STUDIES IN AFROTROPICAL ZOOLOGY VOL. 292

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

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KONINKLIJK MUSEUM
VOOR MIDDEN-AFRIKA
MUSÉE ROYAL
DE L'AFRIQUE CENTRALE

2003

Photo cover: *Holothuria (Microthele) nobilis* (Selenka, 1867), a highly priced species for the bêche-de-mer trade. Past and present exploitation rates endanger the viability of certain western Indian Ocean standing stocks. (photo by B. Van Bogaert)

ISSN 1780-1311
ISBN 90-75894-54-6
D/2003/0254/08

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ABSTRACT

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 investigated. *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 and from Pemba Island (Tanzania). *H. (M.) timana* is a new record for the western Indian Ocean. Diagnostic characters and descriptions (including some brief notes on the ecology) are given for most species. Identification keys up to the species level are also included. The results are compared to the shallow-water holothuroid biodiversity of the western Indian Ocean. This study stresses the richness of the holothuroid biodiversity of Kenya and Pemba Island. The holothuroid fauna of Kenya (with Pemba Island) is now represented by 48 species.

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

RÉSUMÉ

Un total de 225 spécimens – représentant trois ordres, quatre familles, 12 genres, 44 espèces et une variété – prélevés dans les eaux peu profondes du Kenya et de l'île de Pemba (Tanzanie) – sont investigés. *Bohadschia cousteaui, B. similis, Holothuria (Metriatyla) albiventer, Pearsonothuria graeffei, Thelenota anax, Euapta godeffroyi, Opheodesoma grisea, O. spectabilis* et *Synaptula recta* sont signalés pour la première fois au Kenya et à l'île de Pemba (Tanzania). *H. (M.) timana* est signalé pour la première fois au eaux de l'Océan Indien occidental. Les caractères distinctifs et les descriptions (ainsi que quelques notes sommaires sur l'écologie) sont donnés pour la majorité des espèces. Les clefs de détermination spécifique sont également incluses. Les résultats sont comparés et discutés par rapport à la biodiversité des holothuries des eaux peu profondes de l'Océan Indien occidental. Cette étude souligne la richesse de la biodiversité des holothuries du Kenya et de l'île de Pemba. La faune des holothuries du Kenya (avec l'île de Pemba) comprend actuellement 48 espèces.

Mots-clefs: Echinodermata; Holothuroidea; nouvelles observations; Océan Indien ouest; Kenya; Tanzanie; zoogéographie.

INTRODUCTION

Despite 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 holothuroid fauna of Kenya is only known from a handful of publications (LEVIN 1979; HUMPHREYS 1981), while that of Pemba Island (Tanzania) has never been the object of any study. Because, in recent years, several additions have been made to this fauna (MASSIN *et al.* 1999; SAMYN 2000; SAMYN & VANDEN BERGHE 2000; SAMYN *et al.* 2001; MASSIN *et al.* in press), it was thought desirable to draw an up-to-date annotated checklist of the shallow-water holothuroid fauna of Kenya (with Pemba Island). As such, this work forms the first attempt since more then 20 years to document and understand the holothuroid biodiversity in the shallow-waters (up to 50 m depth) of Kenya (with Pemba Island, Tanzania). Recent work of CHERBONNIER (1988) on the holothuroids of Madagascar, an important reference tool that provides detailed descriptions of no less then 122 species, and ROWE (*in* ROWE & RICHMOND 1997) on the echinoderms of eastern Africa, proved to be of immense value towards this endeavour.

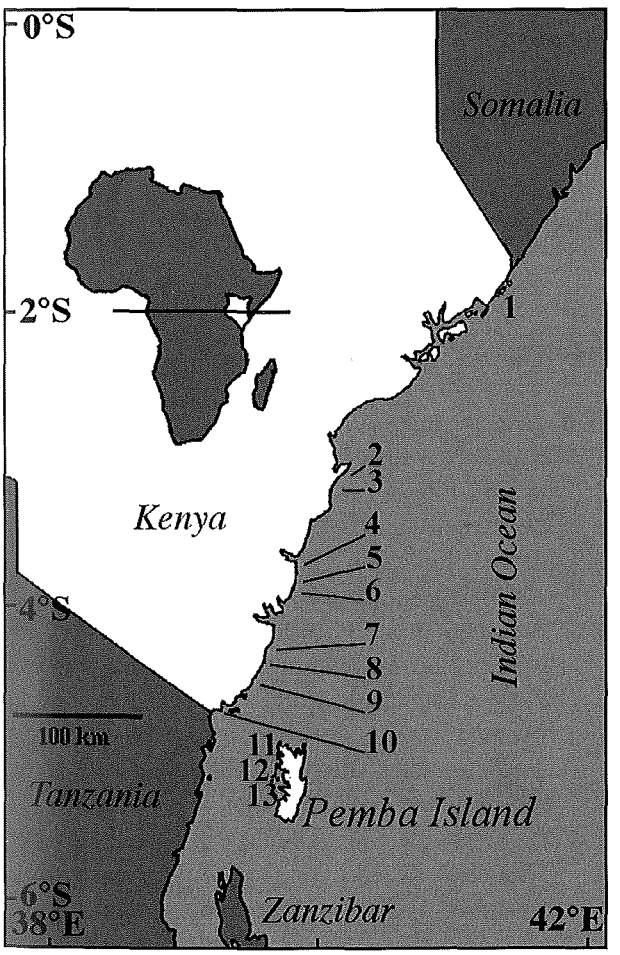
In order to get a better understanding of the holothuroid species richness of Kenya (with Pemba Island), the observed richness is also compared to that of the total western Indian Ocean. Assessing the species richness in the western Indian Ocean was possible by screening the bulk of the available literature. The monographic works of early workers like QUOY & GAIMARD (1833) on material collected by the *Astrolabe*, BRANDT (1835) on *Mertensio* material, SELENKA (1867; 1868), SEMPER (1868; 1869), LAMPERT (1885), FISHER (1907), MITSIKURI (1912) and H.L. CLARK (1946) on Indo-Pacific material, BELL (1884) on material collected by the *H.M.S. Alert*, LUDWIG (1886) on specimens collected by the *Vettor Pisani*, THÉEL (1886) on *Challenger* material, LAMPERT (1889a, b) on *Gazelle* material, SLUITER (1901) on *Siboga* material, and the work of many other researchers on selected groups [LUDWIG (1875; 1887) on the Holothuroidea; H.L. CLARK (1908) on the Apodida; H.L. CLARK (1924) and HEDING (1928; 1929; 1931) on the Synaptidae; PANNING (1929-1935a-d) on *Holothuria*; PANNING (1949) on the Cucumariidae; HEDING & PANNING (1954) on the Phyllophoridae], regions [GRAY (1872), LUDWIG (1877 [1880]; 1886), HÉROUARD (1893), VANEY (1905); HELFER (1911, 1912, 1913), ERWE (1919), MORTENSEN (1926; 1937), TORTONESE (1936a, b; 1947; 1953a, b); A.M. CLARK (1952), CHERBONNIER (1954a, 1955, 1963, 1967) and JAMES & PEARSE (1969) on material from the Red Sea Region; HEDING (1940b) on material from the Persian Gulf; BRITTEN (1910); H.L. CLARK (1923), HEDING (1938), JOHN (1939), DEICHMANN (1944; 1948), CHERBONNIER (1952a; 1953b; 1954b; 1970a), THANDAR (1977; 1984; 1985; 1986; 1987a; 1987b; 1989a; 1989b; 1989c; 1990; 1991; 1994; 1996; 2001) THANDAR & ROWE (1989), RASPAL & THANDAR (1998) and THANDAR & RASPAL (1999) on material from South Africa; HOFFMAN (1874), HAACKE (1880), LAMPERT (1896), LUDWIG (1899), PEARSON (1910, 1913, 1914a), PANNING (1941, 1944), CHERBONNIER (1953a); KALK (1958, 1959) and CHERBONNIER (1970b) on material from the Indian Ocean *sensu lato*] or museum collections [LUDWIG (1881) on Mertens-Brandt's species, LUDWIG (1882) on the collection in the Leyden Museum, LUDWIG (1883) on the collection in the Kieler Museum; KOEHLER & VANEY (1908) on the collection in the Indian Museum; HEDING (1931) on the collection in the Hamburg Museum; TORTONESE (1937-38) on the collection in the Torino Museum; PANNING (1951) on Rüppels collection; CHERBONNIER (1952b) on QUOY & GAIMARD's species and JAMES (1969) on material deposited in the CMFRI collection], brought significant insights into the taxonomy and faunistics of the shallow-water holothuroids of the Indo-pacific Ocean. In the early seventies, CLARK & ROWE (1971) assembled all the available information into a comprehensive (and at that time very complete) monography. DANIEL & HALDER (1974) undertook a similar effort, but their work can hardly be called effective for taxonomic errors and other inconcistencies obstruct a clear understanding of the faunistical relationships. The present monograph incorporates the above taxonomic sources in addition to work that appeared after CLARK & ROWE's (1971) monograph or that was missed by these authors.

It is my strong believe that such an integrated effort was urgently needed for the commercially exploited holothuroids (see also PANNING 1944; CONAND & BYRNE 1993; CONAND 1997; 1998a, b; CONAND 2001; MARSHALL *et al.* 2001 for insights into holothuroid fisheries), as the current Kenyan sea cucumber fisheries are hardly regulated and stocks are in danger of getting depleted (SAMYN 2000; MARSHALL *et al* 2001). Further – as it can be shown that the current insufficient taxonomic documentation for the region and the problems associated with species identifications (SAMYN 2000) hamper understanding of the structure, function, history and future of the geographic range of this important biological and economical group – this work possibly can aid in directing future conservation efforts. This because, as argued before (SAMYN 2000; SAMYN & MASSIN 2002), taxonomic accuracy and systematic stability in combination with faunistics are the first steps towards true estimates of species richness in an area and to an understanding of the observed biodiversity. The present paper thus not only attempts to describe the shallow water holothuroid fauna of Kenya (with Pemba Island), but also tries to provide a stable systematic framework for the species discussed. It is, however, obvious that an accurate description of the diversity and the distribution of the holothuroid fauna of a short stretch of coast like the Kenyan Coast only makes sense when one simultaneously considers the biogeographic regions to which the study area belongs. Thus, the taxonomic and biogeographic literature of the whole western Indian Ocean was screened and compared with that of Kenya. Hereby special care was taken

to avoid the numereous taxonomic inconsistencies and erroneous or dubious distribution records that are hidden in the vast amount of available literature (see for instance DANIEL & HALDER 1974).

