonymy); MUKHOPADHYAY 1991: 408; ROWE & GATES 1995: 301; ROWE & RICHMOND 1997: 304; James 1999: 15; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 27.

STATUS AND LOCATION TYPE – Syntype ZMH E. 2508 (ROWE & GATES 1995).

TYPE LOCALITY – Viti Levu, Fiji (ROWE & GATES 1995).

MATERIAL EXAMINED – KKiun/9945 (one specimen); KMal/9875 (one specimen); KMal/9876 (one specimen); KMal/9877 (one specimen); KMal/9878 (one specimen); KMal/9879 (one specimen); KMal/9880 (one specimen); KVan/9778 (one specimen).

GENERAL DESCRIPTION – Relatively small species, ranging from 80-125 mm in length and from 15-40 mm in width, after preservation. Colour in alcohol similar to the colour in life: whitish-grey

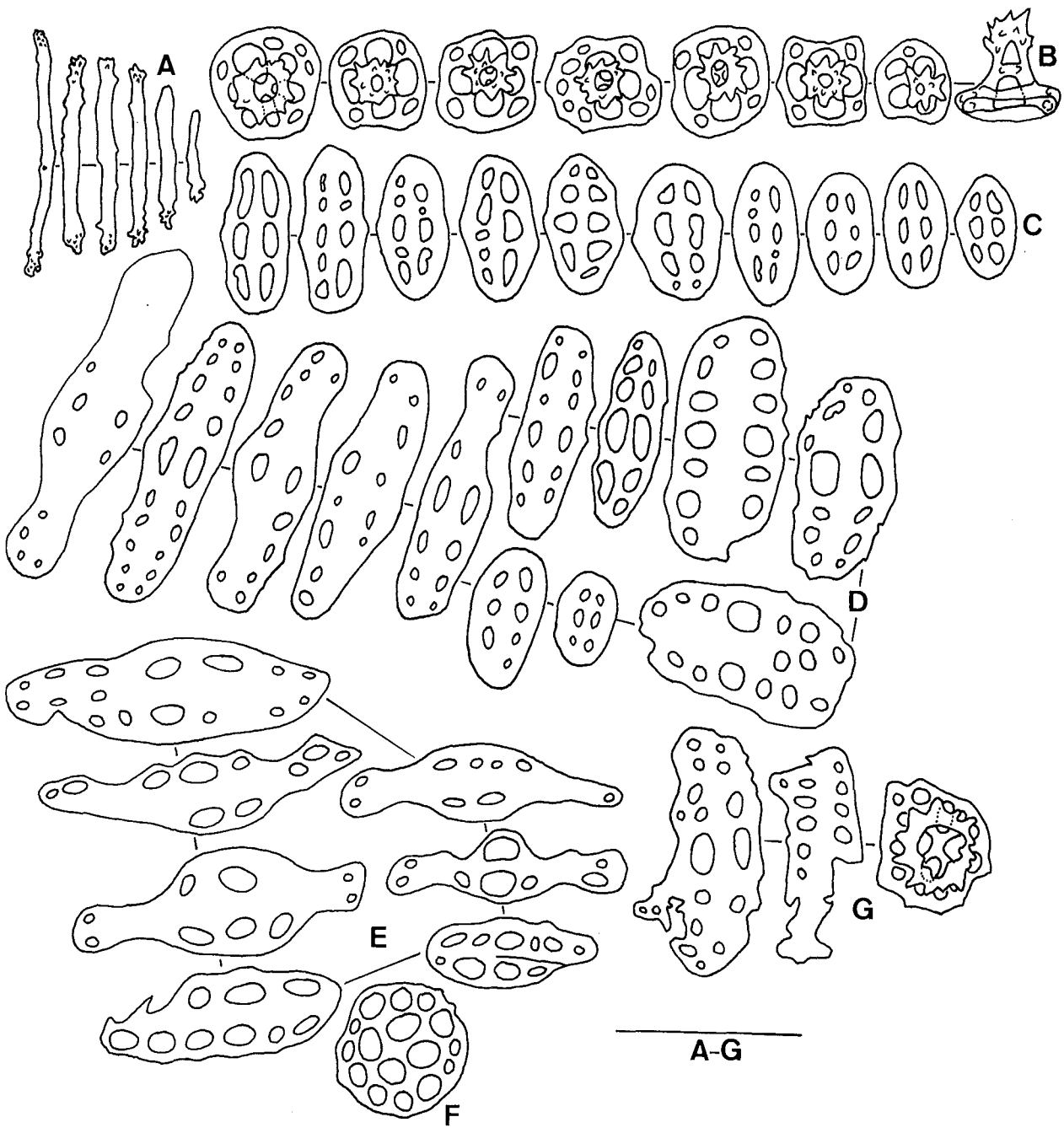

FIG. 32 – *Holothuria (Thymiosycia) arenicola* SEMPER, 1868. A. Rods of tentacles; B. Tables of body wall; C. Buttons of body wall; D. Elongated plates and buttons of ventral tube feet; E. Rod like plates of dorsal tube feet; F. Reduced table of dorsal tube feet; G. Rod-like plates and table of anal papillae. Scale bar A-G rerepresents 100 μm.

to yellow ventrally and yellow to beige with a row of dark brown spots on each ambulacral area dorsally; some specimens are more orange with a white area at the anterior and posterior end; the dorsal blotches can fuse together and form an irregular line. Mouth terminal surrounded by 20 small, brownish tentacles. Anus terminal, surrounded by non-calcified papillae. Body wall is only a few mm thick, gritty to the touch. Ventral tube feet, wide but short, distributed over the ambulacral and interambulacral areas. Dorsal tube feet smaller, distributed over the total surface. Cuvierian tubules absent. Tentacle ampullae short. Single Polian vesicle. Single stone canal ending in a narrow madreporic plate.

Ossicles: Tentacles with rods, 70-135 µm long, the smallest smooth, the larger ones spiny at the extremities (fig. 32A). Ventral and dorsal body wall with the same type of tables and buttons (fig. 32B, C). Tables with rim of disc circular or squarish, disc 40-60 µm across, perforated by four central holes and four to eight peripheral holes, spire moderately long consists of four pillars united by a single cross beam and ending in a rather narrow spiny crown (fig. 32B). Buttons smooth, rim usually rather regular, three to five pairs of holes, 55-90 µm long (fig. 32C). Ventral tube feet with buttons, 50-100 µm long, and elongated plates, 100-180 µm long (fig. 32D). Dorsal tube feet with similar elongated plates as the ones in the ventral tube feet, though the outline is generally more irregular (fig. 32E), and few reduced tables (fig. 32F). Anal papillae with elongated plates similar to the ones of the tube feet and tables similar to the ones of the body wall (fig. 32G)

DIAGNOSIS – See SEMPER 1868: 81, pls 20, 30 fig 13.

ECOLOGY – In Kenya, *H. (T.) arenicola* invariably digs its body in the sand, hereby preferentially hiding under coral or sandstone slabs; its presence is only betrayed by a mound in the sand, at the summit of which characteristic holothurian faeces can be found (see also MACNAE & KALK 1962: 108). In Kenya, *H. arenicola* was only observed in the intertidal zone, but ROWE (*in* ROWE & GATES 1995) reports depths up to 30 m.

DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve, Malindi.

GEOGRAPHIC DISTRIBUTION – Tropical Indo-West Pacific Ocean (with the Red Sea, without the Persian Gulf) (MASSIN 1996a). Figure 54G shows the known distribution in the WIO in detail.

Holothuria (Thymiosycia) impatiens (FORSKÅL, 1775) (fig. 33A-E, fig. 54H, pl. 3G)

Fistularia impatiens FORSKÅL, 1775: 121, pl. 39B

Holothuria botellus SELENKA 1867: 335, pl. 19 figs 82-84; DANIEL & HALDER 1974: 423

Holothuria impatiens; TORTONESE 1936a: 234; TORTONESE 1937-38; 191; HEDING 1940b: 121; CHERBONNIER 1955: 148; A.M. CLARK 1952: 204; KALK 1959: 22 (non *H. cumulus* H.L. CLARK 1921); MACNAE & KALK 1962: 108, 112; CHERBONNIER 1963: 5; CHERBONNIER 1967; JAMES 1969: 61; JAMES & PEARSE 1969: 105; DANIEL & HALDER 1974: 428; HICKMAN 1998: 45 (colour pictures); CONAND 1999: 10, 21, 39; MARSHALL *et al.* 2001: 46 (tab. 29).

Holothuria (Thymiosycia) impatiens; PRICE 1981: 9; MUKHOPADHYAY 1991: 407; MASSIN 1999: 57 (synonymy and records before 1999), fig. 111e (colour plate); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 489; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 18 (tab. 4), 28.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995).

TYPE LOCALITY – Red Sea (ROWE & GATES 1995).

MATERIAL EXAMINED – TFun/9828 (one specimen); TFun/9829 (one specimen); KKiun/9944 (four specimens); TMes/98100 (one specimen); TMes/98101 (one specimen).

GENERAL DESCRIPTION – The size of the collected specimens varies from 13x73 to 30x260 mm, after preservation. Body colour in life similar to that in alcohol. Dorsal body wall beige with brown to dark brown blotches (pl. 3G), ventral side uniform beige. Mouth ventral surrounded by 20 tentacles with a ring of minute conical papillae at the base. Anus terminal. Body wall thin, rough to touch. Tube feet presented on conical elevation of the body wall (especially in the specimens from Fundu), sparsely distributed in both ambulacral and interambulacral areas, visible as narrow yellowish tubes. Respiratory trees short (one third of body length). Muscles bifid and wide. Single Polian vesicle, short (one seventh of body length). Single stone canal ending in simple madreporic plate. Gonad with long, beige tubules. Cuvierian tubules present, white, long and thick.

Ossicles: Tentacles with curved rods, 75-350 µm long, spiny at the extremities (fig. 33A). Ventral and dorsal body wall with similar tables and buttons (fig. 33B, C, D, E). Tables 80-90 µm across,

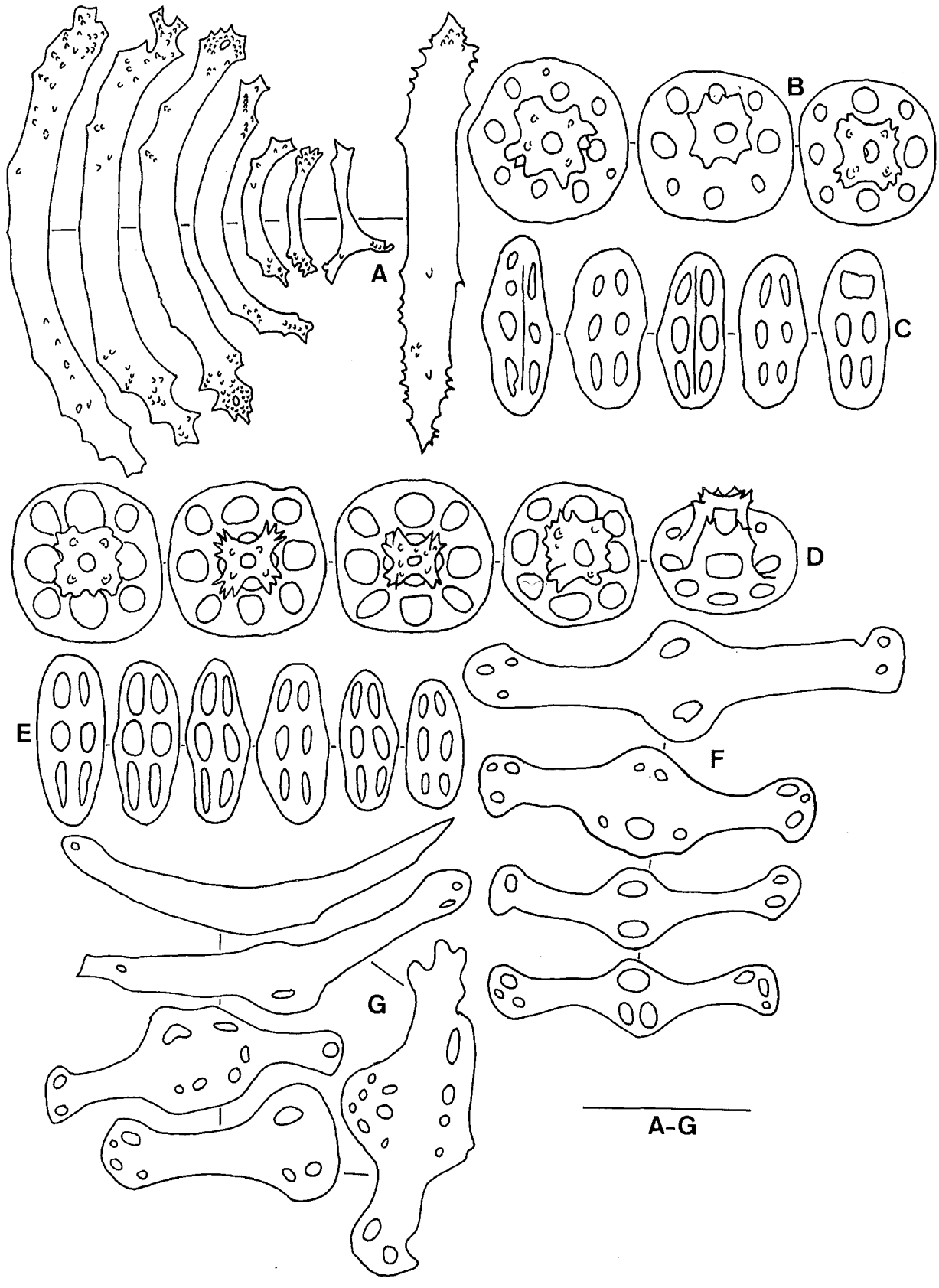

FIG. 33 – *Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775). A. Rods of tentacles; B. Tables of dorsal body wall; C. Buttons of dorsal body wall; D. Tables of ventral body wall. E. Buttons of ventral body wall; F. Rods of ventral tube feet; G. Rods of dorsal tube feet. Scale bar A-G represents 100 μm.

rim of disc smooth, rounded to squarish in outline, perforated by four central and up to eight, relatively large peripheral holes; spire consists of four short pillars, united by a single cross beam, ending in a spiny crown with large central hole (fig. 33B,D). Buttons 60-100 µm long, smooth, with three to four pairs of holes, irregular, sometimes with median longitudinal ridge (fig. 33C, E). Ventral and dorsal tube feet with tables similar to those of the body wall, long buttons, and rods, perforated distally and laterally, 175-270 µm long (fig. 33F, G).

DIAGNOSIS – See PANNING 1935c: 86, fig. 72a-u.

ECOLOGY – Usually well concealed among rocks, more rarely in sand. Our specimens were found from 0 to10 m deep; LANE *et al.* (2000) report a bathymetric range from 0 to 30 m.

DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve; Mombasa, Fundu; Mesali (see also SAMYN & VANDEN BERGHE 2000).

GEOGRAPHIC DISTRIBUTION – Circum-tropical and abundant throughout the Indo-Pacific (with the Red Sea and the Persian Gulf); it is also known from the Mediterranean Sea (TORTONESE 1953b). The distribution map as drawn by MASSIN (1999: 58, fig. 45) gives the global distribution, but the following localities have to be added to the WIO: Gulf of Suez, Suez (SEMPER 1868; 1869; HÉROUARD 1893; MITSIKURI 1912; CHERBONNIER 1955), Taufic (MORTENSEN 1926); Adabiya Point (JAMES 1969; JAMES & PEARSE 1969) (see also GRAY 1872; ERWE 1919; DANIEL & HALDER 1974; PRICE 1982 for unspecified records from the Gulf of Suez); Gulf of Aqaba, Aqaba (TORTONESE 1977), Dahab (A.M. CLARK 1952) (see also DANIEL & HALDER 1974 and PRICE 1982 for unspecified records from the Gulf of Aqaba); Saudi Arabia, Abulat Island., Lith (CHERBONNIER 1955), Jeddah (TORTONESE 1979); Eritrea, Entedebir (CHERBONNIER 1967), Perim Island. (LUDWIG 1886), Massaua (TORTONESE 1936a; CHERBONNIER 1963), Dissei & Nocra Islands (TORTONESE 1953a) (see also TORTONESE 1937-38 for unspecified record from Eritrea); Djibouti (VANEY 1905; CHERBONNIER 1955); Gulf of Aden (DANIEL & HALDER 1974); Persian Gulf, Farur (HEDING 1940b), Arabian Sea (CLARK & ROWE 1971); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000), Mombasa (this work); Tanzania, Fundu and Mesali (this work); northern Mozambique (KALK 1959, as *H. impatiens* and as *H. cumulus*; THANDAR 1984, including specimens identified as *H. (?Lessonothuria) cumulus*), Juan de Nova (LUDWIG 1899; MITSIKURI 1912); southern Mozambique (THANDAR 1984, as *H. (?Lessonothuria) cumulus*; MRAC record pers. observ.); Republic of South Africa, Banhga Nek and Sodwana Bay (pers. observ.) Madagascar, Antsakoaba, Fort Dauphin, St. Augustin, Tuléar (CHERBONNIER 1988). Figure 54H shows the known distribution in the WIO in detail.

REMARKS – The specimens from Kiunga (from 13x33 to 20x72 mm) are distinctly smaller then those from Fundu (from 25x250 to 30x260 mm); the former present a body morphology which at first sight seems different from that presented by the specimens from Fundu: (1) the tube feet in the Kiunga specimens are presented on lower conical elevations, (2) the colouration of the Kiunga specimens is more uniform beige interspersed with brownish blotches which occasionally form transverse bands. Ossicle morphology, however, shows no variation in the specimens from both localities (see also MASSIN 1996a; 1999).

Table 19 lists the other species within the subgenus *Thymiosycia* that are known to occur in the shallow waters of the WIO, but have for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record for East Africa appeared.

Genus *Pearsonothuria* LEVIN, KALIN & STONINK, 1984.

DIAGNOSIS [Type species: *Holothuria graeffei* SEMPER, 1868 by monotypy]

Moderate to large species with cylindrical body reaching lengths up to 350 mm. Tube feet of the trivium in ambulacral areas only. Papillae of the bivium few in number, distributed in longitudinal lines. Mouth ventral, surrounded by 20 tentacles with very specific colouration: black with a white edge. Calcareous ring stout, with the radial pieces almost undistinguishable from the interradial pieces. Ossicles comprise small rosettes that can look like perforated plates and knobbed pseudotables. Tentacles with rosettes only.

Pearsonothuria graeffei is present in the shallow-waters of Kenya and Pemba Island.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Thymiosycia) decorata VON MARENZELLER, 1882	Mauritius	LAMPERT 1885; THÉEL 1886
	East Coast of Africa (unspecified)	DANIEL & HALDER 1974
H. (Thymiosycia) gracilis SEMPER, 1868	Zanzibar	LAMPERT 1885
	Madagascar (Nosy Bé)	CHERBONNIER 1988
H. (Thymiosycia) milloti CHERBONNIER, 1988	Glorious Island	CHERBONNIER 1988
H. (Thymiosycia) remollescens LAMPERT, 1885	Red Sea (Kosseir)	LAMPERT 1885; THÉEL 1886; PRICE 1982
	Arabian Sea?	DANIEL & HALDER 1974
	Seychelles (Aldabra)	SLOAN *et al.* 1979; A.M. CLARK 1984
	South West Indian Ocean	DANIEL & HALDER 1974
H. (Thymiosycia) strigosa SELENKA, 1867	Gulf of Suez (Suez)	HÉROUARD 1893 [1]; PRICE 1982
	Red Sea (unspecified)	LUDWIG 1877 [1880]; LAMPERT 1885; PRICE 1982
	South Yemen (Soccotra)	LEVIN 1979
	Zanzibar	SELENKA 1867; LAMPERT 1885; SEMPER 1868, 1869
	Somalia (Sar Uanle)	TORTONESE 1980
	Madagascar (St. Augustin)	CHERBONNIER 1988
	Arabian Sea?	DANIEL & HALDER 1974
	South West Indian Ocean	DANIEL & HALDER 1974

TABLE 19 – Other species within the holothurian subgenus *Thymiosycia* known to occur in the shallow-waters of the WIO. Cited as [1] *Holothuria boutani* HÉROUARD.

Pearsonothuria graeffei (SEMPER, 1868)
(fig. 34A-C, fig. 55A, pl. 3H)

Holothuria graeffei SEMPER, 1868: 78, pl. 30(9) [as *Holothuria gräffei*].
Bohadschia drachi CHERBONNIER 1954a: 253; CHERBONNIER 1955: 134; DANIEL & HALDER 1974: 417.
Bohadschia graeffei; ARAKAKI & FAGOONEE 1996: 122.
Pearsonothuria (Bohadschia) graeffei; WEINBERG 1997: 248 (colour picture).
Pearosonothuria graeffei; ; MARSHALL *et al.* 2001: 47 (*lapsus calami*).
Pearsonothuria graeffei; MASSIN 1999: 62 (synonymy and records before 1999), fig. 111g, h (colour plates); CONAND 1999: 12, 21, 39, pl. 2 (colour picture); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 489; MARSHALL *et al.* 2001: 46 (tab. 29).

STATUS AND LOCATION TYPE – ZMB, ZMG, ZMH E.2696 (ROWE & GATES 1995).
TYPE LOCALITY – Fiji (Viti Island) (MASSIN 1999).
MATERIAL EXAMINED – KMal/9764 (one specimen); KMal/9765 (one specimen); KShim/9766 (one specimen); TFun/9803(one specimen); TFun/9804 (one specimen); TFun/9805 (one specimen).
GENERAL DESCRIPTION – Specimens ranging from 150 to 347 mm in length and from 28 to 42 mm in width, after preservation. Body colour in life pale cream with numerous small brown specklings and with brown patches (pl. 3H). Body elongated and slender, dorsally somewhat rounded, ventrally slightly flattened. Bivium with two or more longitudinal folds an numerous transverse folds reaching into the trivium. Mouth ventral surrounded by 23-28 black tentacles (brown in alcohol) with white edge, of which two or three are distinctly smaller. Anus terminal, relatively large, no anal papillae. Body wall 2-3 mm thick, smooth to the touch. Trivium with three distinct longitudinal bands of large brownish tube feet with dark brown sucking disk, in four to seven rows on the median ambulacral area, in two to three rows on the lateral ambulacral areas. Bivium with small, low papillae scattered over total dorsal surface. Single very large Polian vesicle. Respiratory trees well developed, reaching to calcareous ring. Cuvierian tubules abundantly present, but usually not ejected upon disturbance. Very massive calcareous ring, with the radial pieces almost undistinguishable from the interradial pieces.
Ossicles: Tentacles with rods which can form rosettes (fig. 34A); Ventral and dorsal body wall with the same type of knobbed pseudo-tables and small rosettes (fig. 34B). Ventral and dorsal tube

feet with small, very complex rosettes that resemble those from the body wall (fig. 34C)

DIAGNOSIS – See CHERBONNIER 1988: 49-51, fig. 17A-F.

ECOLOGY – *Pearsonothuria graeffei* was always observed feeding on coral substrate. Although no conclusive quantitative measurements were taken, the population-size on the West coast of Pemba was markedly greater after the 1998 El Nino then before.

DISTRIBUTION IN THE STUDY REGION – Mombasa, Shimoni, Malindi, Fundu and Mesali.

GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-west Pacific (with the Red Sea, without the Persian Gulf). The global distribution map as drawn by (MASSIN 1999: 63) gives the global distribution, however the following localities have to be added to the WIO: Gulf of Aqaba, Aqaba (CHERBONNIER 1979a; PRICE 1982, both as *Bohadschia drachi* CHERBONNIER 1954); Saudi Arabia, Abulat Island.(CHERBONNIER 1954a; 1955, as *B. drachi*), Jeddah (TORTONESE 1979, as *B. graeffei*); Eritrea, Nocra Island (TORTONESE 1953a, as *Bohadschia graeffei* (SEMPER, 1868)) (see also DANIEL & HALDER 1974 and PRICE 1982 for unspecified records for the Red Sea); Kenya, Malindi, Mombasa, Shimoni (this work); Tanzania, Fundu and Mesali (this work; see also MARSHALL *et al.* 2001 for an unspecified record from Tanzania); Madagascar; Tuléar (CHERBONNIER 1988; see also CONAND 1999 for an unspecified record from Madagascar); Mauritius (ARAKAKI & FAGOONEE 1996, as *Bohadschia graeffei*). Figure 55A shows the known distribution in the WIO in detail.

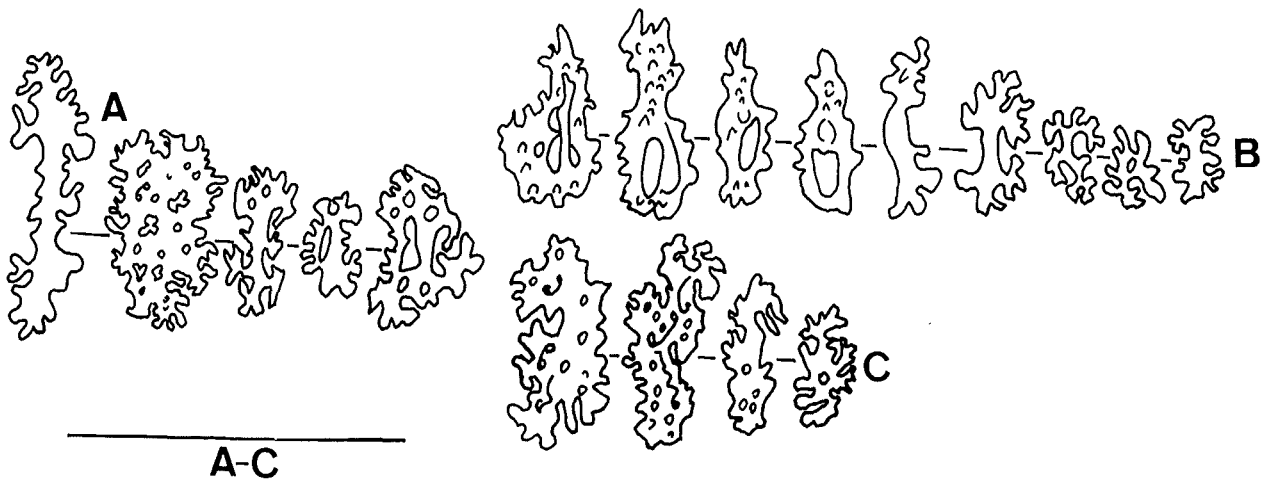

FIG. 34 – *Pearsonothuria graeffei* (SEMPER, 1868). A. Rosettes of tentacles; B. Pseudo-tables and rosettes of body wall; C. Rosettes of tube feet. Scale bar A-C represents 100 µm.

Family Stichopodidae HAECKEL, 1896

KEY TO THE GENERA OF KENYA (WITH PEMBA ISLAND)

1. Moderate to large species; body colour in life greenish; well developed papillae on the radial areas of bivium; ossicles of body wall consist of well developed tables, numerous rosettes, branched rods, C and S shaped rods . . . . . ***Stichopus*** **BRANDT, 1835**

1'. Large species; body colour grey to red; very large, sometimes branching papillae on bivium; ossicles of body wall seldom with poorly developed tables, miliary granules, dichotomously branched rods, C or S-shaped rods never present . . . . . ***Thelenota*** **H.L. CLARK, 1921**

Genus *Stichopus* BRANDT, 1835

DIAGNOSIS [Type-species: *Stichopus (Perideris) chloronotus* BRANDT, 1835 by subsequent designation (H.L. CLARK 1933)]

Size from moderate to large (300 mm); body firm, quadrangular in section; flattened trivium; ambulacral areas of bivium covered by papillae of different sizes; trivium with numerous tube feet in

the radial areas only; calcareous ring well developed with the radial pieces two to three times as large as the interradial pieces; mouth ventral surrounded by 20 tentacles; anus terminal, unguarded; Cuvierian tubules absent. Ossicles in body wall consist of tables, C-or S-shaped rods and rosettes, holothuriid buttons in four spp.; tentacles with curved rods; tube feet with tables, large perforated plates and rods with median perforated extension.

Currently some 19 species are recognised as being valid (MASSIN pers. comm.; ROWE unpublished manuscript)[10]: *Stichopus badionotus* SELENKA, 1867 (usually placed in *Isostichopus*); *S. chloronotus* BRANDT, 1835; *S. ellipes* H.L. CLARK, 1938; *S. flaccus* LIAO, 1980; *S. fuscus* LUDWIG, 1875; *S. herrmanni* SEMPER, 1868; *S. horrens* SELENKA, 1867; *S. johnsoni* THÉEL, 1886; S. *leukothele* (LAMBERT, 1986); *S. ludwigi* ERWE, 1913; *S. macroparentheses* H.L. CLARK, 1922; *S. mollis* (HUTTON, 1872); *S. monotuberculatus* (QUOY & GAIMARD, 1833); *S. naso* SEMPER, 1868; *S. noctivagus* CHERBONNIER, 1980; *S. parvimensis* (H.L. CLARK, 1913); *S. pseudohorrens* CHERBONNIER, 1967; *S. quadrifasciatus* MASSIN, 1999 and *S. vastus* SLUITER, 1888. It is surprising that only three of these species were found in the shallow-waters of Kenya (with Pemba Island), they are keyed hereunder.

It must be stressed that the genus *Stichopus* is in very critical need of review. ROWE (pers. comm.) not only argues that a new genus possibly must be created for those species that have holothuriid-like buttons [*i.e. S. californicus* (STIMPSON, 1857), *S. leukothele* (LAMBERT, 1986), *S. johnsoni* THÉEL, 1886 and *S. parvimensis* (H.L. CLARK, 1913)]; but also that several species most probably need to be transferred to other genera (see also footnote). However, as the *Stichopus* spp. from Kenya (with Pemba Island) do not pose identification and classification problems, further discussion of the taxonomy of *Stichopus* falls outside the scope of the present monograph.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND)

1. Bivium without conspicuous double rows of large papillae. Ossicles of the body wall comprise numerous tables, C-or S-shaped ossicles, in addition to rosettes **2**

1'. Bivium with two conspicuous double dorsal rows of large papillae and two lateral rows of papillae. Ossicles of the body wall comprise numerous tables and C-shaped ossicles, never rosettes . . . . . ***Stichopus chloronotus* BRANDT, 1835**

2. Bivium more or less bright olive-green with numerous brownish spots, trivium slightly lighter . . . ***Stichopus herrmanni* SEMPER, 1868**

2'. Bivium yellow to brown with brown-grey areas (especially in the larger specimens), trivium yellow to brown. Bivium clearly distinguishable from trivium due to the presence of a lateral fringe of large papillae . . . ***Stichopus monotuberculatus* (QUOY & GAIMARD, 1833)**

Stichopus chloronotus BRANDT, 1835
(fig. 35A-F, fig. 55B, pl. 4A)

Stichopus (Perideris) chloronotos BRANDT, 1835: 50.
Stichopus coronpus; PRICE 1971: 166 (*lapsus calami*?).
Stichopus cylindricus HAACKE 1880: 47; DANIEL & HALDER 1974: 423.
Stichopus chloronatus; DANIEL & HALDER 1974: 429 (*lapsus calami*).
Stichopus chlorontus; ARAKAMI & FAGOONEE 1996: 121 (*lapsus calami*).
Stichopus chloronotus; CHERBONNIER 1967: 57; SLOAN *et al.* 1979: 123; PRICE 1982: 11; A.M. CLARK 1984: 87, 99; FÉRAL & CHERBONNIER 1986: 94 (colour picture), 95; CANNON & SILVER 1986: 27, figs 4h, 7h (colour drawing); THANDAR 1987a: 280; CHERBONNIER, 1988: 146 (synonymy); MUKHOPADHYAY 1991: 408; ALLEN & STEENE 1994: 245 (colour picture); MASSIN 1996a: 34; GOSLINER *et al.* 1996: 281 (colour picture); ROWE & RICHMOND: 306, 307 (colour drawing); CONAND 1999: 10, 12, 39, pl. 2; SAMYN 2000: 15 (tab. 1), SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 18 (tab. 4), 30, pl. 2C; MARSHALL *et al.* 2001: 46 (tab. 29), 58 (tab. 37), 59.

STATUS AND LOCATION TYPE – Holotype (probable); whereabouts undetermined (ROWE & GATES 1995).

[10] ROWE (pers. comm.) noted that *Stichopus anapinusus* (LAMPERT, 1885) and *S. paradoxus* LAMPERT, 1885 are not recognisable and that they could as well be *Holothuria* spp; *Eostichopus arnesoni* CUTRESS & MILLER, 1982 could also belong to *Stichopus*; *S. flaccus* LIAO 1980 could be a synonym of *S. naso* SEMPER, 1868 and *S. mollis* (HUTTON, 1872) probably must be transferred to *Neostichopus* DEICHMANN, 1948.

TYPE LOCALITY – Insula Lugunor and Guam (as Guahan) (ROWE & GATES 1995).

MATERIAL EXAMINED – KMom/9768 (one specimen); KKan/9728 (one specimen); KKan/9729 (one specimen); KMom/9847 (one specimen); KMom/9848 (one specimen); KMom/9849 (one specimen); KMom/9850 (one specimen); KMom/9851 (one specimen).

GENERAL DESCRIPTION – Specimens ranging from 85 to 145 mm in length and from 24 to 40 mm in width, after preservation. Live specimens approximately 20 % larger. Body colour of live specimens is dark green to brown (pl. 4A); preserved specimens faint brown to whitish; ventral side slightly lighter in colour. Mouth ventral, surrounded by large dark green papillae and 19-20 white to grey (after preservation) tentacles. Anus terminal surrounded by five large papillae. Body wall smooth, 2-4 mm thick. Ventral tube feet, long, dark green, spread over the radial and interradial areas, posteriorly in four distinct rows. Dorsal side with two rows of large, conical, yellow to orange papillae; laterally, single row of similar papillae. Tentacle ampullae short. Single to two Polian vesicles large. Single to three stone canals. Calcareous ring stout, radial pieces with small concave depression posteriorly and four tooth-like extensions anteriorly (after CHERBONNIER 1988: 149, fig. 60 O).

Ossicles: Tentacles with rods, 90-265 μm long, sometimes slightly bifurcated, knobbed distally; and spiny edged plates, perforated by a variable number of holes (fig. 35A). Ventral and dorsal body wall with similar tables and C-shaped rods (fig. 35B), rosettes always absent; tables, 40-45 μm across, perforated by four central holes and a variable number of peripheric openings, single cross beam ending in simple, sometimes spiny crown; C-shaped rods 30-50 μm long. Tube feet with irregularly perforated plates, up to 250 μm long (fig. 35D); tables, 35-45 μm across (fig. 51E); and spiny rods, 285-470 μm long, some of them with enlarged median part, pierced by uneven holes (fig. 35F). Dorsal papillae filled with C-shaped rods, 45-65 μm long, occasionally irregular; tables similar though slightly larger than the ones from the body wall (fig. 35C); and perforated plates at the top of the papillae.

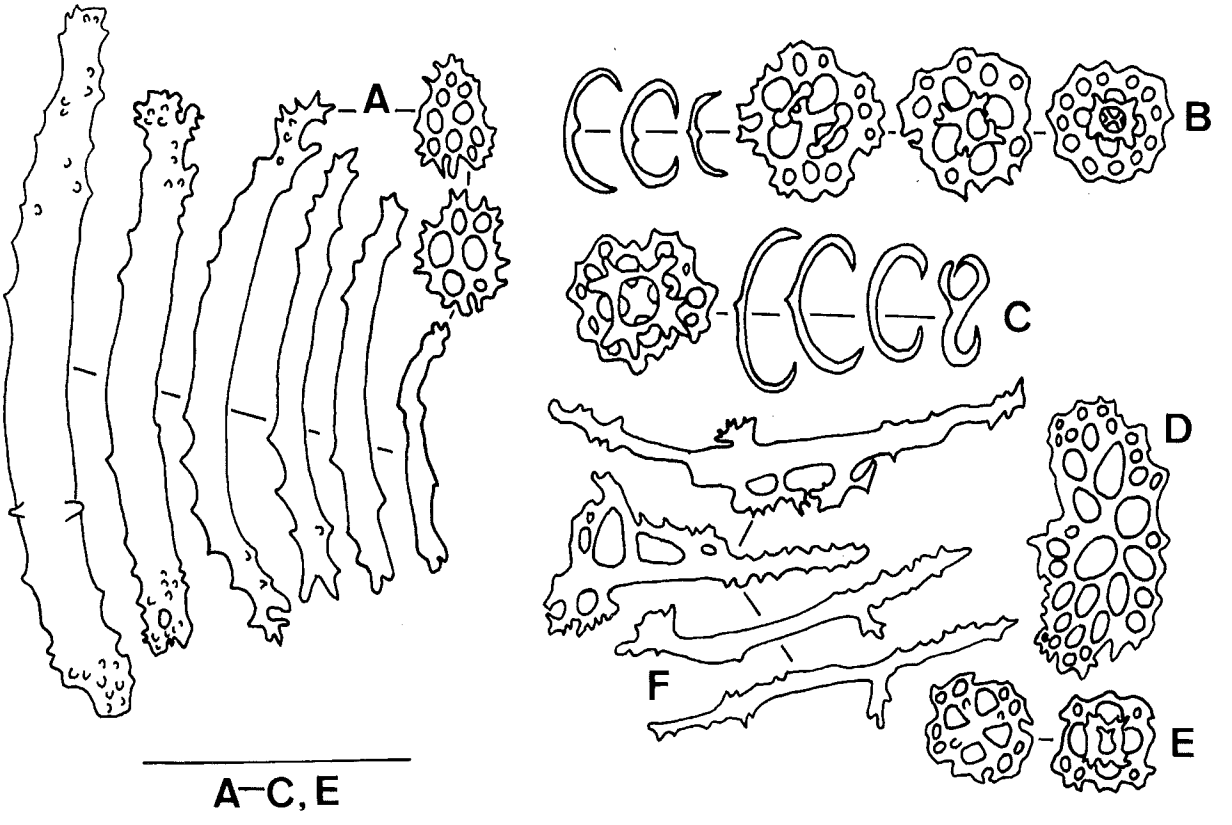

FIG. 35 – *Stichopus chloronotus* BRANDT, 1835. A. Rods and plates of tentacles; B. Tables and C-shaped rods of body wall; C. Tables and C-shaped rods of dorsal papillae; D. Perforated plate of ventral tube feet; E. Tables of ventral tube feet; F. Rods of ventral tube feet. Scale bar A-C, E represents 100 μm; scale bar D, F represents 200 μm.

DIAGNOSIS – See CHERBONNIER, 1988: 146, fig. 60 A-O.
ECOLOGY – Shallow water (2-12 m), on sand between coral patches, in seagrass beds. ROWE (*in* ROWE & GATES 1995) report depths from 0-20 m.

DISTRIBUTION IN THE STUDY REGION – Kanamai, Mobasa Marine National Park and Reserve, Watamu Marine National Park.
GEOGRAPHIC DISTRIBUTION – Well known species from the tropical, Indo-west-central Pacific (with the Red Sea, without the Persian Gulf) (CHERBONNIER 1988; ROWE & GATES 1995). CHERBONNIER (1988) lists it from the Persian Gulf, probably based on HEDING's (1940a) record. However, this record stems from the Seychelles (Mahé) and not from the Persian Gulf. Figure 55B shows the known distribution in the WIO in detail.
REMARKS – This species was recently reported as new to the Kenyan fauna (SAMYN & VANDEN BERGHE 2000), in the present work the following localities are added: Watamu, Kanamai, Mombasa.

Stichopus herrmanni SEMPER, 1868
(fig. 36A-L, fig. 55C, pl. 4B)

Stichopus variegatus Herrmanni SEMPER, 1868: 73, pl. 17, pl. 30, fig. 2.
Stichopus variegatus; THANDAR 1987a (synonymy): 281; GOSLINER *et al.* 1996: 281 (colour picture); CONAND 1999: 10, 12, 20, 39, pl. 2 (colour picture); MARSHALL *et al.* 2001: 46 (tab. 29), 53, 54, 58 (tab. 37).
? Stichopus variegatus; MUKHOPADHYAY 1991: 409; ARAKAKI & FAGOONEE 1996: 121.
Stichopus hermanii; MARSHALL *et al.* 2001: 47 (*lapsus calami*).
Stichopus herrmanni; MASSIN 1999: 63 (synonymy and records before 1999); SAMYN 2000: 15 (tab. 1), fig. 1 (colour picture); SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 18 (tab. 4), 31, pl. 2E.

STATUS AND LOCATION TYPE – Syntypes whereabouts undetermined (ROWE & GATES 1995).
TYPE LOCALITY – Philippines and Samoa (ROWE & GATES 1995).
MATERIAL EXAMINED – KKan/9709 (two specimens); KMom/9852 (one specimen); KVan/9767 (one specimen).
GENERAL DESCRIPTION – Specimens ranging from 110 to 267 mm in length and from 30 to 64 mm in width, after preservation.The specimen collected in Vanga is in very poor state; preserved animals with deep transverse folds. Colour of live animals bright olive-green with numerous brownish spots dorsally (pl. 4B), slightly lighter ventrally; in alcohol uniform light green to nearly white. Mouth ventral with 16-18 greenish tentacles. Anus terminal, unguarded by anal teeth or papillae. Body wall, smooth, 3-5 mm thick. Flattened ventral side with cylindrical tube feet spread over ambulacral and partially also the interambulacral areas. Dorsal side with conical light green papillae with dark green stripes and yellow to orange distal tips, spread without alignment over ambulacral and interambulacral areas. Single Polian vesicle. Calcareous ring relatively small but firm; radial pieces more than twice as wide as interradial pieces; radial piece with two short posterior projections and shallow anterior notch; interradial pieces with single anterior tooth (from MASSIN 1999: 64, fig. 52a).
Ossicles: Tentacles with curved rods, 75-500 µm long, spiny at the extremities (fig. 36A, B). Ventral and dorsal body wall present tables, rosettes and C-shaped rods (fig. 36C, D, E). C-shaped bodies very numerous, 75-110 µm long (fig. 36C). Rosettes very numerous, 20-45 µm long (fig. 36D). Tables with disc 25-45 µm across, disc rounded, perforated by four central and four to eight peripheral holes, spire short, four pillars united by single cross beam, ending in narrow, often spined crown (fig. 36E). Dorsal papillae with rods up to 200 µm long (fig. 36F); C-or S-shaped bodies, similar in size and shape as those from the body wall (fig. 36G); and tables up to twice the size as those from the body wall (fig. 36H). Ventral tube feet present rods, up to 335 µm long, with median part often enlarged and perforated (fig. 36J); perforated plates, irregular in outline, up to 235 µm long (fig. 36K); and few tables with poorly developed crown, similar in size as the ones from the body wall (fig. 36L).
DIAGNOSIS – See MASSIN 1999: 63-65, fig. 52.
ECOLOGY – In seagrass beds, grazing on sand and detritus piles; 2-12 m depth.
DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve; Watamu; Kanamai; Mombasa; Diani and Vanga (see also SAMYN & VANDEN BERGHE 2000).
GEOGRAPHIC DISTRIBUTION – Probably tropical, Indo-west Pacific Ocean (with the Red Sea and the Persian Gulf) (ROWE & GATES 1995; MASSIN 1999). Figure 55B shows the known distribution in the WIO if we take the records identified as

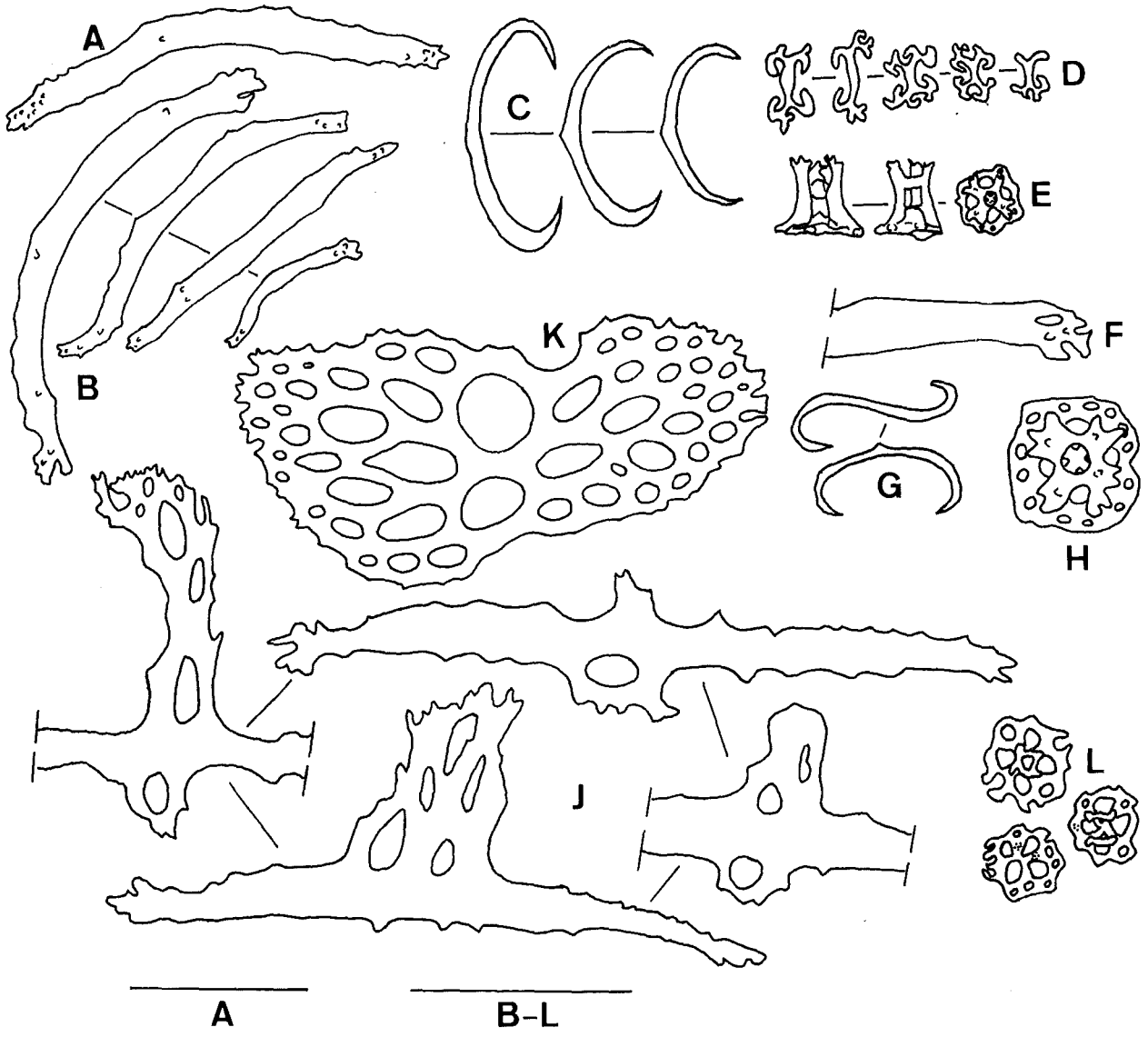

FIG. 36 – *Stichopus herrmanni* SEMPER, 1868. A. Large rod of tentacles; B. Rods of tentacles; C. C-shaped bodies of body wall; D. Rosettes of body wall; E. Tables of body wall; F. Rod of dorsal papillae; G. C-and S-shaped bodies of dorsal papillae; H. Table of dorsal papillae; J. Rods of ventral tube feet; K. Perforated plate of ventral tube feet; L. Tables of ventral tube feet. Scale bar A represents 200 μm; scale bar B-L represents 100 μm.

Stichopus variegatus by CHERBONNIER (1967) from the Gulf of Aqaba; ERWE (1919) from the Gulf of Suez; HEDING (1940b) from the Persian Gulf; LAMPERT (1885), TORTONESE (1936a; 1953a), JAMES (1969), JAMES & PEARSE (1969) and CLARK & ROWE's (1971) from the Red Sea; CLARK & ROWE (1971) from the Arabian Sea; LUDWIG (1887) and LAMPERT (1896) from Zanzibar; PEARSON (1910) and THANDAR (1987a) from Mozambique; THANDAR (1987a) from Natal; PANNING (1944) and CONAND (1999) from Madagascar; SLOAN *et al.* (1979), ARAKAKI & FAGOONEE (1996) and CONAND (1999) from the Seychelles; LUDWIG (1883), LAMPERT (1885), THÉEL (1886) and CONAND (1999) from Mauritius; CONAND (1999) from La Réunion, to be *S. herrmanni* (see also remarks hereunder). HAACKE's (1880; see also DANIEL & HALDER 1974) record of *Stichopus naso* SEMPER, 1868 from Mauritius is most probably also *S. herrmanni* (or *S. monotuberculatus* (QUOY & GAIMARD, 1833)), as *S. naso* is known as a tropical, east Indo-west Pacific Ocean species (ROWE & GATES 1995).

Remarks – Rowe (*in* Rowe & Gates 1995) and later Massin (1999) showed that the specimens identified as *S. variegatus* Semper, 1868, the senior synonym of *S. horrens* Selenka, 1867, are or *S. herrmanni* or *S. monotuberculatus* (Quoy & Gaimard, 1833). Hence the distribution map of this ubiquitous species remains largely unknown. Nevertheless, fig. 55C attempts to visualise the known distribution in the WIO.
This species was previously reported from Kenya, Kiunga Marine Reserve (Samyn & Vanden Berghe 2000); in the present work the following localities are added: Watamu, Kanamai, Mombasa, Diani, Vanga.

Stichopus cf. monotuberculatus (Quoy & Gaimard, 1833) (fig. 37A-K, fig. 55D, pl. 4C)

Holothuria monotuberculata Quoy & Gaimard, 1833: 131, pl. 432, fig. 1.
Stichopus unituberculatus; Selenka 1867: 320.
Holothuria lutea Quoy & Gaimard 1833: 130 [see also Cherbonnier 1952b: 21].
Stichopus luteus; Lampert 1885: 109; Théel 1886: 197.
Stichopus monotuberculatus; Cherbonnier 1955: 161; James 1969: 61; Cherbonnier 1967: 57; James 1969: 61; James & Pearse 1969: 102; Tortonese 1977: 275; Price 1982: 11; Massin 1996b: 163 (synonymy); Rowe & Richmond 1997: 306.
Stichopus cf. *monotuberculatus*; Samyn 2000: 15 (tab. 1); Samyn & Vanden Berghe 2000: 5 (tab. 2), 18 (tab. 4), 31, Pl 2E.

Status and location type – Holotype probably in MNHNP (Rowe & Gates 1995).
Type locality – Port Louis, Mauritius (Rowe & Gates 1995).
Material examined – TFun/9812 (one specimen); TFun/9813 (one specimen); Tfun/9814 (one specimen); KKiun/9950 (one specimen).
General description – Specimens from 130 to 232 mm in length and from 25 to 55 mm in width, after preservation. Colour in alcohol: yellow to brown ventrally, yellow to brown with brown-grey areas (especially in the larger specimens) dorsally (pl. 4C). Bivium clearly distinguishable from trivium due to the presence of a lateral fringe of large papillae. Mouth ventral surrounded by 16-18 large yellow-brown tentacles with whitish stalk, surrounded at their base by large papillae. Anus terminal. Body wall up to 3 mm thick. Ventral tube feet, numerous, large and long, in four to five rows on the lateral radii and in eight to ten rows on the median radius. Bivium with some short papillae. Single, large Polian vesicle. Calcareous ring relatively small for the size of the specimens, radial pieces high; interradial pieces with elongated anterior tooth (see also Massin 1996b: 165, fig. 9A).
Ossicles: Ventral body wall presents tables and C-shaped bodies (fig. 33A,B); tables with rim of disc smooth and outline squarish, 30-45 µm across, perforated by four large central holes and three to six peripheral holes, spire short, four pillars united by single cross beam ending in a wide, spiny crown (fig. 37A); C-shaped bodies rare, up to 85 µm long (fig. 37B). Dorsal body wall with tables of similar size and shape as those from the ventral body wall and with rosette-like rods (fig. 37C). Ventral tube feet with spiny rods, 250-415 µm long, with enlarged median process, unevenly perforated (fig. 37D); spiny plates 85-100 µm long; X-shaped rods; and tables with rounded but spiny disc (fig. 37E). Dorsal papillae with tables, rim of disc round but irregular, disc 45-70 µm across, perforated by four large central holes and up to 20 smaller peripheral holes (fig. 37F); some perforated rods which can be X-shaped (fig. 37G); and numerous large, 135-350 µm long, rods, that often have an enlarged median process (fig. 37H). Tentacles present rods, 140-650 µm long, straight to C-shaped, spiny at the extremities (fig. 37J, K).
Diagnosis – See Massin 1996b: 163-164; fig. 9, 10, pl. 1.C, D.
Ecology – In the Kiunga Marine Reserve two specimens were observed at night, foraging on sandy substrate between live coral; the specimens from Pemba Island were found during the day; depth ranges from 5 to 23 m in the study region. Massin's (1996b) ecological observations on Easter Island, state occurrence from intertidal pools up to depths of 45 m.
Distribution in the study region – Kiunga Marine Reserve; Fundu (see also Samyn & Vanden Berghe 2000).
Geographic distribution – The species seems to have a tropical Indo-west Pacific Ocean (with the Red Sea and the Persian Gulf), but as Rowe (*in* Rowe & Gates 1995) and Massin (1996b; 1999) have noted, there is some confusion with *S. herrmanni* and *S. horrens* when it comes to drawing the distribution map. Massin's (1996b: 174, map 3) distribution map has to be completed

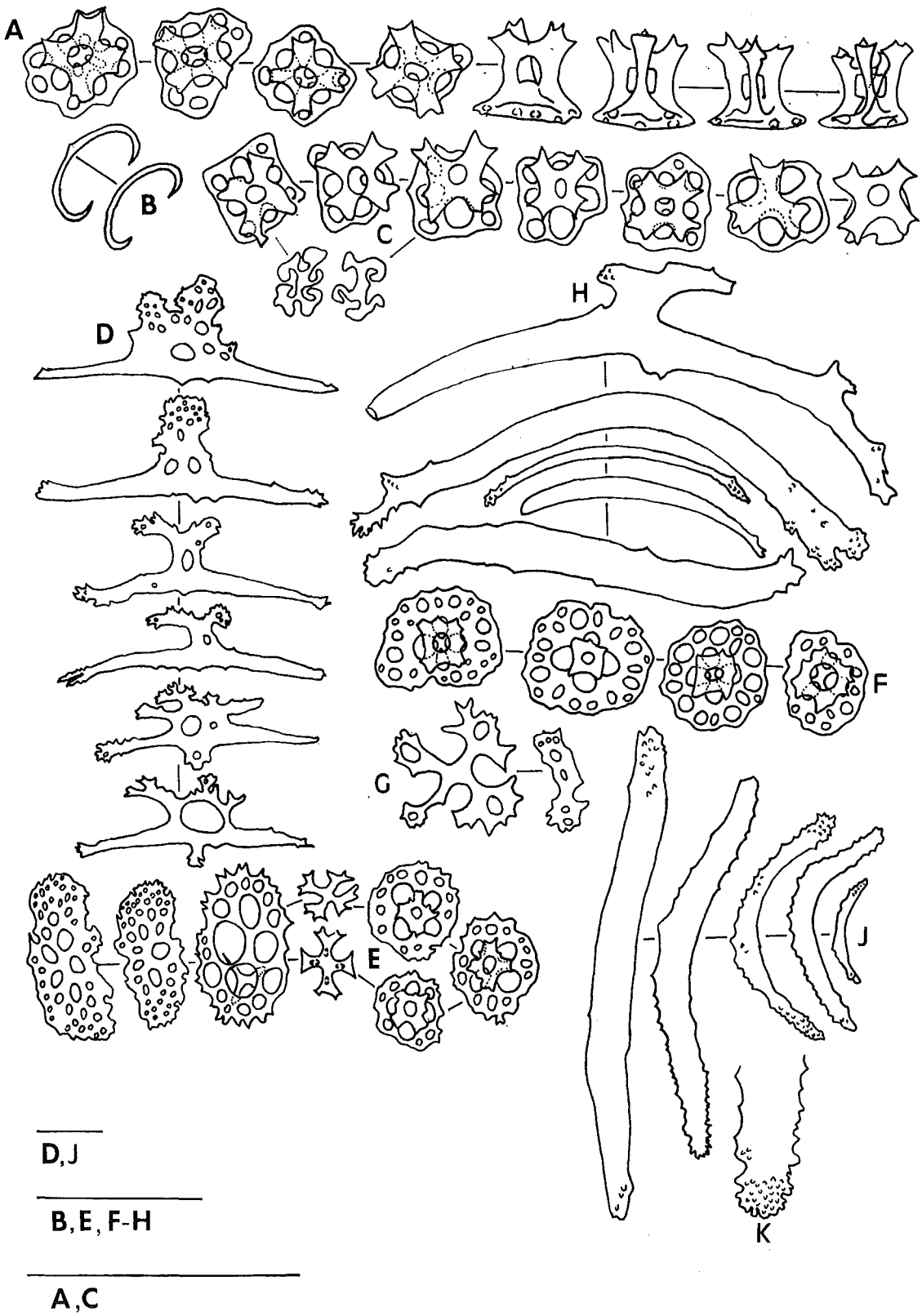

FIG. 37 – *Stichopus monotuberculatus* (QUOY & GAIMARD, 1833). A. Tables of ventral body wall; B. C-shaped rods of ventral body wall; C. Tables and rosette-like rods of dorsal body wall; D. Rods of ventral tube feet; E. Plates and tables of ventral tube feet; F. Tables of dorsal papillae; G. Table fragment and small rod of dorsal papillae; H. Rods of dorsal papillae; J. Rods of tentacles; K. Detail of rod of tentacle. All scale bars represent 100 μm.

with the following records: Gulf of Suez, Wadi el Dom (JAMES 1969; JAMES & PEARSE 1969) (see also CHERBONNIER 1955; PRICE 1982 for unspecified localities in the Gulf of Suez); Gulf of Aqaba, Eilat (CHERBONNIER 1963; 1967), Aqaba (TORTONESE 1977) (see also PRICE 1982 for unspecified locality in the Gulf of Aqaba); Red Sea, Entedebir (CHERBONNIER 1967); Arabian Sea (PRICE 1982); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000); Tanzania, Fundu (this work); Mauritius (QUOY & GAIMARD 1833, as *Holothuria monotuberculata* QUOY & GAIMARD, 1833; SELENKA 1867, as *S. unituberculatus* QUOY & GAIMARD, 1833; LAMPERT 1885 and THEÉL 1886, both as *S. luteus* QUOY & GAIMARD, 1833; CHERBONNIER 1952b); Mascarene Islands (CLARK & ROWE 1971). Figure 55D shows the suspected WIO distribution in detail.

Table 20 lists the other species within the genus *Stichopus* that are known to occur in the shallow-waters of the WIO, but have for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record appeared.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
Stichopus horrens SELENKA, 1867	Mozambique (Inhaca)	MRAC records, pers. observ.
	Madagascar (Nosy Bé)	CHERBONNIER 1988
	Seychelles (Aldabra)	SLOAN *et al.* 1979
	La Réunion	CHERBONNIER 1988
	Mauritius	ARAKAKI & FAGOONEE 1996
	West Indian Ocean to West Pacific Ocean, with the Red Sea	ROWE & RICHMOND 1997
Stichopus pseudohorrens CHERBONNIER, 1967	Gulf of Aqaba (Aqaba, Eilat)	CHERBONNIER 1967; TORTONESE 1977; CHERBONNIER 1979a; PRICE 1982

TABLE 20 – Other species within the genus *Stichopus* known to occur in the shallow-waters of the WIO.

Genus *Thelenota* H.L. CLARK, 1921

DIAGNOSIS (See H.L. CLARK 1921:183) [Type species: *Trepang ananas* JAEGER, 1833 by original designation].
Currently three species are regarded as being valid: *Thelenota ananas* (JAEGER, 1833); *T. anax* H.L. CLARK, 1921 and *Thelenota rubralineata* MASSIN & LANE, 1991[11]. The first two species are present in the shallow-waters of Kenya; they are keyed hereunder.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND).

1. Bivium bears prominent di-to quadrichotomously branched warts. Ossicles consist of pseudo-tables and large, more or less spiny; X-shaped plates; no grains . . . . . ***T. ananas* (JAEGER, 1833)**
1'. Bivium with conical warts, never branched in structure. Ossicles never in the form of pseudo-tables; numerous very small grains and smooth X-shaped plates . . . . . ***T. anax* H.L. CLARK, 1921**

Thelenota ananas (JAEGER, 1833) (fig. 38A-E, fig. 55E, pl. 4D)

Trepang ananas JAEGER, 1833: 24, pl. 3 fig. 1.
Actinopyga formosa SELENKA 1867: 314, pl. 17 fig. 19a,b,c; DANIEL & HALDER 1974: 422.
Thelenota ananas; MUKHOPADHYAY 1991: 409; ARAKAKI & FAGOONEE 1996: 122; WEINBERG 1997: 249 (colour picture); MASSIN 1999:77 (synonymy and records before 1999); CONAND 1999: 10, 12, 18, 39, pl. 2 (colour picture); MARSHALL *et al.* 2001: 46 (tab. 29), 47, 50, 53, 54, 58 (tab. 37).
Thelenota ananas?; ARAKAKI & FAGOONEE 1996: 122.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995).
TYPE LOCALITY – Sulawesi (Indonesia) (ROWE & GATES 1995).
MATERIAL EXAMINED – KKis/9843 (one specimen).

[11] WEINBERG (1997) calls upon all recreational and non-recreational divers to report spottings of *T. rubralineata* MASSIN & LANE, 1991 in the WIO. To my knowledge, since then, this eye-catching species has not been reported.

General description – Large species, squarish in cross-section. The single specimen measures 362x100 mm, after preservation. Colour in life, uniform orange-red (pl. 4D); colour in alcohol slightly faded. Mouth ventral, surrounded by 20 dark-orange tentacles. Anus terminal, unguarded. Thickness of body wall varies between 7 (anteriorly) and 10 mm (posteriorly). Bivium with prominent di-to quadrichotomously branched orange-red extensions which end in papillae ('cockscomb papillae'); interspersed between these large extensions, smaller brownish papillae can be found. Trivium densely covered by numerous long and thick reddish tube feet; ambulacral and interambulacral areas not discernable. Single large Polian vesicle. Single short stone canal. Gonad single, poorly developed. Calcareous ring relatively small with large radial and short interradial pieces.

Ossicles: Tentacles present large plates, 135 µm long and 95 µm wide (fig. 38A) and some smaller rods. Dorsal body wall with branched rods which are slightly spined, 40-80 µm long (fig. 38B). Ventral body wall with similar, though smooth plates (fig. 38C). Dorsal papillae with branched rods similar to the ones from the body wall and with slightly curved, spined rods, up to 155 µm long (fig. 38D). Ventral tube feet present large plates, 75-135 µm long and rods similar to the ones in the dorsal papillae (fig. 38E).

Diagnosis – See Cherbonnier & Féral 1984b: 829, fig. 62A-S.

Ecology – In Kenya, always seen in deeper water, never found above ten m depth; feeding on detritus piles and coarse sand. Massin (pers. comm.) notes that in Papua New Guinea, this species is common in 1-2 m deep water, in the lagoon.

Distribution in the study region – Kisite, Mombasa Vanga.

Geographic distribution – Well-known species from the tropical, Indo-west Pacific Ocean (not recorded from the Red Sea nor from the Persian Gulf). The distribution map as drawn by Massin

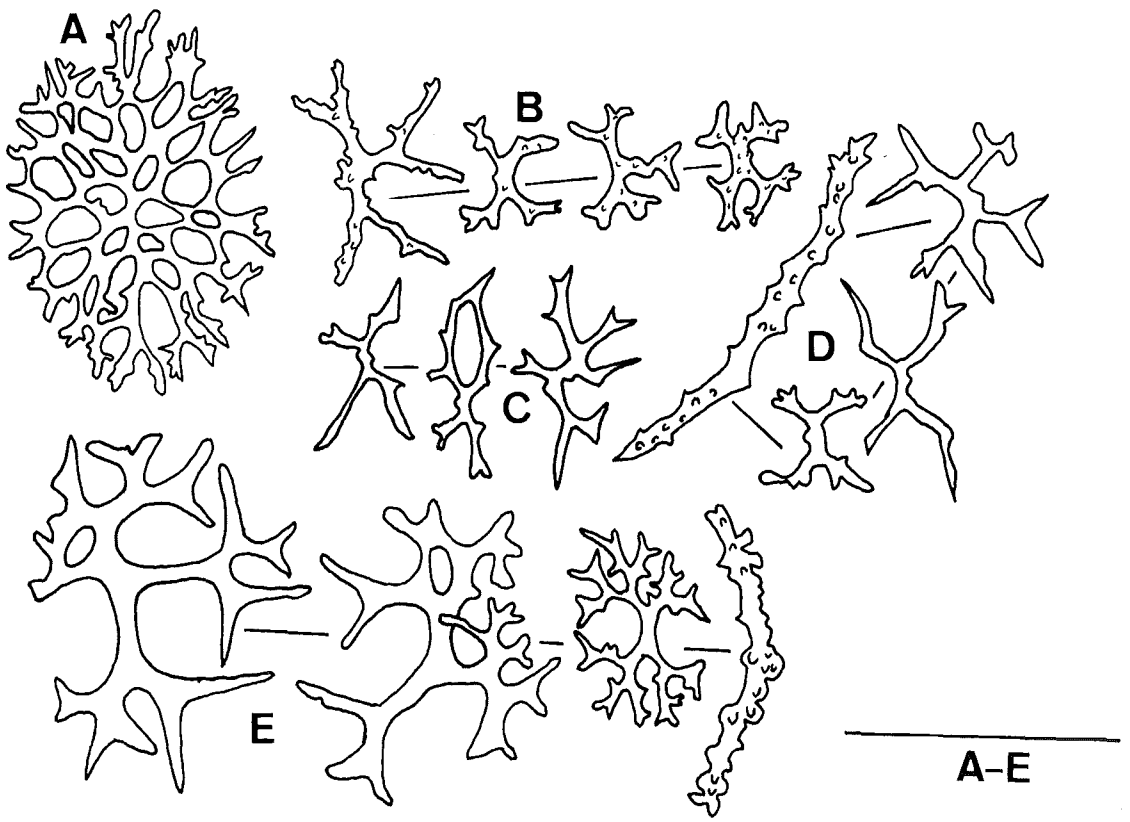

Fig. 38 – *Thelenota ananas* (Jaeger, 1833). A. Perforated plate of tentacle; B. Branched rods of dorsal body wall; C. Branched rods of ventral body wall; D. Branched and unbranched rods of dorsal papillae; E. Branched and unbranched rods of ventral tube feet. Scale bar A-E represents 100 µm.

(1999: 77, fig. 62; see also LANE 1999: 20, fig. 2), gives the global distribution. Figure 55E shows the known distribution in the WIO in detail, whereby the record of ARAKAKI & FAGOONEE (1996) from the Seychelles, Mahé, must be treated with caution for these authors marked it with a question mark.

Thelenota anax H.L. CLARK, 1921 (fig. 39A-C, fig. 55F, pl. 4E)

Thelenota anax H.L. CLARK, 1921: 185, pl. 18 fig. 3
Thelenota anax; WEINBERG 1997: 248 (colour picture); MASSIN 1999: 78 (synonymy and records before 1999); CONAND 1999: 12, 19, 39, pl. 2 (colour picture); SAMYN 2000: 15, tab. 1; MARSHALL *et al.* 2001: 46 (tab. 29).
? Thelenota sp. 1.; ARAKAKI & FAGOONEE 1996: 122.
? Thelenota sp. 2.; ARAKAKI & FAGOONEE 1996: 122.

STATUS AND LOCATION TYPE – Holotype; MCZ 1068 (ROWE & GATES 1995).
TYPE LOCALITY – Mer, Murray Islands, Torres Strait, Queensland (Australia) (H.L. CLARK 1921).
MATERIAL EXAMINED – KKis/9841 (one specimen); KKis/9842 (one specimen).
GENERAL DESCRIPTION – Preserved specimens measure 360 x 90 mm and 450 x 75 mm.; live specimens can reach the dimensions of the arm of an adult man. Markedly square in cross section. Body colour of live specimens grey-brownish dappled with dark-red; preserved specimens uniformly grey. Mouth ventral. Anus dorsal. Body wall up to 20 mm thick, very smooth to the touch. Dorsal body wall lacks large 'cockscomb' papillae as on *T. ananas*, but presents short papillae and very short tube feet. Ventral body wall flattened, uniformly covered with numerous fine and long tube feet. Bivium separated from trivium by row of large papillae which can be fused. Polian vesicles numerous. Calcareous ring relatively small; radial pieces twice as wide as interradial pieces and with two posterior extensions; radial pieces with short anterior tooth (see also MASSIN 1999: 79: fig. 63a).
Ossicles: Tentacles present spiny perforated plates, 80-100 µm long, and branched rods, 70-125 µm long (fig. 39A); Ventral and dorsal body wall with dichotomously branched rods, 70-100 µm long (fig. 39B), pseudotables and an almost infinite number of miliary granules only few µm across (not illustrated). Ventral tube feet with rods, 70-100 µm long, and large perforated plates, up to 275 µm long (fig. 39C).
DIAGNOSIS – See CHERBONNIER 1988: 156-158, fig.64.
ECOLOGY – Species restricted to 15-45 m depth; invariably found grazing on coarse sand.
DISTRIBUTION IN THE STUDY REGION – Kisite.
GEOGRAPHIC DISTRIBUTION – Tropical Indo-West Pacific species (not recorded from the Red Sea nor from the Persian Gulf). The distribution map as drawn by MASSIN (1999: 80, fig. 64; see also LANE 1999: 20, fig. 2), gives the global distribution, but the following have to be added: southern Mozambique (THANDAR 1987a); Seychelles, Aldabra (SLOAN *et al.* 1979); Mauritius (CONAND 1999). The present record is new to Kenya. Figure 55F shows the known distribution in the WIO in detail.
REMARKS – *T. anax* is one of the high-value trepang species (prickly redfish), probably overharvested by fishermen. Hence local geographic distribution possibly was much larger then reported here.
The records of ARAKAKI & FAGOONEE (1996, as *Thelenota* sp. 1 and *Thelenota* sp. 2) from Mauritius, most probably are *T. anax* for these authors recognised *T. ananas* as a distinct species in the same paper.