STUDY SITES

Kenya's coast, from Somalia in the North to Tanzania in the South, stretches over some 480 km, Pemba Island is located some 30 km South of Kenya and experiences the same physical and biological oceanographic conditions as the South of Kenya. Map 1 shows the different sites (Kenya: Kiunga Marine Reserve; Malindi Marine National Park and Reserve, Watamu Marine National Park and Reserve, Shariani, Kanamai, Mombasa Marine National Park and Reserve, Diani Marine Reserve, Gazi Bay, Shimoni Marine National Park and Reserve and Vanga; Tanzania, Pemba Island: Fundu and Mesali) where collecting was done. Sampling was done in the inner and outer coral reefs, in the sea grass beds, but due to practical reasons not in the extensive mangrove forests that fringe the coastline under study.

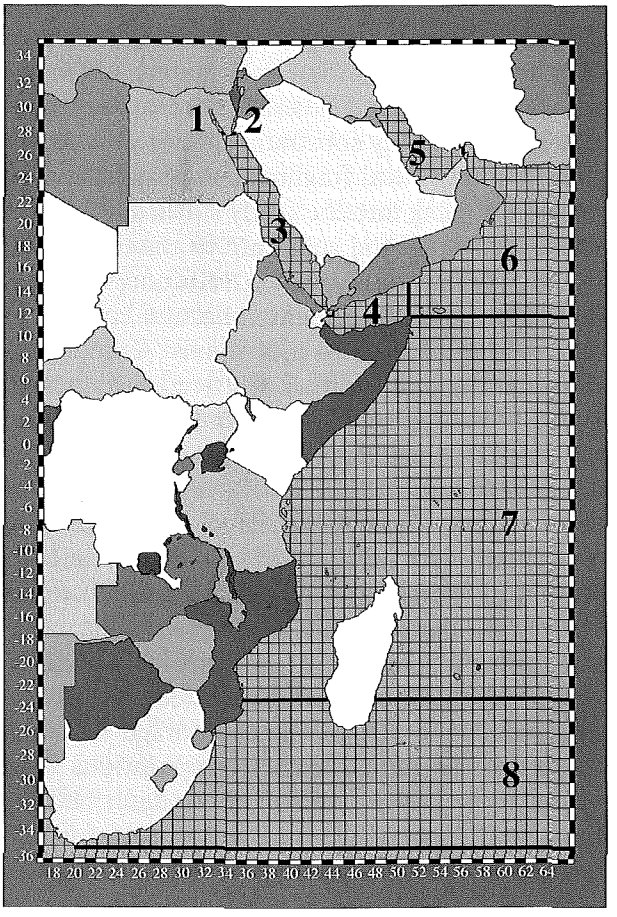


MAP 1 – Collection and observation sites. 1. Kiunga Marine Reserve; 2. Malindi Marine Park & Reserve; 3. Watamu Marine Park & Reserve; 4. Shariani; 5. Kanamai; 6. Mombasa Marine Park & Reserve; 7. Diani Marine Reserve; 8. Gazi Bay; 9. Shimoni Marine Park; 10. Vanga; 11. Fundu North; 12. Fundu South; 13. Mesali.

MATERIALS & METHODS

The specimens for the present study were collected during three separate expeditions (July to August 1997, July to August 1998 and April 1999) to several sites along the Kenyan Coast and along the western coastline of Pemba Island. Collection was done by hand-picking at low tide, by snorkelling and by SCUBA diving up to depths of maximum 40 m. Fugitive (i.e. those partially concealed under hard substrate such as corals or rocks) and fossorial (i.e. those found burried more or less completely in the sandy substrate) species were recovered by lifting coral fragments and rocks and by selective digging into the sandy substrate. Systematical sieving of the substrate to uncover small infaunal forms was however not done. As such, the majority of the present collection consists of moderate to large sized individuals. As individuals generally had a rather scattered distribution over the reef, line and / or quadrate transects were not used in estimating density. Instead by using the Catch Per Unit Effort (CPUE), *i.e.* the number of observed individuals per species per diver per hour, an approximate estimate of abundancy in each sampling locality was obtained (see table 1). Specimens were anaesthetized in 5 % magnesium chloride during 4 hours, transferred to 100 % buffered alcohol for 24 hours, and transferred to 70 % buffered alcohol for permanent storage. Of some specimens permanent ossicle preparations were made according to the method described by MASSIN (1999). Scaled ossicle illustrations were made by *camera lucida*. Part of this collection is deposited in the IRSNB (holothuroids from the Kiunga Marine Reserve), part of it in the MRAC. All the species sampled during the present surveys are keyed and full descriptions are provided for the majority of them. For each species that is reported from the study area a list of synonyms and records (complementary with previous

works) is given, whereby special attention was paid to the records from the shallow-waters of the western Indian Ocean[1].
In addition, species that belong to genera that are present in Kenya, but have *hitherto* not been reported from the study area, are mentioned in the text-tables under each genus (for the genus *Holothuria*, all the subgenera found in the WIO are treated in the main text). These, for now, non-Kenyan species are not incorporated in the identification keys, nor in the systematic account, but the geographical region, the exact locality (when known) and the reference wherein the record appeared are given. Moreover, species reported from the shallow-waters of the WIO but not belonging to genera found in Kenya are tabulated according to the following eight areas in the WIO: Gulf of Suez, Gulf of Aqaba, Red Sea, Gulf of Aden, Persian Gulf, Arabian Sea, tropical WIO and southern WIO. The area tropical WIO was deliberately kept wide as preliminary analysis showed that it was rather uniform in species composition. Map 2 visualizes this arbitrary eight-fold division of the WIO.



Map 2 – The western Indian ocean as study area was divided in cells of one degree latitude/longitude and eight larger geographic areas were descerned herein: (1) Gulf of Suez, (2) Gulf of Aqaba, (3) Red Sea, (4) Gulf of Aden; (5) Persian Gulf, (6) Arabian Sea, (7) tropical WIO and (8) southern WIO.

To facilitate further studies on the biodiversity of the shallow-water holothuroids of the WIO, the whole area was divided into cells of one degree latitude/longitude. All records were fed into a *Filemaker Pro* database that allowed automated mapping with the freeware *imap*. Distribution in the WIO has been mapped for all the species known with certainty from Kenya (with Pemba Island, Tanzania).

Results

A total of 225 specimens distributed over three orders, four families, twelve genera and 44 species and one variety were collected. A list of the specimens collected at the different localities is given in table 1.

Systematic account

Key to the orders and families of Kenya (with Pemba island) (after Clark & Rowe 1971: 196)

1. Small to large body; tube feet and / or papillae present; body usually stout and muscular; ossicles: mostly tables, buttons, perforated plates, cups, rods or rosettes . . . . . **.2**

1'. Tentacles pinnate; tube feet and / or papillae, anal papillae and respiratory trees absent; warty prominences often present; body usually vermiform; skin thin, often sticky to the touch; ossicles: anchors and anchor-plates in combination with granules . . . . . **Apodida (Synaptidae)** . . . 4

2. Tentacles peltate or peltato-digitate; true introvert with associated retractor muscles absent . . . . . **Aspidochirotida** . . . **3**

2'. Tentacles bushy or tree-shaped, much branched (dendritic); true introvert with retractor muscles present . . . . . **Dendrochirotida (Sclerodactylidae)**

[1] "Shallow-waters of the western Indian Ocean" will be abbreviated hereafter as "WIO".

3. Body cylindrical; gonad in single tuft to the left of the dorsal mesentery; ossicles in the body wall mainly tables, buttons and plates; S or C shaped rods always absent . . . . . **Holothuriidae**

3'. Body squarish in transverse view; gonad in two tufts, one on each side of the dorsal mesentery; ossicles in the tegument contain S and C shaped rods; buttons always absent . . . . . **Stichopodidae**

4. Ossicles in the tegument anchors and anchor-plates in combination with granules; tentacles pinnate . . . . . **Synaptidae**

Locality	Depth (m)	Systematics	CPUE	Collection number	Number of voucher specimens
		DENDROCHIROTIDA			
		Sclerodactylidae			
Kiunga	i.t.	*Afrocucumis africana* (SEMPER, 1868)	5	KKiun/9918	4
		ASPIDOCHIROTIDA			
		Holothuriidae			
Kanamai	1-2	*Actinopyga echinites* (JAEGER, 1833)	3	KKan/9715; KKan/9716;	1; 1
Malindi	3			KKan/9724	1
Chale Island	2		2	KMal/9888	1
Vanga	3		2	KCi /9743	1
			3	KVan/9762	1
Kiunga	1-4		6	KKiun/9922	4
Fundu	8		1	none	0
Chale Island	2	*Actinopyga lecanora* (JAEGER, 1833)	1	KCi /9761	1
Mombasa	11		2	none	0
Fundu	12-14		3	TFun/9809; TFun/9810;	1; 1
				TFun/9811	1
Shariani	1-3	*Actinopyga mauritiana* (QUOY & GAIMARD, 1833)	2	none	0
Kanamai	1-2		4	KKan/9719; KKan/9720	1; 1
Mombasa	2-4		2	none	0
Chale Island	1-4		4	KCi/9744 ; KCi/9753;	1; 1
				KCi/9754; KCi/9755	1; 1
Malindi	3-7		3	KMal/9885; KMal/9886;	1; 1
				KMal/9887	1
Vanga	3		2	KVan/9763	1
Kiunga	1		4	KKiun/9921	1
Fundu	16-18	*Actinopyga miliaris* (QUOY & GAIMARD, 1833)	2	TFun/9822; TFun/9823	1; 1
Kiunga	2-3		2	KKiun/9923; KKiun/9924	1; 1
Mombasa	14		1	none	0
Malindi	8-12		2	none	0
Mesali	18		1	none	0
Fundu	12	*Bohadschia atra* MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999	2	IRSNB, IG 28 628/Fun 90-91	2
Mombasa	2-10		3	IRSNB, IG 28 628/Mom12;	1
				IRSNB, IG 28 628/Mom 60-61	2
Shariani	2-3		2	IRSNB, IG 28 628/Shar 11;	1
				KShar/9734; KShar/9735	1; 1
Kiunga	1-4		4	KKiun/9927; KKiun/9928	3; 1
Malindi	1-6		3	none	0
Watamu	6		1	none	0
Kanamai	2	*Bohadschia cousteaui* CHERBONNIER, 1954	1	KKan/9714	1
Fundu	10-14		2	TFun/9895; TFun/9896	1; 1
Kiunga	2-3	*Bohadschia marmorata* (JAEGER, 1833)	5	KKiun/9925; KKiun/9926	3; 2
Mombasa	4		1	None	0
Kanamai	1-3		3	None	0
Chale Island	3	*Bohadschia* cf. *similis* (SEMPER, 1868)	1	KCi/9742	1
Shariani	1	*Bohadschia subrubra* (QUOY & GAIMARD, 1833)	1	IRSNB, IG 28 628/Shar 10	1
Mombasa	14-18		4	IRSNB, IG 28 628/Mom 89-92-93-94	1; 1; 1; 1
Fundu	14		1	IRSNB, IG 28 628/Fun 7	1
Kiunga	?			none	0
Malindi	3		2	none	0
Watamu	12		1	none	0
Kanamai	1-2		3	none	0
Chale island	16		1	none	0
Shimoni	18		1	none	0
Vanga	?		?	none	0