Ordo APODIDA BRANDT, 1835

Family Synaptidae BURMEISTER, 1837

Subfamily Rynkatorpinae SMIRNOV, 1989

KEY TO THE GENERA OF KENYA (WITH PEMBA ISLAND) (after CLARK & ROWE 1971: 207)

1. Stock of anchor irregularly branched; cartilaginous ring usually not present **2**
1'. Stock of anchor unbranched; cartilaginous ring commonly present **3**
2. Anchor-plates not abruptly contracted at posterior end but with a large central hole on each side; calacreous ring without conspicuous anterior projections . . . . ***Euapta* ØSTERGREN, 1898**
2'. Anchor-plates abruptly contracted posteriorly, thus lacking a large smooth hole on each side of the bridge; calcareous ring with conspicuous anterior projections . . . . . ***Opheodesoma* FISHER, 1907**

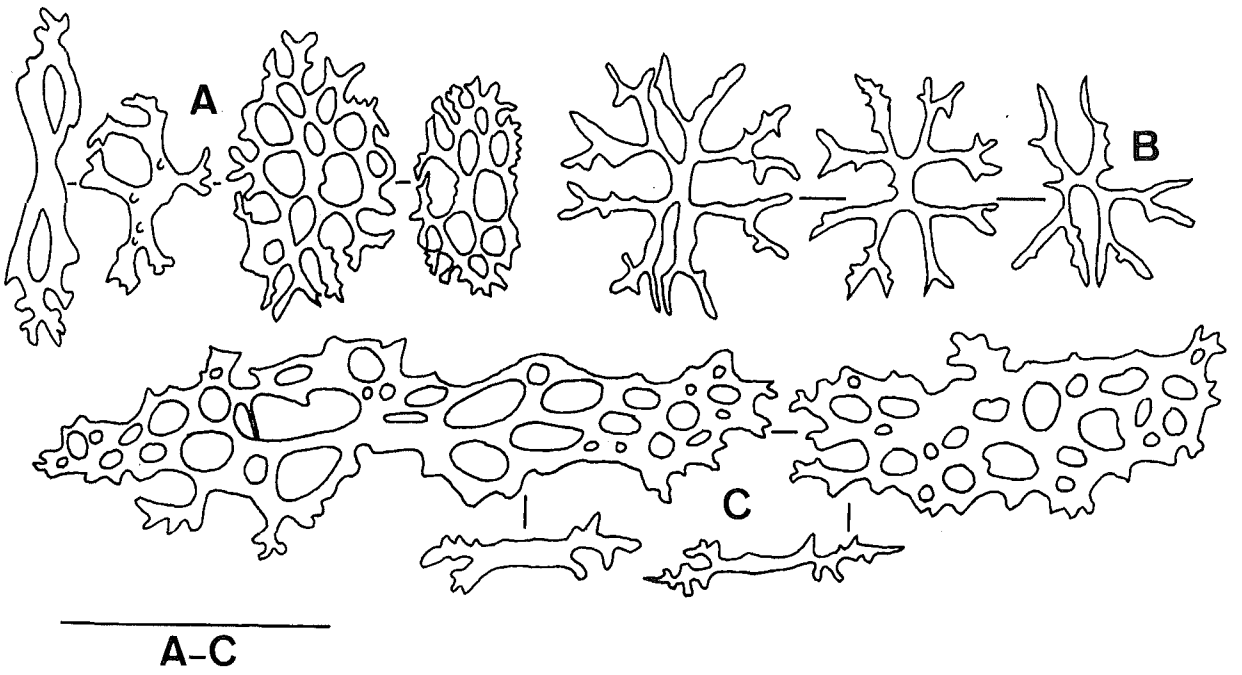

FIG. 39 – *Thelenota anax* H.L. Clark, 1921. A. Rods and perforated plates of tentacles; B. Rods of body wall; C. Rods and perforated plates of ventral tube feet. Scale bar A-C represents 100 µm.

3. Ossicles very large, anchors up to 1 mm or more; anchor-plates up to 650 µm long, subrectangular or irregular, broad posteriorly with numerous smooth holes . . . . . ***Synapta* ESCHSCHOLTZ, 1829**

3'. Ossicles never particularly large, anchors rarely exceeding 400 µm or anchor-plates 300 µm in length, anchor-plates rounded anteriorly and narrowing posteriorly, with a few holes and these generally regularly arranged and toothed . . . . . ***Synaptula* Ørsted, 1849**

Genus *Euapta* ØSTERGREN, 1898

DIAGNOSIS (See FISHER 1907: 721) [Type species: *Synapta godeffroyi* SEMPER, 1868 by subsequent designation]
Six species are currently regarded as being valid: *Euapta godeffroyi* SEMPER, 1868; *E. lappa* (MÜLLER, 1850); *E. magna* HEDING, 1928; *E. polii* (LUDWIG, 1894); *E. tahitiensis* CHERBONNIER, 1955 and *E. tobagoensis* HEDING, 1928. In addition, *Opheodesoma sinevirga* CHERBONNIER, 1988 is here transferred to the genus *Euapta* for the structure of the anchor-plates are typical of the latter genus; *i.e.* they have a anchor-plates that are not abruptly contracted at posterior end, but with a large hole on each side.
Only *E. godeffroyi* is found in the shallow-waters of Pemba Island

Euapta godeffroyi (SEMPER, 1868)
(fig. 40A-E, fig. 55G)

Synapta Godeffroyi SEMPER, 1868; 231, pl. 39 fig. 13.
Euapta godeffroyi; CHERBONNIER 1967: 57; DANIEL & HALDER 1974: 423; TORTONESE 1977: 275; MUKHOPADHYAY 1991: 410; WEINBERG 1997: 250 (colour picture); MASSIN 1999: 100 (synonymy and records before 1999); LANE *et al.* 200:492.

STATUS AND LOCATION TYPE – Syntype: ZMH E. 2950 (ROWE & GATES 1995).
TYPE LOCALITY – Samoa (Navigator Islands) (ROWE & GATES 1995).
MATERIAL EXAMINED – TFun/9817 (one specimen); TFun/9818 (one specimen).
GENERAL DESCRIPTION – Medium sized species; size from 110-260 mm in length and from 8-20 mm in width, after preservation. Body cylindrical, sticky to the touch. Body colour in life: whitish-yellow with numerous transverse dark brown bands and five conspicuous, narrow,

brown longitudinal lines in the radial areas. Colour in alcohol fades to uniform beige with some brown blotches and traces of the longitudinal lines (especially visible at the anterior end). 14-15 feather-like tentacles that bear 20 or more pairs of digits, united by a web. Polian vesicles very thin, numerous. Stone canal not observed. Gonad branched. Cartilaginous ring wanting. Calcareous ring faint greenish, narrow; two interradial pieces alternating with one radial piece that is perforated anteriorly by a minute hole allowing passage for the nerve.

Ossicles: Body wall presents numerous miliary granules, few anchors and anchor-plates (fig. 40A-C, E). Anchors: arms smooth; vertex armed with four to six nodules; stock branched and granulous at the extremities; 300-315 x 170 µm (fig. 40B). Anchor-plates: oval in outline, *i.e.* without contracted posterior side; seven large serrated (fig. 40A) or smooth (fig. 40E) holes; two smooth articular holes and three small, smooth, posterior holes; bridge well developed, undulating to slightly angular, occasionaly perforated by small, smooth, holes; 200-225 µm long and 145-160 µm wide. Tentacles present spiny rods with bifurcating extremities, 150-225 µm long and occasionaly some smooth rods (fig. 40D) in addition to miliary granules exactely like the ones of the body wall.

Diagnosis – See Semper 1868: 230, pl. 39 fig. 13; see also Massin 1996b: 164-167, fig. 11, p. 168.

Ecology – *E. godeffroyi* was found at night in a healthy reef; bathymetric range 0-77 m (Lane *et al.*, 2000).

Distribution in the study region – Fundu.

Geographic distribution – Well-known species from the tropical Indo-West-central Pacific Ocean (with the Red Sea, not recorded from the Persian Gulf). The distribution map as drawn by Massin (1996b: 174, map 3; 1999: 102, fig. 85) gives the global distribution, but the following localities have to be added: Gulf of Aqaba, Eilat (Cherbonnier 1967), Aqaba (Tortonese 1977) (see also Price 1982 for unspecified record from the Gulf of Aqaba); Madagascar, Tuléar (Cherbonnier 1988) and Tanzania, Fundu. (this work). Figure 55G shows the known distribution in the WIO in detail.

Remarks – Massin (1999) noted that *E. godeffroyi* is assumed to be common (a fact reflected in his distribution map); however only few records are known from the East African coast, *i.e.* Zanzibar, Aldabra, Madagascar, Mauritius and S. Africa. The present record is the first for Tanzania. Due to its nocturnal habit, the species was possibly overlooked in previous studies; and most probably also belongs to the Kenyan fauna as it was previously found in the northern (Seychelles: Aldabra) and the southern western Indian Ocean (Zanzibar, Madagascar, Mauritius, South Africa). Malformed anchor-plates are supposed to be characteristic for this species (Heding 1928: 138, fig. 10.1). Despite the fact that such anchor-plate were not found in the two specimens under study, the shape of the calcareous ring and the rods from the tentacles leave no doubt over its identity.

Table 21 gives the only other species within the genus *Euapta* that is known to occur in the shallow waters of the WIO, but has for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the reference wherein the record appeared.

Genus *Opheodesoma* Fisher, 1907

Diagnosis [Type species: *Opheodesoma spectabilis* Fisher, 1907 by original designation]

Moderate to large species, vermiform body reaching lengths up to 1m or more in life; 15 pinnate large tentacles with numerous tentacular digits; body wall very thin, sticky to the touch; calcareous ring with conspicuous anterior projections, two interradial pieces for each radial piece; stone canals very numerous and short. Ossicles of the body wall comprise anchors, anchor-plates and

Current Species Name	Known WIO Distribution	Reference(s)
E. sinevirga (Cherbonnier, 1988)	Madagascar (Tuléar)	Cherbonnier 1988

Table 21 – *Euapta sinevirga* (Cherbonnier, 1988), the second species within *Euapta* known to occur in the shallow-waters of the WIO. Rowe's (pers. comm.) observation that this species belongs to *Euapta* rather than to *Opheodesoma* is here confirmed.

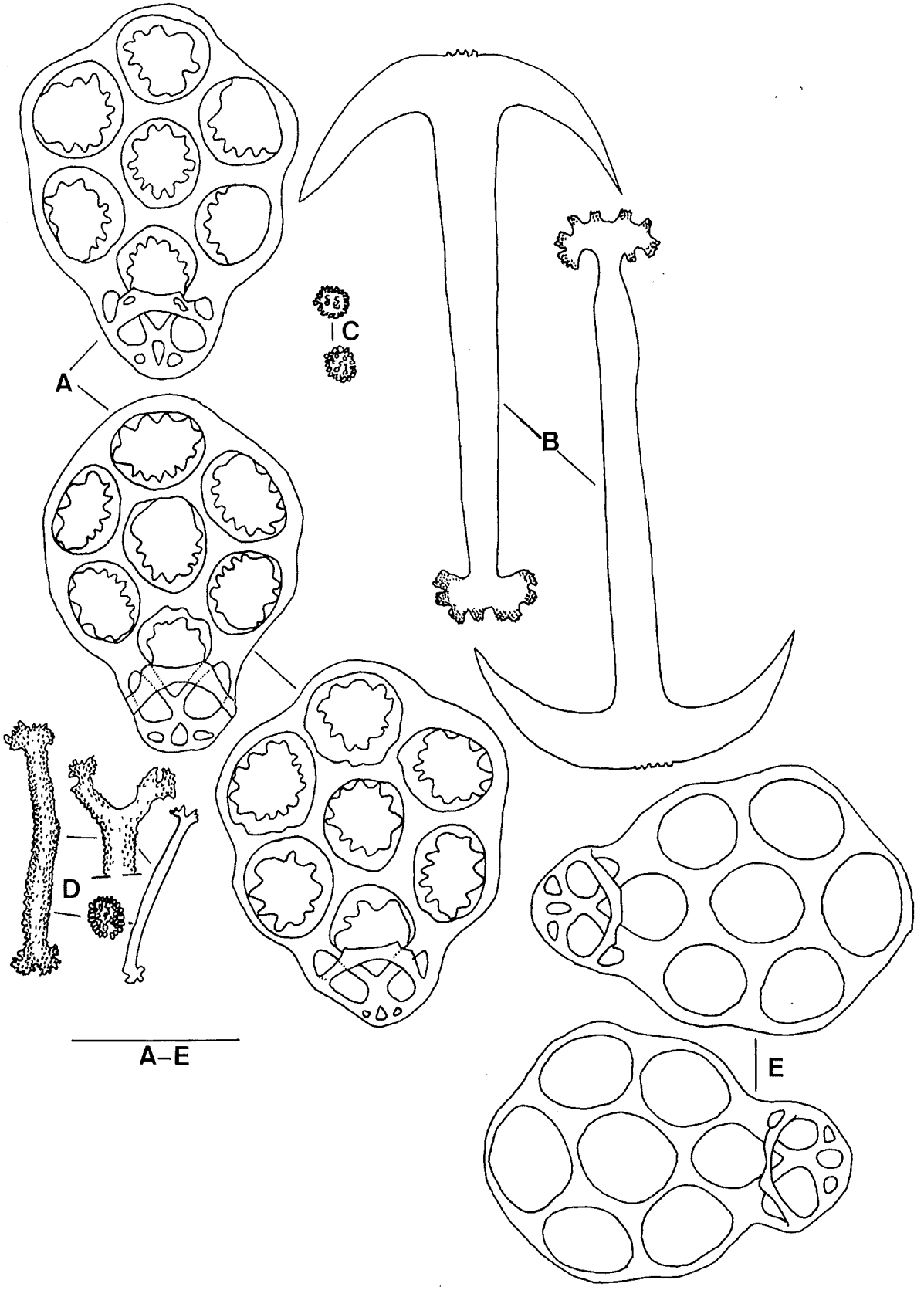

FIG. 40 – *Euapta godeffroyi* (SEMPER, 1868). A. Anchor-plates with serrated holes of body wall; B. Anchors of body wall; C. Miliary granules of body wall; D. Rods and miliary granule of tentacles; E. Anchor-plates with smooth holes of body wall. Scale bar A-E represents 100 μm.

miliary granules; of the tentacle miliary granules and sometimes rods; anchors with stock branched and spiny, arms smooth with vertex variously knobbed; anchor-plates quadrangular, abruptly contracted posteriorly thus lacking a large smooth hole on each side of the bridge.

Ten species are currently regarded as being valid: *Opheodesoma africana* HEDING, 1931; *O. australiensis* HEDING, 1931; *O. clarki* HEDING, 1928; *O. glabra* (SEMPER, 1868); *O. grisea* (SEMPER, 1868); *O. lineata* HEDING, 1928; *O. kamaranensis* A.M. CLARK, 1951; *O. mauritiae* HEDING, 1928; *O. serpentina* (J. MÜLLER, 1850) and *O. spectabilis* FISHER, 1907. Five of these are found in the shallow-waters of Kenya (with Pemba Island), they are keyed hereunder.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND)

1. Web between the tentacle digits absent . . . **2**
1'. Shallow web between the tentacle digits present . . . ***Opheodesoma glabra* (SEMPER, 1868)**
2. Tentacle and oral disc contain ossicles . . . **3**
2'. Tentacles and oral disc without ossicles apart from some highly fragmented miliary granules . . . . . ***Opheodesoma grisea* (SEMPER, 1868)**
3. Calcareous ring greenish **4**
3'. Calcareous ring white; tentacles present rods in addition to miliary granules. . . . . ***Opheodesoma mauritiae* HEDING, 1928**
4. Tentacles present miliary granules only. . . . . ***Opheodesoma spectabilis* FISHER, 1907**
4'. Tentacles present few rods in addition to miliary granules . . . . . ***Opheodesoma* sp.**

Opheodesoma glabra (SEMPER, 1868)
(fig. 41 A-E, fig. 55H)

Synapta glabra SEMPER, 1868: 12, pl. 2 (colour drawing), pl. 4, fig. 8; Ludwig 1881: 577; THÉEL 1886: 10, 20; SLUITER 1894: 105.

Euapta glabra; SLUITER 1901: 123.

Opheodesoma glabra; H.L. CLARK 1908: 74; ?H.L. CLARK 1921: 159; H.L. CLARK 1924: 465; HEDING 1928:123; H.L. CLARK 1946: 448; CLARK & ROWE 1971: 184 (distribution table); TAN TIU 1981: 63; CANNON & SILVER 1986: 41; ROWE & GATES 1995: 333; LANE *et al.* 2000: 492.

STATUS AND LOCATION TYPE – Holotype whereabouts undetermined (?ZMH E. 5075) (ROWE & GATES 1995).

TYPE LOCALITY – 'Canal von Lapinig', Bohol (Phillippines) (ROWE & GATES 1995).

MATERIAL EXAMINED – KKan/9782 (two specimens).

GENERAL DESCRIPTION – Small to moderate species reaching lengths of about 200 mm in life; 90-145 mm long and 4-5 mm wide after preservation. Body colouration in life: dorsal body wall variegated yellow-green to brown with transvere irregular bands, ventral body wall lighter, whithout transverse bands; colour after preservation much lighter: dorsal body wall greyish with some greenish irregular blotches, ventral body wall uniform grey, white spots due to large heaps of miliary granules visible over the total body wall. Tentacles 15, yellow, each with ±25 pairs of digits, united by a shallow web. On the oral disc, at the base of each tentacle two minute, brown eye-spots. Calcareous ring low, white, radial pieces peforated for the nerve. Stone-canals minute, numerous. Polian vesicles at least as numerous, short. Cartilaginous ring thin, without slits, extending posteriorly for about the same length as the calcareous ring.

Ossicles: Body wall with anchors, anchor-plates and numerous miliary granules (fig. 41A); same size and shape at the anterior and posterior side of an individual; variation with size of the individual not apparent. Anchors: 235-265 µm long and 140-165 µm wide; arms smooth, vertex with some minute, irregular, knobs; stock branched and granulous (fig. 41A). Anchor-plates: quadrangular, 185-200 µm long and 155-170 µm wide; seven serrated holes; posterior part with three to six small, smooth holes; bridge convex, slightly undulating, occasionaly perforated (fig. 41B). Miliary granules 15-20 µm across (fig. 41C, F). Tentacles with miliary granules similar in size and shape as those of the body wall, in addition to very few rods, approximately 75 µm long with rounded extremities (fig. 41D, G). Oral disc with miliary granules similar in size and shape to those in the tentacles, in addition to rods of the same size and shape as those from the tentacles (fig. 41E).

DIAGNOSIS – See H.L. CLARK 1924: 465-466, pl. 2 figs 7-9.

ECOLOGY – H.L. CLARK (1946) noted that nothing is as yet recorded as to habitat or habits of this species. Since then, ROWE & GATES (1995) note that it is a benthic, inshore, detritus and deposit feeder and LANE *et al.* 2000 report on a

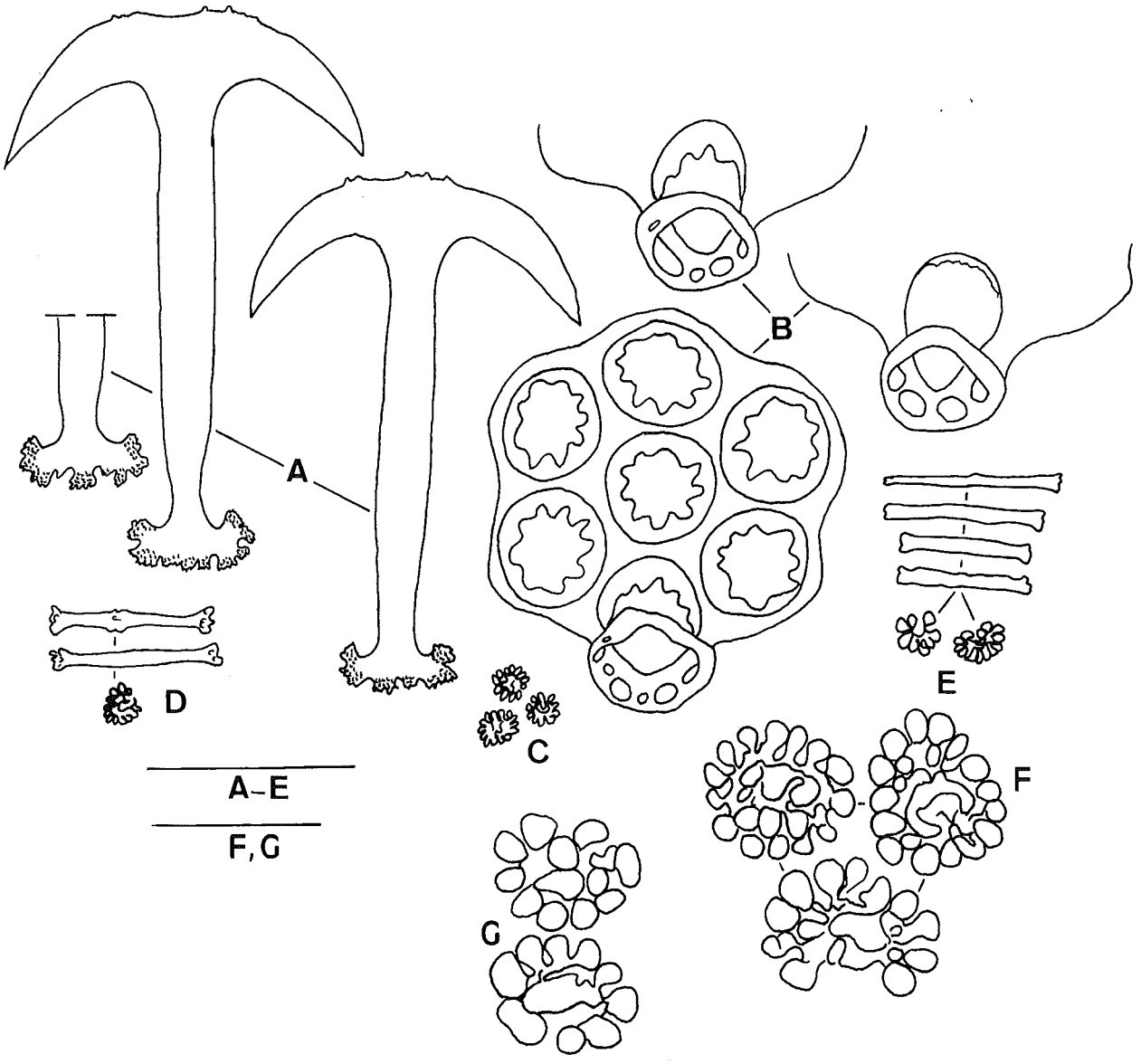

FIG. 41 – *Opheodesoma glabra* (SEMPER, 1868). A. Anchors of body wall; B. Anchor-plates of body wall; C & F. Miliary granules of body wall; D & G. Miliary granule and rods of tentacle; E & G Milary granules and rods of oral disc. Scale bar A-E represents 100 μm; scale bar F, G represents 20 μm.

bathymetric range of 0-20 m. The two specimens were found at the base of sea-grass in the lower eulittoral of the seagrass platform of Kanamai; during daytime they were actively sweeping their tentacles on the fine sand surrounding the sea grass *Thalassodendron cilliatum* (FORSKAAL, 1757).

DISTRIBUTION IN THE STUDY REGION – Kanamai.

GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific Ocean (no recorded from the Red Sea nor from the Arabian Gulf) (CLARK & ROWE 1971). The present record is the only one known for the WIO (see fig. 55H).

REMARKS – Only four species within the genus *Opheodesoma* present a distinct web between the digits of the tentacles (HEDING 1928; 1931): *O. australiensis* HEDING, 1931; *O. clarki* HEDING, 1928, *O. glabra* (SEMPER, 1868) and *O. spectabilis* FISHER, 1907. HEDING (1928) used length:width proportion to distinguish the last three species. His table is repeated below (table 22) and completed with information on *O. australiensis* HEDING, 1931. From this table (comparison of species with tentacle digits webbed) it is clear that the two specimens under study fit best with the description of *O. glabra* as given

Species	Web	Anchors			Anchor plates			Tentacles	Oral disc
		Length	Width	W:L	Length	Width	W:L		
O. australiensis	+	290-370	180-250	0.62-0.68	240-290	180-220	0.75-0.76	MG + few R	MG + few R
O. clarki	+	150-250	90-150	0.55-0.60	150-200	140-180	0.90-0.93	MG + R	MG + R
O. glabra	+	270-280	160-170	0.60-0.66	180-240	140-180	0.76-0.81	MG	MG + R
O. spectabilis	+	150-130	185-200	0.66-0.74	220-250	180-185	0.74-0.81	MG	MG+R
KKan/9782	+	235-265	140-165	0.60-0.62	185-200	155-170	0.83-0.85	MG + few R	MG + R
O. mauritiae	-	285-305	175-200	0.61-0.65	220-235	160-180	0.73-0.77	MG+R	MG+R
O. serpentina	-	270	170	0.63	200	170	0.85	MG + R	MG + R
TFun/9819	-	385-435	260-300	0.68-0.69	265-325	205-240	0.74-0.77	MG + R	R

Table 22 – Overview of some *Opheodesoma* species in relation to specimens studied in the present work. MG represents miliary granules; R represents rods. The two specimens belonging to KKan/9782 best fit with *O. glabra*, while the two specimens belonging to TFun/9819 best with *O. mauritiae* or O. *serpentina.*

by Heding (1928). The only difference of significance is that the specimens under study (length from 90-145 mm) present few rods in the tentacles, while Heding (1928) did not report these in the single specimen (length 450 mm) he studied. Future studies (re-examination of the type material of *O. glabra*, in combination with a complete growth series) will have to confirm (or reject) the observation that small individuals of *O. glabra* have rods in their tentacles whereas large individuals lack these.

Prior to the present study *O. glabra* was only known from the Philippines, the Dutch Indies, Fiji Islands, the South China Sea and Northern Australia (see H.L. Clark 1946; Clark & Rowe 1971; Rowe & Gates 1995; Lane *et al.* 2000). The presence of *O. glabra* on the East Coast of Africa extends the range of distribution considerably.

Opheodesoma grisea (Semper, 1868) (fig. 42A-E, fig. 56A)

Synapta grisea Semper, 1868: 11, pl. 4 figs 6-7.
Euapta grisea; Daniel & Halder 1974: 420.
Ophiodesoma grisea; Macnae & Kalk 1962: 111 (*lapsus calami*).
Ophendesoma grisea; Mukhopadhyay 1991: 410 (*lapsus calami*).
Opheodesoma grisea; Massin 1999: 102 (synonymy and records before 1999); Lane *et al.* 2000: 492.

Status and location type – Status and whereabouts undetermined (?ZMH E. 5075) (Rowe & Gates 1995).

Type locality – Bohol (Phillippines) (Rowe & Gates 1995).

Material examined – KKan/9725 (one specimen); KKan/9726 (one specimen).

General description – Moderate sized species that can reach a length of up to 400 mm in life; 160 and310 mm long after preservation. Body colour in life similar to colour after preservation: ventral and dorsal side variegated brownish-green with five narrow, longitudinal, cream coloured longitudinal bands; ventral side generally lighter. Tentacles 15, feather-like, with numerous pairs of digits not united by a web. Numerous long Polian vesicles. Numerous short stone canals. Calcareous ring with a minute tinge of green; two interradial pieces for each radial piece; posterior side of the pieces undulating; interradial pieces with a long pointed tooth and radial pieces peforated anteriorly. Cartilagenous ring as high as the calcareous ring.

Ossicles: Body wall presents anchors, anchor-plates and few miliary granules (fig. 42A-C). Anchors: 285-325 µm long and 195-225 µm wide; stock regularly branched and spinose; arms smooth, vertex with some irregular small knobs (fig. 42A). Anchor-plates: quadrangular in outline; 240-255 µm long and 165-175 µm wide; seven serrated holes; narrow posterior part with three to eight smooth holes; bridge smooth (fig. 42B). Miliary granules, 15-20 µm across (fig. 42C). Tentacles with highly fragmented miliary granules only (fig. 42D).

Diagnosis – See H.L. Clark 1924: 466-467, pl. 2 figs 1-3.

Ecology – The two specimens were found in a shallow-water, 1 m deep at low tide, in seagrass bed; both specimens were actively sweeping their tentacles over the sand surface. Lane *et al.* 2000 give a bathymetric range of 0-36 m.

Distribution in the study region – Kanamai.

Geographic distribution – Well-known species from the Indo-west Pacific (with the Red Sea, without the Arabian Gulf). The distribution map as drawn by Massin (1999: 104, fig. 77) gives the global distribution, but the following localities have to be added: Gulf of Aqaba, Aqaba (Tortonese 1977, as *O. griseum*) (see also Price 1982 for unspecified record from the Gulf of Aqaba); Arabian Sea (Price 1982; Daniel & Halder 1974, as *Euapta grisea*); Mozambique, Tunghi Bay (Pearson 1910, as *Synapta grisae* Semper, 1868), Inhaca (MRAC record pers observ.); Madagascar, Fort Dauphin (Cherbonnier 1988; and Kenya (present study). Figure 56A shows the known distribution in the WIO in detail.

Remarks – These two specimens were identified as *O. grisea* even if one of the distinctive characters of the species – presence of rods in the oral disc but not in the tentacles – could not be confirmed; in fact no ossicles at all were found either in the tentacles or in the oral disc. However, as the body morphology, the structure of the calcareous ring and the sizes of the ossicles agree well with previous descriptions of *O. grisea* (Cherbonnier 1988; Massin 1996b; 1999), I feel justified in my identification. In this viewpoint it must nevertheless

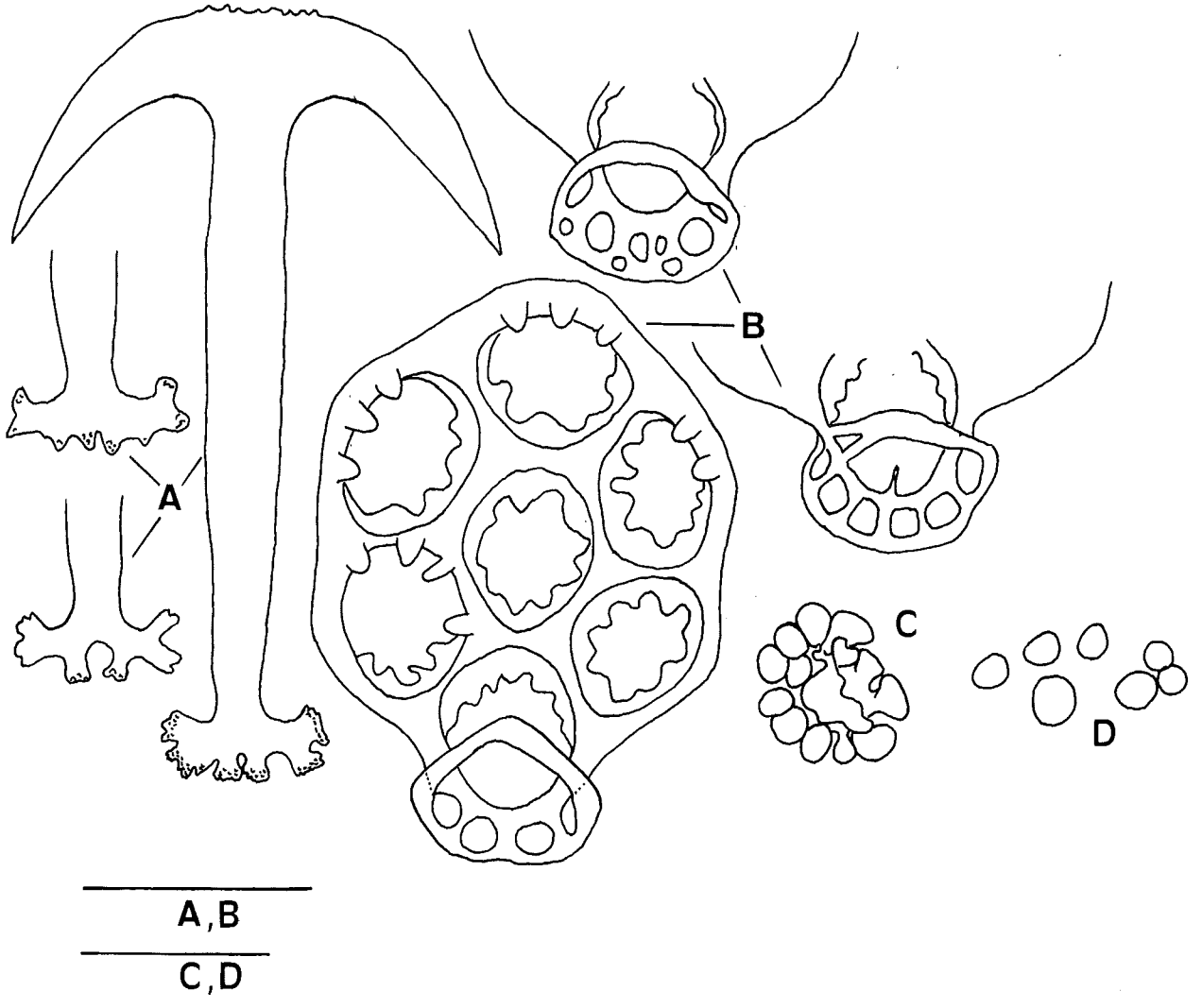

Fig. 42 – *Opheodesoma grisea* (Semper, 1868). A. Anchor of body wall; B. Anchor-plates of body wall; C. Miliary granule of body wall, D. Fragmented miliary granules of tentacles. Scale bar A & B represents 100 µm; scale bar D, E represents 20 µm.

be noted that some species in the genus *Polyplectana* H.L. CLARK, 1908 [*Polyplectana kefersteini* (SELENKA, 1867) and *P. nigra* (SEMPER, 1868)] are known to lack ossicles in the tentacles (see MASSIN 1999: 106, 108). However, the present specimens can hardly be referred to *Polyplectana* as the structure of the calcareous ring and the spicule morphology (unbranched stock of the anchor, ovate anchor-plates) is totally different to the ones described here; even so the number of tentacles in *Polyplectana* typically is 25 [although for *P. kefersteini* it has been noted that the number of tentacles varies from 16 to 27 (HEDING 1928; CHERBONNIER & FÉRAL 1984b; MASSIN 1999)]; and the shape of the miliary granules in *Polyplectana* (branched or curved rods) does not agree with what is reported from the specimens under study.

These two poorly preserved specimens represent the first records for Kenya (Kanamai). *O. grisea* was previously reported from the western Indian Ocean in Zanzibar (H.L. CLARK 1924) and in Madagascar.(CHERBONNIER 1988).

Opheodesoma mauritiae HEDING, 1928 (fig. 43A-D, fig. 56B)

Opheodesoma mauritiae HEDING, 1928: 130, text figs 4(1), 6(14-17), 7 (4, 10); CHERBONNIER 1952a: 497, pl. 47, figs. 1-18; MACNAE and KALK 1958: 43, 130 (from THANDAR 1984); KALK 1959: 22; MACNAE & KALK 1962: 111; CLARK & ROWE 1971: 186; DANIEL & HALDER 1974: 423.

Opheodesoma africana HEDING, 1931; 645, fig. 2 (2, 6-11).

Synapta serpentina LAMPERT 1896: 64 (non J. MÜLLER 1850 = *O. serpentina)*

STATUS AND LOCATION TYPE – ZMUC (?).

TYPE LOCALITY – Mauritius.

MATERIAL EXAMINED – KKan/9873 (one specimen); KKan/9874 (one specimen); TFun/9832 (one specimen)

General description – Moderate sized species reaching lengths of about 600 mm in life; from 190 to 270 mm long after preservation. Body colour after preservation: ventral side more or less uniform greyish, dorsal side darker variegated brownish-grey with three narrow, longitudinal, brownish longitudinal bands. Tentacles 15, feather-like, with numerous pairs of digits not united by a web. Numerous long Polian vesicles. Numerous short stone canals. Calcareous ring white in colouration; anterior processes of radial pieces not more than one third of the height of the calcareous ring. Cartilagenous ring higher than calcareous ring.

Ossicles: Body wall presents anchors, anchor-plates and numerous miliary granules (fig. 43A-C). Anchors 285-305 µm long and 175-200 µm wide; stock regularly branched and spinose, occasionaly perforated by a small hole; arms smooth, vertex with some irregular small knobs (fig. 43A). Anchor-plates: quadrangular in outline; 220-235 µm long and 160-180 µm wide; seven serrated holes; narrow posterior part with three to six smooth holes; bridge straight (fig. 43B). Miliary granules very numerous, 17-22 µm across (fig. 43C). Tentacles and oral disc with miliary granules similar to those of the body wall and rods with rounded or slightly spinose extremities, 70-115 µm long (fig. 43D).

Diagnosis – See CHERBONNIER 1952a: 497-498, pl. 47 figs 1-18.

Distribution in the study region – Kanamai, Fundu.

Geographic distribution – Western Indian Ocean (no records from the Red Sea nor from the Persian Gulf). Figure 56B shows the known distribution in the WIO in detail.

REMARKS – This specimen bears very close similarity to *O. serpentina* described below. However, the anchors and anchor-plates are distinctively smaller. The present records are new to Kenya (Kanamai) and Tanzania (Fundu).

Opheodesoma cf. *mauritiae* HEDING, 1928 (fig. 44A-D, pl. 4F)

STATUS AND LOCATION TYPE – See *O. mauritiae.*

TYPE LOCALITY – See *O. mauritiae.*

MATERIAL EXAMINED – KKan/9731 (one specimen).

General Description – The single specimen at our disposition is strongly contracted; 71 x 8 mm after preservation. Gross body morphology similar to that of *O. mauritiae.*

Ossicles: Body wall presents anchors, anchor-plates and miliary granules (fig. 44A, B) similar, but slightly smaller to those presented by the other specimens of *O. mauritiae.*. Oral disc presents miliary granules and rods (fig. 44C) similar in size and shape as those from *O. mauritiae.* Tentacles present miliary granules only (fig. 44D)

Diagnosis – See *O. mauritiae.*

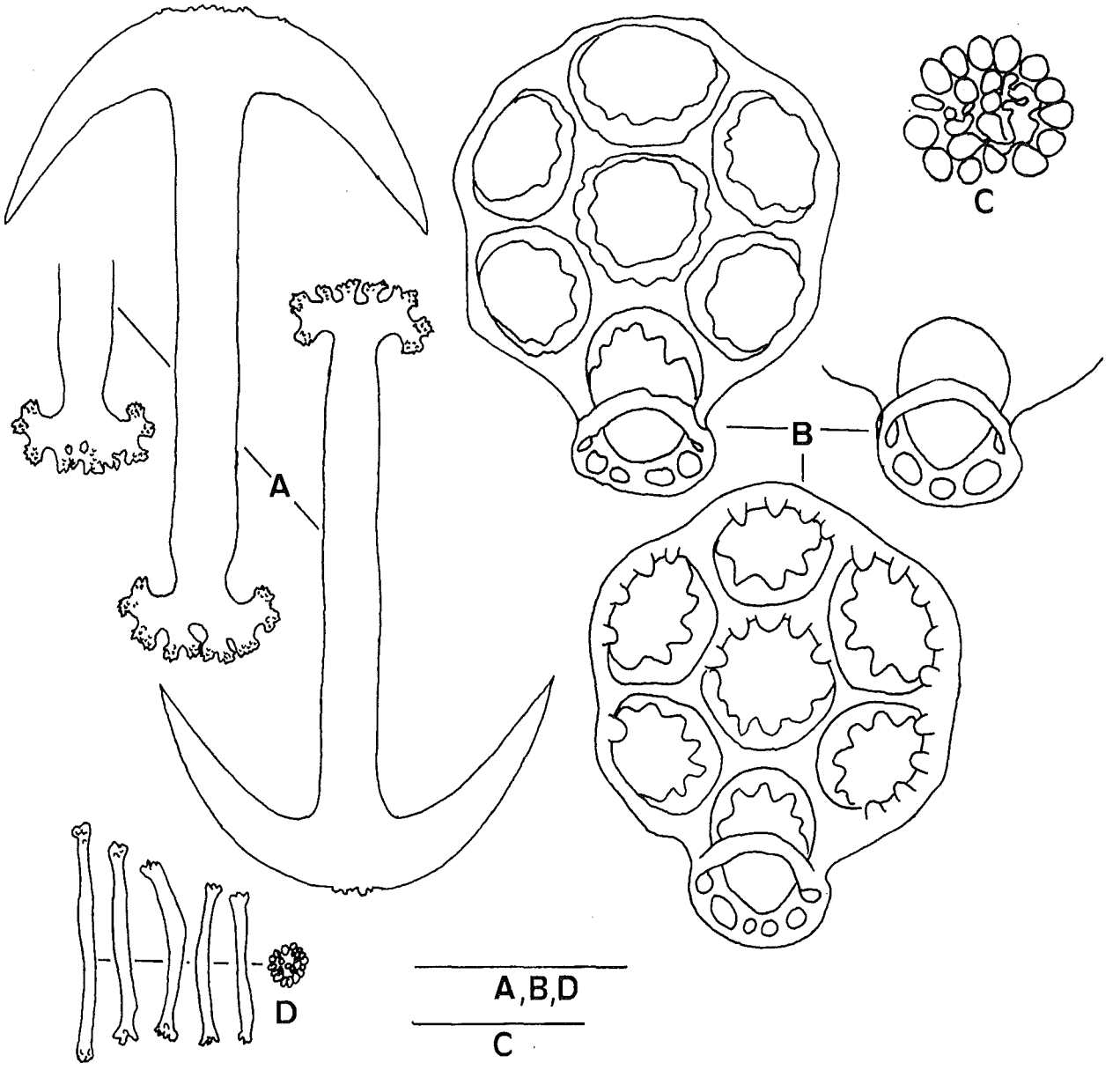

FIG. 43 – *Opheodesoma mauritiae* HEDING, 1928. A. Anchors of body wall; B. Anchor-plates of body wall; C. Miliary granules of body wall; D. Miliary granules and rods of tentacles and oral disc. Scale bar A, B, D represents 100 μm; scale bar C represents 20 μm.

Distribution in the study region – Kanamai only.
Geographic distribution – See *O. mauritiae.*
Remarks – Although the overall body morphology and the shape of the ossicles agrees well with *O. mauritiae*, I dare not identify it as such for two differences are apparent. *Primo*, the tentacles of *O. mauritiae* present rods and miliary granules (fig. 43D), while those of the present specimen present miliary granules only (fig. 44D). *Secundo,* the anchor and anchor-plates of *O. mauritiae* are markedly smaller than those of the present specimen (anchors: 285-305 μm long and 175-200 μm wide in *O. mauritiae* versus 330-360 μm long and 205-225 μm wide in *O.* cf. *mauritiae*, anchor-plates: 220-235 μm long and 160-180 μm wide in *O. mauritiae* versus 265-280 μm long and 185-205 μm wide in *O.* cf. *mauritiae*). Even thought is a well known fact that the size of the ossicles in many apodids changes with body size (MASSIN 1999), increase of size of ossicles with decreasing body size has not been reported. These two differences bring the specimen close to another *Opheodesoma* known to occur in the western Indian Ocean: *O. spectabilis*

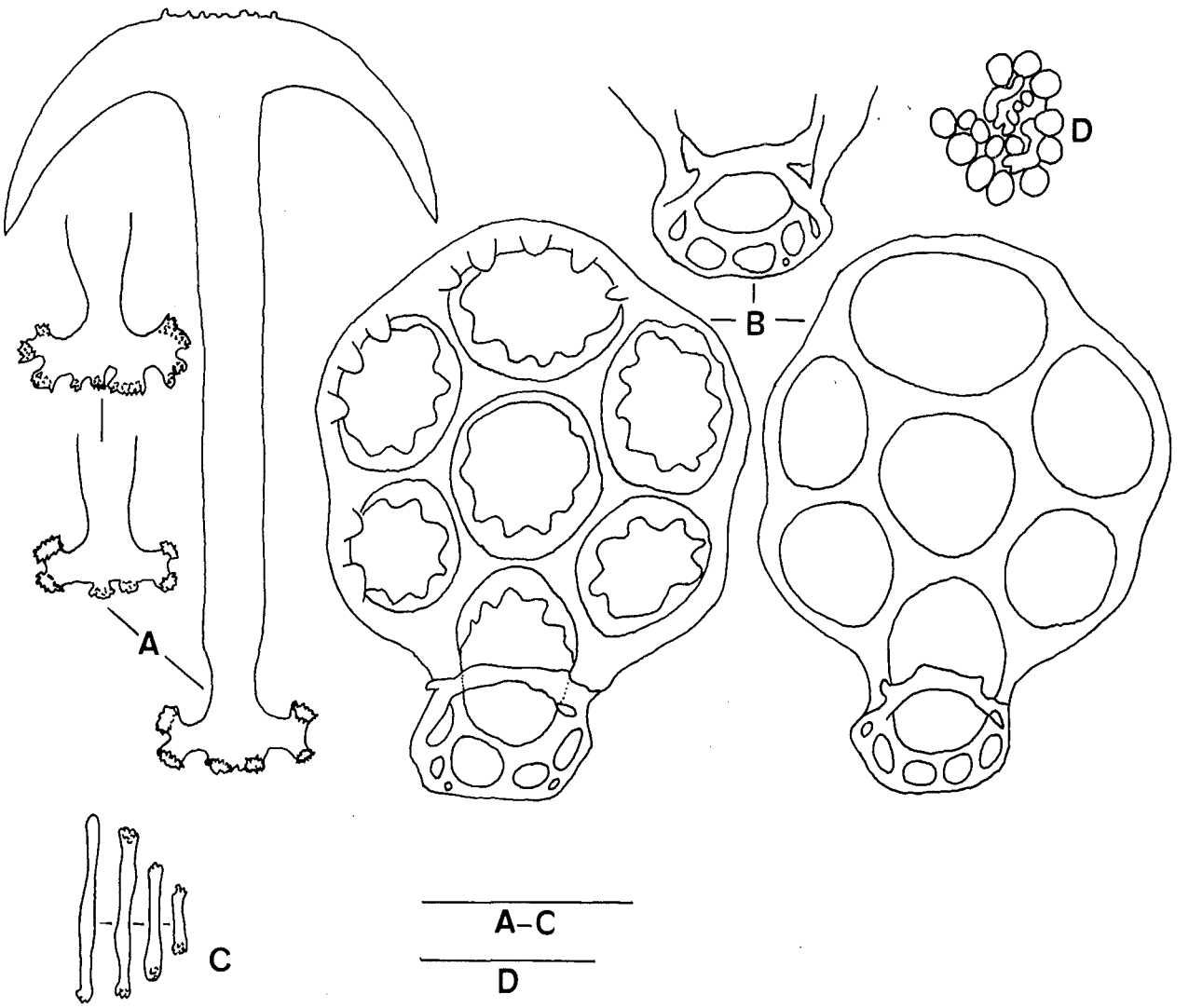

FIG. 44 – *Opheodesoma* cf. *mauritiae* HEDING, 1928. A. Anchors of body wall; B. Anchor-plates of body wall; C. Rods of oral disc; D. Miliary granule of tentacles. Scale bar A-C represents 100 μm; scale bar D represents 20 μm.

FISHER, 1907. However, the latter species was reported only once from the East African coast (CHERBONNIER 1974), at a depth of 25 m. Other specimens of *O. spectabilis* have been found in the tropical Pacific Ocean, always at depths exceeding 20 m (CLARK & ROWE 1971; LANE *et al.* 2000).

Opheodesoma sp.
(fig. 45A-D, fig. 56C, pl. 4G)

MATERIAL EXAMINED – TFun/9819 (one specimen).

DESCRIPTION – The single specimen at my disposition is 510 mm long and on average 25 mm wide. Life colouration is uniform dark-brown to black with conspicuous white tentacles; after preservation body colouration dark chocolate-brown overall, although slightly lighter ventrally, posterior side of the tentacles chocolate brown, anterior side whitish, digits somewhat more yellow Tentacles 15, with over 25 pairs of digits, not webbed together. Stout calcareous ring, greenish in colouration, with two interradial pieces alternating with one radial piece; posterior margin undulating; radial pieces with a large quadrangular hole for the nerve; anterior tooth of the interradial pieces not more than one third of the length of the calcareous ring. Polian vesicles numerous. Stone canals numerous and very short.

Cartilaginous ring well developed, slightly higher than the calcareous ring; pierced by small holes just below the calcareous ring.

Ossicles: Body wall presents anchors, anchor-plates and numerous miliary granules (fig. 45A-C). Anchors: 385-435 µm long and 260-300 µm wide; stock regularly branched and spinose; arms smooth; vertex with some irregular small knobs (fig. 45A). Anchor-plates: more or less quadrangular in outline; 265-325 mm long and 205- 240 µm wide; seven serrated holes; narrow posterior part with three to eight smooth holes; bridge straight (fig. 45B). Miliary granules, 15-20 µm across (fig. 45C). Tentacles with miliary granules, 16-23 µm across (fig. 45D) and few rods with the ends a little swollen (fig. 45E). Oral disc with rods, 80-120 µm long, rounded or slightly spinose at the extrimities (fig. 45F)

ECOLOGY – The single specimen was found at night, 12 m deep, the posterior part of the body was hiding under a large coral slab. The animal seemed to be actively feeding on the mucus attached to live coral.

DISTRIBUTION IN THE STUDY REGION – Fundu only.

GEOGRAPHIC DISTRIBUTION -Unknown,

REMARKS – To my knowledge, only five species within the genus *Opheodesoma* have miliary granules and rods in both the tentacles and the oral disc: *O. australiensis* HEDING, 1931; *O. clarki* HEDING 1928; *O. glabra* (SEMPER, 1868) (see above remarks under *O. glabra*); *O. mauritiae* HEDING, 1928 and *O. serpentina* J. MÜLLER, 1850. The first three species are characterized by having a distinct web between the tentacle digits while the latter two species does not present this character.

As shown in table 22, the specimen under study fits best with *O. serpentina* or *O. mauritiae*. However, as the colouration of the specimen, the dimensions of the ossicles and the absence of miliary granules in the oral disc does not fit with the above two species, it cannot be assigned to it. As I have only one specimen at my disposition I refrain from creating a new species. Fig. 56C gives the WIO distribution for *O. serpentina* with the present specimen included.

Opheodesoma spectabilis FISHER, 1907 (fig. 46A-D, fig. 56D)

Opheodesoma spectabilis FISHER, 1907: 723, pl. 66, pl. 80, fig. 1a-d, pl. 81 fig 2.

Opheodesoma spectabilis; CLARK 1908: 75; H.L. CLARK 1924: 467; HEDING 1928: 120; CLARK & ROWE 1971: 186; CHERBONNIER 1974; 1445 (synonymy); FÉRAL & CHERBONNIER 1986: 104 (colour picture), 105; LANE *et al.* 2000: 492; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2).

Opheodesoma sp. prob. *O. spectabilis*; HUMPHREYS 1981: 36.

STATUS AND LOCATION TYPE – Most probably type material exists in the Smithsonian Institute.

TYPE LOCALITY – Pearl Harbour, Hawaii Islands.

MATERIAL EXAMINED – TMes/9834 (one specimen).

GENERAL DESCRIPTION – Moderate sized species reaching lengths of about 450 mm in life; 290 mm long and 21 mm wide after preservation. Body colour after preservation: ventral side more or less uniform white, dorsal side white grey with numerous transverse greyish bands. Tentacles 15, white-cream in colouration, feather-like, with numerous pairs of digits not united by a web. Numerous long Polian vesicles. Numerous short stone canals. Calcareous ring greenish with anterior processes less then one third of the height of the calcereous ring. Cartilagenous ring higher as the calcareous ring, with opening in it below the calcareous ring.

Ossicles: Body wall presents anchors, anchor-plates and miliary granules (fig. 46A, B). Anchors 440-455 µm long and 270-280 µm wide; stock regularly branched and spinose; arms smooth, vertex with some irregular small knobs (fig. 46A). Anchor-plates: quadrangular in outline; 300-310 µm long and 225-235 µm wide; 7 serrated holes; narrow posterior part with 4-7 smooth holes; bridge straight (fig. 46B). Miliary granules very numerous. Tentacles with miliary granules only; these are similar to those of the body wall (fig. 46C). Oral disc with rods only, rounded or slightly spinose extrimities, 80-100 µm long (fig. 46D).

DIAGNOSIS – See FISHER 1907: 723, pl. 66, pl. 80, fig. 1a-d, pl. 81 fig 2; CHERBONNIER 1974: 1445-1447, text fig. 1A-H.

ECOLOGY – The specimen was found during a night-dive, actively sweeping its tentacles over fine coralline sand between coral boulders, 10 m depth. LANE *et al.* (2000) state that this species lives at depths exceeding 20 m; CHERBONNIER's (1974) record was found at 25 m depth. It is noteworthy that *O. spectabilis* is reported as the host of the pontoniid shrimp *Periclimenes imperator* BRUCE, 1967 (CHERBONNIER 1974).

DISTRIBUTION IN THE STUDY REGION – Mesali only.

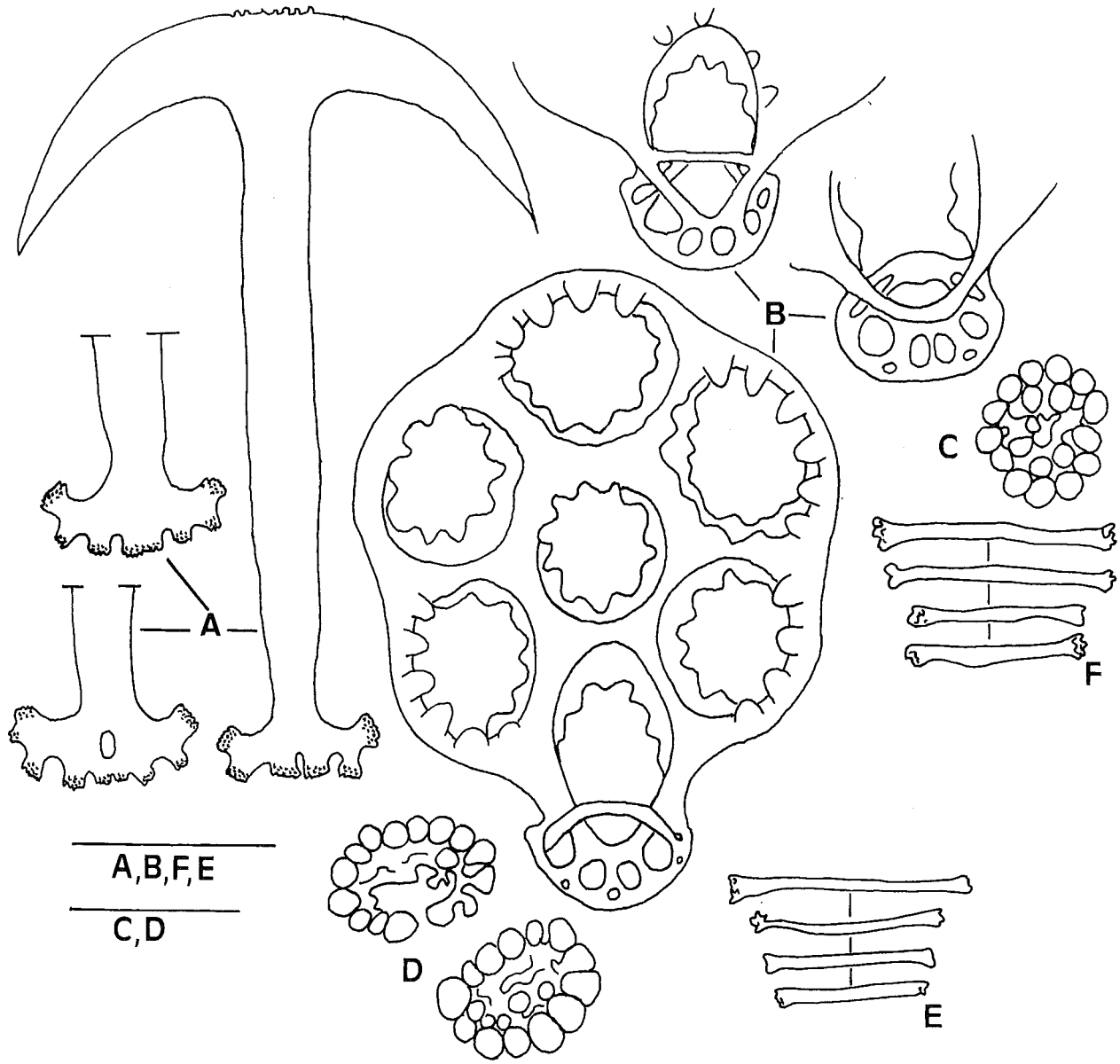

FIG. 45 – *Opheodesoma* sp. A. Anchors of body wall; B. Anchor-plates of body wall; C. Miliary granule of body wall; D. Miliary granule of tentacle; E. Rods of tentacle; F. Rods of oral disc. Scale bar A, B, F, E represents 100 μm; scale bar C, D represents 20 μm.

GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific (no records from the Red Sea nor from the Persian Gulf). In the WIO only known from a few localities: Tanzania, Zanzibar (CHERBONNIER 1974), Mesali (this work); Kenya, Ras Ngomeni (HUMPHREYS 1981, as *Opheodesoma* sp. prob. *O. spectabilis*). Figure 56D shows the known WIO distribution in detail.

REMARKS – H.L. CLARK (1924) examined 29 specimens of *O. spectabilis* from Pearl Harbor, Oahu, Hawaiian Islands and noted that large differences exist between young and old specimens. Two vari-

Length body wall (in mm)	Average length anchor ossicle (in μm)
40	232
100	295
160-200	326
More than 200	Often exceeding 400

TABLE 23 – Intraspecific variation in *O. spectabilis* FISHER, 1907 as observed by H.L. CLARK (1924). Note that the length of the ossicles increases with increasing body length.

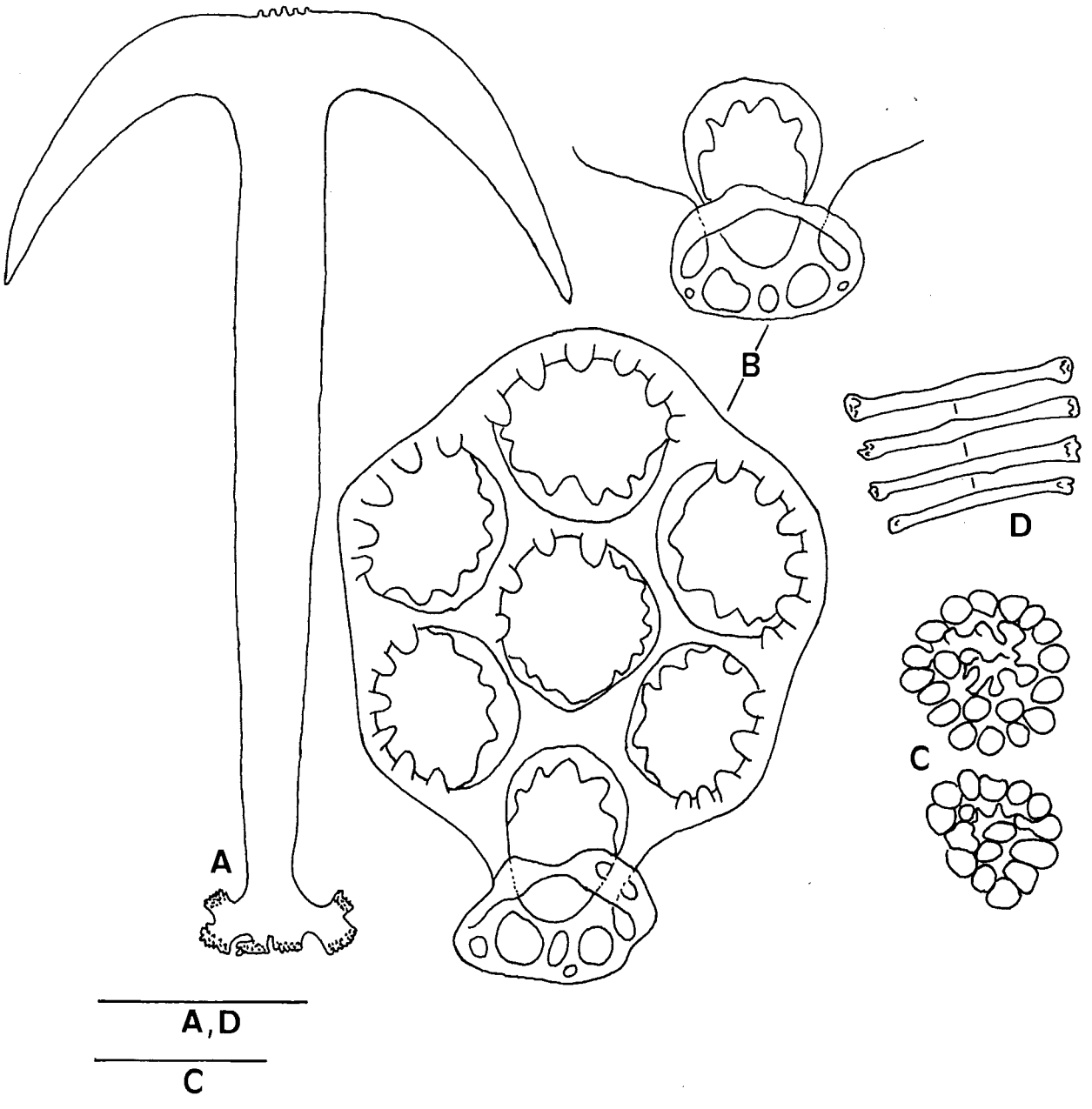

FIG. 46 – *Opheodesoma spectabilis* FISHER, 1907. A. Anchor of body wall; B. Anchor-plate of body wall; C. Miliary granule of tentacle; D. Rods of oral disc. Scale bar A, B, D represents 100 μm; scale bar C represents 20 μm.

ations with size are apparent: (1) the development of the cartilagenous ring: "in general, it (the calcareous ring) may be said to be wanting in very small specimens and heavy in those that are full grown [sic]"; and (2) the size of the calcareous deposits increases with increasing body length (table 23).

The length of the specimen under study (290 mm long) falls in the last category and its ossicle dimensions agree with H.L. CLARK's (1924) observations. To further confirm the identification, it can be noted that absence of rods in the tentacles and presence of smooth to slightly knobbed rods in the oral disc agrees with *O. spectabilis* (CHERBONNIER 1974).

Up to now, CHERBONNIER (1974) was the only researcher to document *O. spectabilis* with certainity from E. Africa, Zanzibar (see also distribution table CLARK & ROWE 1971: 186). It should however be noted that HUMPHREYS (1981) reported on *Opheodesoma* sp. prob. *spectabilis* from Ras

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
O. kamaranensis A.M. CLARK, 1951	Red Sea (Kamaran Islands)	A.M. CLARK 1951; DANIEL & HALDER 1974 PRICE 1982

TABLE 24 – *O. kamaranensis* A.M. CLARK, 1951 is the only other species within the genus *Opheodesoma* known to occur in the shallow-waters of the WIO.

Ngomeni (near Malindi, Kenya). Hereby, he stated that, if his identification is correct, his record is a range extension from the western Pacific, thus ignoring CHERBONNIER's (1974) record. Unfortunately I failed to locate HUMPHREYS (1981) voucher specimen in the MRAC or NHM.

Table 24 lists the other species within the genus *Opheodesoma* that is known to occur in the shallow waters of the WIO, but has for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record appeared.

Genus *Synapta* ESCHSCHOLTZ, 1829

DIAGNOSIS [Type species: *Synapta mammillosa* ESCHSCHOLTZ, 1829 (=*Holothuria maculata* CHAMISSO & EYSENHARDT, 1821) by subsequent designation].
CLARK (1908) believed the genus *Synapta* to be monotypic, but HEDING (1928; 1929; 1931) consitently included *S. oceanica* (LESSON, 1830) as a second valid species and recognised two varieties of *S. maculata*: *S. maculata* var. *sundaensis* HEDING, 1928 and *S. maculata* var. *Andrea* HEDING, 1928. The latter varieties are now regarded as true synonyms of *S. maculata*.

Synapta maculata (CHAMISSO & EYSENHARDT, 1821) (fig. 47A-G, fig. 56E)

Holothuria maculata CHAMISSO & EYSENHARDT, 1821: 235, pl. 25.
Chondrocloea beselli JÄGER, 1833; DANIEL & HALDER 1974: 427.
Synapta beselli; DANIEL & HALDER 1974: 429.
Synapta oceanica (LESSON, 1830): 99; MACNAE & KALK 1958: 43, 69, 75, 99, 107, 117, 130 (from THANDAR 1984); MACNAE & KALK 1962: 111, 118; KALK 1959: 22; BRANCH & BRANCH 1981: 247 (from THANDAR 1984).
Synapta maculata; DANIEL & HALDER 1974: 418; HUGHES & GAMBLE 1977: 355; MUKHOPADHYAY 1991: 410, 412; ARAKAKI & FAGOONEE 1996: 122; BRANCH *et al.* 1999: 202, 203 (colour picture); MASSIN 1999: 108 (synonymy and records before 1999); LANE *et al.* 2000: 492; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 18.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995).
TYPE LOCALITY – Marshall Islands (as 'Ad Insulas Radack') (ROWE & GATES 1995).
MATERIAL EXAMINED – KKan/9712 (one specimen); KShar/9736 (one specimen); KShar/9737 (one specimen); KShar/9738 (one specimen); KCi/9749 (one specimen); KCi/9750 (one specimen); KCi/9751 (one specimen); KKiun/9951 (one specimen); KMom/9862 (one specimen).
GENERAL DESCRIPTION – Large species; live specimens attain two to three meters in length by 3-5 cm in diameter; observed specimens range from 90 to1170 mm in length and from 8 to 35 mm in width, after preservation. Colour in life more or less retained after preservation: body olive-green with five olive-brown stripes and numerous white spots, tentacles similar in colouration but with some fine white stripes instead of white spots. Mouth terminal, surrounded by 15 tentacles, each of them with 30-40 pairs of digits that are not united by a web. Anus terminal, small. Single to two stone canals ending in a circular madreporic plate. Gonad long, branched. Calcareous ring weakly developed, composed of radial and interradial pieces of the same size; radial pieces perforated for the nerve, posterior part of the pieces undulating, anterior part of the pieces pointed. Cartilaginous ring huge, almost completely envelopping the calcareous ring. Polian vesicles numerous and long.
Ossicles: Body wall with anchors, anchor-plates and miliary granules (fig. 47A-G). Anchors 750-950 µm long and 575-740 µm wide; stock

unbranched but finely toothed (fig. 47C); arms smooth, some minute knobs positioned on the vertex or in little groups on each side of the vertex. Anchor-plates 600-715 µm long and in the articular end 375-400 µm wide; articular end typically 25-30 % wider than the anterior end; bridge usually well developed (broken in some anchor-plates), irregular, occasionaly with more or less prominent spines; central hole in the anchor-plates usually with a fine meshwork; anterior side of the plate with numerous small holes; posterior side with larger holes (fig. 47B, F). Miliary granules are simple rosettes of irregular shape, 15-25 µm across (fig. 47D, G). Tentacles with numerous miliary granules similar in size and shape as those found in the body wall; suporting rods always absent.

DIAGNOSIS – See HEDING 1928: 113, fig. 2 (1-10).

ECOLOGY – In seagrass beds, feeding on organic material attached to the leaves of sea grasses and algae, or sweeping the sandy substrate. LANE *et al.* 2000 report a bathymethric range of 0-25 m. In Kenya never seen deeper than 5 m. MACNAE & KALK (1962) report the pontoniid shrimp *Periclimenes rex* KEMP on *S. maculata* (as *S. oceanica*).

DISTRIBUTION IN THE STUDY REGION – Seagrass beds along the coast, very large population in Kanamai.

GEOGRAPHIC DISTRIBUTION – Tropical, Indo-west Pacific Ocean (with the Red Sea, without the Persian Gulf). The distribution map as drawn by MASSIN (1999: 109, fig. 92) gives the global distribution, but the following localities have to be added: Gulf of Aqaba, Aqaba (TORTONESE 1977), Um Nageila (A.M. CLARK 1952; DANIEL & HALDER 1974) (see also PRICE 1982 for unspecified record from the Gulf of Aqaba); Saudi Arabia, Jeddah (TORTONESE 1979); Djibouti (CHERBONNIER 1955); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000), Shariani, Kanamai, Mombasa, Chale Island (this work); Madagascar, Tuléar, Ile St. Marie, Antsakoabe (CHERBONNIER 1988), Figure 56E shows the known distribution in the WIO in detail.

REMARKS – *Synapta maculata* is a well-known species from the western Indian Ocean and was reported by numerous workers under its junior synonym *Synapta Beselli* JAEGER, 1833 (see CLARK & ROWE 1971).

THANDAR (1984) and THANDAR & ROWE (1989) believe that two fragments of body wall collected along the coast of Mozambique are referable to *S. oceanica*, for the observed colouration pattern (dirty greyish yellow with five darker longitudinal lines in the radial areas) is similar to that described by HEDING (1929) for *S. oceanica*. MACNAE & KALK (1958) reported the latter species from Mozambique. As I have not seen these or HEDING's voucher specimens, I am not in the position to debate the taxonomic status of *S. oceanica*, but nevertheless, after examination of several individuals of *S. maculata* from Kenya and the Seychelles, I remain extremely sceptical about the validity of *S. oceanica* that to me fits into the intraspecific variation of *S. maculata*.