Locality	Depth (m)	Systematics	CPUE	Collection number	Number of voucher specimens
Kiunga	1-4	*Labidodemas pertinax* (LUDWIG, 1875)	3	KKiun/9919; KKiun/9920	1; 2
Kiunga	4	*Holothuria (Cystipus) rigida* (SELENKA, 1867)	1	KKiun/9948	1
Chale Island	2	*Holothuria (Cystipus)* cf. *rigida* (SELENKA, 1867)	1	KCi/9760	1
Kanamai	1	*Holothuria (Halodeima) atra* JAEGER, 1833	+10	KKan/9705; KKan/9706;	1; 1
				KKan/9707	1
Chale Island	2		3	KCi/9747; KCi/9748	1; 1
Shariani	2		1	KShar/9733	1
Mombasa	8		5	KMom/9825	1
Fundu	30		2	TFun/9826; TFun/9827	1; 1
Malindi	5		5	KMal/9883	1
Kiunga	1-4		6	KKiun/9929; KKiun/9930	1; 5
Vanga	2		2	none	0
Watamu	1-3		1	none	0
Fundu	18-22	*Holothuria (Halodeima) edulis* LESSON, 1830	2	TFun/9801; TFun/9802	1; 1
Kiunga	14		3	KKiun/9931	1
Watamu	20		2	none	0
Mombasa	21		3	none	0
Chale Island	15		1	none	0
Kiunga	2-4	*Holothuria (Lessonothuria) pardalis* SELENKA, 1867	5	KKiun/9934; KKiun/9935;	1; 1
				KKiun/9936; KKiun/9937	1; 1
Mombasa	5		2	none	0
Mesali	21	*Holothuria (Lessonothuria) verrucosa* SELENKA, 1867	1	TMes/9899	1
Mombasa	5	*Holothuria (Mertensiothuria) hilla* LESSON, 1830	8	KMom/9857	1
Kisite	6		2	KKis/98102	1
Kiunga	2-3		5	KKiun/9942; KKiun/9943	1; 3
Mesali	10		1	none	0
Kanamai	1-2	*Holothuria (Mertensiothuria) leucospilota* (BRANDT, 1835)	6	KKan/9701; KKan/9702;	1; 1
				KKan/9703; KKan/9704	1; 1
Mesali	3-5		8	TMes/9854; TMes/9855;	1; 1
				TMes/9856	1
Kiunga	1-3		5	KKiun/9932; KKiun/9933	1; 1
Shariani	2		1	KShar/9741	1
Chale Island	1		3	none	0
Mombasa	1-4		3	none	0
Malindi	1-3		2	none	0
Watamu	1-3		4	none	0
Vanga	0-2	*Holothuria (Metriatyla) albiventer* SEMPER, 1868	4	KVan/9780; KVan/9781	1; 1
Chale Island	0-2	*Holothuria (Metriatyla) scabra* JAEGER, 1833	3	KCi/9756; KCi/9757;	1; 1
				KCi/9758; KCi/9759	1; 1
Kanamai	1-3		2	KKan/9863; KKan/9864;	1; 1
				KKan/9865	1
Vanga	2-3		8	KVan/9769; KVan/9770;	1; 1
				KVan/9771; KVan/9772;	1; 1
				KVan/9773	1
Kiunga	2		1	KKiun/9939	1
Malindi	8		1	none	0
Mesali	21	*Holothuria (Metriatyla) scabra* var. *versicolor* CONAND, 1986	1	TMes/9898	1
Kanamai	2	*Holothuria (Metriatyla) timana* LESSON, 1830	2	KKan/9717; KKan/9718	1; 1
Vanga	12		1	KVan/9774	1
Fundu	32	*Holothuria (Microthele) fuscopunctata* JAEGER, 1833	1	TFun/9806	1
Mombasa	16-18	*Holothuria (Microthele) nobilis* (SELENKA, 1867)	4	KMom/9845; KMom/9846	1; 1
Kiunga	16-21		3	KKiun/9940	2
Malindi	12-20		3	none	0
Watamu	24		1	none	0
Shimoni	17		1	none	0
Fundu	19	*Holothuria (Microthele) nobilis* (SELENKA, 1867)	2	TFun/9820; TFun/9821	1; 1
Vanga	15	*(sensu fuscogilva)*	1	KVan/9776	1
Kiunga	2	*Holothuria (Platyperona) difficilis* SEMPER, 1868	1	KKiun/9949	1
Malindi	1	*Holothuria (Selenkothuria) erinacea* SEMPER, 1868	5	KMal/9866; KMal/9867;	1; 1
				KMal/9868; KMal/9869;	1; 1
				KMal/9870; KMal/9872	1; 1
Malindi	0-2	*Holothuria (Semperothuria) cinerascens*	3	KMal/9871	1
Mombasa	4	(BRANDT, 1835)	1	KMom/9859	1
Kiunga	1		1	KKiun/9941	1
Kanamai	1	*Holothuria (Stauropora) fuscocinerea* JAEGER, 1833	1	KKan/9730	1
Vanga	i.t.		1	KVan/9777	1
Mombasa	3		1	KMom/9858	1
Fundu	28		3	TFun/9830	1
Kiunga	5		1	KKiun/9938; KKiun/9946	1; 1

Locality	Depth (m)	Systematics	CPUE	Collection number	Number of voucher specimens
Kananmai	2-3	*Holothuria (Stauropora) pervicax* SELENKA, 1867	2	KKan/9722; KKan/9723	1; 1
Malindi	13		1	none	0
Mombasa	12		1	none	0
Chale Island	2		1	none	0
Kiunga	5-7	*Holothuria (Theelothuria) turriscelsa*	2	KKiun/9947	2
Fundu	9-10	CHERBONNIER, 1980	3	TFun/9815; TFun/9816	1; 1
Kiunga	i.t.	*Holothuria (Thymiosycia) arenicola* SEMPER, 1868	1	KKiun/9945	1
Mailindi	0-1		12	KMal/9875; KMal/9876;	1; 1
				KMal/9877; KMal/9878;	1; 1
				KMal/9879; KMal/9880	1; 1
Vanga	i.t.		1	KVan/9778	1
Mombasa	2		1	none	0
Fundu	10	*Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775)	2	TFun/9828; TFun/9829	1; 1
Kiunga	i.t.		3	KKiun/9944	4
Mesali	21		3	TMes/98100; TMes/98101	1; 1
Fundu	15-26	*Pearsonothuria graeffei* (SEMPER, 1868)	6	TFun/9803; TFun/9804;	1; 1
				TFun/9805	1
Malindi	12		2	KMal/9764; KMal/9765	1; 1
Shimoni	16		1	KShim/9766	2
Mombasa	18-28		4	none	0
Mesali	23		6	none	0
		Stichopodidae			
Mombasa	2-12	*Stichopus chloronotus* BRANDT, 1835	10	KMom/9847; KMom/9848;	1; 1
				KMom/9849; KMom/9850;	1; 1
				KMom/9851; KMom/9768	1; 1
Kanamai	0-2		2	KKan/9728: KKan/9729	1; 1
Watamu	6		2	none	0
Mombasa	12	*Stichopus herrmanni* SEMPER, 1868	3	KMom/9852	1
Kanamai	2		2	KKan/9709	2
Vanga	4		1	KVan/9767	1
Watamu	3		1	none	0
Kiunga	3		2	none	0
Diani	1		1	none	0
Fundu	16-23	*Stichopus* cf. *monotuberculatus* (QUOY & GAIMARD, 1833)	3	TFun /9812; TFun/9813;	1; 1
				TFun/9814	1
Kiunga	5-7		2	KKiun/9950	1
Kisite	19	*Thelenota ananas* (JAEGER, 1833)	2	KKis/9843	1
Mombasa	18-25		2	none	0
Vanga	?		?	none	0
Kisite	18-32	*Thelenota anax* H.L. CLARK, 1921	2	KKis/9841; KKis/9842	1; 1
		APODIDA			
		Synaptidae			
		Cladolabinae			
Fundu	14-16	*Euapta godeffroyi* (SEMPER, 1868)	3	TFun/9817; TFun/9818	1; 1
Fundu	12	*Opheodesoma* sp. (J. MÜLLER, 1850)	1	TFun/9819	1
Kanamai	1	*Opheodesoma grisea* (SEMPER, 1868)	2	KKan/9725; KKan/9726	1; 1
Kanamai	1-2	*Opheodesoma mauritiae* HEDING, 1928	2	KKan/9873; KKan/9874	1; 1
Fundu	10		1	TFun/99832	1
Kanamai	2	*Opheodesoma* cf. *mauritiae* HEDING, 1928	1	KKan/9731	1
Mesali	10	*Opheodesoma spectabilis* FISHER, 1907	1	TMes/9834	1
Kanamai	1	*Synapta maculata* (CHAMISSO & EYSENHARDT, 1821)	5	KKan/9712	1
Kiunga	2		1	KKiun/9951	1
Shariani	1-3		4	KShar/9736; KShar/9737;	1; 1
				KShar/9738	1
Chale Island	1-2		4	KCi/9749; KCi/9750;	1; 1
				KCi/9751	1
Mombasa	2		2	KMom/9862	1

TABLE 1 – List of the holothurians collected at the different locations along the coast of Kenya and Pemba Island (Tanzania). CPUE stands for the Catch Per Unit Effort, the number of observed individuals per species per diver per hour. '?' Means that data could not be acquired, e.g. in those few cases were a specimen was bought from a sea cucumber fisherman.

Ordo Dendrochirotida GRUBE, 1840

Family Sclerodactylidae PANNING, 1949

Subfamily Cladolabinae HEDING & PANNING, 1954

Genus *Afrocucumis* DEICHMANN, 1944

DIAGNOSIS [Type species: *Cucumaria africana* SEMPER, 1868 by original designation] See HEDING & PANNING 1954:108.

Currently only two species are known in *Afrocucumis*: *Afrocucumis africana* (SEMPER, 1868) and *A. stracki* MASSIN, 1996a. The first species has a wide Indo-Pacific distribution and is found in the shallow-waters of Kenya (with Pemba Island); the latter species is for now only known from its type locality (Ambon).