Genus *Synaptula* ÖRSTED, 1849

DIAGNOSIS (after HEDING, 1928: 154) [Type species: *Synaptula vivipara* ÖRSTED, 1849 (= *Synaptula hydriformis* LESUEUR, 1824) by monotypy; see also ROWE & GATES 1995: 336]

Small to moderate species, vermiform bodies reaching lengths up to 800 mm in life; usually 10 or 13 tentacles (occasionaly 12 or 15), each with 4-30 pairs of digits (digit number increases with age), web between digits present or absent; body wall very thin, sticky to the touch; calcareous ring fine with one or two interradial pieces for each radial piece, that are always perforated; cartilaginous ring present, development from very faint and translucent to voluminous, often perforated close to the ring canal; 3-50 Polian vesicles; one to several stone canals; gonad distinctly branched (except in *S. hydriformis* and *S. indivisa*). Ossicles: body wall present anchors, anchor-plates and miliary granules (except in *S. aspera*); tentacles present miliary granules only (except in *S. hydriformis* which also presents some rods); anchors with stock unbranched and slightly spiny, arms smooth, vertex with some quadrangular teeth; anchor-plates rounded anteriorly and narrowing posteriorly; anchors and anchor-plates in posterior body end often a little larger than those in the anterior body end; miliary granules generally rosettes, but sometimes circles of 'minute granules'.

Currently 29 species are regarded as being valid: *Synaptula alba* HEDING, 1928, *S. albolineata* HEDING, 1928; *S. aspera* (SLUITER, 1901); *S. ater* HEDING, 1928; *S. bandae* HEDING, 1928; *S. denticulata* HEDING, 1928; *S. hydriformis* (LESUEUR,

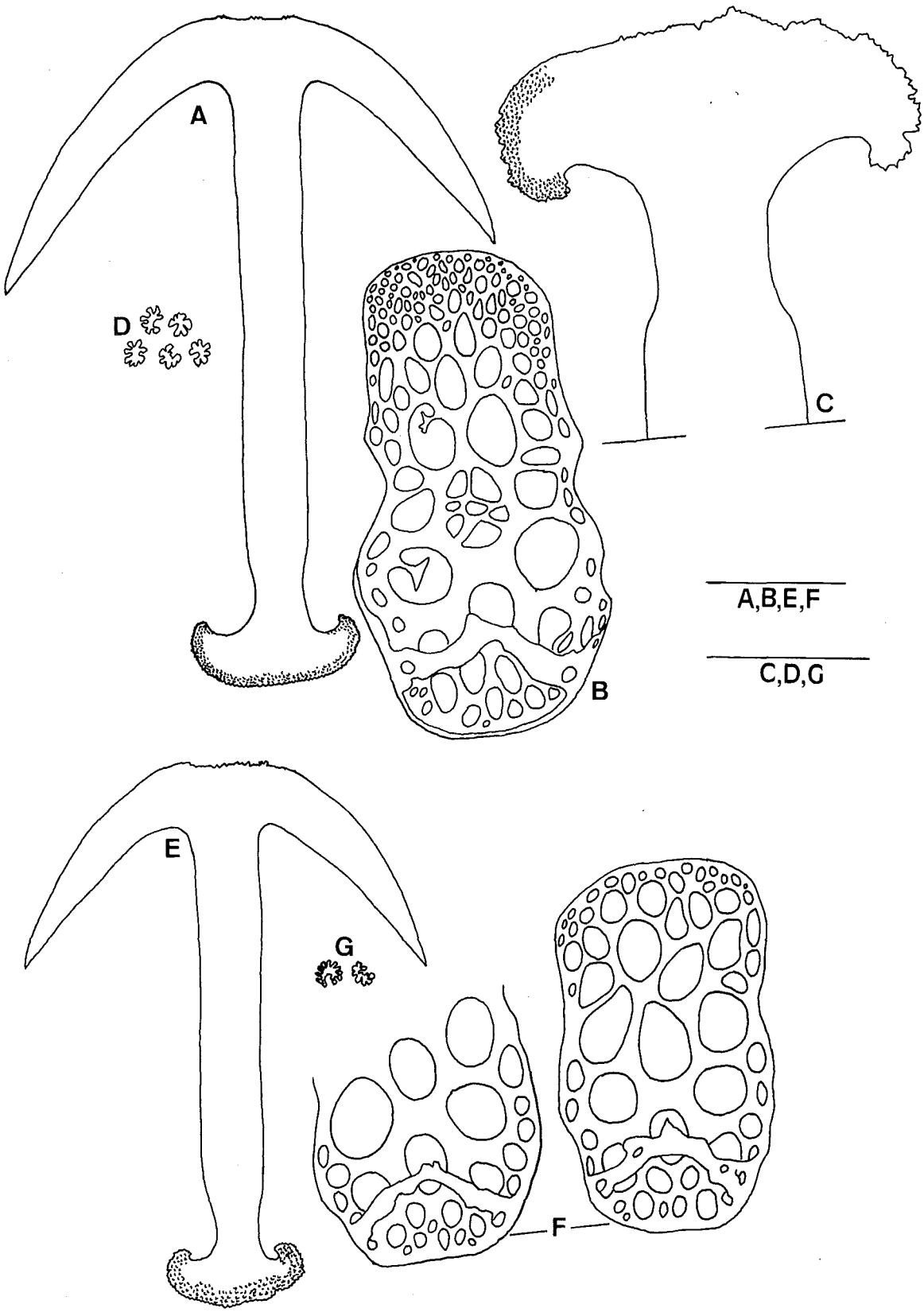

FIG. 47 – *Synapta maculata* (CHAMISSO & EYSENHARDT, 1821). A. Anchor of body wall (L=600 mm); B. Anchor-plate of body wall (L=600 mm); C. Detail of stock of anchor (L=600 mm); D. Miliary granules of body wall (L=600 mm); E. Anchor of body wall (L=87 mm); F. Anchor-plates of body wall (L=87 mm); G. Miliary granules of body wall (L=87 mm). Scale bar A, B, E, F represents 200 µm; scale bar C, D, G represents 100 µm.

1824); *S. indivisa* (SEMPER, 1868); *S. jolensis* HEDING, 1928; *S. lactea* (SLUITER, 1887)[12]; *S. lamperti* HEDING, 1928; *S. macra* (H.L. CLARK, 1938)[13]; *S. maculata* (SLUITER, 1888); *S. madreporica* HEDING, 1928; *S. media* CHERBONNIER & FÉRAL, 1984; *S. minima* HEDING, 1928; *S. mortenseni* HEDING, 1929; *S. neirensis* HEDING, 1928; *S. nigra* (SEMPER, 1868); *S. psara* (SLUITER, 1887); *S. reciprocans* (FORSKÅL, 1775); *S. recta* (SEMPER, 1868); *S. reticulata* (SEMPER, 1868); *S. rosetta* HEDING, 1928; *S. spinifera* MASSIN & TOMASICK, 1996; *S. tualensis* HEDING, 1928; *S. varians* (NAIR, 1946); *S. violacea* HEDING, 1928; *S. virgata* (SLUITER, 1901) and *S. vittata* (FORSKÅL, 1775).

Even though HEDING's contributions (1928; 1929; 1931) brought significant insights into this important genus, careful examination of his type material (in ZM), in comparison with other museum and new material, most probably will reveal the synonymous nature of several of the above species (ROWE *in* ROWE & GATES 1995; see also footnotes). This because (i) HEDING described a number of species based on single specimens and often fragmented material (ROWE *in* ROWE & GATES 1995), and (ii) it is known for several *Synaptula* spp. that several characters (size of anchors and anchor plates, presence of a long spine on the anchor-plate bridge, number of tentacles and number of tentacular digits) vary with size of the species (MASSIN 1999). In zoogeographic respect it is interesting to note that HEDING (1928) thought that all *Synaptula* species (apart from *S. hydriformis*) were restricted to the Malay Archipelago. It is however now known[14] that several species extend into the western Indian Ocean and the Red Sea[15]: Table 26 shows that several *Synaptula* spp. have been recorded in the Gulf of Suez, Gulf of Aqaba, Red Sea and eastern Africa; no *Synaptula* sp. has apparently reached the Persian Gulf.

Synaptula recta (SEMPER, 1868) (fig. 48A-F, fig. 56F, pl. 4H)

Synapta recta SEMPER, 1868: 14, pl. 4 figs 2-3, pl. 5 fig. 18, pl. 8 fig. 2.

Chondrocloea recta; DANIEL & HALDER 1974: 429.

Synaptula recta; TORTONESE 1936a: 241; TORTONESE 1953a; 46; MUKHOPADHYAY 1991: 411, 413; MASSIN 1999: 116 (synonymy), fig 102 (distribution), 114b,c (colour pictures); LANE *et al.* 2000: 492.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995).

TYPE LOCALITY – Bohol (Philippines).

MATERIAL EXAMINED – TMes/9833 (one specimen); TMes/9835 (one specimen); TMes/9836 (one specimen); TMes/9837 (one specimen); TMes/9838 (one specimen); TMes/9839 (one specimen); TMes/9840 (one specimen).

GENERAL DESCRIPTION – Moderate to large species reaching lengths up to 800 mm in life; observed specimens 120-470 mm long and 4-17 mm wide after preservation. Body colour in life variable: from uniform beige-brown with slightly darker tentacles to uniform dark red with orange to brown tentacles. Body colour after preservation faded to greyish, slightly lighter ventrally. Tentacles 13 (12 in TMes/9836); digits united by a very shallow web, number of digits variable, but commonly 15-25 pairs (abberant numbers seem to results from bad preservation). In well-preserved specimens, heaps of miliary granules forming white transverse bands in the tentacles can be seen. Huge cartilaginous ring, perforated at the base, completely masks the calcareous ring. Numerous (15-23) Polian vesicles of at least two sizes. Gonads well developed and branched several times. Intestinal loop not observed. Calcareous ring consists of two interradial pieces for each radial piece, radial and interradial pieces of the same size with the radial pieces perforated for the nerve.

Ossicles: Body wall with anchors, anchor-plates and miliary granules (fig. 48A-F). Anchors of anterior and posterior side of the same shape: stock unbranched, finely dented at the periphery, arms smooth and a few tooth on the vertex

[12] ROWE (*in* ROWE & GATES, 1995) notes that the relationship between *Synaptula reticulata* (SEMPER, 1868), *Synaptula lactea* (SLUITER, 1887) and *Synaptula lamperti* HEDING, 1928 needs further investigation.

[13] ROWE (*in* ROWE & GATES, 1995) notes that *Synaptula macra* (H.L. CLARK, 1938) 'almost certainly will prove to be a large form of *Synaptula recta* (SEMPER, 1868) when sufficient material has been compared' [sic].

[14] TORTONESE (1936a) even went so far to note the following 'Tutte queste Sinapte [here referring to *Synaptula*] sono littorale ed abitano la regione indo-pacifica, ad eccezione di una (*S. hydriformis* (LESS.)) vivente nel mar delle Antille', a statement which is not substantiated by our present state of knowledge on the distribution of *Synaptula*.

[15] H.L. CLARK (1908: 132) provides a map with the global distribution of the genus *Synaptula*; three distinct regions are drawn: (i) the Red sea and East Africa (up to equator), (ii) central Indonesia / northern Australia and (iii) the Caribbean area.

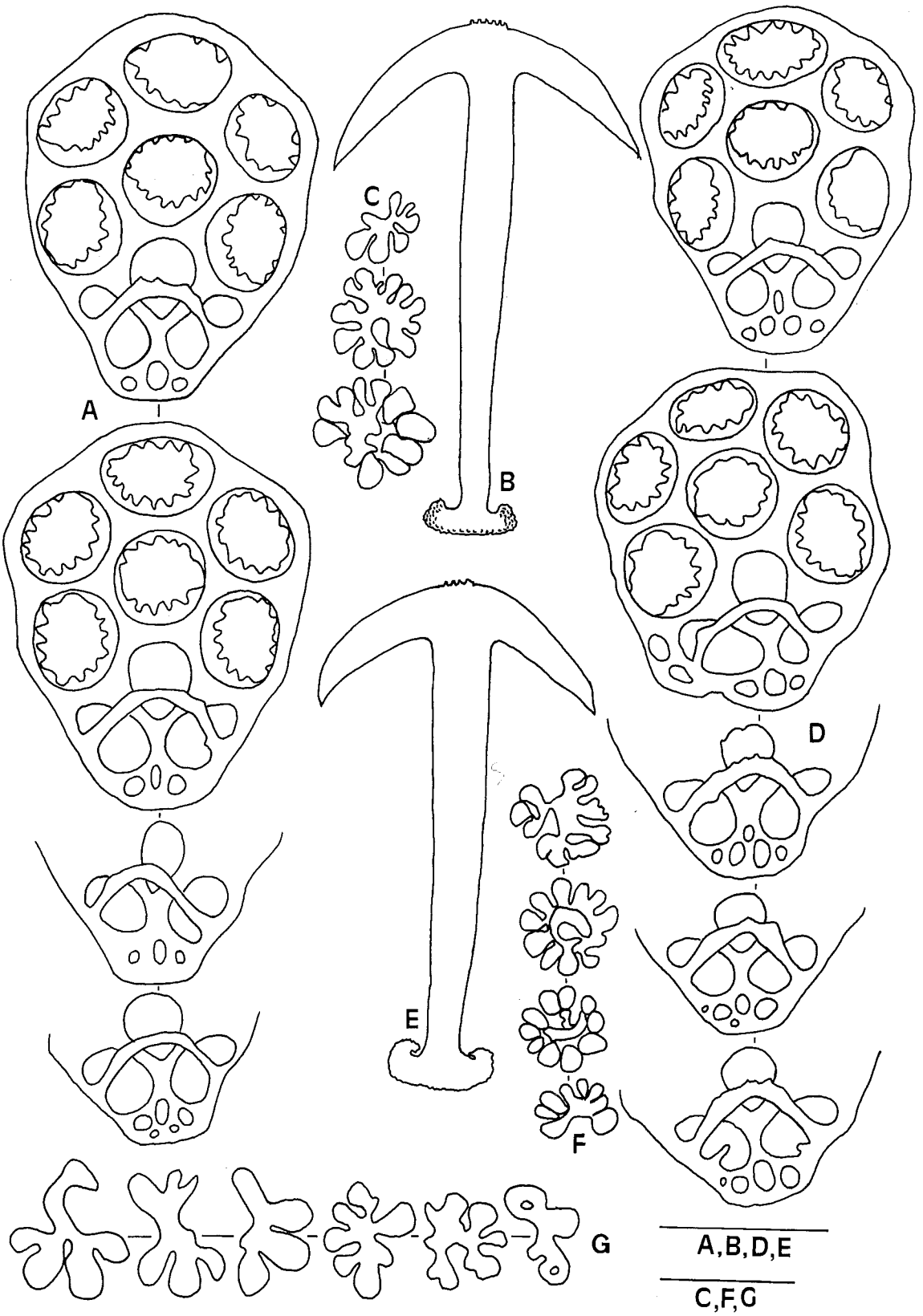

FIG. 48 – *Synaptula recta* (SEMPER, 1868). A. Anchor-plates of posterior body wall; B. Anchor of posterior body wall; C. Miliary granules of posterior body wall; D. Anchor-plates of anterior body wall; E. Anchor of anterior body wall; F. Miliary granules of anterior body wall; G. Miliary granules of tentacles. Scale bar A, B, D represents 100 μm; scale bar C, F, G represents 50 μm.

(fig. 48B, E). Anchor size significantly larger posteriorly (fig. 48B) than anteriorly (fig. 48E) (280.7 ± 19.6 µm versus 310.5 ± 19.5 µm; n = 120; t-value = -13.39). Anchor-plates of posterior (fig. 48A) and anterior (fig. 48D) side of the same shape: six serrated holes and three smooth articular holes (central one occasionally slightly serrated), bridge slightly knobbed to spiny; posterior holes one to six, average of 3.2 ± 0.8 (n= 120) on the posterior anchor-plates and three to seven, average of 3.95 ± 1.2 (n=120) on the anterior ones. Miliary granules (fig. 48C, F), 15-25 µm across, from rosettes to dissociated grains. In the tentacles miliary granules only, somewhat larger than in the body wall, 25-45 µm across, mostly as rosettes (fig. 48G).

DIAGNOSIS – See HEDING 1928: 167, figs16 (4-6), 17 (3-8), 17.

ECOLOGY – *S. recta* specimens were found on sponges (beige to red forms) and on a sandy bottom (beige form) between two coral slabs. LANE *et al.* 2000 give a bathymetric range of 0-20 m; our deepest specimen was found at 35 m depth.

DISTRIBUTION IN THE STUDY REGION – Mesali.

GEOGRAPHIC DISTRIBUTION – First record for the East African coast. Previous African records were only known from the Gulf of Aqaba (TORTONESE 1977; PRICE 1982), Red Sea (TORTONESE 1936a; 1953a; 1979; A.M. CLARK 1952; CLARK & ROWE 1971; PRICE 1982) and Gulf of Aden (H.L. CLARK 1908). Overall, this species has a tropical Indo-west Pacific Ocean (without the Persian Gulf) distribution as evident from the distribution map as drawn by MASSIN (1999: 116, fig. 100). However, DANIEL & HALDER's (1974 as *Chondrocloea recta* (SEMPER, 1868)) unverifiable records from Somalia (? *lapsus* for French Somalia = Djibouti?) and Zanzibar possibly have to be added. Figure 56F shows the known distribution in the WIO in detail.

REMARKS – It was already noted above that the genus *Synaptula* is in critical need of review. A first morphological examination of the collected specimens on a morphological level (body colouration, structure of the calcareous and cartilageneous ring, number of tentacles, number of digits on these tentacles,...) revealed some variation. However, factor analysis of the ossicle assemblage of each specimen of *S. recta* (maximum length and width of 20 anterior & 20 posterior anchors, 20 anterior & 20 posterior anchor-plates and the number of posterior holes in these anchor-plates), pointed in the direction of one (or maybe two; see *S.* cf. *recta* below) species (fig. 49).

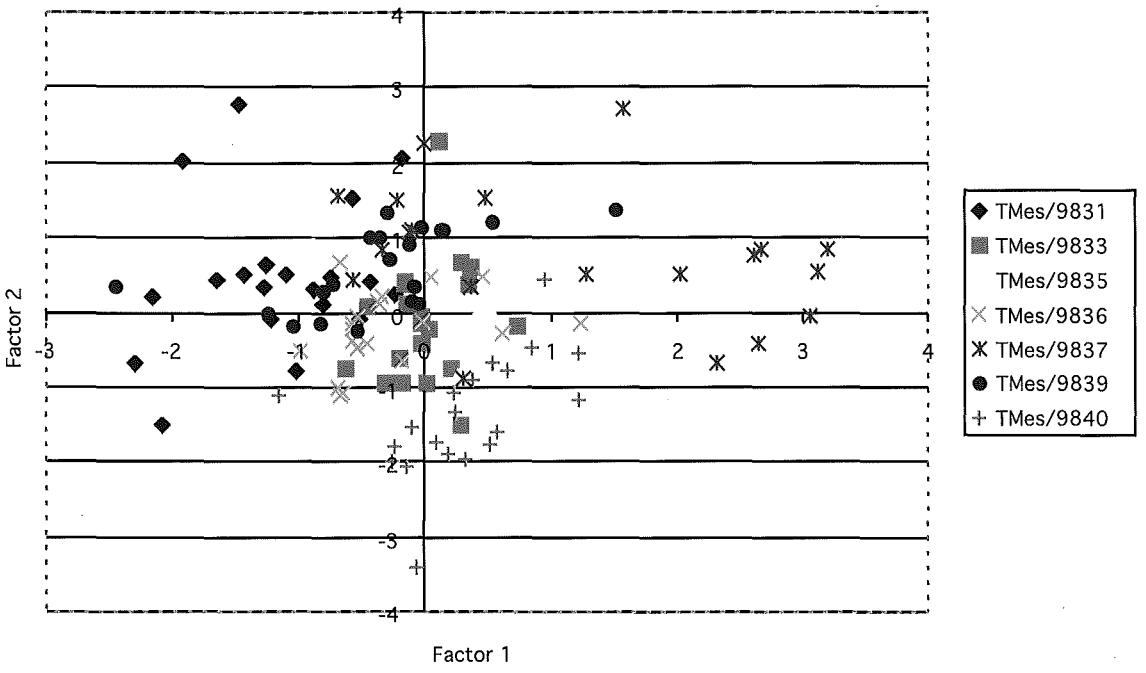

FIG. 49 – Factor analysis performed on the ossicle assemblage of the collected *Synaptula recta* specimens, with factor 1 explaining 36.17 % of the variation and factor 2 explaining 16.53 % of the variation. The observed variation thus seems to be intra-rather than interspecific.

Synaptula cf. *recta* (SEMPER, 1868)
(fig. 50 A-F, pl. 4J)

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995)
TYPE LOCALITY – Bohol (Phillipines).
MATERIAL EXAMINED – TFun/9831 (one specimen).
GENERAL DESCRIPTION – See *S. recta*.
DIAGNOSIS – See *S. recta*.
ECOLOGY – The single specimen was found under live hard coral, on coralline sand.
DISTRIBUTION IN THE STUDY REGION – Mesali.
GEOGRAPHIC DISTRIBUTION – See *S. recta*.
REMARKS – While fig. 49 shows that the present specimen largely falls within the cluster of *S. recta*, I hesitate in identifying it as such for the specimen differs in several aspects: (i) the body wall does not have the warty extensions typical of *S. recta* (see pl. 4H versus pl. 4J); (ii) the live specimen was light beige rather then dark-beige to brownish red, the preserved specimen is clear white while the others are faint gray; (iii) the cartilageneous ring has regular, narrow slits rather then irregular holes as observed in the other specimens; and (iv) the ossicles are significantly different in size (not in shape) to those found in a *Synaptula recta* specimen of similar dimensions (table 25). Nevertheless, as I have only one specimen at my disposition, it is unwise to put it under another name until more material from the same region becomes available.

Table 26 lists the other species within the genus *Synaptula* that are known to occur in the shallow waters of the WIO, but have for now not been reported in Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record(s) appeared.

DISCUSSION

The (urgent) need to assess native levels of shallow-water holothuroid biodiversity in Kenya

During my first trip to Kenya (back in 1995) I noticed that large numbers of different species of holothuroids were collected *en masse* in several locations along the Kenyan Coast (e.g. Gazi Bay, Kanamai). At that time, I was surprised that nobody could tell me what species were fished and what the impact of such harvesting was on the fragile seagrass and coral reef ecosystem. Back in those days, little did I know that almost no checklists existed for the sea cucumber or bêche-de-mer resources of Kenya, and in fact of all East Africa. These observations prompted me to submit a project for describing and mapping the holothuroid biodiversity of the shallow-waters of Kenya. Later on, during a recreational dive trip to the western side of Pemba Island, I observed the very rich and apparently pristine underwater fauna of these coral gardens. As the holothuroid fauna of Pemba Island had not been the object of any study, I chose to include it in detail in the present paper.

Ossicle	TMes/9831 (L=150mm)	TMes/9835 (L=160mm)	Significance
Length AP $_{(anterior)}$	187.67 ± 10.6 µm (n=20)	210.00 ± 11.7 µm (n=20)	*** (t=-5.23)
Width AP $_{(anterior)}$	145.67 ± 8.1 µm (n=20)	164.67 ± 7.8 µm (n=20)	*** (t=-6.27)
Length AP $_{(posterior)}$	211.50 ± 10.6 µm (n=20)	224.33 ± 7.8 µm (n=20)	*** (t=-4.45)
Width AP $_{(posterior)}$	171.67 ± 8.8 µm (n=20)	180.17 ± 8.2 µm (n=20)	** (t=-3.51)
# Posterior holes $_{(anterior)}$	4.85 ± 1.1 (n=20)	4.70 ± 1.3 (n=20)	NS
# Posterior holes $_{(posterior)}$	3.50 ± 1.0 (n=20)	3.20 ± 0.7 (n=20)	NS
Length A $_{(anterior)}$	267.50 ± 16.3 µm (n=20)	281.00 ± 15.4 µm (n=20)	** (t=-2.92)
Length A $_{(posterior)}$	311.33 ± 15.9 µm (n=20)	313.67 ± 9.2 µm (n=20)	NS

TABLE 25 – Pairwise comparison between a specimen of *Synaptula recta* and the specimen temporarily identified as *Synaptula* cf. *recta* of similar length. Significance is assessed through a two-tailed (paired) t-test; levels of signifigance:*** = $P < 0.001$; ** = $P < 0.01$; NS: not significant; n: number of ossicles measured; AP: anchor plate; A: anchor.

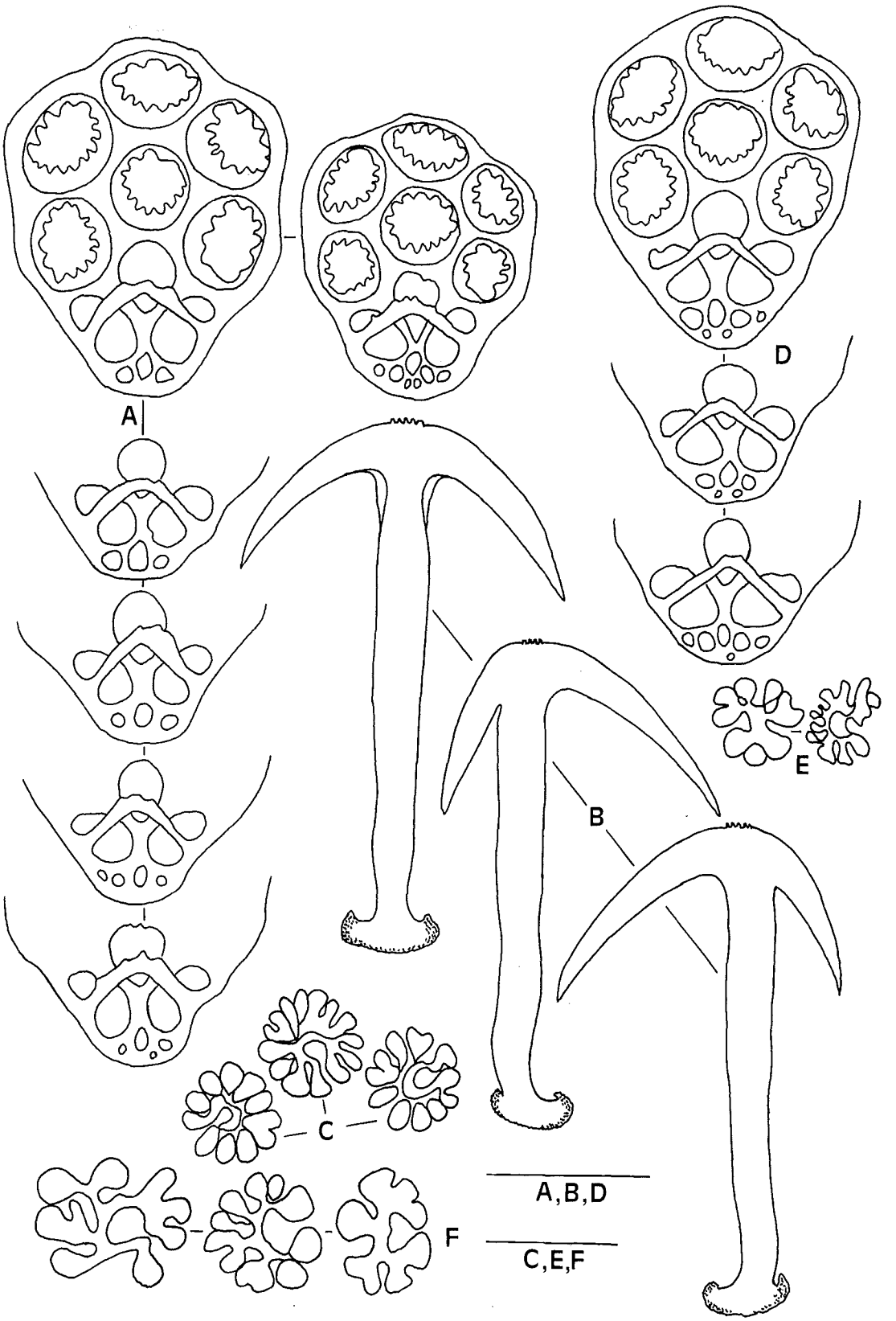

FIG. 50 – *Synaptula* cf. *recta* (SEMPER, 1868). A. Anchor-plates of posterior body wall; B. Anchors of posterior body wall; C. Miliary granules of posterior body wall; D. Anchor-plates of anterior body wall; E. Miliary granules of anterior body wall; F. Miliary granules of tentacle. Scale bar A, B, D represents 100 μm; scale bar C, E, F represents 50 μm.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
S. reciprocans (FORSKÅL, 1775) (see also discussion)	Gulf of Suez (Suez, Great Lake Amer, Lake Timash, Great Bitter Lake, fontaine de Moise,Wadi el Dom, Ismaila)	SELENKA 1867; SEMPER 1868; 1869; FORSKÅL, 1775; GRAY 1872; LAMPERT 1885; THEÉL 1886; HÉROUARD 1893; MORTSENSEN 1926; HEDING 1928; CHERBONNIER 1955; JAMES 1969; JAMES & PEARSE 1969; DANIEL & HALDER 1974; PRICE 1882
	Gulf of Aqaba (Aqaba)	CHERBONNIER 1979a; PRICE 1982
	Red Sea (Entedebir, Abulat Island, Disei Island, Dur Chella, Hurghada, Jeddah, Noccra Island, Shek Said)	DE BLAINVILLE 1821; SELENKA 1867; TORTONESE 1936a; 1937-38; 1953a; 1977; MORTENSEN 1937; CHERBONNIER 1955; 1967; JAMES 1969; JAMES & PEARSE 1969; DANIEL & HALDER 1974; PRICE 1982
	Gulf of Aden (Djibouti)	VANEY 1905; CHERBONNIER 1955
	Arabian Sea	DANIEL & HALDER 1974; PRICE 1982
	Somalia?	DANIEL & HALDER 1974
	Madagascar (Nosy Komba and Mitsio Island)	CHERBONNIER 1988
S. mortenseni HEDING, 1929 (see also discussion)	Madagascar (Tuléar)	CHERBONNIER 1988
	Zanzibar	HEDING 1929
S. nigra (SEMPER, 1868)	Gulf of Suez	H.L. CLARK 1908
	Red Sea (Kosseir, Bay Margabla, Assab)	LAMPERT 1885; LUDWIG 1886; H.L. CLARK 1908
	Gulf of Aden?	DANIEL & HALDER 1974
S. vittata (FORSKÅL, 1775)	Gulf of Suez	GRAY 1872; DANIEL & HALDER 1974
	Red Sea	DANIEL & HALDER 1974

TABLE 26 – Other species within the genus *Synaptula* known to occur in the shallow-waters of the WIO.

During three sampling expeditions (from 1997 to 1999), I observed that in some locations holothuroid stocks were reaching depletion due to extensive harvesting for the bêche-de-mer industry, an observation which is apparently shared by the sea cucumber fishermen (MARSHALL *et al.* 2001). However, to date, conservation and management of the Kenyan holothuroid fauna is still in its infancy; one of the main reasons probably results from the fact that the Kenyan Government lacks accurate species lists. For now, the Kenya Government addressed the problem of resource exploitation by gazetting marine reserves and parks. Marine parks being fully protected areas (no exploitation allowed), while marine reserves are only partially protected (fishing by traditional means is allowed). In addition the Kenyan authorities, through *The Fisheries Act 1991,* imposes collectors and traders in bêche-de-mer to hold a license, but as an extensive interview amongst holothuroid fishermen revealed, few fishermen hold such a license and many of them believe that the buyers and/or middlemen are the ones for whom this rule applies (MARSHALL *et al.* 2001).

Estimating the Kenyan holothuroid richness – How complete is the present checklist?

In order to develop a rational program to conserve as many species as possible we need to have an idea of the total number and distribution of the species in the area (MAY 1992; SAMYN 2000; DOPHLIN & QUICKE 2001). A rough prediction of the species richness of Kenya (with Pemba Island) can be obtained by plotting the cumulative number of species reported from the area against the sampling effort; the species accumulation curve that fits to the data predicts the final number of species (the asymptote) that exist in the area (fig. 57). This approximation reveals a number somewhere around 50; a number not far from what is reported here.

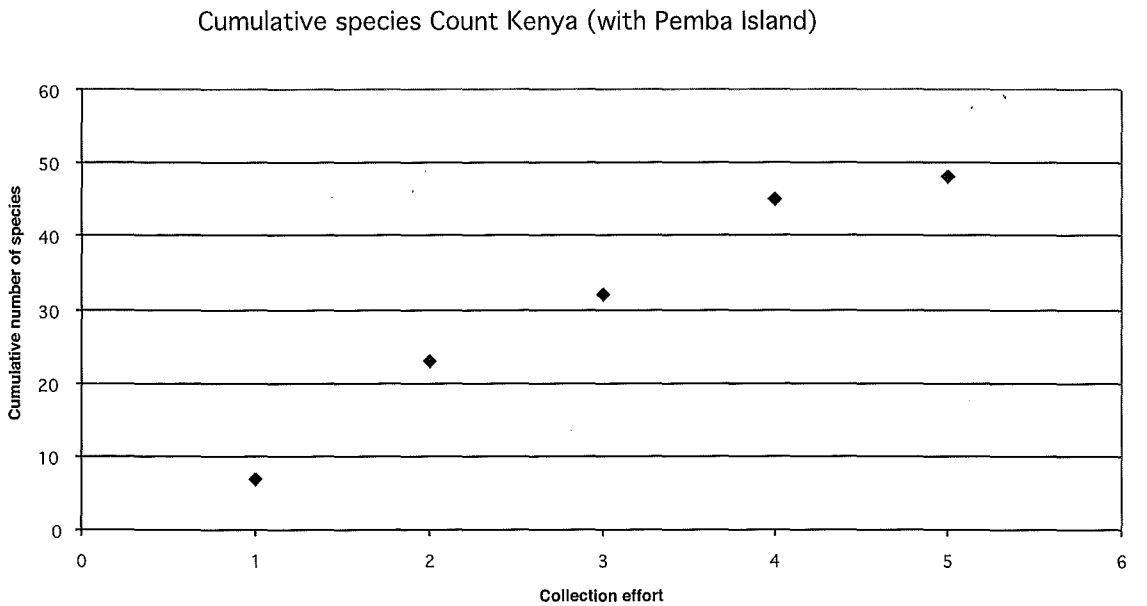

FIG. 57 – Estimating *holothuroid* species richness from Kenya (with Pemba Island) by constructing a cumulative count. 1 Denotes the cumulative count after PANNING (1941); 2 gives the known species after the former and LEVIN (1979); 3 after the former and HUMPHREYS (1981); 4 the former and the 1997 survey; 5. after the former and the 1998 survey; 6 after the former and the 1999 survey.

It can be argued that the observed discrepancy is due to the patchiness of the sampling effort and the sampling efficiency. This can be tested by looking for species that have been reported from the immediate North (Somalia) and from the immediate South (Tanzania) of Kenya, but not from Kenya. In such a way it is revealed that only three species – *H. (S.) parva* LAMPERT, 1885, *H. (P.) strigosa* SELENKA, 1867 and *Polycheira fusca* (QUOY & GAIMARD, 1833) – are missing in the present checklist (see fig. 58).

However, as the sampling effort, sampling efficiency and taxonomic effort in Tanzania and especially in Somalia can hardly be called sufficient, it was thought desirable to examine at the broader geographic scale of the western Indian Ocean. This way several species that are potentially present in Kenya can be found; these species are listed in the different text tables included under each genus or subgenus. Some of these[16] need some additional comments in terms of distribution and expected occurrence in Kenya.

- *Actinopyga bannwarthi* PANNING, 1944. This species is reported from the Red Sea (up to Djibouti), the Seychelles and Madagascar (see table 2). The records from the Seychelles and Madagascar must however be treated with caution as the former was reported as *Actinopyga* sp. cf. *A. bannwarthi* (SLOAN *et al.* 1979) and the latter might not be *A. bannwarthi* for the ossicles reported from the dorsal body wall (CHERBONNIER 1988: 17, fig. 1E, F, G, K) differ to some extent with those depicted in the original decription (PANNING 1944: 54, fig. 22k-r). Its occurrence in the Kenyan shallow waters thus remains doubtful.
- *A. obesa* (SELENKA, 1867). The most northern record in the western Indian Ocean is Ile Mayotte (Comores), wherefrom it is known from a single specimen. It is further known from South Africa (pers. observ.), the Phillipines and Hawaii. Its occurrence in the Kenyan shallow waters is improbable.
- *Bohadschia argus* JAEGER, 1833. In East Africa this species is reported with certainity from the Seychelles and Madagascar (PANNING 1944 states that *B. argus* is distributed between 30°N

[16] While the text-tables give the distribution in the WIO, it was thought wise to discuss the possibility of occurrence in Kenya in more detail. However, species of which it is obvious that they are restricted to a certain area (for instance all records of the species stem from the Red Sea) are here not further discussed. On the other hand records that are problematic (possibility of misidentification) are more thoroughly analyzed.

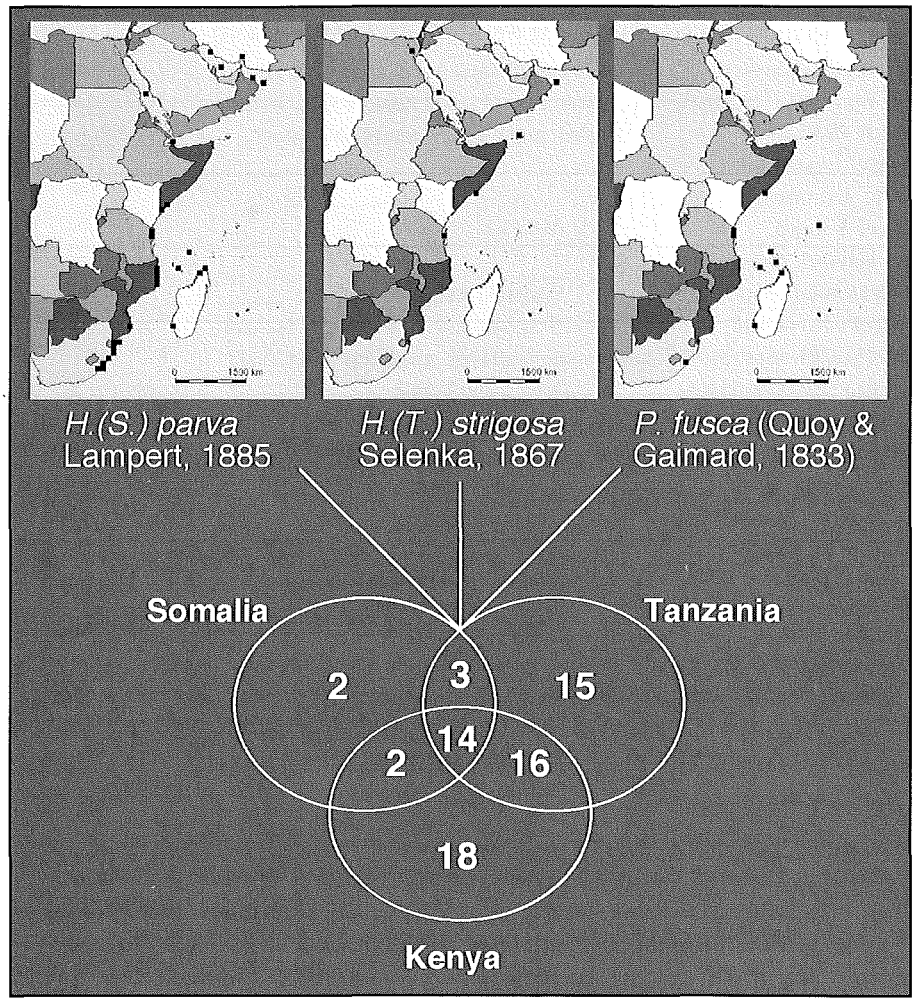

FIG. 58 – Gap analysis of the Somalian and the Tanzanian shallow-water Holothuroidea. Of the 17 species that are reported from both Somalia and Tanzania, only three [*Holothuria (Selenkothuria) parva* LAMPERT, 1885; *Holothuria (Thymiosycia) strigosa* SELENKA, 1867 and *Polycheira fusca* (QUOY & GAIMARD, 1833)] have not been found in Kenya.

& 20°S and between 50°E & 140°W). Recently, it has also been reported along the coastline of the African continent (MARSHALL *et al.* 2001). This species with its conspicuous circles on the body wall can be identified without doubt in the field. Most probably, the record of MARSHALL *et al.* (2001) is *B. atra* rather than *B. argus*. Its occurrence in the Kenyan waters is thus extremely doubtful, especially since questioning of several recreational and professional divers (with the aid of the pictures in GOSLINER *et al.* 1996 and WEINBERG 1997) on the presence of this ubiquitous species yielded no positive response.

- *B. maculisparsa* CHERBONNIER & FÉRAL, 1984. CONAND (1999) is the only one to report this species from the Indian Ocean. Most probably, CONAND's recording is *B. marmorata* rather then *B. maculisparsa* as the latter species is known only from the holotype (New Caledonia).
- *B. mitsioensis* CHERBONNIER, 1988. This species is only known from the holotype and the paratype, both specimens from North-western Madagascar (Mitsio Island). CHERBONNIER (1988) himself expresses his doubts on the validity of this species. The ossicle assemblage as shown in CHERBONNIER (1988) makes me believe that it is a colour variety of *B. marmorata* rather then a valid species.
- *Labidodemas rugosum* (LUDWIG, 1875). This species undoubtedly can also thrive in the Kenyan waters; however the burrowing behavior of *Labidodemas* spp. makes them difficult

to find. Global distribution maps of all *Labidodemas* spp. can be found in MASSIN *et al.* (in prep.).

- *Holothuria (Cystipus) jousseaumei* CHERBONNIER, 1954. Prior to the present study, this species was only known from the Red Sea (see table 6); the finding of a voucher specimen from the Seychelles in the MRAC, expands the distribution considerably, making its presence in the Kenyan waters probable.
- *Holothuria (Cystipus) sucosa* ERWE, 1919. Endemic species to the Red Sea (see table 6). As most records are derived from secondary sources, it is difficult to ascertain the validity of the species.
- *Holothuria (Lessonothuria) lineata* LUDWIG, 1875. ROWE (*in* ROWE & GATES 1995) resurected this species from the synonymy of *H. (L.) pardalis* SELENKA, 1867. It remains to be investigated if the specimens from Mauritius are indeed *H. lineata* or rather, as I suspect, misidentified individuals of *H. pardalis*.
- *Holothuria (Mertensiothuria) fuscorubra* THÉEL, 1886. This species has long been regarded as a synonym of *H. (M.) leucospilota* but was recently resurected as a valid species (SAMYN & MASSIN in press). If the vast amount of voucher specimens of *H. leucospilota* could be re-examined, undoubtedly the distribution of *H. fuscorubra* would be more detailed, making it very possible that the species belongs to the Kenyan fauna.
- *Holothuria (Mertensiothuria) papillifera* HEDING *in* MORTENSEN, 1938. Prior to the present study, this species was only known from the Red Sea (SAMYN & MASSIN in press); the finding of a voucher specimen [identified as *Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775)] from Tanzania (Dar Es Salaam) in the MRAC, expands the distribution considerably, making its presence in the Kenyan waters very probable.
- *Holothuria (Metriatyla) horrida* MASSIN, 1987. The recognition that CHERBONNIER's (1988) *Holothuria (Metriatyla)* sp. shows almost no differences with the recently described *H. (Metriatyla) horrida* expands the distribution from Indonesia to Madagascar. It remains uncertain if this rare species also thrives in Kenya.
- *Holothuria (Microthele) whitmaei* BELL, 1887. The only record of this species from the WIO is that of ROWE & RICHMOND (1997). As these authors made their book by drawing on other sources, it is strange that the species figures in their work for I failed to find a publication dealing with the holothuroids of the WIO that mentions this species. Its occurrence in the shallow-waters of the WIO seems improbable even if ROWE & GATES (1995) state that it is distributed through the tropical, Indo-west Pacific Ocean.
- *Holothuria (Selenkothuria) moebii* LUDWIG, 1883. It remains most uncertain if this species with a wide Indo-west Pacific distribution has indeed reached the East Coast of Africa as claimed by DANIEL & HALDER (1974). DEICHMANN (1958) gives a distribution from Mauritius to Japan.
- *Holothuria (Semperothuria) flavomaculata* SEMPER, 1868. This well-known, easily recognisable and widely distributed species has strangely enough never been found along the East African coast (but see CHERBONNIER 1988: 69). The MRAC record from the Seychelles and the records from Madagascar (see table 16) for now indicate the most western localities in the Indian Ocean, but I believe it is only a matter of time before this species will be found along the East African coast.
- *Holothuria (Stauropora) olivacea* LUDWIG, 1888. CHERBONNIER's (1988) recent finding of of this species in Madagascar indicate that this Indo-west-central Pacific species possibly also thrives along the East African coasts.
- *Holothuria (Theelothuria) hamata* PEARSON, 1913. The recent findings of this species at the North coast of Australia (ROWE & GATES 1995) indicate that this species most probably is distributed throughout the tropical Indian Ocean (with the Red Sea) and that SLOAN *et al.*'s (1979) record from the Seychelles (Aldabra) is probable; presence in Kenya is thus also possible.
- *Holothuria (Theelothuria) maculosa* PEARSON, 1913. Difficult to state if this species will ever be found in Kenya; for now this species is known only from the Seychelles (Aldabra), Madagascar and Inhaca (CHERBONNIER 1988).
- *Holothuria (Theelothuria) notabilis* LUDWIG, 1874. ROWE (*in* ROWE & GATES 1995) gives the tropical Indo-Malayan region as the distribution area. The discovery of *H. notabilis* on the KwaZulu-Natal coast, expands its distribution

considerably. Whether this species is present in Kenya seems to depend on the dispersion route taken by the species. If it traversed the Indian Ocean with the South Equatorial Current and arrived in North-East South Africa with the Mozambique and the Agulhas Current, presence in Kenya is also likely. If, on the other hand it split of with the Madagascar current (the current that flows the eastern Madagascar coast) and from there reached South Africa with the Agulhas Current, presence in Kenya is unlikely. Pointing the most probable hypothesis is at present difficult, and will depend on future explorations along the Mozambique Channel.

- *Holothuria (Thymiosycia) gracilis* SEMPER, 1868. This species is rather ill-known, with the sparse distribution records spread over the Indo-West Pacific (CLARK & ROWE 1971; CHERBONNIER 1988; LANE *et al.* 2000), but as it has been found in Zanzibar (LAMPERT 1885), presence in Kenya is also very probable.
- *Stichopus horrens* SELENKA, 1867. The confusion of *Stichopus variegatus* SEMPER, 1868 (junior synonym of *S. horrens*) with *S. monotuberculatus* (QUOY & GAIMARD, 1833) and *S. herrmanni* SEMPER, 1868 makes it difficult to discuss the distribution of this species. Nevertheless, as the species is known from the North and the south of Kenya, it most probably also belongs to the Kenyan fauna.
- *Stichopus pseudohorrens* CHERBONNIER, 1967. CONAND (1999: 10) is the only one who lists the species from the Indian Ocean, all the other records in the WIO are from the Gulf of Aqaba (see table 20). FÉRAL & CHERBONNIER (1986) report the species also from New Caledonia and LANE *et al.* (2000) from the South China Sea. The record of LANE *et al.* (2000) cannot be judged for the paper does not give descriptions, the record of FÉRAL & CHERBONNIER (1986) on the other hand differs from CHERBONNIER's (1967) original description in several ways, hence their species might be another (new?) species. During a recreational dive at Pemba Island (Fundu) I was able to photograph a *Stichopus* sp. (fig. 59) which morphologically corresponds to CHERBONNIER's (1967) description of *S. pseudohorrens*. Unfortunately, at that time I lacked a collecting permit so no voucher specimen could be taken; later, I never found the species again. I hesitate to identify it as *Stichopus pseudohorrens*, but given CONAND's (1999) record from the Indian ocean (no exact locality given), it is likely that this species has to be added to the Kenyan fauna as well. For now, until a voucher specimen is available, I refrain from doing so.
- *Synaptula mortenseni* HEDING, 1929. Species known only from Zanzibar (Heding 1929) and Madagascar (CHERBONNIER 1988); most probably it can also be found in Kenya.
- *Synaptula reciprocans* (FORSKÅL, 1775). This species has been reported from the Red Sea by an impressive number of authors (see table 26). But, as CHERBONNIER (1988) was the only one to report it from the Indian Ocean (Madagascar, Nosy Komba and Mitsio Island), his voucher specimens need careful re-examination to check their validity. In fact, as this genus is in critical need of review, it is almost impossible to comment on the zoogeography of this group.

In addition, a large number of species that do not fall under genera (or even families and orders) known from Kenya can be found in the shallow waters of the WIO. These are grouped in table 27, whereby the eight arbitrary chosen geographic regions correspond with those specified in map 2. As most of these species are ill-known to me, I will (for now) refrain from commenting on their taxonomy, but nevertheless will flag (with footnotes and question marks) those species that are improbable in terms of occurrence (depth, geographic locality), validity or systematic position. The exact locality of collection of each of the mentioned species can be found in the accompanying references.

FIG. 59 – *Stichopus sp.* as photographed at Pemba Island (Fundu) most probably represents *S. pseudohorrens* CHERBONNIER, 1967.

TAXON	CITED AS	REFERENCE(S)	1	2	3	4	5	6	7	8
APODIDA										
Chiridotidae ÖSTERGREN, 1907										
Chiridota durbanensis THANDAR, 1996	*Chiridota durbanensis* THANDAR	THANDAR 1996								x
Chiridota eximia HAACKE, 1880	*Chiridota eximia* HAACKE	HAACKE 1880; LAMPERT 1885; THÉEL 1886; DANIEL & HALDER 1974							x	
Chiridota rigida SEMPER, 1868	*Chiridota rigida* SEMPER	THANDAR & ROWE 1989							x	x
Chiridota stuhlmanni LAMPERT, 1896	*Chiridota stuhlmanni* LAMPERT	LAMPERT 1896; H.L. CLARK 1908; HEDING 1931; CHERBONNIER 1967; TORTONESE 1977; SLOAN *et al.* 1979; PRICE 1982; A.M. CLARK 1984; CHERBONNIER 1988		x					x	x
Chiridota violacea PETERS *in* J. MÜLLER, 1850	*Chiridota violacea* (J. MÜLLER)	CLARK & ROWE 1971; SLOAN *et al.* 1979; A.M. CLARK 1984; CHERBONNIER 1988							x	x
	Chiridota violacea PETERS	MÜLLER 1850; SELENKA 1867; SEMPER 1868; BELL 1884; LAMPERT 1885; DANIEL & HALDER 1974							x	
	Chiridota violacea PETERS *in* MÜLLER	THÉEL 1886							x	
	Chiridota violacea	H.L. CLARK 1908; HUGHES & GAMBLE 1977		x					x	
Polycheira fusca (QUOY & GAIMARD, 1833)	*Polycheira fusca* (QUOY & GAIMARD, 1833)	CHERBONNIER 1988							x	x
	Chiridota rufescence BRANDT	DANIEL & HALDER 1974			x				x	
	Chiridota rufescens BRANDT	LAMPERT 1896; LUDWIG 1899							x	
	Polycheira rufescens (BRANDT)	HEDING 1929; CLARK & ROWE 1971; SLOAN *et al.* 1979; TORTONESE 1980; A.M. CLARK 1984; THANDAR 1989a							x	x
	Polycheira rufescens CLARK	HEDING 1931							x	
Trochodota mira CHERBONNIER, 1988	*Trochodota mira* CHERBONNIER	CHERBONNIER 1988								x
Trochodota vivipara CHERBONNIER, 1988	*Trochodota vivipara* CHERBONNIER	CHERBONNIER 1988							x	x
Synaptidae BURMEISTER, 1837										
Anapta gracilis SEMPER, 1868	*Anapta gracilis* SEMPER	CLARK & ROWE 1971							x	
Labidoplax mortenseni HEDING, 1931	*Labidoplax* sp	MORTENSEN 1926	x							
	Labidoplax mortenseni HEDING	HEDING 1931	x							
Leptosynapta chela MORTENSEN, 1926	*Leptosynapta chela* MORTENSEN	MORTENSEN 1926; CLARK & ROWE 1971; PRICE 1981; 1982; 1983	x		x		x	x		
Leptosynapta geyserensis CHERBONNIER, 1988	*Leptosynapta geyserensis* CHERBONNIER	CHERBONNIER 1988							x	
? *Leptosynapta inhaerens*	*Synapta inhaerens* O. F. MÜLLER	LAMPERT 1885			x					
(O. F. MÜLLER, 1776)[17]	*Synapta inharens* O.F. MÜLLER	DANIEL & HALDER 1974			x	x				
Leptosynapta knysnaensis (CHERBONNIER, 1952)	*Epitomapta knysnaensis* CHERBONNIER	CHERBONNIER 1952a; DANIEL & HALDER 1974								x
	Epitomapta sp.	CHERBONNIER 1954b								x
	Leptosynapta ancaracuta CHERBONNIER	DANIEL & HALDER 1974								x
	Leptosynapta ancoracuta CHERBONNIER	CHERBONNIER 1954b								x
	Leptosynapta knysnaensis (CHERBONNIER)	THANDAR & ROWE 1989								x
	Leptosynapta sp.	CHERBONNIER 1954b								x
Leptosynapta naiga THANDAR & ROWE, 1989	*Leptosynapta naiga* THANDAR & ROWE	THANDAR & ROWE 1989								x
Leptosynapta oblonga CHERBONNIER, 1988	*Leptosynapta oblonga* CHERBONNIER	CHERBONNIER 1988							x	
Leptosynapta pustulosa CHERBONNIER, 1970	*Leptosynapta pustulosa* CHERBONNIER	CHERBONNIER 1970a								x
Leptosynapta tantula CHERBONNIER, 1988	*Leptosynapta tantula* CHERBONNIER	CHERBONNIER 1988								x
Oestergrenia spatula THANDAR & ROWE, 1989	*Oestergrenia spatula* THANDAR & ROWE	THANDAR & ROWE 1989							x	x
Patinapta crosslandi HEDING 1928	*Patinapta crosslandi* HEDING	HEDING 1929; TORTONESE 1936a; 1937-38; DEICHMANN 1948; CLARK & ROWE 1971; DANIEL & HALDER 1974; PRICE 1982; CHERBONNIER 1988; THANDAR 1989a			x				x	x
	Patinapta crosslandii HEDING	HEDING 1931							x	
Patinapta dumasi CHERBONNIER, 1954	*Patinapta dumasi* CHERBONNIER	CHERBONNIER 1954a; 1955; CHERBONNIER 1967; JAMES 1969; JAMES & PEARSE 1969; DANIEL & HALDER 1974; PRICE 1982	x		x					
	Leptosynapta steinitzi CHERBONNIER	CHERBONNIER 1967; PRICE 1982			x					
Patinapta ooplax (VON MARENZELLER, 1881)	*Patinapta ooplax* (VON MARENZELLER)	CLARK & ROWE 1971; CHERBONNIER 1988							x	x
	Synapta ooplax V. MARENZELLER	LAMPERT 1896; LUDWIG 1899							x	
	Leptosynapta ooplax	H.L. CLARK 1908							x	

[17] The records of LAMPERT (1885) and DANIEL & HALDER (1974) need confirmation. In fact this species, together with *Holothuria (Roweothuria) poli* DELLE CHIAJE, 1823 and *H. (Thymiosycia) impatiens* (FORSKÅL, 1775), are the only ones, known with certitude, to be present in both the Mediterranean Sea and the WIO (TORTONESE 1953b).

TAXON	CITED AS	REFERENCE(S)	1	2	3	4	5	6	7	8
Patinapta vaughani CHERBONNIER, 1953	*Patinapta vaughani* CHERBONNIER	CHERBONNIER 1953a							x	
Polyplectana kefersteini (SELENKA, 1867)	*Polyplectana kefersteini* (SELENKA)	TORTONESE 1977; SLOAN *et al.* 1979; PRICE 1982; A.M. CLARK 1984; ARAKAKI & FAGOONEE 1996; MASSIN unpublished		x	x				x	x
	Polyplectana kefersteinii	H.L. CLARK 1908			x					
	Synapta kefersteinii SELENKA	LAMPERT 1885; DANIEL & HALDER 1974			x	x				
	Synaptula kefersteinii (SELENKA)	FISHER 1907					x			
Protankyra autopista (VON MARENZELLER, 1881)	*Protankyra autopista* (MARENZELLER)	TORTONESE 1977; PRICE 1982		x						
Protankyra magnihamula HEDING, 1928	*Protankyra magnihamula* HEDING	HEDING 1940b; PRICE 1982, 1983					x			
Protankyra picardi CHERBONNIER, 1988	*Protankyra picardi* CHERBONNIER	CHERBONNIER 1988								x
Protankyra pseudodigitata (SEMPER, 1868)	*Protankyra pseudodigitata* (SEMPER)	HEDING 1928; HEDING 1940b; CHERBONNIER 1955; PRICE 1982; 1983	x				x			
	Protankyra sp.	MORTENSEN 1926	x							
ASPIDOCHIROTIDA										
Stichopodidae HAECKEL, 1896										
Neostichopus grammatus (H.L. CLARK, 1923)	*Neostichopus grammatus* (H.L. CLARK)	DEICHMANN 1948; THANDAR 1987a; CHERBONNIER 1988; pers. observ.								x
	Neostichopus grammata (H.L. CLARK)	DANIEL & HALDER 1974								x
	Holothuria grammata HL CLARK	H.L. CLARK 1923								x
Synallactidae LUDWIG, 1894										
? *Synallactes mollis* CHERBONNIER, 1952[18]	*Synallactes mollis* CHERBONNIER	DANIEL & HALDER 1974								x
? *Synallactes viridilimus* CHERBONNIER, 1952[19]	*Synallactes viridilimus* CHERBONNIER	DANIEL & HALDER 1974								x
DENDROCHIROTIDA										
Cucumariidae LUDWIG, 1894										
Actinocucumis typica LUDWIG, 1875	*Actinocucumis typicus* LUDWIG	DANIEL & HALDER 1974						x		
Aslia forbesi (BELL)	*Cucumaria forbesi* BELL	DANIEL & HALDER 1974						x		
Aslia spyridiphora (H.L. CLARK, 1923)	*Aslia spyridiphora* (H.L. CLARK)	THANDAR 1991								x
	Cucumaria spyridiphora H.L. CLARK	H.L. CLARK 1923; DEICHMANN 1948; DANIEL & HALDER 1974								x
Athyone exila CHERBONNIER, 1988	*Athyone exila* CHERBONNIER	CHERBONNIER 1988								x
Athyone maculisparsa CHERBONNIER, 1988	*Athyone maculisparsa* CHERBONNIER	CHERBONNIER 1988								x
? *Cercodemas anceps* SELENKA, 1867[20]	*Pentacta tuberculosus* (QUOY & GAIMARD)	DANIEL & HALDER 1974						x		x
? *Colochirus colloradiatus* HAACKE, 1880[21]	*Colochirus colloradiatus* HAACKE	HAACKE 1880; LAMPERT 1885; THÉEL 1886							x	
? *Colochirus propinquus* HAACKE, 1880[22]	*Colochirus propinquus* HAACKE	HAACKE 1880; LAMPERT 1885							x	
Colochirus quadrangularis TROSCHEL, 1846	*Colochirus tristis* LUDWIG	LUDWIG 1875; LAMPERT 1885; THÉEL 1886; PANNING 1949							x	
	Cucumaria tristis LUDWIG	DANIEL & HALDER 1974							x	
	Pentacta quadrangularis (LESSON)	DANIEL & HALDER 1974								x
Cucumella decaryi CHERBONNIER, 1988	*Cucumella decaryi* CHERBONNIER	CHERBONNIER 1988								x
Koehleria unica CHERBONNIER, 1988	*Koehleria unica* CHERBONNIER	CHERBONNIER 1988; pers. observ.								x
Leptopentacta javanicus (SLUITER, 1881)	*Leptopentacta javanicus* (SLUITER)	CLARK & ROWE 1971; PRICE 1982						x		
Neocucumis kilburni RAJPAL & THANDAR, 1998	*Neocucumis kilburni* RAJPAL & THANDAR	RAJPAL & THANDAR 1998								x
Ocnus (?) *amiculus* CHERBONNIER, 1988	*Ocnus amiculus* CHERBONNIER	CHERBONNIER 1988								x
Ocnus (?) *corbulus* (CHERBONNIER, 1953)	*Cucumaria corbula* CHERBONNIER	CHERBONNIER 1953b; DANIEL & HALDER 1974								x
	Ocnus corbulus (CHERBONNIER)	THANDAR 1991								x
Ocnus(?) *cylindricus* SEMPER, 1867[23]	*Cucumaria cylindrica* SEMPER	SEMPER 1868							x	
? *Ocnus planci* (BRANDT, 1835)[24]	*Cucumaria planci* BRANDT	THÉEL 1886; DANIEL & HALDER 1974							x	

[18] From DANIEL & HALDER's (1974) list, it cannot be judged if this species occurs in shallow-water (up to 50 m). As this is most probably not the case, CHERBONNIER (1952) reports a depth of 200 fths, this species is best omitted in future analyses of the shallow-water holothuroids of the WIO.

[19] Idem as footnote 18; CHERBONNIER (1952) reports a depth of 290 fths for this species.

[20] ROWE (*in* ROWE & GATES 1995: 271) re-established the genus *Cercodemas* SELENKA, 1867 from the synonymy of *Pentacta* GOLDFUSS, 1820, because his comparative studies revealed that the type species – *C. anceps* SELENKA, 1867 – and others included in *Cercodemas*, *Colochirus* TROSCHEL, 1846 and *Plesiocolochirus* CHERBONNIER, 1946 do not correspond with the diagnosis of *Pentacta* [type species *P. doliolum* (PALLAS, 1766)] as supposed by H.L. CLARK (1946). The records of DANIEL & HALDER [1974, as *P. tuberculosus* (QUOY & GAIMARD, 1833) which are considered senior synonyms by ROWE (pers. comm)] must be treated with care as the known distribution of *C. anceps* is the tropical east-Indo-west Pacific Ocean (ROWE & GATES 1995).

[21] As this species has not been found since it's original description, its validity is dubious, and thus best omitted in future analyses.

[22] Idem as footnote 21.

[23] Idem as footnote 21, but see also footnote 24.

[24] It is doubtful that the European species *Ocnus planci* (BRANDT, 1835) is present in the WIO; ROWE (pers. comm.) notes that the present record "surely must be a misidentification which is best omitted from the present list". However, as only

TAXON	CITED AS	REFERENCE(S)	1	2	3	4	5	6	7	8
Ocnus (?) *tantulus* CHERBONNIER, 1988	*Ocnus tantulus* CHERBONNIER	CHERBONNIER 1988								x
Orbithyone megapodia H.L. CLARK, 1938	*Orbythyone megapodia*	HUGHES & GAMBLE 1977; SLOAN *et al.* 1979							x	
Parathyone incurva CHERBONNIER, 1988	*Parathyone incurva* CHERBONNIER	CHERBONNIER 1988							x	
Pawsonellus africanus THANDAR, 1986	*Pawsonellus africanus* THANDAR	THANDAR 1986; 1991; pers. observ.								x
Pentacta capensis (THÉEL, 1886)	*Cucumaria capensis* THÉEL	THÉEL 1886; LUDWIG 1887								x
	Psolus capensis	DANIEL & HALDER 1974								x
Pentacta doliolum (PALLAS, 1766)	*Pentacta doliolum* (PALLAS)	DEICHMANN 1948; DANIEL & HALDER 1974; PRICE 1982; THANDAR 1991	x							x
	Colochirus doliolum (PALLAS)	THÉEL 1886; HELFER 1912; MITSIKURI 1912	x							x
	Cucumaria discolor THÉEL	THÉEL 1886; H.L. CLARK 1923; DANIEL & HALDER 1974							x	x
	Cucumaria doliolum PALLAS	SEMPER 1868								x
	Cucumaria posthuma	THÉEL 1886								x
	Holothuria doliolum LAMK.	DE BLAINVILLE 1821								x
Pentacta minuta MACNAE & KALK, 1958 (non LUDWIG, 1875)[25]	*Colochirus minutus* ((MACNAE & KALK, 1958 (non LUDWIG))	THANDAR 1991								x
Pentacta ? pusilla (HELFER, 1912)[26]	*Pentacta pusilla* (HELFER)	PRICE 1982	x							
	Colochirus pusillus HELFER	HELFER 1912	x							
	Pentacta pusillus HELFER	DANIEL & HALDER 1974	x							
Pentacta tesselara CHERBONNIER, 1970	*Pentacta tesselara* CHERBONNIER	CHERBONNIER 1970a; THANDAR 1991								x
	Unidentified MRAC record	pers. observ.								x
Pentacta verrucula CHERBONNIER, 1988	*Pentacta verrucula* CHERBONNIER	CHERBONNIER 1988								x
Plesiocolochirus armatus (VON MARENZELLER, 1881)	*Pentacta loeppenthini* (HEDING)	PRICE 1982; 1983					x			
	Colochirus löppenthini HEDING	HEDING 1940b					x			
Plesiocolochirus dispar (LAMPERT, 1889)	*Pentacta dispar* (LAMPERT)	PRICE 1982; CHERBONNIER 1988						x	x	x
	Pentacta gravieri (VANEY)	CHERBONNIER 1955; DANIEL & HALDER 1974				x			?	
	Colochirus Gravieri VANEY	VANEY 1905				x				
Pseudocnella insolens (THÉEL, 1886)	*Cucumaria sykion*	DEICHMANN 1948								x
	Cucumaria insolens THÉEL	THÉEL 1886; H.L. CLARK 1923; CHERBONNIER 1952a; DANIEL & HALDER 1974							x	x
	Semperia insolens (THÉEL)	LUDWIG 1887								x
	Pseudocnella insolens (THÉEL)	THANDAR 1987b; 1991								x
Pseudocnella sinorbis (CHERBONNIER, 1952)	*Cucumaria sykion*	DEICHMANN 1948								x
	Cucumaria sinorbis CHERBONNIER	DANIEL & HALDER 1974								x
	Pseudocnella sinorbis (CHERBONNIER)	THANDAR 1987b; 1991								x
Pseudocnella sykion (LAMPERT, 1885)	*Pseudocnella sykion* (LAMPERT)	THANDAR 1987b; 1991; pers. observ.								x
	Cucumaria jageri LAMPERT	LAMPERT 1885; THÉEL 1886; DANIEL & HALDER 1974								x
	Cucumaria sykion (LAMPERT)	THÉEL 1886; H.L. CLARK 1923; DEICHMANN 1948; CHERBONNIER 1952a; KALK 1958; DANIEL & HALDER 1974								x
	Semperia sykion LAMPERT	LAMPERT 1885								x
Pseudocnus echinatus VON MARENZELLER, 1881	*Pseudocnus echinatus* (V. MARENZELLER)	CHERBONNIER 1963; PRICE 1982			x					
Pseudocolochirus violaceus (THÉEL, 1886)	*Pseudocolochirus violaceus* (THÉEL)	PEARSON 1910; CHERBONNIER 1988; THANDAR 1991							x	x
	Pseudocolochirus bicolor CHERBONNIER	CHERBONNIER 1970b								x
Roweia frauenfeldi (LUDWIG, 1882)	*Roweia frauenfeldi* (LUDWIG)	THANDAR 1985; 1991								x
	Cucumaria deichmanni CHERBONNIER	DANIEL & HALDER 1974								x
	Cucumaria frauenfeldi LUDWIG	LUDWIG 1882; THÉEL 1886; H.L. CLARK 1923; JOHN 1939; DEICHMANN 1948; CHERBONNIER 1952a								x

examination of the voucher specimen will allow correct identification, it is here temporarily retained. Recently, O'LOUGHLIN & ALCOCK (2000) re-assigned several New Zealand and Australian cucumariid species, previously assigned to *Ocnus* FORBES & GOODSIR *in* FORBES, 1841, to other genera. The latter authors (2000: 2) regard *Ocnus* as "a European genus with diagnostic characters inapplicable to the New Zealand and Australian species". Similarily, the other *Ocnus* spp. here reported on, possibly must be allocated to other genera. For now, until comparative analysis of the voucher specimens is possible, they are retained in this genus.

[25] THANDAR (1991) draws on CHERBONNIER's expertise for keeping *Colochirus minutus* MACNAE & KALK, 1958 (non LUDWIG) (determined by CHERBONNIER) separate from *P. tesselara* CHERBONNIER, 1970. THANDAR's (1991) judgment to retain it as a valid species in *Pentacta* is here respected.

[26] The systematic position of this ill-known species (only known from the 6 mm long holotype) is most uncertain and almost certainly this species cannot be classified under *Pentacta*. In future analyses, it is best omitted, unless examination of its type assigns it to its correct systematic position (which cannot be determined from the poor original description).