Afrocucumis africana (SEMPER, 1868) (fig. 1A-C, fig. 51A)

Cucumaria africana SEMPER, 1868: 53, 270, pl. 15 fig. 16.
Pseudocucumis africana; DANIEL & HALDER 1974: 428.
Afrocucumis africana; THANDAR 1989c: 298; MUKHOPADHYAY 1991: 409; MASSIN 1999: 96 (synonymy and records before 1999), fig. 79 (distribution map), fig. 113c (colour picture); LANE *et al.* 2000: 490; SAMYN & VANDEN BERGHE 2000: 5 (tab.2), 18 (tab. 4), 32.

STATUS AND LOCATION TYPE – Holotype: unknown; syntypes: ZMB (three specimens) (ROWE, *in* ROWE & GATES 1995).

TYPE LOCALITY – Querimba Islands (northern Mozambique).

MATERIAL EXAMINED – KKiun/9918 (four specimens).

GENERAL DESCRIPTION – Small species, reaching lengths up to 60 mm and widths up to 10 mm; tapering at both ends. Total body surface homogeneous dark green to brown. Mouth terminal, surrounded by 20 small tentacles, positioned in two crowns: 15 large tentacles in outer and five small tentacles in inner crown. Anus terminal, unguarded. Tube feet long, cylindrical, same colour as the rest of the body, distributed in the ambulacral areas only. Single Polian vesicle. Single stone canal. Calcareous ring long; interradial pieces pointed anteriorly; radial pieces sub rectangular, high, extended posteriorly by 4-5 calcareous fragments (see CHERBONNIER 1988: 219, fig. 95D).

Ossicles: Body wall with lenticular, rough-surfaced, perforated pieces, 100-300 µm across; and smaller smooth plates (fig. 1A). Tube feet with straight rods perforated distally, 125-190 µm long; and small perforated plates, 150-200 µm long

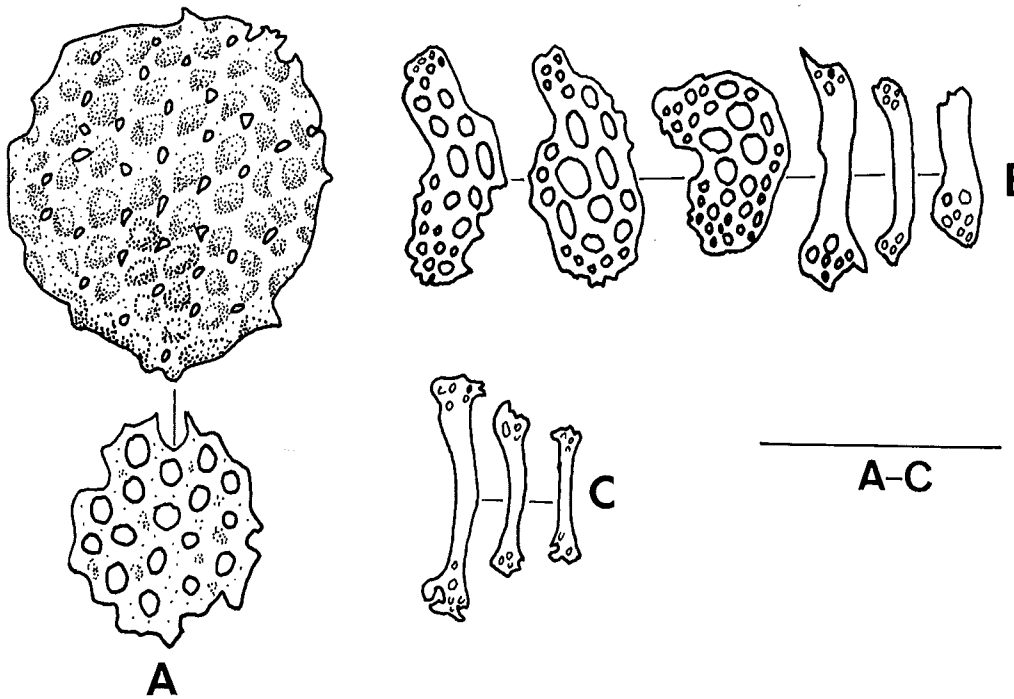


FIG. 1 – *Afrocucumis africana* (SEMPER, 1868). A. Lenticular and developing plate of dorsal body wall; B. Perforated rods and plates of tube feet; C. Rods of tentacles. Scale bar A-C represents 100 µm.

(fig. 1B); endplate ca. 400 µm across. Tentacles with rods similar in size and shape to the ones from the tube feet (fig. 1C).

DIAGNOSIS – See HEDING & PANNING 1954: 109, fig. 39.

ECOLOGY – Only found intertidally, under coral blocks, on fine sand and coral debris; specimens firmly attached to the substratum to withstand surf.

DISTRIBUTION IN THE STUDY REGION – This species was only observed at Kui in the Kiunga Marine Reserve (See also SAMYN & VANDEN BERGHE 2000). HUMPHREYS (1981) reports this species from Kenya (Mida Creek, from the foreshore of Watamu Marine National Park and from Kibirijini).

GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-West Pacific Ocean (no records from the Red Sea nor from the Persian Gulf). The distribution map as drawn by MASSIN (1999: 96, fig. 79) gives the global distribution, but the following localities in the WIO have to be added: Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000); Madagascar, Tuléar, St. Augustin and Nosy Lava (CHERBONNIER 1988). Figure 51A shows the known distribution in the WIO in detail.

Ordo Aspidochirotida GRUBE, 1840

Family Holothuriidae LUDWIG, 1894

KEY TO THE GENERA OF KENYA (WITH PEMBA ISLAND) (AFTER ROWE 1969: 126)

1. Ossicles: rods only, usually dichotomously branched or lobed (rosettes); tables, buttons and perforated plates always absent **2**
1'. Ossicles: tables nearly always present; buttons, rods, perforated plates and rosettes present or absent **3**
2. Anus guarded by 5 prominent calcified anal teeth; 20-30 tentacles . . . . . ***Actinopyga* BRONN, 1860**
2'. Anus not guarded by anal teeth, sometimes uncalcified papillae may be present around the anus; 20 tentacles . . . . . ***Bohadschia* JAEGER, 1833**
3. Calcareous ring with interradial plates almost as large as radial plates; body wall with small rosettes and knobbed pseudoplates; tentacles with complex rosettes and heavily branched rods . . . . . ***Pearsonothuria* Levin, Kalinin & Stonik, 1984**
3' Calcareous ring with interradial plates always distinctly smaller as radial plates; body wall never with knobbed pseudoplates; tentacles with rods only, never rosettes **4**
4. Calcareous ring slender and ribbon-like; tube feet mostly confined to the ambulacral areas; ossicles: tables either with reduced disc and low spire ending in a spiny ring, or disc well developed and spinose, spire as high as the width of the disc, buttons present or absent. . . . . ***Labidodemas* SELENKA, 1867**
4'. Calcareous ring stout, never ribbon-like; tube feet of trivium (ventral side) more or less regularly arranged in the ambulacral areas; papillae and / or tube feet of bivium (dorsal side) more or less irregularly arranged in the ambulacral and interambulacral areas . . . . . ***Holothuria* LINNAEUS, 1767**

Genus *Actinopyga* BRONN, 1860

DIAGNOSIS (after ROWE 1969: 130) [Type species: *Mülleria echinites* JAEGER, 1833 by subsequent designation].

Size from moderate up to very large (400 mm); stout body with thick and firm body wall, covered by small and numerous tube feet and papillae; mouth ventral, surrounded by 20-30 peltate tentacles; firm calcareous ring with the radial pieces about twice as large as the interradial pieces; anus dorsal, guarded by five prominent calcified papillae (anal teeth). Ossicles in body wall consist of dichotomously branched, smooth or spiny, rods; tentacles with rods, often spiny at the extremities; tube feet with rods and rosettes similar to the ones of the body wall; longitudinal muscles with rods similar to the ones from the body wall; tables, buttons, and S- or C-shaped rods absent in the latter tissue.

Fifteen species are currently recognized as being valid[2]: *Actinopyga agassizi* (SELENKA, 1867); *A.*

[2] PEARSON (1914b) grouped the genera *Holothuria* LINNAEUS, 1767 and *Mülleria* JAEGER, 1833 SELENKA, 1867 in *Holothuria* sens. nov. wherein he discerned five ill-defined subgenera; one of them being *Actinopyga* BRONN, 1860 (= *Actinopyga* BRONN, 1860, partim; *Mülleria* JAEGER, 1833, partim). In that subgenus PEARSON (1914b) grouped eight species, one of these being *Holothuria (Actinopyga) formosa* (SELENKA, 1867). Based

albonigra CHERBONNIER & FÉRAL, 1984; *A. bacilla* CHERBONNIER, 1988; *A. bannwarthi* PANNING, 1944; *A. caroliniana* TAN TIU, 1981[3]; *A. crassa* PANNING, 1944; *A. echinites* (JAEGER, 1833); *A. flammea* CHERBONNIER, 1979; *A. lecanora* (JAEGER, 1833); *A. mauritiana* (QUOY & GAIMARD, 1833); *A. miliaris* (QUOY & GAIMARD, 1833); *A. obesa* (SELENKA, 1867); *A. palauensis* PANNING, 1944; *A. serratidens* PEARSON, 1903 and *A. spinea* CHERBONNIER, 1980. Four of these are found in the waters of Kenya (with Pemba Island); they are keyed hereunder.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND)

1. Anus not surrounded by a lighter zone; body colour variable. **2**
1'. Anus surrounded by a lighter zone; body colour green to brown, fairly uniform though some small yellowish patches may be present; ossicles range from rosettes in the ventral body wall to slender dichotomously branched rods in the dorsal body wall. . . . . . ***A. lecanora* (JAEGER, 1833)**
2. Species always with more than 20 tentacles, usually 25; body colour variable but never uniform dark brown to black; dorsally usually chocolate brown with numerous conical papillae; ventrally white-grey to brown, densely covered with large brown to green tube feet scattered over interambulacral and ambulacral areas; bivium clearly distinguishable from trivium; ossicles: ventral body wall with smooth granules, stout rods, and rosettes; dorsal body wall with spiny rods and rosettes . . . . . ***A. mauritiana* (QUOY & GAIMARD, 1833)**
2'. Never more than 20 tentacles **3**
3. Tube feet on trivium distributed mainly in the ambulacral areas; body colour from light brown to dark green; ossicles: ventral body wall with branching rods and rosettes, granules always absent; dorsal body wall with rods with lateral extensions, spiny, sometimes X or Y shaped; dorsal pedicels with rosette-like ossicles . . . . . ***A. echinites* (JAEGER, 1833)**
3'. Tube feet on ventral surface spread into the interambulacral areas; body colour uniform, from dark brown to black; ossicles: similar rosettes in ventral and dorsal body wall, no rods nor granules present in the body wall . . . . . ***A. miliaris* (QUOY & GAIMARD, 1833)**

Actinopyga echinites (JAEGER, 1833)
(fig. 2A-E, fig. 51B, pl. 1A, B)

Muelleria echinites JAEGER, 1833: 17, pl. 3 fig.6.
Actinopyga echinites; DANIEL & HALDER 1974: 429; HUGHES & GAMBLE 1977: 355; SLOAN *et al.* 1979: 121; HUMPHREYS 1981: 32; TAN TIU 1981: 70, 102 pl. 12; PRICE 1982: 10; A.M. CLARK 1984:99; FÉRAL & CHERBONNIER 1986: 70, 71 (colour picture); CANNON & SILVER 1986: 20, figs 3a, 5a (colour drawing); CHERBONNIER 1988: 31 (synonymy); MUKHOPADHYAY 1991: 413; MARSH *et al.* 1993: 63; VANDENSPIEGEL & JANGOUX 1993: 43, fig 1A-B; MASSIN 1996a: 8, fig. 2A-B; ROWE & GATES 1995: 286; ROWE & RICHMOND 1997: 302, 303 (colour drawing); CONAND 1998b: 1167; CONAND 1999: 10, 12, 16, 39, pl. 1 (colour picture); LANE *et al.* 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 4 (tab. 2), 17 (tab. 4), 18; MARSHALL *et al.* 2001: 46 (tab. 29), 47, 53, 54, 58 (tab. 37).
Actinopyga plebeja (SELENKA, 1867); MACNAE & KALK, 1958: 130; 1962: 112; LEVIN 1979: 19; PRICE 1982: 10; CHERBONNIER, 1988: 28 (synonymy).
Actinopyga plegeja; KALK, 1959: 22 (*lapsus calami*).
Actinopyga echinites plebeja; DANIEL & HALDER, 1974: 422.

STATUS AND LOCATION TYPE – Status and data of whereabouts undetermined (ROWE, *in* ROWE & GATES 1995).
TYPE LOCALITY – Sulawesi (as Celebes), Indonesia.

on MITSIKURI's (1912) observation that *formosa* is virtually identical to *Stichopus ananas* (JAEGER, 1833) (apart from the presence of anal teeth), H.L. CLARK (1921: 184) removed the species from *Actinopyga* and believed that it "very possibly belongs to *Thelenota*", BRANDT's (1835) subgeneric taxon (in *Holothuria*) he had raised to generic level to accommodate *T. ananas* (JAEGER, 1833) and *T. anax* H.L. CLARK, 1921 (see also Clark & Rowe 1967, for decision of authorship of *Thelenota*). PANNING (1944), upon examination of SELENKA's type, followed H.L. CLARK (1921) in recognizing that the ossicle assemblages of *formosa* and *ananas* are identical and that the type of *formosa* is in such a bad state that presence or absence of anal teeth could not be confirmed. The species was thus put to the synonymy of *T. ananas*. ROWE (pers. comm.) however feels that the species might be *T. anax* rather than *T. ananas*; if this should be the case then the older name *formosa* has priority over *anax*. Unfortunately, as the type material of *formosa* is currently unavailable (TROESTER, pers. comm.), ROWE's claim can here not be confirmed.

[3] The validity of *Actinopyga caroliniana* TAN TIU, 1981, needs to be ascertained by examining the type series (deposited in the University of San Carlos marine collection at the Science Complex), since the original dscription (TAN TIU 1981) is not distinctive enough to distinguish it from *A. echinites* (JAEGER, 1833) or *A. crassa* PANNING, 1944.

MATERIAL EXAMINED – KKan/9715 (one specimen); KKan/9716 (one specimen); KKan/9724 (one specimen); KCi/9743 (one specimen); KVan/9762 (one specimen); KMal/9888 (one specimen); KKiun/9922 (four specimens).

GENERAL DESCRIPTION – Medium sized species reaching lengths up to 300 mm and widths up to 65 mm. Colour in life from green to light brown, both on bivium and trivium (pl. 1A, B); bivium sometimes mottled with dark brown. Body wall up to 6 mm thick. Mouth ventral, surrounded by 20, large, brown tentacles. Anus terminal guarded by five calcified papillae. Trivium with numerous long, yellow to green tube feet, in smaller specimens distributed solely in the ambulacral areas, in larger individuals scattered into the interambulacral areas. Ventrally, tube feet absent in the first 10-15 mm posterior to the mouth. Bivium with fewer tube feet, both in radial and interradial areas. Radial areas of the bivium also bear few, large, yellow to green conical papillae. Cuvierian tubules not observable in preserved specimens, though in live specimens a pink to reddish tuft can be seen when the animal is squeezed for a couple of minutes (inset pl. 1B). One to two, long, Polian vesicles. One to three stone canals. Calcareous ring stout, radial piece almost twice as wide as the interradial pieces; radial pieces with wide anterior notch, interradial pieces toothed (see CHERBONNIER 1988: 33, fig. 9P).

Ossicles: Tentacles with rods, 135-375 µm long, straight or slightly arched, the larger ones spiny at the extremities (fig. 2A). Ventral body wall with straight and branching rods and rosettes (fig. 2C). Dorsal body wall with similar rods and rosettes, although more branched (fig. 2B). Ventral tube feet with smooth to spiny rods, often branching (fig 2D); some rosettes similar to those of the body wall also present. Dorsal tube feet present pseudo-plates (fig. 2E).

DIAGNOSIS – See PANNING 1941: 5-7, figs 3, 4a-u; CHERBONNIER 1988: 31-32, fig. 9A-O.

ECOLOGY – Only found in shallow water (up to 8 m); detritus feeder; almost invariably on hard coralline substrates browsing on sediment trapped in turf algae.

DISTRIBUTION IN THE STUDY REGION – Kiunga, Malindi, Kanamai, Chale Island, Vanga, Fundu (see also SAMYN & VANDEN BERGHE 2000).

GEOGRAPHIC DISTRIBUTION – Tropical Indo-West Pacific Ocean (see also ROWE & DOTY 1977; ROWE & GATES 1995). *A. echinites* was also recorded

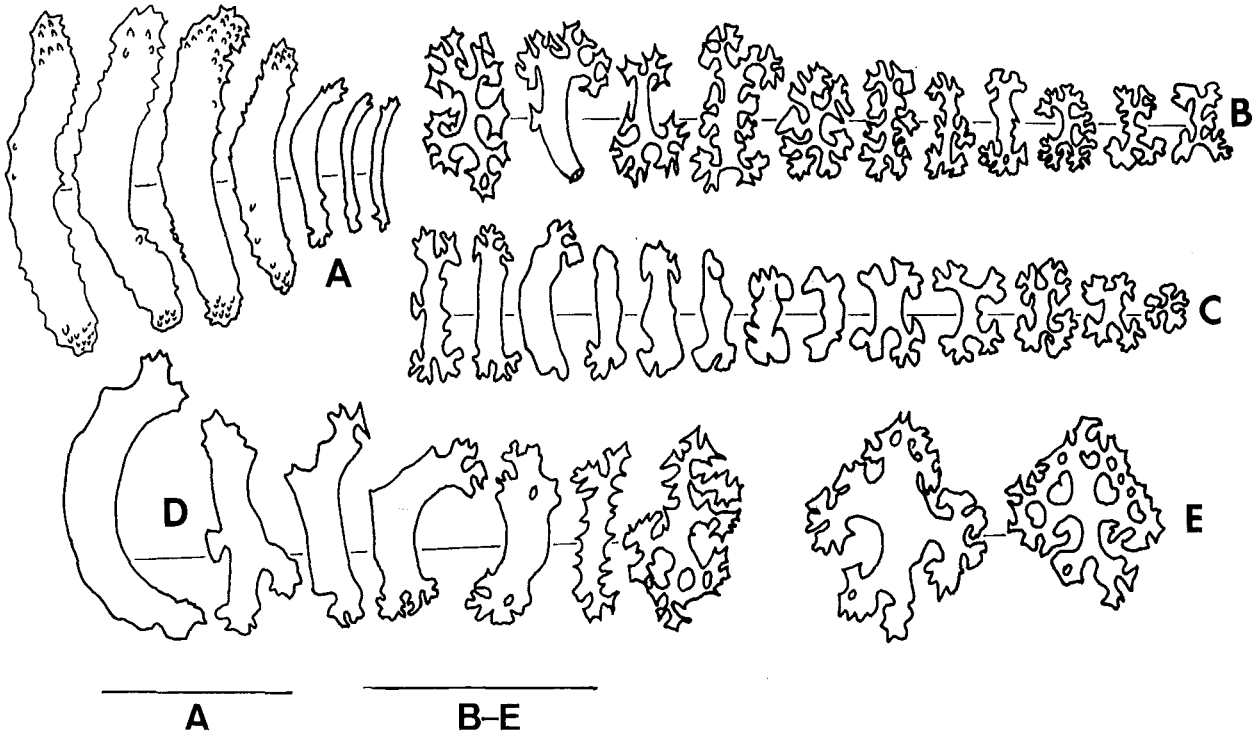


FIG. 2 – *Actinopyga echinites* (JAEGER, 1833). A. Rods of tentacles; B. Rods and rosettes of dorsal body wall; C. Rods and rosettes of ventral body wall; D. Rods and branched rods of ventral tube feet; E. Pseudo-plates of dorsal papillae. Scale bar A represents 200 µm; scale bar B-E represents 100 µm.

from the Gulf of Suez, unspecified locality (PRICE 1982); Gulf of Aqaba, Faraun Island [A.M. CLARK 1952, as *A. miliaris* (QUOY & GAIMARD, 1833)]; Red Sea, unspecified locality (LUDWIG 1877 [1880], as *Mülleria miliaris* QUOY & GAIMARD, 1833; ERWE 1919, as *M. echinites* JÄGER, 1833; PANNING 1944, as *A. echinites plebeja* (SELENKA, 1867), and PRICE 1982, as *A. echinites* and as *A. plebeja*); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000), Malindi, Kanamai, Chale Island, Vanga (this work); and Tanzania, Fundu (this work). Figure 51B shows the known distribution in the WIO in detail.