Taxon	Cited as	Reference(s)	1	2	3	4	5	6	7	8
	Cucumaria posthuma Lampert	Lampert 1885; Daniel & Halder 1974							x	x
	Cucumaria webbi Thandar	Thandar 1977								x
	Phyllophorus Frauenfeldi Ludwig	Ludwig 1875; 1880; Lampert 1885; Théel 1886; Hérouard 1893; Daniel & Halder 1974	x		x	x				
Roweia stephensoni (John, 1939)	*Roweia stephensoni* (John)	Thandar 1985; 1991								x
	Cucumaria frauenfeldi Ludwig	H.L. Clark 1923								x
	Cucumaria stephensoni John	John 1939; Deichmann 1948; Cherbonnier 1953b; Daniel & Halder 1974								x
Staurothyone rosacea (Semper, 1869)	*Staurothyone rosacea* (Semper)	Price 1982						x		
	Thyone (Stolus) rosacea Semper	Semper 1869				x				
	Thyone rosacea Semper	Lampert 1885; Théel 1886; Semper 1868; Daniel & Halder 1974				x		x		
Trachythyone crucifera (Semper, 1869)	*Trachythyone crucifera* (Semper)	Price 1982; A.M. Clark 1984; Cherbonnier 1988; Thandar 1991; pers. observ.			x			x	x	x
	Cucumaria crucifera Semper	Semper 1868; 1869; Lampert 1885; 1896; Théel 1886; Ludwig 1887; 1899; Deichmann 1948; Kalk 1958; Daniel & Halder 1974				x			x	x
	Unidentified MRAC record	pers. observ.								x
Trachythyone glaberrima (Semper, 1869)	*Cucumaria glaberrima* Semper	Semper 1869; Ludwig 1883; Lampert 1885; Théel 1886; Daniel & Halder, 1974				x				
	Paracucumaria glaberrima (Semper)	Price 1982						x		
	Trachythyone dollfusi Cherbonnier	Cherbonnier 1954a; 1955; Daniel & Halder 1974; Price 1982			x					
Trachythyone improvisa (Ludwig, 1875)	*Cucumaria improvisa* Ludwig	Ludwig 1875; Lampert 1885; Théel 1886; H.L. Clark 1923; Deichmann 1948; Daniel & Halder 1974							x	x
	Trachythyone improvisa (Ludwig)	Thandar 1991								x
Trachythyone rigidapeda (Cherbonnier, 1952)	*Cucumaria rigidapeda* Cherbonnier	Cherbonnier 1952a; Daniel & Halder 1974								x
Phyllophoridae Oestergren, 1907										
Globosita murrea Cherbonnier, 1988	*Globosita murrea* Cherbonnier	Cherbonnier 1988								x
Havelockia ferali Cherbonnier, 1988	*Havelockia ferali* Cherbonnier	Cherbonnier 1988							x	x
Havelockia festina (Koehler & Vaney, 1908)	*Thyone festina* Koehler & Vaney	Koehler & Vaney 1908; Daniel & Halder 1974; Price 1982, 1983					x			
Havelockia transitoria (Vaney, 1905)	*Havelockia transitoria* (Vaney)	Price 1982						x		
	Athyone transitoria (Vaney)	Cherbonnier 1955				x				
	Athyone transitoria Cherbonier non Vaney	Price 1982						x		
	Cucumaria transitera Vaney	Daniel & Halder 1974				x			x	
	Cucumaria transitoria Vaney	Vaney 1905				x				
Havelockia turrispinea Cherbonnier, 1988	*Havelockia turrispinea* Cherbonnier	Cherbonnier 1988							x	
? *Havelockia venustella* (Heding & Panning, 1954)[27]	*Thyone venustella*	Daniel & Halder 1974							x	
Havelockia versicolor (Semper, 1868)	*Havelockia versicolor* (Semper)	Thandar 1989c								x
	Thyone mirabilis	Kalk 1958								x
Hemithyone semperi (Bell, 1884)	*Hemithyone semperi* (Bell)	Cherbonnier 1988							x	
	Cucumaria semperi Bell	Pearson 1910; Daniel & Halder 1974							x	
Lipotrapeza ambigua Cherbonnier, 1988	*Lipotrapeza ambigua* Cherbonnier	Cherbonnier 1988								x
Lipotrapeza incurva Cherbonnier, 1988	*Lipotrapeza incurva* Cherbonnier	Cherbonnier 1988								x
Lipotrapeza ventripes (Joshua & Greed, 1915)	*Lipotrapeza ventripes* (Joshua & Greed)	Cherbonnier 1988								x
Neothyonidium arthroprocessum Thandar, 1989	*Neothyonidium arthroprocessum* Thandar 1989	Thandar 1989b; 1990; 1996; pers. observ.								x
Neothyonidium dissimilis Cherbonnier, 1988	*Neothyonidium dissimilis* Cherbonnier	Cherbonnier 1988								x
Neothyonidium? sp nov.[28]		pers. observ.								x
Phyllophorus (Phyllonovus) anomalia Cherbonnier, 1988	*Phyllophorus (Phyllonovus) anomalia* Cherbonnier	Cherbonnier 1988								x
Phyllophorus (Phyllophorella) calypsoi Cherbonnier, 1954	*Phyllophorus calypsoi* Cherbonnier	Cherbonnier 1954a; 1955; Daniel & Halder 1974	x		x					
	Phyllophorus (Phyllophorella) calypsoi Cherbonnier	Price 1982	x							

[27] Even though Daniel & Halder (1974) do not give the depth of occurrence for this species, it is safe to state that it is no shallow-water species. In future analyses it is thus best omitted.

[28] A new phyllophorid species is currently being described, it has most affinity with *Neothyonidium* Deichmann, 1938.

TAXON	CITED AS	REFERENCE(S)	1	2	3	4	5	6	7	8
Phyllophorus (Phyllophorella) contractura CHERBONNIER, 1988	*Phyllophorus (Phyllophorella) contractura* CHERBONNIER	CHERBONNIER 1988								x
Phyllophorus (Phyllophorella) rosetta THANDAR, 1994	*Phyllophorus (Phyllophorella) rosetta* THANDAR	THANDAR 1994								x
Phyllophorus (Phyllophorella) spiculata CHANG, 1935	*Phyllophorus parvipedes* H.L. CLARK	DANIEL & HALDER 1974						x		
Phyllophorus (Urodemella) brocki LUDWIG, 1888	*Phyllophorus (Urodemella) brocki* LUDWIG	CHERBONNIER 1988							x	x
Phyllophorus (Urodemella) oculus CHERBONNIER, 1988	*Phyllophorus (Urodemella) oculus* CHERBONNIER	CHERBONNIER 1988							x	
Phyllophorus (Urodemella) tenuis HAACKE, 1880	*Phyllophorus tenuis* HAACKE	HAACKE 1880; LUDWIG 1883; LAMPERT 1885; DANIEL & HALDER 1974							x	
Selenkiella paradoxa CHERBONNIER, 1970	*Selenkiella paradoxa* CHERBONNIER	CHERBONNIER 1970a; 1988; THANDAR 1990								x
Stolus buccalis (STIMPSON, 1856)	*Stolus buccalis* (STIMPSON)	CLARK & ROWE 1971; PRICE 1982; 1983; CHERBONNIER 1988; THANDAR 1990; pers. observ.			x		x	x	x	x
	Stolus sacellus SELENKA	SEMPER 1968; 1869; HEDING 1940b; CHERBONNIER 1955; 1967			x	x	x		x	
	Thyone sacella SELENKA	SELENKA 1867; THÉEL 1886				x			x	
	Thyone sacellus SELENKA	LAMPERT 1885; VANEY 1905; MITSIKURI 1912; H.L. CLARK 1923; KALK 1958; DANIEL & HALDER 1974				x	x		x	x
	Unidentified MRAC record	pers. observ.								x
Thorsonia fusiformis HEDING, 1940	*Thorsonia fusiformis* HEDING	HEDING 1940b; PRICE 1982; 1983					x			
Thyone aurea (QUOY & GAIMARD, 1833)	*Thyone aurea* (QUOY & GAIMARD)	SEMPER 1868; LAMPERT 1885; THÉEL 1886; H.L. CLARK 1923; DANIEL & HALDER 1974; THANDAR 1990								x
	Thyone proceracorona CHERBONNIER	DANIEL & HALDER 1974								x
	Thyone turrissolida CHERBONNIER	CHERBONNIER 1954b								x
	Thyone turrisoolida CHERBONNIER	DANIEL & HALDER 1974								x
Thyone avenusta CHERBONNIER, 1970	*Thyone avenusta* CHERBONNIER	CHERBONNIER 1970a; 1988; THANDAR 1990								x
Thyone carens CHERBONNIER, 1988	*Thyone carens* CHERBONNIER	CHERBONNIER 1988							x	x
Thyone comata CHERBONNIER, 1988	*Thyone comata* CHERBONNIER	CHERBONNIER 1988							x	x
Thyone crebrapodia CHERBONNIER, 1988	*Thyone crebrapodia* CHERBONNIER	CHERBONNIER 1988								x
Thyone curvata LAMPERT, 1885	*Thyone curvata* LAMPERT	LAMPERT 1885; THÉEL 1886; DANIEL & HALDER 1974							x	x
Thyone dura KOEHLER & VANEY, 1908	*Thyone dura* KOEHLER & VANEY	KOEHLER & VANEY 1908; HEDING 1940b; PRICE 1982					x	x		
	Thyone sp. ? *T. dura* KOEHLER & VANEY	PRICE 1983					x			
Thyone guillei CHERBONNIER, 1988	*Thyone guillei* CHERBONNIER	CHERBONNIER 1988								x
Thyone hirta CHERBONNIER, 1970	*Thyone hirta* CHERBONNIER	CHERBONNIER 1970a; THANDAR 1990								x
Thyone imperfecta (CHERBONNIER, 1970)	*Havelockia imperfecta* CHERBONNIER	CHERBONNIER 1970a								x
	Thyone imperfecta (CHERBONNIER)	THANDAR 1990								x
Thyone infusca CHERBONNIER, 1954	*Thyone infusca* CHERBONNIER	CHERBONNIER 1954b; DANIEL & HALDER 1974; THANDAR 1990							x	
Thyone longicornis CHERBONNIER, 1988	*Thyone longicornis* CHERBONNIER	CHERBONNIER 1988								x
Thyone propinqua CHERBONNIER, 1970	*Thyone propinqua* CHERBONNIER	CHERBONNIER 1970a; THANDAR 1990								x
Thyone quadriperforata CHERBONNIER, 1954	*Thyone quadriperforata* CHERBONNIER	DANIEL & HALDER 1974			x					
	Thyone sp. ? *T. quadruperforata* CHERBONNIER	PRICE 1982						x		
	Thyone (?) *quadriperforata* CHERBONNIER	CHERBONNIER 1954a; 1955				x				
Thyone sineturra CHERBONNIER, 1988	*Thyone sineturra* CHERBONNIER	CHERBONNIER 1988								x
Thyone vadosa CHERBONNIER, 1988	*Thyone vadosa* CHERBONNIER	CHERBONNIER 1988								x
Thyone venusta SELENKA, 1868	*Thyone venusta* SELENKA	SELENKA 1868; 1869; LAMPERT 1885; ERWE 1919; DANIEL & HALDER 1974; PRICE 1982; THANDAR 1990; pers. observ.	x		x					x
Thyonidiella exigua CHERBONNIER, 1988	*Thyonidiella exigua* CHERBONNIER	CHERBONNIER 1988								x
Thyonidiella oceana HEDING & PANNING, 1954	*Thyonidiella oceana* HEDING & PANNING	HEDING & PANNING 1954; DANIEL & HALDER 1974; CHERBONNIER 1988							x	x
Thyonina articulata (VANEY, 1908)	*Thyonina articulata* (VANEY)	THANDAR 1990								x
Psolidae PERRIER, 1902										
Psolidium ornatum (Ed. PERRIER, 1893)	*Psolidium (Geoïsia) ornatum* (PERRIER)	PERRIER 1893							x	
	Psolidium ornatum (Ed. PERRIER)	CHERBONNIER 1988							x	

Taxon	Cited as	Reference(s)	1	2	3	4	5	6	7	8
? *Psolus agulhasicus* Ludwig & Heding, 1935[29]	*Psolus agulhasicus*	Daniel & Halder 1974								x
? *Psolus appendiculatus* (de Blainville, 1821)[30]	*Psolus appendiculatus* Blainville	Selenka 1867; Lampert 1885; Théel 1886							x	
	?*Psolus appendiculatus* Blainville	Semper 1868							x	
	Psolus appendiculata Philippi	Daniel & Halder 1974							x	
	Holothuria appendiculata De Blainv.	De Blainville 1821							x	
? *Psolus imperfectus* H.L. Clark, 1923[31]	*Psolus imperfectus*	Daniel & Halder 1974								x
Rhopalodinidae R. Perrier, 1902										
Rhopalodinaria gigantea Cherbonnier, 1970	*Rhopalodinaria gigantea* Cherbonnier	Cherbonnier 1970a; Thandar 2001								x
Rhopalodinaria minuta Cherbonnier, 1970	*Rhopalodinaria minuta* Cherbonnier	Cherbonnier 1970a; Thandar 2001								x
Sclerodactylidae Panning, 1949										
Cladolabes aciculus (Semper, 1868)	*Cladolabes aciculus* (Semper)	Heding & Panning 1954							x	
	Pseudocucumis acicula Semper	Haacke 1880; Théel 1886; Lampert 1885; Daniel & Halder 1974							x	x
	Unidentified MRAC record	pers. observ.							x	
Cladolabes bifurcatus (Deichmann, 1944)	*Cladolabes bifurcatus* (Deichmann)	Cherbonnier 1988; Thandar 1989c; pers. observ.								x
	Urodemas bifurcatum Deichmann	Deichmann 1944; Daniel & Halder 1974								x
Cladolabes pichoni Cherbonnier, 1988	*Cladolabes pichoni* Cherbonnier	Cherbonnier 1988							x	
Ohshimella ehrenbergi (Selenka, 1868)	*Ohshimella ehrenbergi* (Selenka)	Cherbonnier 1967; James 1969; James & Pearse 1969; Clark & Rowe 1971; Daniel & Halder 1974; Price 1981; 1982; 1983; Cherbonnier 1988; Thandar 1989c; pers. observ.	x	x	x		x	x	x	x
	Ohshimella ehrenbergii (Selenka)	Heding & Panning 1954			x					
	Phyllophorus ehrenbergi Selenka	Vaney 1905; Daniel & Halder 1974			x	x				
	Phyllophorus ehrenbergii (Selenka)	Semper 1868; 1869; Lampert 1885; Théel 1886; Erwe 1919; Cherbonnier 1955	x		x	x				
	Phyllophorus frauenfeldi	H.L. Clark 1923								x
	Phyllophorus gracilis (Selenka)	Semper 1868; 1869; Erwe 1919	x		x					
	Phyllophorus gracile Selenka	Lampert 1885; Théel 1886; Daniel & Halder 1974			x					
	Phyllophorus sp.nov.	Semper 1868			x					
	Cucumaria turbinata Hutton	Pearson 1910; Daniel & Halder 1974							x	x
	Unidentified MRAC record	pers. observ.								x
	Urodemas ehrenbergii Selenka	Selenka 1868			x					
	Urodemas gracile Selenka	Selenka 1868			x					
	Orcula torrense Helfer	Helfer 1913	x							
Ohshimella mauritiensis Heding & Panning, 1954	*Ohshimella mauritiensis* Heding & Panning	Heding & Panning 1954; Daniel & Halder 1974; Massin unpubl							x	x
Sclerothyone velligera (Ludwig & Heding, 1935)[32]	*Pentamera velligera*	Daniel & Halder 1974								x
MOLPADIIDA										
Caudinidae (Heding, 1931)										
Acaudina leucoprocta (H.L. Clark, 1938)	*Acaudina irania* (Heding)	Price 1982; 1983					x			
	Aphelodactyla irania H.L. Clark	Heding 1940b					x			

Table 27 – Species of the shallow-waters of the WIO that do not belong to genera found in Kenya. For locations 1 to 8 see map 2 and table 28; the question marks refer to uncertainties in terms of occurrence (misidentifications, location, depth) or systematic status.

[29] Idem as footnote 27.
[30] Idem as footnote 21.
[31] Idem as footnote 27.
[32] Idem as footnote 27.

From the above data-sets several superficial observations can easily be made. The Kenyan holothuroid fauna can be called rich in terms of species richness (near 50 species), but it is equally obvious that the majority of these species belongs to the order Aspidochirotida (81.3 %) and to a lesser extent to the Apodida (16.7 %). The observation that only 2.1 % (represented by only one species: *Afrocucumis africana*) of the reported species belongs to the order Dendrochirotida is striking. Table 28 shows the taxonomic composition (at the level of the order) for the eight defined areas in the WIO.

	1	2	3	4	5	6	7	8	
	Gulf of Suez	Gulf of Aqaba	Red Sea	Gulf of Aden	Persian Gulf	Arabian Sea	Tropical WIO	Southern WIO	Kenya
Apodida	14.6 % (7 spp)	22.5 % (9 spp)	20.3 % (15 spp)	15.8 % (6 spp)	14.8 % (4 spp)	9.3 % (4 spp)	17.0 % (23 spp)	14.5 % (22 spp)	16.7 % (8 spp)
Adjusted	-	-	*19.4 %*	-	*15.4 %*	*9.5 %*	*17.8 %*	*15.1 %*	-
Aspidochirotida	72.9 % (35 spp)	72.5 % (29 spp)	66.2 % (49 spp)	60.5 % (23 spp)	59.3 % (16 spp)	67.4 % (29 spp)	60.7 % (82 spp)	40.1 % (61 spp)	81.3 % (39 spp)
Adjusted	-	-	*66.7 %*	-	*61.5 %*	*69 %*	*62.0 %*	*41.8 %*	-
Dendrochirotida	12.5 % (6 spp)	5 % (2 spp)	13.5 % (10 spp)	23.7 % (9 spp)	22.2 % (6 spp)	23.3 % (10 spp)	22.2 % (30 spp)	45.4 % (69 spp)	2.1 % (1 spp)
Adjusted	-	-	*13.9 %*	-	*23.1 %*	*21.4 %*	*20.2 %*	*43.2*	-
Molpadida	0 % (0 spp)	0 % (0 spp)	0 % (0 spp)	0 % (0 spp)	3.7 % (1 spp)	0 % (0 spp)	0 % (0 spp)	0 % (0 spp)	0 % (0 spp)
Adjusted	-	-		-	*0 %*	-	-	-	-
Species richness	48 spp	40 spp	74 spp	38 spp	27 spp	43 spp	135 spp	152 spp	48 spp
Adjusted	-	-	*72 spp*	-	*26 spp*	*42 spp*	*129 spp*	*146 spp*	-

TABLE 28 – Taxonomic composition at the level of the order (%) of the eight arbitrary regions in the WIO compared to Kenya (see also map 2). The adjusted values take into account those species that can be omitted due to improbable horizontal (geographical distribution) or vertical distribution (depth exceeding 50 m).

The reason for the low number of dendrochirotids needs further investigation, especially since a plot of the taxonomic composition (at the level of the order) in a 10° circumtropical belt shows that this situation holds for the Somalian side and not for the Tanzanin side (fig. 60). In this regard, it is interesting to note that Levin (1999: 104, fig. 6.3 A, B), upon an analysis of 39 lists of holothuroids inhabiting different parts of the World Ocean, uncovered a similar latitudinal zonation of species community in the meridian direction. Massin (1999) on the other hand, upon a study of the tropical reef-dwelling fauna of the Spermonde Archipelago (South-West Sulawesi, Indonesia), found that only ±57 % (32 out of 56 spp) of the recovered species are aspidochirotids, ±18 % are dendrochirotids (10 spp.) and 25 % are apodids (14 spp). Thus, *de novo* sampling along the sandy coastline of Somalia must be carried out to reveal if this is a truthful situation or conversely an artefact of undersampling.

Future research – understanding the factors that control the holothuroid biodiveristy of the WIO

In order to really understand the zoogeography of the present day holothuroid biodiversity of the WIO, it is not sufficient to inventor the species richness in the different areas, but it is of equal importance to understand how, when and why the present day distributions appear like they are. In order to do so, we must not only get insight in the descriptive (faunistics, phylogeography and biocoenotic zoogeography), but also in the causal (historical and ecological) zoogeography. Therefore, future work (in preparation) will put geological history, physical and

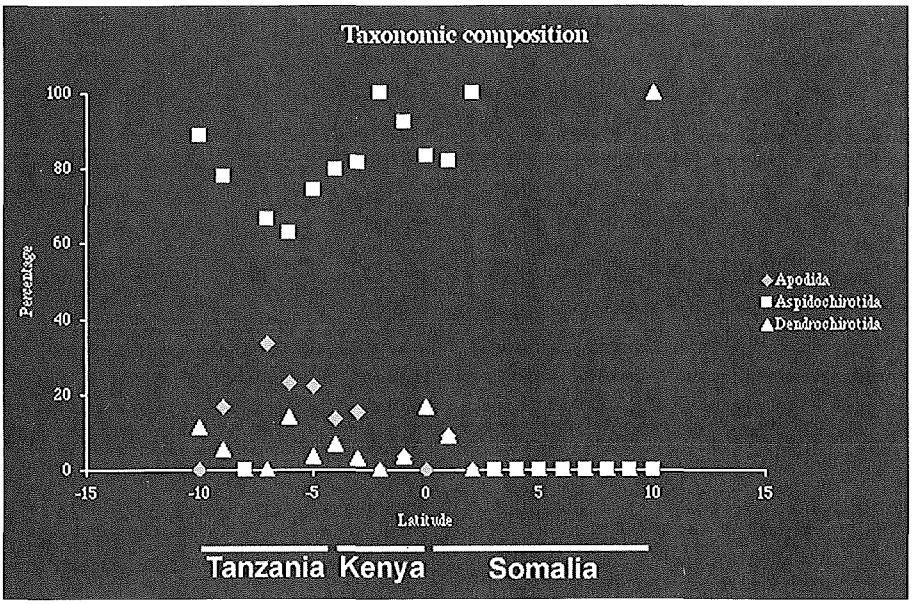

FIG. 60 – Taxonomic composition (at the level of the order) in the 10 °circum-tropical belt in the WIO reveals that dendrochirotids are underrepresented throughout the tropical WIO (the 100 % at 10°N represents only a single species).

biological oceanography in perspective to the present day distribution. The format of the present dataset (*i.e.* the distribution records catalogued in cells of one degree longitude/latitude) allows such an intricate analysis. Once this analysis is done, we will be able to construct a transdisciplinary, integrative holistic, heuristic and balanced framework that makes conservation scientifically correct and exploitation sustainable.

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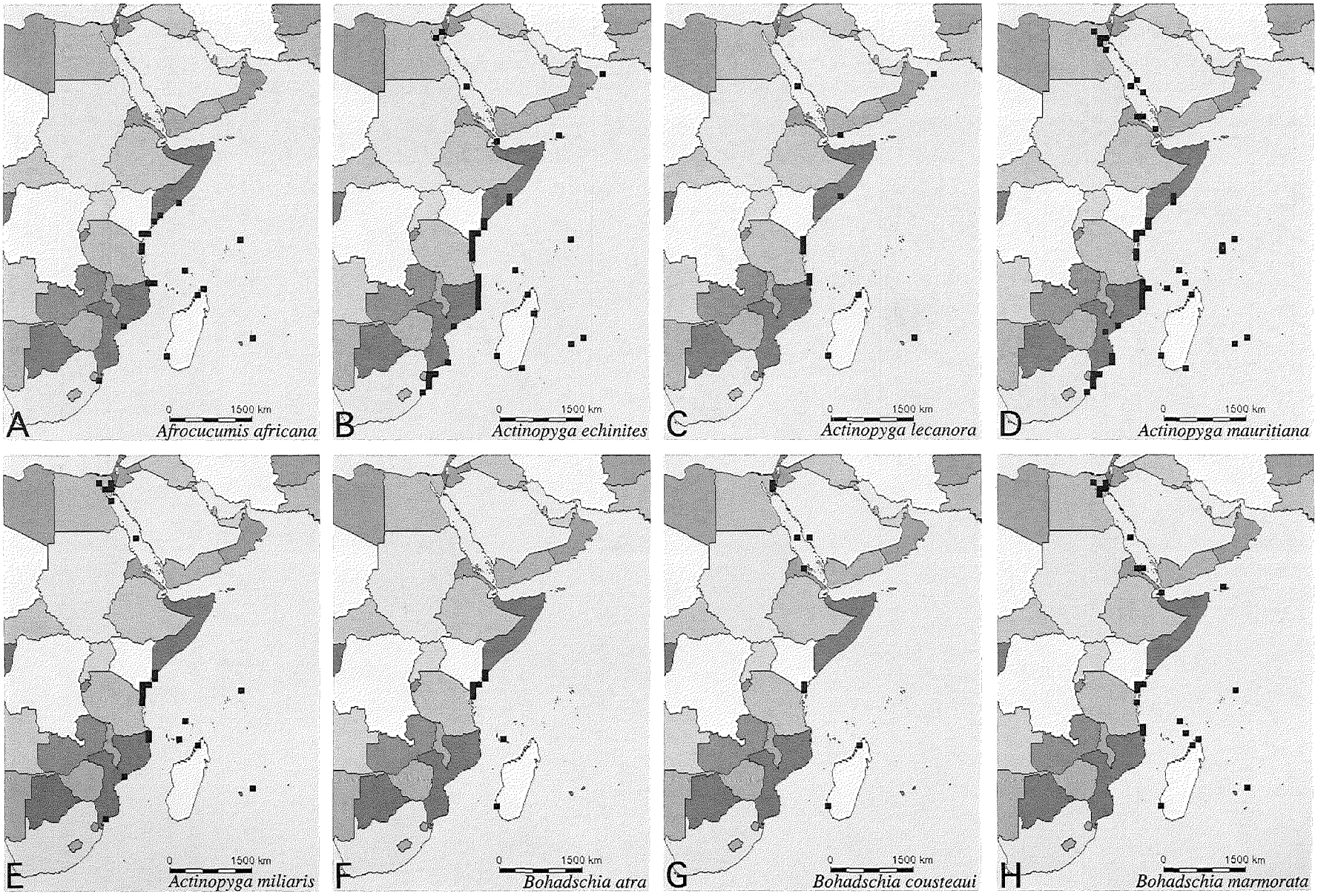

FIG. 51 – WIO distribution of shallow-water holothurians known from Kenya and/or Pemba Island. A. *Afrocucumis africana* (SEMPER, 1868); B. *Actinopyga echinites* (JAEGER, 1833); C. *Actinopyga lecanora* (JAEGER, 1833); D. *Actinopyga mauritiana* (QUOY & GAIMARD, 1833); E. *Actinopyga miliaris* (QUOY & GAIMARD, 1833); F. *Bohadschia atra* MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999; G. *Bohadschia cousteaui* CHERBONNIER, 1954; H. *Bohadschia marmorata* (JAEGER, 1833).

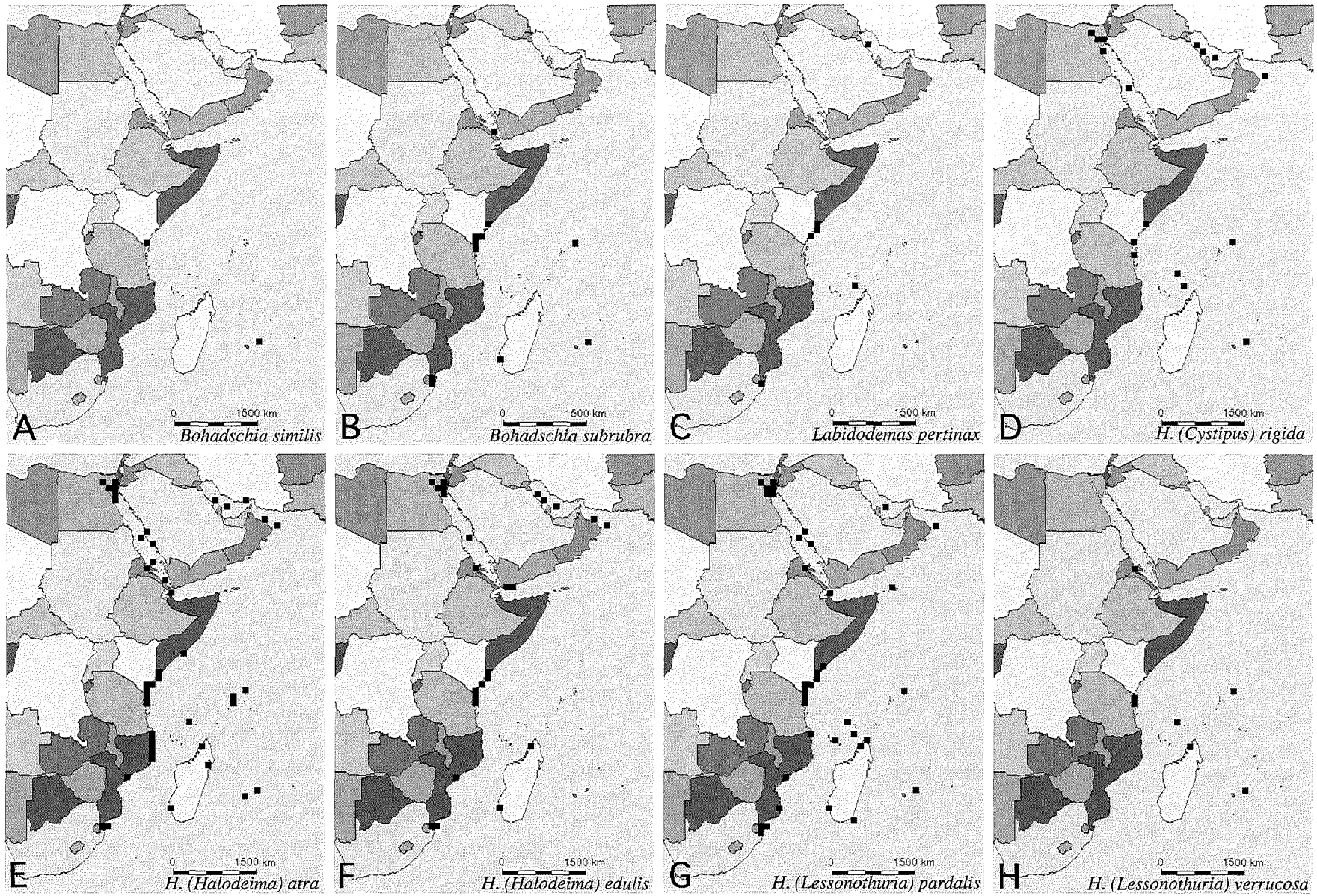

FIG. 52 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Bohadschia* cf. *similis* (SEMPER, 1868); B. *Bohadschia subrubra* (QUOY & GAIMARD, 1833); C. *Labidodemas pertinax* (LUDWIG, 1875); D. *Holothuria (Cystipus) rigida* (SELENKA, 1867); E. *Holothuria (Halodeima) atra* JAEGER, 1833; F. *Holothuria (Halodeima) edulis* LESSON, 1830; G. *Holothuria (Lessonothuria) pardalis* SELENKA, 1867; H. *Holothuria (Lessonothuria) verrucosa* SELENKA, 1867.

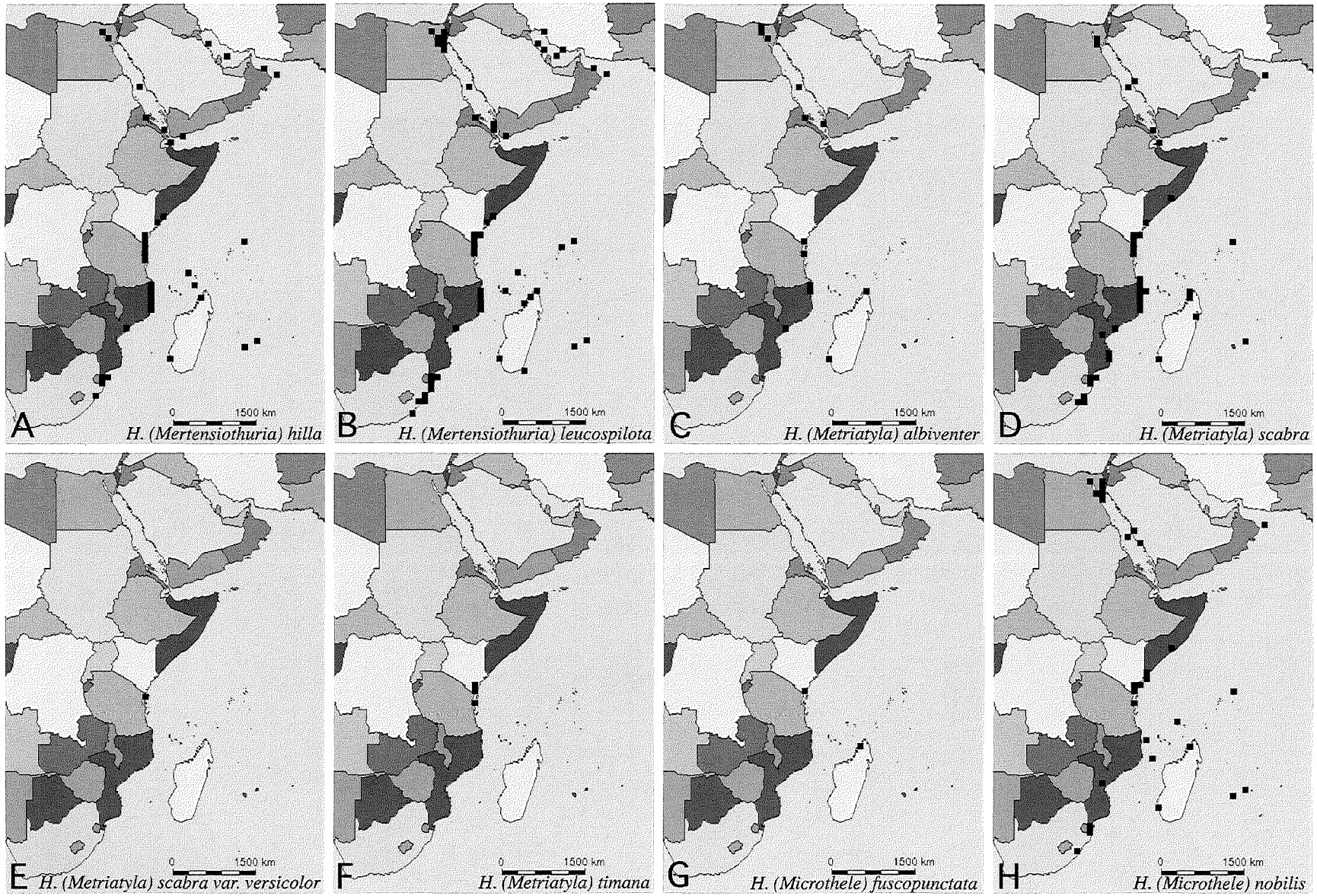

FIG. 53 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Holothuria (Mertensiothuria) hilla* LESSON, 1830; B. *Holothuria (Mertensiothuria) leucospilota* (BRANDT, 1835); C. *Holothuria (Metriatyla) albiventer* SEMPER, 1868; D. *Holothuria (Metriatyla) scabra* JAEGER, 1833; E. *Holothuria (Metriatyla) scabra* var. *versicolor* (Conand, 1986); F. *Holothuria (Metriatyla) timana* LESSON, 1830; G. *Holothuria (Microthele) fuscopunctata* JAEGER, 1833; H. *Holothuria (Microthele) nobilis* (SELENKA, 1867).

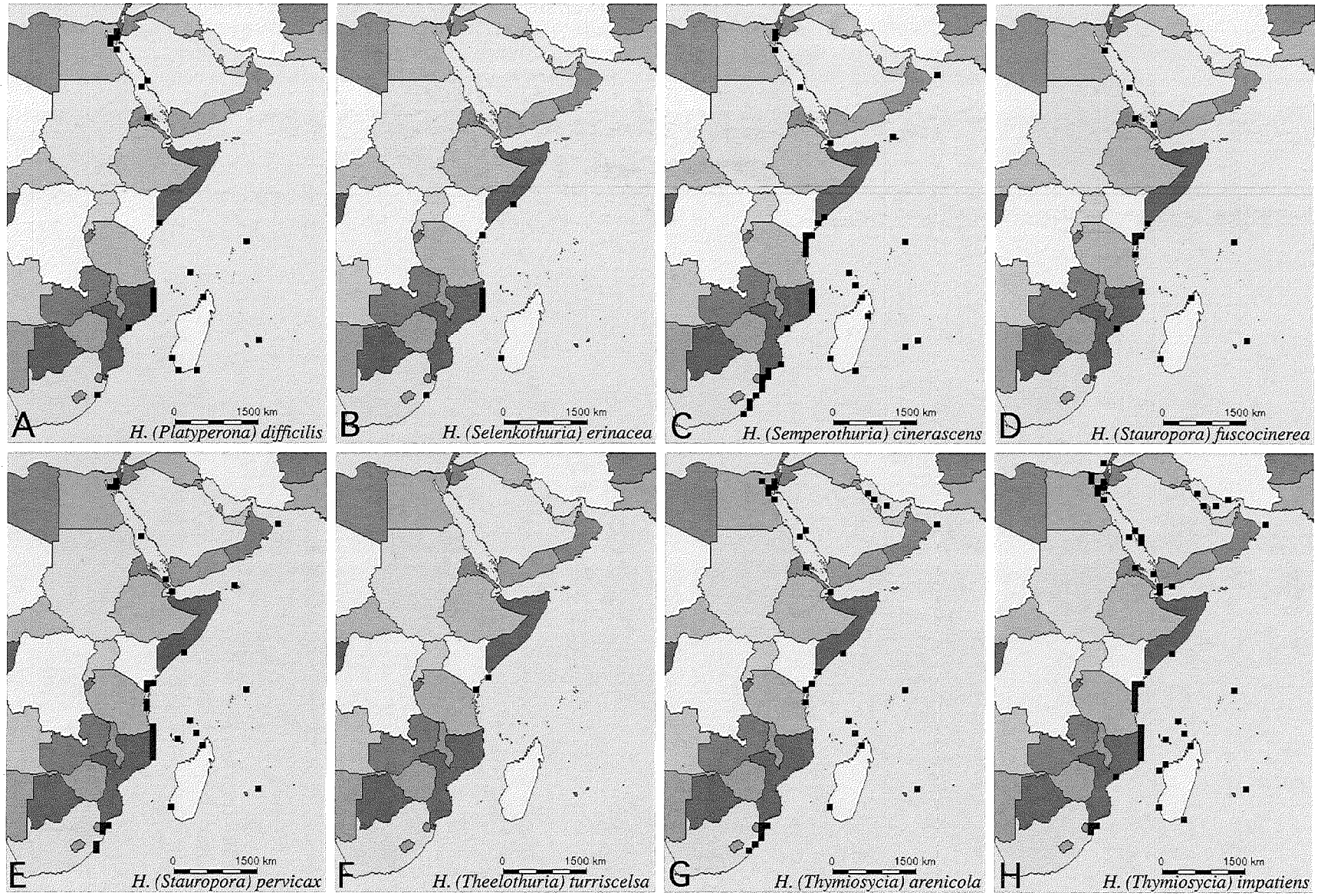

FIG. 54 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Holothuria (Platyperona) difficilis* SEMPER, 1868; B. *Holothuria (Selenkothuria) erinacea* SEMPER, 1868; C. *Holothuria (Semperothuria) cinerascens* (BRANDT, 1835); D. *Holothuria (Stauropora) fuscocinerea* JAEGER, 1833; E. *Holothuria (Stauropora) pervicax* SELENKA, 1867); F. *Holothuria (Theelothuria) turriscelsa* CHERBONNIER, 1980; G.. *Holothuria (Thymiosycia) arenicola* SEMPER, 1868; H. *Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775).

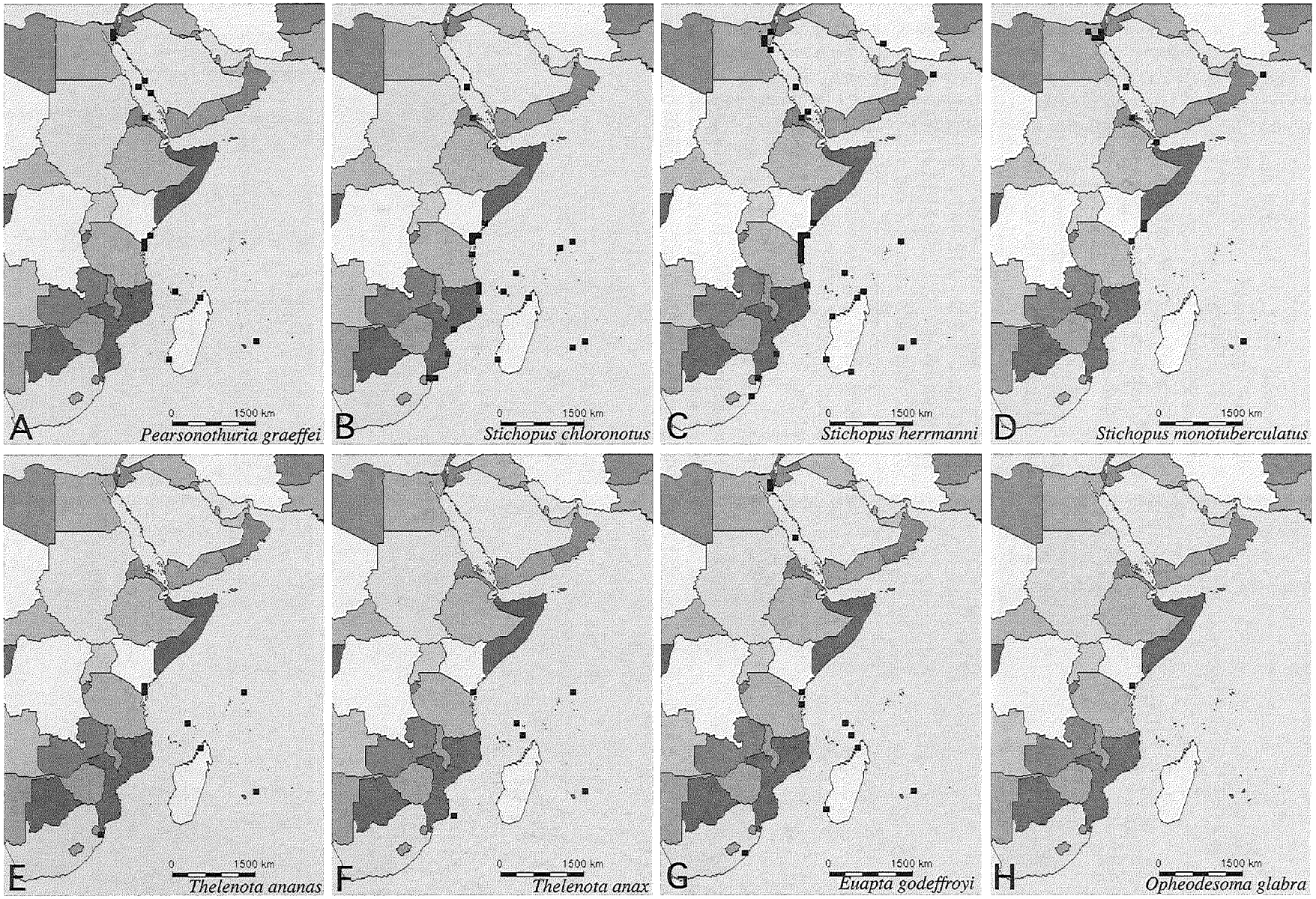

FIG. 55 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Pearsonothuria graeffei* (SEMPER, 1868); B. *Stichopus chloronotus* BRANDT, 1835; C. *Stichopus herrmanni* SEMPER, 1868; D. *Stichopus* cf. *monotuberculatus* (QUOY & GAIMARD, 1833); E. *Thelenota ananas* (JAEGER, 1833); F. *Thelenota anax* H.L. CLARK, 1921; G. *Euapta godeffroyi* (SEMPER, 1868); H. *Opheodesoma glabra* (SEMPER, 1868).

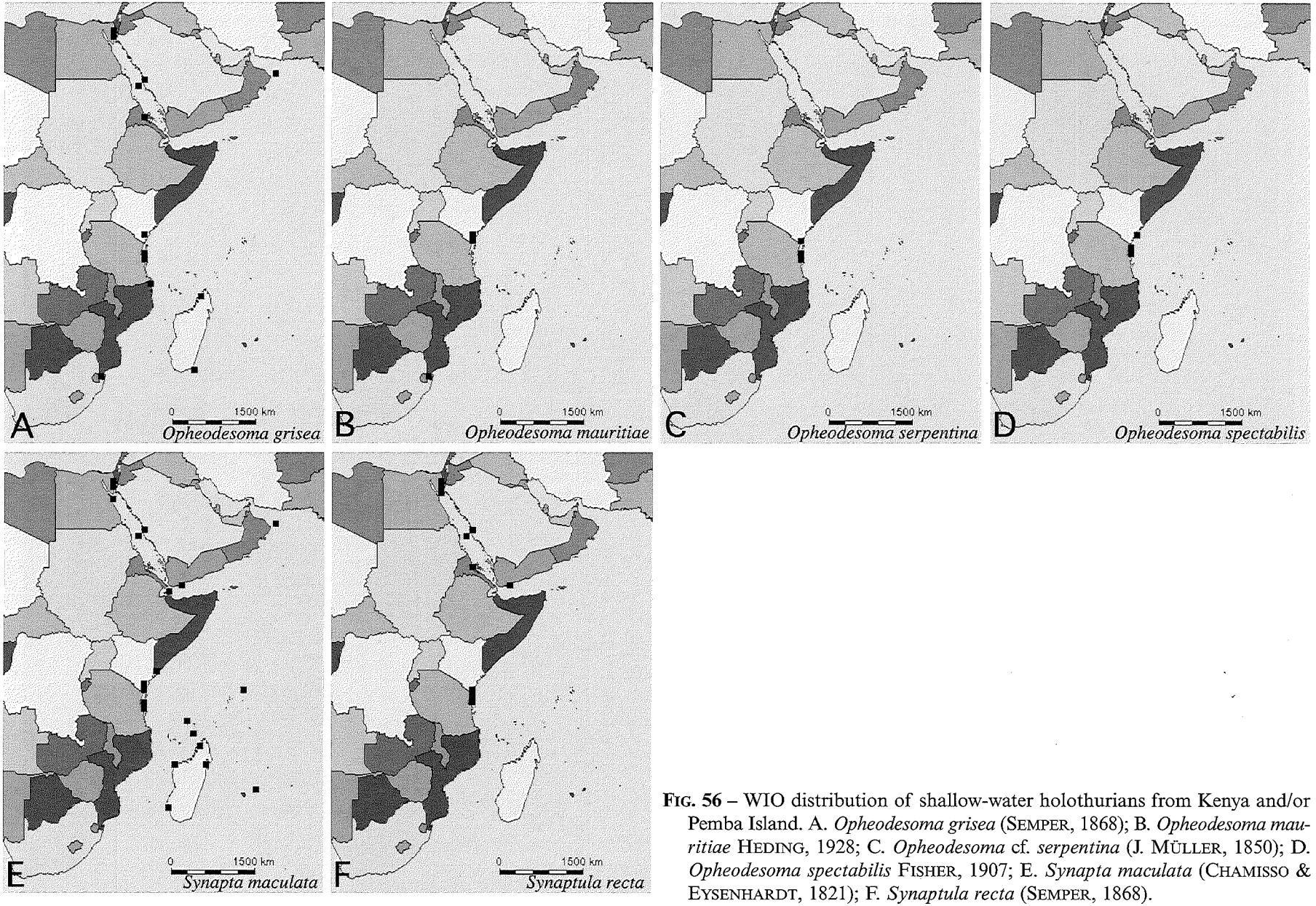

FIG. 56 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Opheodesoma grisea* (SEMPER, 1868); B. *Opheodesoma mauritiae* HEDING, 1928; C. *Opheodesoma* cf. *serpentina* (J. MÜLLER, 1850); D. *Opheodesoma spectabilis* FISHER, 1907; E. *Synapta maculata* (CHAMISSO & EYSENHARDT, 1821); F. *Synaptula recta* (SEMPER, 1868).

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Plate 1 (page 147)

A. Ventral view of *Actinopyga echinites* (JAEGER, 1833).
B. *In situ* dorsal view of *Actinopyga echinites* (JAEGER, 1833), arrow on inset picture shows the Cuvierian tubules.
C. *In situ* dorsal view of *Actinopyga mauritiana* (QUOY & GAIMARD, 1833).
D. Ventral view of *Actinopyga mauritiana* (QUOY & GAIMARD, 1833).
E. Dorso-terminal view of *Actinopyga miliaris* (QUOY & GAIMARD, 1833).
F. Dorsal view of *Bohadschia atra* MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999.
G. Dorsal view of *Bohadschia cousteaui* CHERBONNIER, 1954.
H. Dorsal view of *Bohadschia marmorata* (JAEGER, 1833).

Scale bar A-D, G & H = 5 cm; E = 3 cm; F = 10 cm. All pictures by the author.

Plate 2 (page 148)

A. Dorsal view of *Bohadschia* cf. *similis* (SEMPER, 1868).
B. Lateral view of *Bohadschia subrubra* (QUOY & GAIMARD, 1833); top left inset picture shows the animal in situ, the anus with surrounding papillae and the pontoniid commensal shrimp *Periclimenes imperator* BRUCE, 1967.
C. Dorsal view of *Holothuria (Cystipus) rigida* (SELENKA, 1867).
D. Ventral view of *Holothuria (Cystipus)* cf. *rigida* (SELENKA, 1867).
E. Dorsal view of *H. (H.) atra* JAEGER, 1833.
F. Dorsal *in situ* view of *Holothuria (Halodeima) edulis* LESSON, 1830.
G. Dorsal view of *Holothuria (Lessonothuria) pardalis* SELENKA, 1867.
H. Dorsal view of *Holothuria (Metriatyla) albiventer* SEMPER, 1868.

Scale bar A, B, E, F & G = 5 cm; C, D & H = 2 cm. All pictures by the author.

Plate 3 (page 149)

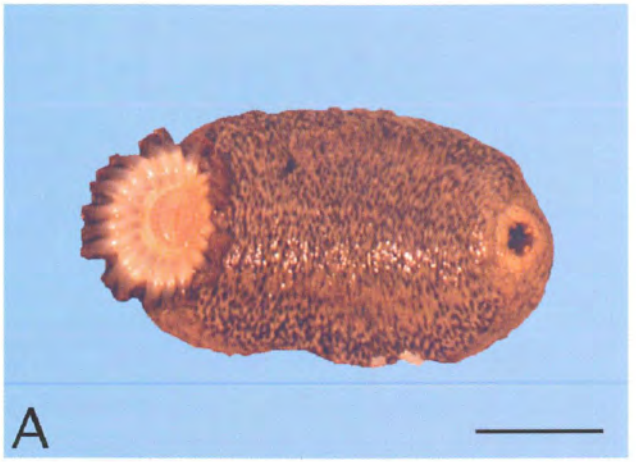
A. Dorsal view of *Holothuria (Metriatyla) scabra* JAEGER, 1833.
B. Dorsal view of *Holothuria (Metriatyla) timana* LESSON, 1830.
C. Dorsal view of *Holothuria (Microthele) fuscopunctata* JAEGER, 1833.
D. Dorsal view of *Holothuria (Microthele) nobilis* (SELENKA, 1867), inset picture shows the species *in situ*.
E. Dorsal view of *Holothuria (Semperothuria) cinerascens* (BRANDT, 1835).
F. Dorsal view of *Holothuria (Stauropora) pervicax* SELENKA, 1867.
G. Dorsal view of *Holothuria (Thymiosycia) impatiens* (Forskål, 1775).
H. *Pearsonothuria graeffei* (SEMPER, 1868) grazing on mucus of live hard coral.

Scale bar A, B, H = 5 cm; C, D, G = 7 cm; E, F = 3 cm. All pictures by author, except inset with D and H by B. Van Bogaert.

Plate 4 (page 150)

A. *Stichopus chloronotus* BRANDT, 1835.
B. *In situ* dorsal view of *Stichopus herrmanni* SEMPER, 1868.
C. Dorsal view of *Stichopus* cf. *monotuberculatus* (QUOY & GAIMARD, 1833).
D. *In situ* dorsal view of *Thelenota ananas* (JAEGER, 1833).
E. *In situ* dorsal view of *Thelenota anax* H.L. CLARK, 1921.
F. View of *Opheodesoma mauritiae* HEDING, 1928.
G. View of *Opheodesoma* sp. (J.MÜLLER, 1850).
H. View of *Synaptula recta* (SEMPER, 1868).
I. View of *Synaptulai cf. recta* (SEMPER, 1868).

Scale bar A-C = 5 cm; D = 8 cm; E = 10 cm; F-J = 3 cm. All pictures by the author except D and E by B. Van Bogaert.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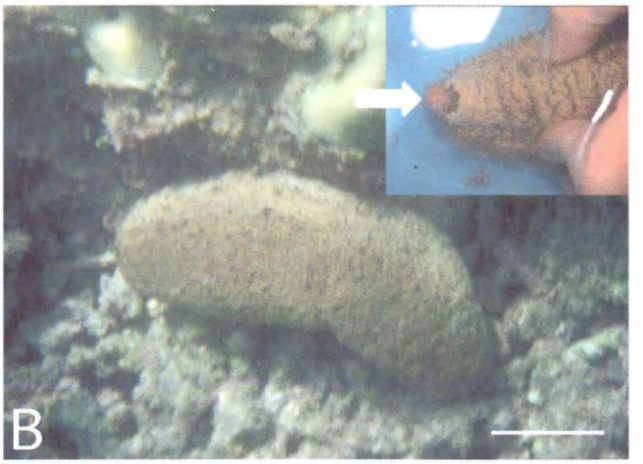
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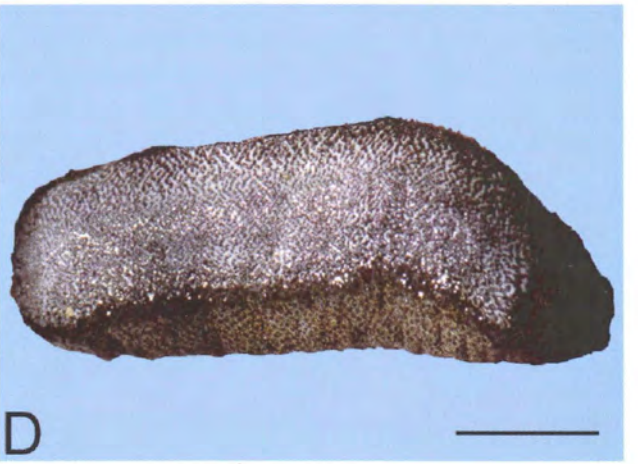
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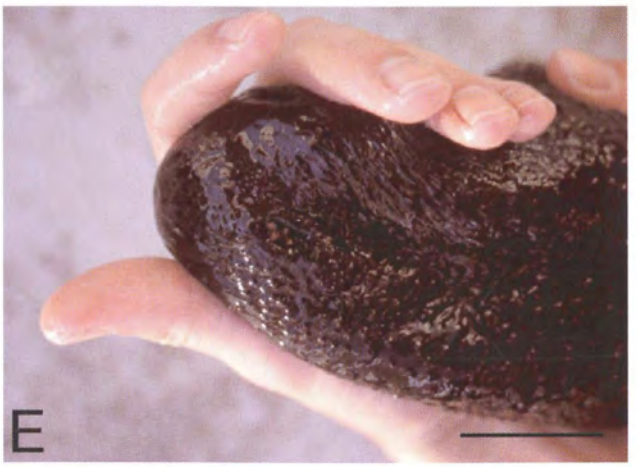
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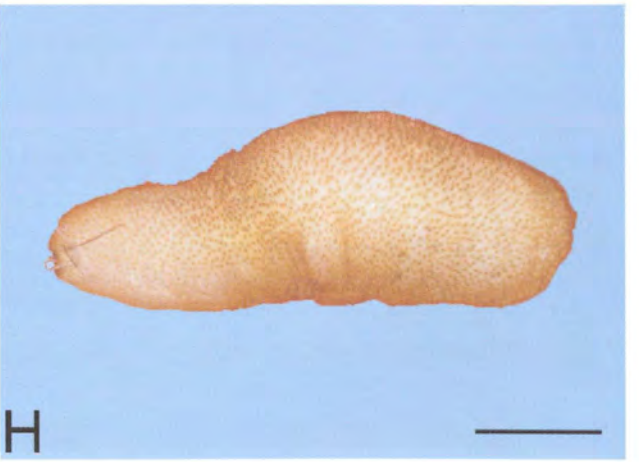
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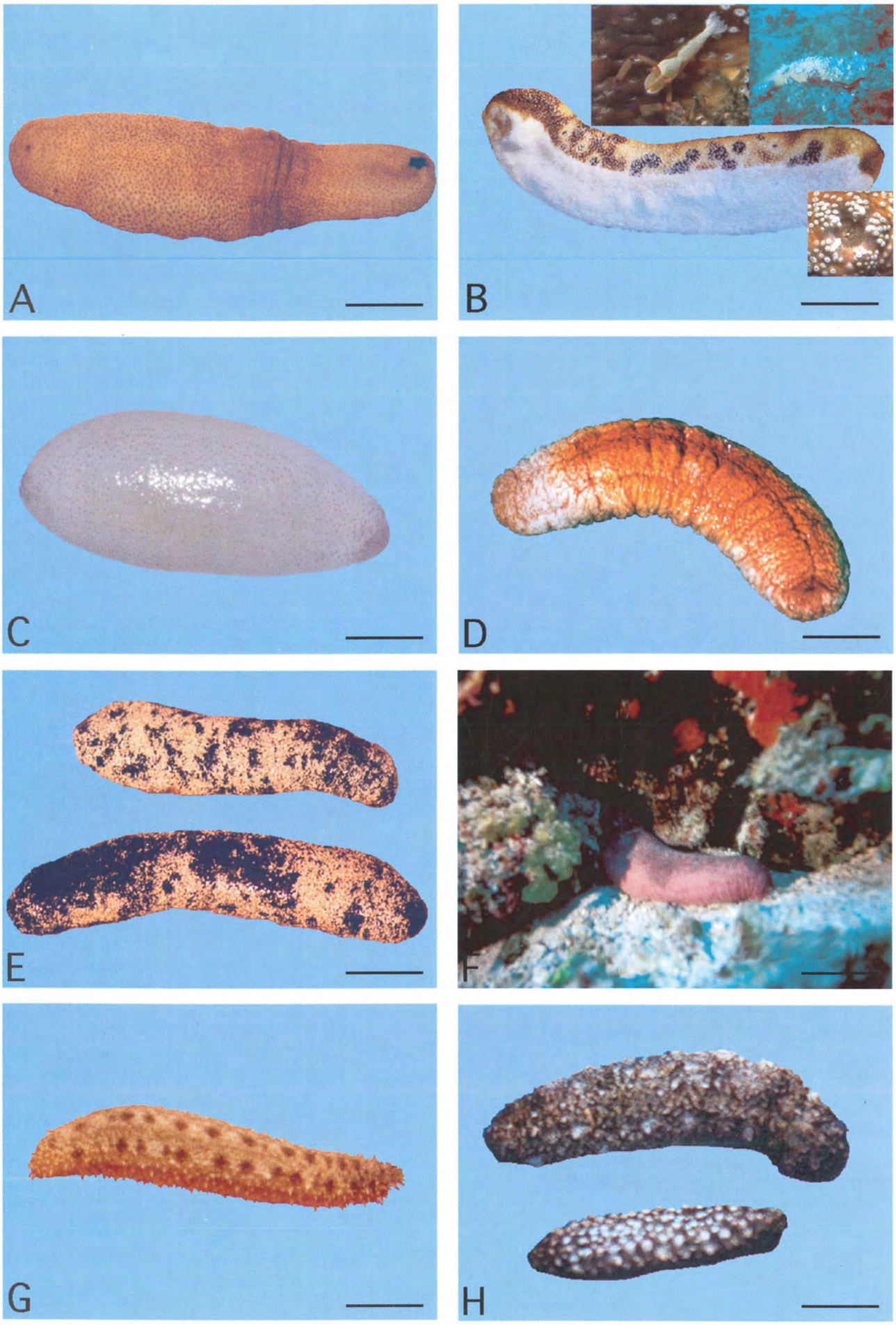
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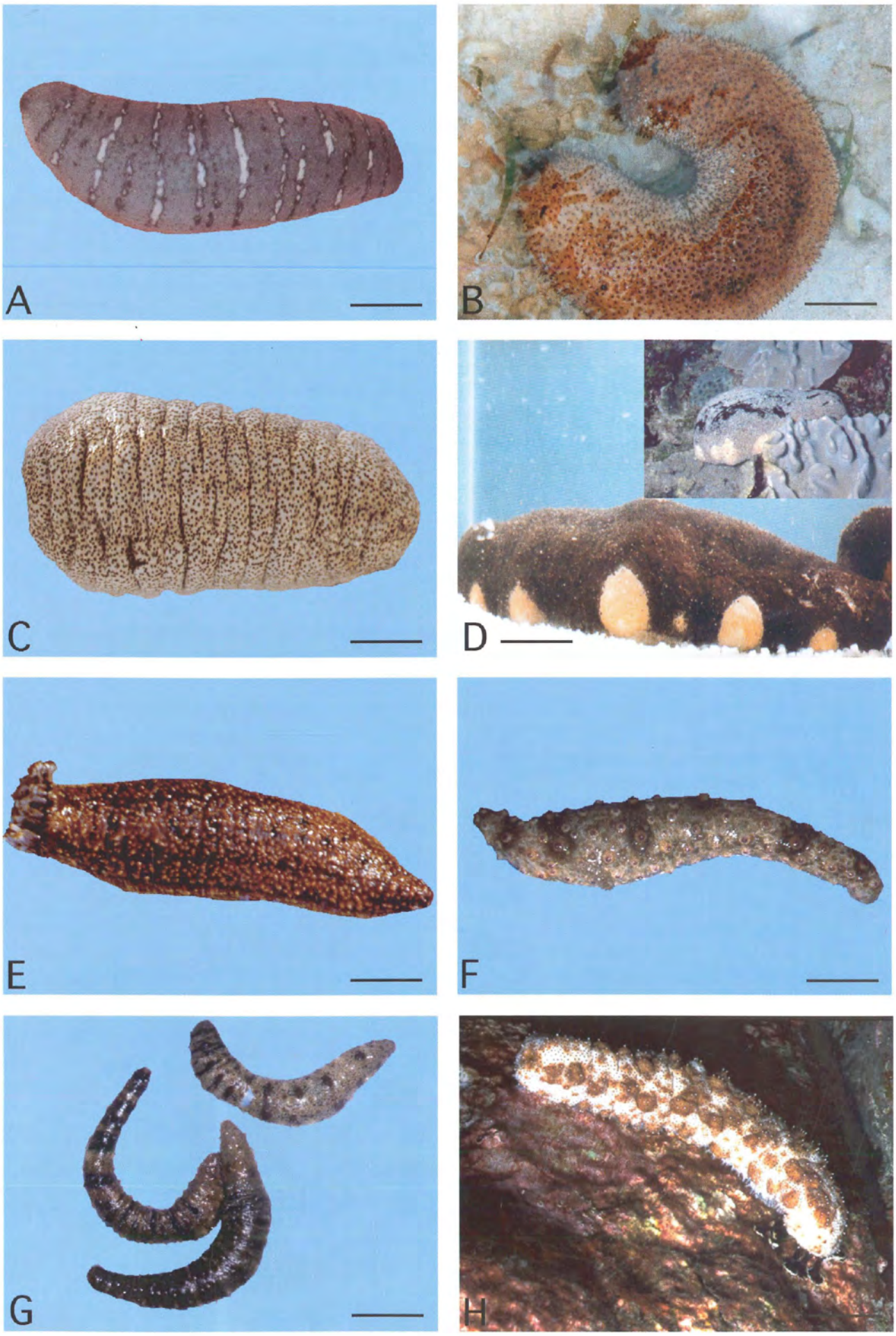
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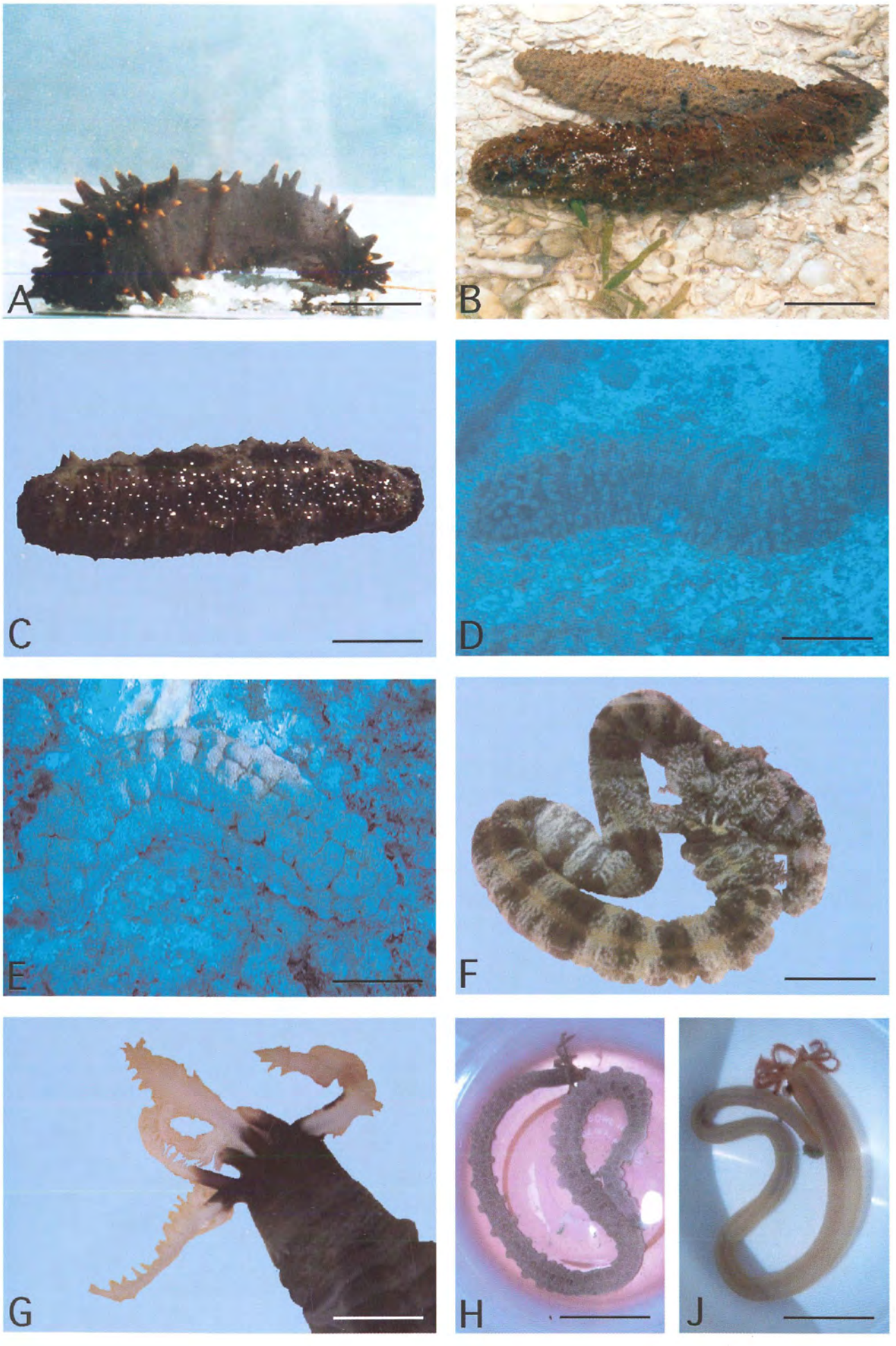
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APPENDIX

1. Museum acronyms

NHM	Natural History Museum, London, England
IRSNB	Institut Royal des Sciences Naturelles, Brussels, Belgium
IM	Indian Museum, Calcutta, India
MCZ	Museum of Comparative Zoology. Harvard University Cambridge, Massachusetts, USA
MGH	Museum Goddefroyi, Hamburg (now in ZMH), Germany
MNHNP	Muséum National d'Histoire Naturelle, Paris, France
MRAC	Muséum Royal de l'Afrique central, Tervuren, Belgium
RMNH	Nationaal Natuurhistorisch Museum, Leiden, Netherlands
TIU	University of Tokyo, Tokyo, Japan
ZM	Zoological Museum, Copenhagen, Denmark
ZMB	Museum für Naturkunde an der Universität Humboldt zu Berlin, Berlin, Germany
ZMH	Zoologisches Museum für Hamburg, Hamburg, Germany

2. Taxonomic index

Orders are marked in bold capitals, families and subfamilies in bold non-capitals, genera in bold non-capital italics and subgenera and binominal species names in italics only. Page-numbers in bold refer to the page in the present manuscript where an elaborate diagnosis or description of the taxon can be found.

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Shallow-water Holothuroidea (Echinodermata) from Kenya and Pemba Island, Tanzania

Holothuroidea, commonly known as sea cucumbers, make up one of the five extant classes of echinoderms. As a highly successful group these animals have colonized the whole marine realm, from the intertidal zone to the deep ocean trenches and from the poles to the tropics. So far some 1600 species have been described worldwide. However, notwithstanding the fact that in the past two centuries many notable naturalists have turned their attention to the holothuroid fauna of the Indo-Pacific, the shallow-water (up to 50 m depth) holothuroid fauna of Kenya was only known from a few publications, while that of Pemba Island (Tanzania) has never been the subject of any study. In order to rectify this situation, several sampling trips to Kenya and Pemba Island have been organized in recent years. These expeditions resulted in an important reference collection that enabled us to recognize new taxa, to add new records to the local fauna, and to clarify some long-standing systematic uncertainties.

A total of 225 specimens – representing three orders, four families, 12 genera, 44 species and one variety – collected in the shallow-waters of Kenya and Pemba Island (Tanzania) – are here investigated in detail. Of these, *Bohadschia cousteaui, B. similis, Holothuria (Metriatyla) albiventer, Pearsonothuria graeffei, Thelenota anax, Euapta godeffroyi, Opheodesoma grisea, O. spectabilis, and Synaptula recta* are new records for Kenya (with Pemba Island), while *H. (M.) timana* is a new record for the western Indian Ocean. Diagnostic characters and descriptions, including some brief notes on the ecology, are provided for most species. Identification keys up to the species level are also included. The holothuroid fauna of Kenya (with Pemba Island) is now represented by 48 species.

The present monograph further relates this updated and annotated taxonomic list to the holothuroid fauna of the western Indian Ocean, the area stretching from Suez to Cape Town and from the East African Coast (Red Sea and Persian Gulf included) to 65 degrees East. The motive for this extension is to promote further studies on causal zoogeography; studies that should direct the conservation of this (over)exploited group.

Keywords – Echinodermata; Holothuroidea; new records; Western Indian Ocean; Kenya; Tanzania; zoogeography.

Dr Yves Samyn *is a senior researcher at the University of Brussels (VUB). He devoted his career to the study of echinoderms, his main interest being the holothuroid biodiversity in shallow-water ecosystems of the western Indian Ocean. His latest publications offer a journey into recent taxonomic, systematic, and phylogenic findings for this group. The present monograph gives an extensive species list of the shallow-water holothuroids of the region, which in turn allows important inferences in terms of their causal zoogeography.*

Africa Tervuren

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