REMARKS – VANDENSPIEGEL & JANGOUX (1993) demonstrated that several species in the genus *Actinopyga* possess Cuvierian tubules (no more than ten tubules per individual) that are attached independently to the left respiratory tree near the cloaca. According to these authors, these tubules differ from those of other holothuroid genera in several ways: (i) they are never expelled; (ii) they cannot elongate or become sticky; (iii) each of these tubules has three distinctive parts: (a) a smooth proximal half of the trunk, (b) a slightly rugged distal half of the trunk, and (c) highly ragged, elongated primary and secondary branches. It is remarkable that it is almost impossible to find these typical Cuvierian tubules in preserved material (pers. observ.; VANDENSPIEGEL pers. comm.). This type of Cuvierian tubules has thus far been reported in *A. echinites, A. mauritiana* (QUOY & GAIMARD, 1833), *A. miliaris* (QUOY & GAIMARD, 1833), and *A. agassizi* (SELENKA, 1867). We here confirm the presence of this type of Cuvierian tubules in *A. echinites* (see also inset plate 1B).

Actinopyga lecanora (JAEGER, 1833) (fig. 3A-E, fig. 51C)

Muelleria lecanora JAEGER, 1833: 18, pl. 2 figs 2, 2b, pl. 3 fig. 8.

Actinopyga lecanora; DANIEL & HALDER 1974: 429; CONAND 1999: 12, 16, 39 pl. 1 (colour picture); MASSIN 1999: 8 (synonymy and records before 1999), fig. 4 (distribution map), fig. 110a (colour picture); LANE *et al.*, 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 4 (tab. 2).

STATUS AND LOCATION TYPE – Status and data of whereabouts undetermined (ROWE, *in* ROWE & GATES 1995).

TYPE LOCALITY – Sulawesi (as Celebes), Indonesia.

MATERIAL EXAMINED – KCi/9761 (one specimen); TFun/9809 (one specimen); TFun/9810 (one specimen); TFun/9811 (one specimen).

GENERAL DESCRIPTION – Medium sized species: live specimens reaching lengths up to 250 mm and widths up to 85 mm. The four specimens examined measure 143 to 160 mm in length and 35 to 83 mm in width, after preservation. Colour in life similar to colour in alcohol: ventrally yellow to beige; dorsally beige, green or brown; 10 to 20 mm above the anus with a lighter zone with fine brownish lines. Body wall smooth, up to 8 mm thick. Mouth ventral, surrounded by 20 green to brown tentacles. Anus dorsal, surrounded by five yellowish anal teeth. Ventral tube feet long, in ambulacral areas only, in five to eight rows. Dorsal tube feet small, conical, scattered in interambulacral and ambulacral areas. Cuvierian tubules not observed in the preserved nor in the live specimens (see also remarks with *A. echinites*). Single Polian vesicle. Single stone canal. Calcareous ring stout, radial pieces twice as wide as the interradial pieces; radial pieces with narrow slit on their central anterior tooth (See MASSIN 1999: 9, fig. 3A).

Ossicles: Tentacles with massive rods up to 300 µm long, spiny at their extremities (fig. 3A). Dorsal body wall with slender dichotomously branched rods to rosettes, 25-30 µm long (fig 3B). Ventral body wall with similar rods and rosettes, 20-30 µm long (fig. 3C). Ventral tube feet with small rosettes, 20-35 µm long and branched rods, up to 60 µm long (fig. 3D). Dorsal papillae with rosettes similar to the ones from the body wall, rods, 65-90 µm long, and plate-like ossicles (fig. 3E).

DIAGNOSIS – See JAEGER 1833: 18, pl. 2 figs 2, 2b, pl. 3 fig. 8; PANNING 1929 [1931]: 127, fig. 9a-c.

ECOLOGY – Depth range from 0-23 m; detritus / deposit feeder on coral debris, occasionally in sea grass beds. The specimens from Fundu were found at night, attached to live coral.

DISTRIBUTION IN THE STUDY REGION – Chale Island; Fundu and Mombasa (see also LEVIN 1979).

GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-West Pacific. The distribution map as drawn by MASSIN (1999: 10, fig. 4) gives the global distribution, but the following localities in the WIO have to be added: northern Red Sea, Habban Dschidda (PANNING 1944, as *Actinopyga lecanora miliaris* (QUOY & GAIMARD, 1833)); Gulf of Aden, unspecified locality (DANIEL

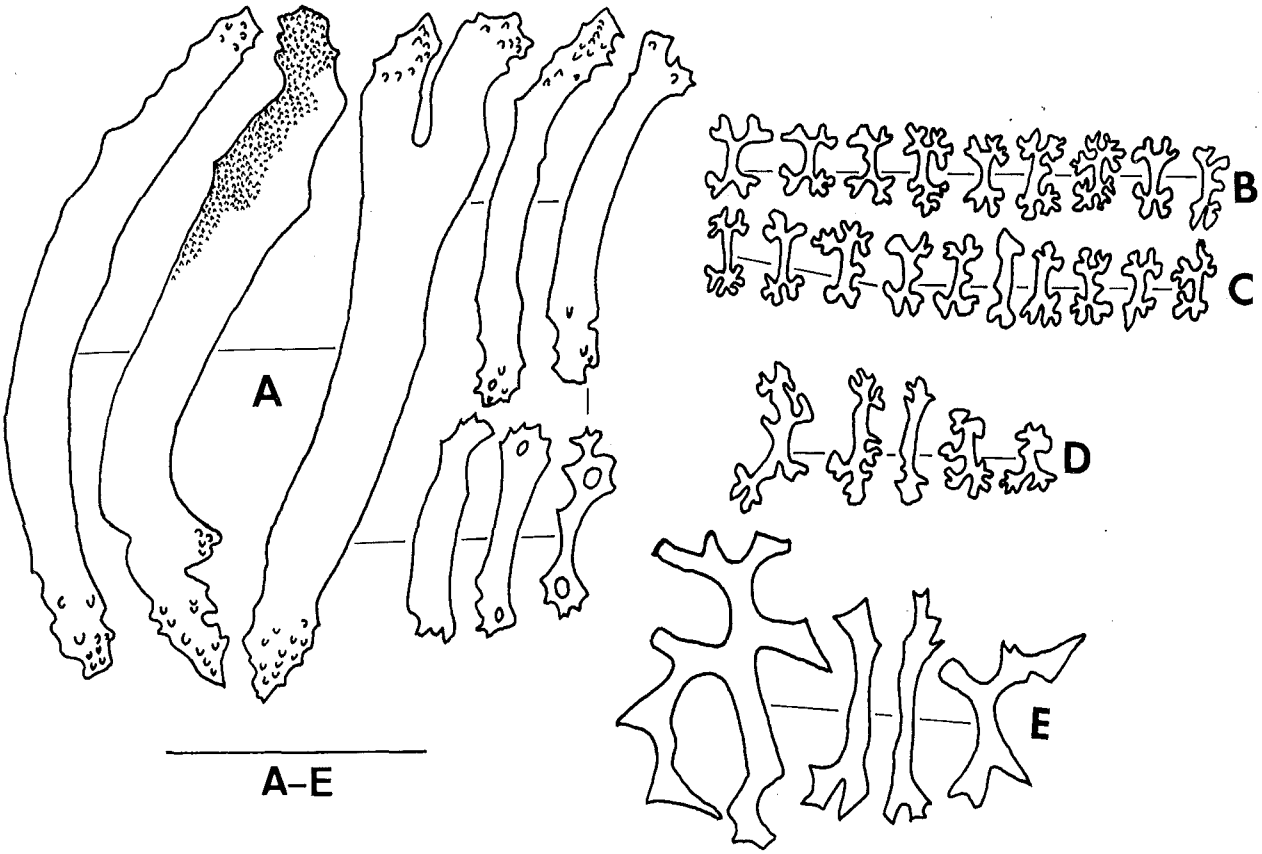


FIG. 3 – *Actinopyga lecanora* (JAEGER, 1833). A. Rods of tentacle; B. Rosettes of dorsal body wall; C. Rosettes of ventral body wall; D. Rosettes of ventral tube feet; E. Rods of dorsal pedicels. Scale bar A-E represents 100 µm.

& HALDER 1974); Arabian Sea, unspecified locality (PRICE 1982); Kenya, Chale Island (this work); Tanzania, Fundu (this work), Zanzibar (PANNING 1941; PANNING 1944, as *A. lecanora lecanora;* DANIEL & HALDER 1974); Madagscar, Tuléar and Nosy Bé (CHERBONNIER 1988) and Mozambique, Maiyapa Bay (PEARSON 1910, as *Mülleria lecanora* JAEGER, 1833; see also THANDAR 1984). Figure 51C shows the known distribution in the WIO in detail.

Actinopyga mauritiana (QUOY & GAIMARD, 1833) (fig. 4A-C, fig. 51D, pl. 1C, D)

Holothuria mauritiana QUOY & GAIMARD, 1833: 138 (see also CHERBONNIER 1952b: 41, fig. 16a-o).

Holothuria guamensis QUOY & GAIMARD, 1833: 137-138.

Microthele guamensis; CHERBONNIER 1952b: 40, pl. 2 fig1.

Actinopyga mauritiana; CHERBONNIER 1955: 139; MACNAE & KALK 1958: 34, 99, 107 (from THANDAR 1984); KALK 1959: 5, 22; JAMES 1969: 61; JAMES & PEARSE 1969: 103; DANIEL & HALDER 1974: 429; TORTONESE 1979: 316; HUMPHREYS 1981: 33; PRICE 1982: 10; CANNON & SILVER 1986: 20; SLOAN *et al.* 1979: 121; BRANCH & BRANCH 1981: 248 (from THANDAR 1984); A.M. CLARK 1984: 87, 99; CANNON & SILVER 1986: 20; FÉRAL & CHERBONNIER 1986: 72, 73 (colour picture); CHERBONNIER 1988: 16 (synonymy), fig. 2A-M; MUKHOPADHYAY 1991:403, 412; MARSH *et al.* 1993: 63; VANDENSPIEGEL & JANGOUX 1993: 43, figs 2, 3A-B, 4-18; ALLEN & STEENE 1994: 242 (colour picture; possibly not *A. mauritiana*); MASSIN 1996a: 11; ROWE & GATES 1995: 287; ROWE & RICHMOND 1997: 302, 303 (colour drawing); CONAND 1999: 10, 12, 16, 39, pl. 1 (colour picture), 16; LANE *et al.*, 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE, 2000: 4 (tab. 2), 17 (tab. 4), 19; MARSHALL *et al.* 2001: 46 (tab. 29), 47, 53, 58 (tab. 37)..

TYPE LOCATION – Three syntypes in MNHNP (CHERBONNIER 1952b; ROWE, *in* ROWE & GATES 1995).

TYPE LOCALITY – Mauritius.

MATERIAL EXAMINED – KKan/9719 (one specimen); KKan/9720 (one specimen); KCi/9744 (one specimen); KCi/9753 (one specimen); KCi/9754 (one specimen); KCi/9755 (one specimen); KMal/-9885 (one specimen); KMal/9886 (one specimen); KMal/9887 (one specimen); KVan/9763 (one specimen); KKiun/9921 (one specimen).

GENERAL DESCRIPTION – Relatively large species: live specimens reaching lengths up to 350 mm and widths up to 100 mm; preserved specimens up to 30 % smaller. Colour very variable: dorsal side greenish to chocolate brown with numerous light-brown conical papillae, scattered evenly over the total bivium (body wall around the lateral papillae in the bivium is often light-brown to grey); ventral body wall white-grey to light brown, densely covered with long, light-brown to green, tube feet, scattered over the interambulacral and ambulacral areas. Bivium clearly separated from the somewhat flattened trivium. Thickness of body wall up to 10 mm. Mouth ventral, surrounded by (at least) 25 dark brown, stout, peltate tentacles, which in turn are surrounded by a distinct collar of brown papillae. Tentacle ampullae, 30-40 mm long. Anus small, terminal, guarded by five white anal teeth. Cuvierian tubules not observed in the preserved specimens (see also remark with *A. echinites*); visible as a small pinkish tuft in live specimens (SAMYN pers. observ.). Three Polian vesicles (two long; one short). Ten stone canals each ending in relatively large egg-shaped madreporic plate. Calcareous ring very stout, radial pieces almost three time as wide as the interradial pieces, interradial pieces almost as high as the radial pieces (See CHERBONNIER 1988: 19, fig. 2H).

Ossicles: Tentacles with large, rugose rods, 165-210 µm long (fig. 4A). Dorsal body wall with spiny rods, 55-90 µm long, and simple, very small rosettes, 20-45 µm long (fig. 4B). Ventral body wall with small grains, elongated grains and rods that can be spiny or smooth (fig 4C).

DIAGNOSIS – See PANNING 1944: 5, figs 3, 4; CHERBONNIER 1952b: 41, fig. 16.

ECOLOGY – Depth range: from 1 to 7 m (0-12 m according to LANE *et al.* 2000); detritus/deposit feeder in coral reef lagoon, on hard coral rubble substrate, also in sea grass beds.

DISTRIBUTION IN THE STUDY REGION – Shariani, Kanamai, Mombasa, Gazi Bay, Malindi, Vanga, Kiunga Marine Reserve (see also SAMYN & VANDEN BERGHE 2000).

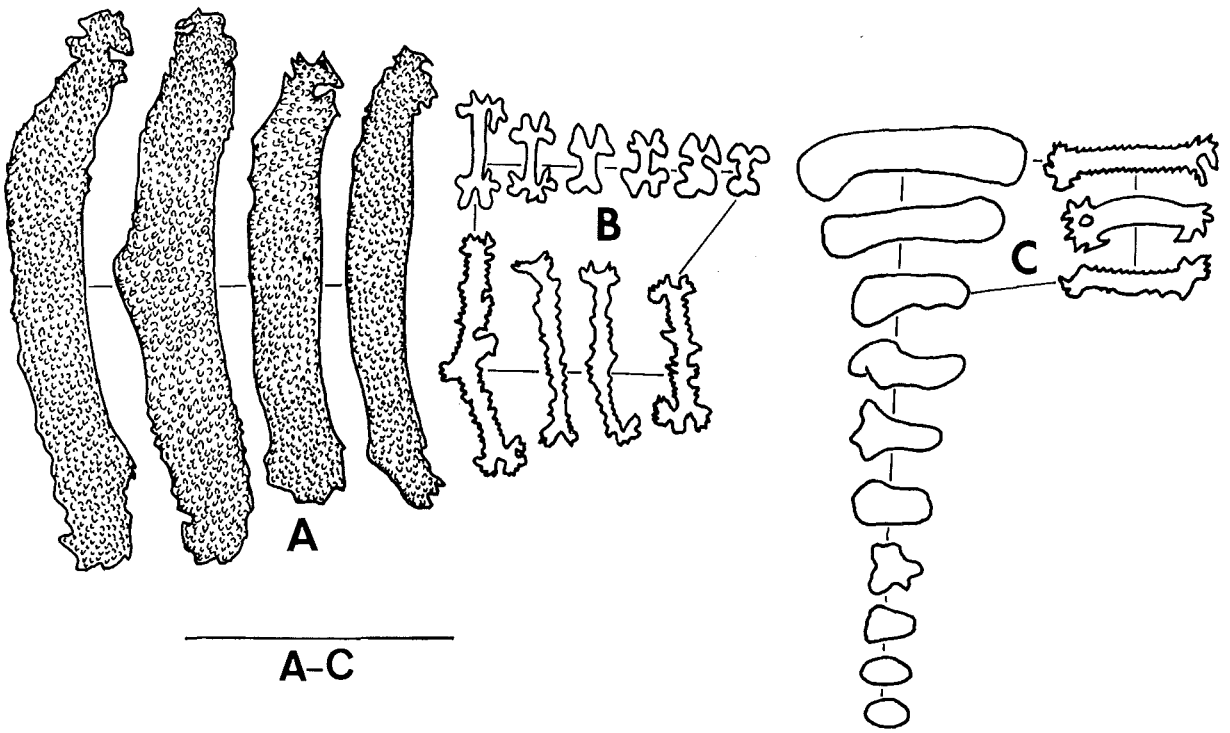


FIG. 4 – *Actinopyga mauritiana* (QUOY & GAIMARD, 1833). A. Rods of tentacle; B. Rosettes and rods of dorsal body wall; C. Grains and rods of ventral body wall. Scale bar A-C represents 100 µm.

GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-west-central Pacific (ROWE, *in* ROWE & GATES 1995), with the Red Sea, but no records from the Persian Gulf. Figure 51D shows the known distribution in the WIO in detail.

Actinopyga miliaris (QUOY & GAIMARD, 1833)
(fig. 5A-E, fig. 51E, pl. 1E)

Holothuria miliaris QUOY & GAIMARD, 1833: 137 (see also CHERBONNIER 1952b: 39, pl. III fig. 3)
Actinopyga miliaris; KALK 1954: 112 (from THANDAR 1984); KALK 1958: 198, 238; DANIEL & HALDER 1974: 429; MUKHOPADHYAY 1991: 403; VANDEN-SPIEGEL & JANGOUX 1993: 43; CONAND 1999: 10, 12, 16, 39 pl. 1 (colour picture), 16; MASSIN 1999: 10 (synonymy and records before 1999), fig. 6 (distribution), fig. 110b (colour picture); LANE *et al.*, 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 4 (tab. 2), 17 (tab. 4), 19; MARSHALL *et al.* 2001: 46 (tab. 29), 47, 53, 58 (tab. 37).

STATUS AND LOCATION TYPE – Holotype lost, possibly in MNHNP (ROWE, *in* ROWE & GATES 1995).
TYPE LOCALITY – Vanikoro Islands (Solomon Islands).

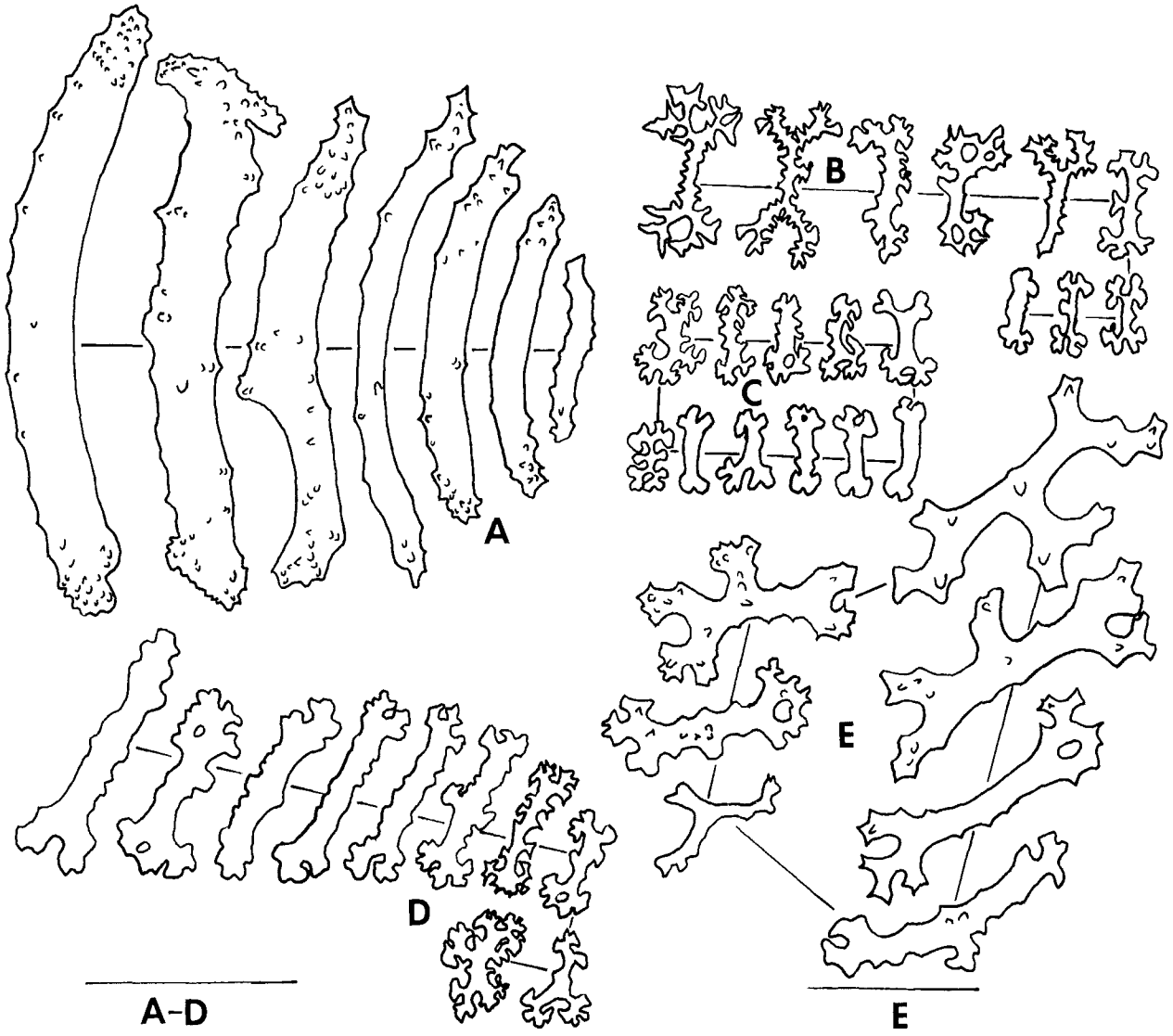


FIG. 5 – *Actinopyga miliaris* (QUOY & GAIMARD, 1833). A. Rods of tentacle; B. Rosettes and rods of dorsal body wall; C. Rosettes and rods of ventral body wall; D. Rods of ventral tube feet; E. Rods of dorsal tube feet. Scale bar A-D represents 100 µm; scale bar E represents 200 µm.

MATERIAL EXAMINED – TFun/9822 (one specimen); TFun/9823 (one specimen); KKiun/9923 (one specimen); KKiun/9924 (one specimen).
GENERAL DESCRIPTION – Large species reaching lengths up to 400 mm and widths up to 100 mm. Examined specimens, after preservation, 190 to 210 mm long and 50 to 70 mm wide. The smallest specimen auto eviscerated. Colour in life uniform dark brown to black (pl. 1E) (some specimens are slightly lighter ventrally); colours preserved in alcohol. Body wall soft to the touch, up to 8 mm thick. Mouth ventral surrounded by 16-20 firm, brown to black, tentacles. Anus terminal, surrounded by five, yellow to orange, anal teeth. Trivium with numerous black tube feet scattered over the radial and interradial areas. Bivium easily distinguishable from the trivium by the scarcity of evenly distributed pedicels on the former. Cuvierian tubules neither observed in life, nor in preserved specimens (see also remarks with *A. echinites*). One or two (then one long and one short) Polian vesicles. Single, very short, stone canal. Calcareous ring stout, radial pieces twice as broad as the interradial ones; radial pieces with three anterior teeth (see MASSIN 1999: 11, fig. 5a).
Ossicles: Tentacles with knobbed rods up to 260 µm long (fig. 5A). Dorsal and ventral body wall with rosettes and rods (fig. 5B, C). Ventral tube feet with similar but larger rods and rosettes (fig. 5D). Dorsal tube feet with very large (up to 370 µm long) rods and pseudo-plates (fig. 5E).
DIAGNOSIS – See PANNING, 1929 [1931]: 127, fig. 10a-g.
ECOLOGY – Depth range from 0 to 20 m; detritus/deposit feeder on sandy patches between coral heads. Forages actively during the day.
DISTRIBUTION IN THE STUDY REGION – Malindi, Mombasa, Fundu, Mesali, Kiunga (see also SAMYN & VANDEN BERGHE 2000).
GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-West Pacific (with the Red Sea, no records from the Persian Gulf). The distribution map as drawn by MASSIN (1999: 11, fig. 6) gives the global distribution, but the following localities in the WIO have to be added: Gulf of Suez, Ras el Millan (HELFER 1912, as *Mülleria miliaris* QUOY & GAIMARD, 1833), Suez (MORTENSEN 1926) (see also PRICE 1982 for unspecified localities from the Gulf of Suez); Gulf of Aqaba, Aqaba (TORTONESE 1977) (see also PRICE 1982 for unspecified locality from the Gulf of Aqaba); Red Sea, unspecified locality (LAMPERT 1885, as *M. miliaris*; THÉEL 1886, as *M. miliaris*; MITSIKURI 1912, as *M. miliaris*; CLARK & ROWE 1971; PRICE 1982); Tanzania, Fundu and Mesali (this work); Mozambique, unspecified locality (LAMPERT 1885, as *M. miliaris*; THÉEL 1886, as *M. miliaris*; MITSIKURI 1912; H.L. CLARK 1923); southern Mozambique (KALK 1958). Figure 51E shows the known distribution in the WIO in detail.

Table two lists the other *Actinopyga* species 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.

Genus *Bohadschia* JAEGER, 1833

DIAGNOSIS (after ROWE, 1969: 129-130) [Type species: *Bohadschia marmorata* JAEGER, 1833 by subsequent designation].
Size from moderate up to very large (450 mm); body stout, body wall variable in thickness and usually muscular; covered by small and numerous tube feet and papillae; mouth ventral surrounded by 20 peltate tentacles; calcareous ring very stout with the radial pieces twice as large as the interradial pieces and possessing a median anterior ampullary notch, interradial pieces with a short anterior median tooth-like projection; anus dorsal, without anal teeth though five groups of papillae may be present. Ossicles: tables, buttons, S- or C-shaped rods always absent; body wall with perforated and unperforated grains, tentacles and tube feet with rods; longitudinal muscles devoid of ossicles.
Eleven species are currently recognized as being valid: *Bohadschia argus* JAEGER, 1833; *B. atra* MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999; *B. cousteaui* CHERBONNIER, 1954; *B. maculisparsa* CHERBONNIER & FÉRAL, 1985; *B. marmorata* JAEGER, 1833; *B. mitsioensis* CHERBONNIER, 1988; *B. paradoxa* (SELENKA, 1867); *B. similis* (SEMPER, 1868); *B. steinitzi* CHERBONNIER, 1963; *B. subrubra* (QUOY & GAIMARD, 1833) and *B. vitiensis* (SEMPER, 1868). Five of these are found in the waters of Kenya (with Pemba Island); they are keyed hereunder.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
A. bacilla CHERBONNIER, 1988	Madagascar (Nosy Bé) only	CHERBONNIER 1988
A. bannwarthi PANNING, 1944 (see also discussion)	Gulf of Suez (Suez, Mersa Thlemel)	PANNING 1944; CHERBONNIER 1955; DANIEL & HALDER 1974; PRICE 1982?
	Gulf of Aqaba (Eilat, Aqaba)	CHERBONNIER 1963; 1967; TORTONESE 1977; PRICE 1982
	Red Sea (unspecified)	PANNING 1944; CLARK & ROWE 1971; PRICE 1982?
	Arabian Sea	PRICE 1982
	Gulf of Aden (Djibouti, Obok)	VANEY 1905[1]; CHERBONNIER 1955
	Seychelles (Aldabra)	SLOAN *et al.* 1979
	Madagascar (Nosy Bé, Fort Dauphin)	CHERBONNIER 1988
A. crassa PANNING, 1944	Arabian Sea	PRICE 1982
	Gulf of Aden (Djibouti)	CHERBONNIER 1955
	Madagascar (Nosy Bé, Fort Dauphin)	CHERBONNIER 1988
	Mozambique (Querimba Archipelago, Port Moresby)	PANNING 1944; THANDAR 1984
	Mascarene Islands (unspecified)	CLARK & ROWE 1971
A. obesa (SELENKA, 1867) (see also discussion)	Comores	CHERBONNIER 1988
	South Africa (KwaZulu-Natal)	pers. observ.
A. serratidens PEARSON, 1903	Gulf of Suez (Mersa Thlemel)	CHERBONNIER 1955; PRICE 1982
	Gulf of Aqaba (Eilat, Aqaba)	TORTONESE 1977; PRICE 1982; CHERBONNIER 1967
	Red Sea (Hurghada, Dahlak Kebir, Entedebirand Nocra, Djeddah)	PEARSON 1914a; MORTENSEN 1937; PANNING 1944; TORTONESE 1953a; CHERBONNIER 1967; TORTONESE 1979; PRICE 1982
	Madagascar (Nosy Bé)	CHERBONNIER 1988

TABLE 2 – Other species within the genus *Actinopyga* known to occur in the shallow-waters of the WIO. [1] Cited as *Mülleria lecanora* JÄGER.

KEY TO THE SPECIES OF KENYA (WITH PEMBA ISLAND)

1. Bivium and trivium with a more or less uniform colouration, ranging from yellow-brown to black 2
1'. Body not uniformly coloured: bivium brown to orange with unevenly distributed dark brown to black areas; trivium white, with tiny black spots between the tube feet; bivium clearly separated from the trivium by a brown line with dark brown triangular areas. . . . . ***B. subrubra* (QUOY & GAIMARD, 1833)**
2. Body colour ranging from yellow to light brown. 3
2'. Body colour dark brown to black 4
3. Body colour yellow-white ventrally and laterally, brownish dorsally, spotted by numerous small brown spots corresponding to the tube feet; body wall with grains (occasionally perforated) and rosettes; ventral and dorsal tube feet with bended, sometimes cruciform, rods. . . . . ***B. marmorata* JAEGER, 1833**
3'. Body colour uniform yellow to light brown ventrally; brownish with numerous dark patches corresponding to the papillae dorsally. Body wall with some perforated grains and numerous rosettes; ventral tube feet with grains, rosettes and simple rods; dorsal pedicels with simple rosettes . . . . . ***B. similis* (SEMPER, 1868)**
4. Deep brown to black bivium with numerous brown to red spots, surrounding black dorsal papillae; trivium slightly lighter in colour, without red spots; dorsal and ventral body wall with grains, granules, rosettes and rods; ventral tube feet with smooth rods and grains; dorsal papillae with rosettes; tentacles with spiny rods . . . . . ***B. atra* MASSIN *et al.*, 2000**
4'. Body colour uniform dark brown, slightly lighter ventrally; ventral body wall with imperforated grains, rods and simple rosettes; dorsal body wall with cross shaped rods and complex rosettes; ventral tube feet with smooth straight rods, sometimes perforated at their extremities, grains, and cross shaped

rods; dorsal tube feet with long smooth or spiny rods, cross-shaped rods, and some small rosettes. . . . . ***B. cousteaui*** **CHERBONNIER, 1954**

Bohadschia atra MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999
(fig. 6A-E, fig. 51F, pl. 1F)

Bohadschia atra MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999: 151, figs 1A-J, 2A-E, Pl. 1B, D (colour pictures); SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 4 (tab. 2), 17 (tab. 4), 20.
Bohadschia aff. *subrubra*; CONAND 1999: pl. 2 [colour picture with *B. subrubra* (top) and *B. atra* (bottom)].

STATUS AND LOCATION TYPE – Holotype: MNHNP, EcHh 7133; Paratypes: IRSNB, IG 28 628/Fun90-91 (two specimens).

TYPE LOCALITY – Mayotte (Comores).
MATERIAL EXAMINED – KShar/9734 (one specimen); KShar/9735 (one specimen); IRSNB IG 28 628/Fun90-91 (two specimens); IRSNB 28 628/Mom12 (one specimen); IRSNB IG 28 628/Shar11 (one specimen); IRSNB IG 28 628/Mom60-61 (two specimens); KKiun/9927 (three specimens); KKiun/9928 (one specimen).
GENERAL DESCRIPTION – Large species; living specimens up to 400 mm long and 150 mm wide, preserved specimens up to 25 % smaller. Bivium; deep brown to black with numerous brown to red spots, surrounding black dorsal papillae (pl. 1F). Trivium slightly lighter in colour, without red spots. Transverse brown-red bands may be visible in larger individuals. Body wall smooth, 2-5 mm thick Mouth ventral, surrounded by 18-20 black tentacles. Anus dorsal, unguarded. Ventral tube feet scattered over radial and interradial areas.

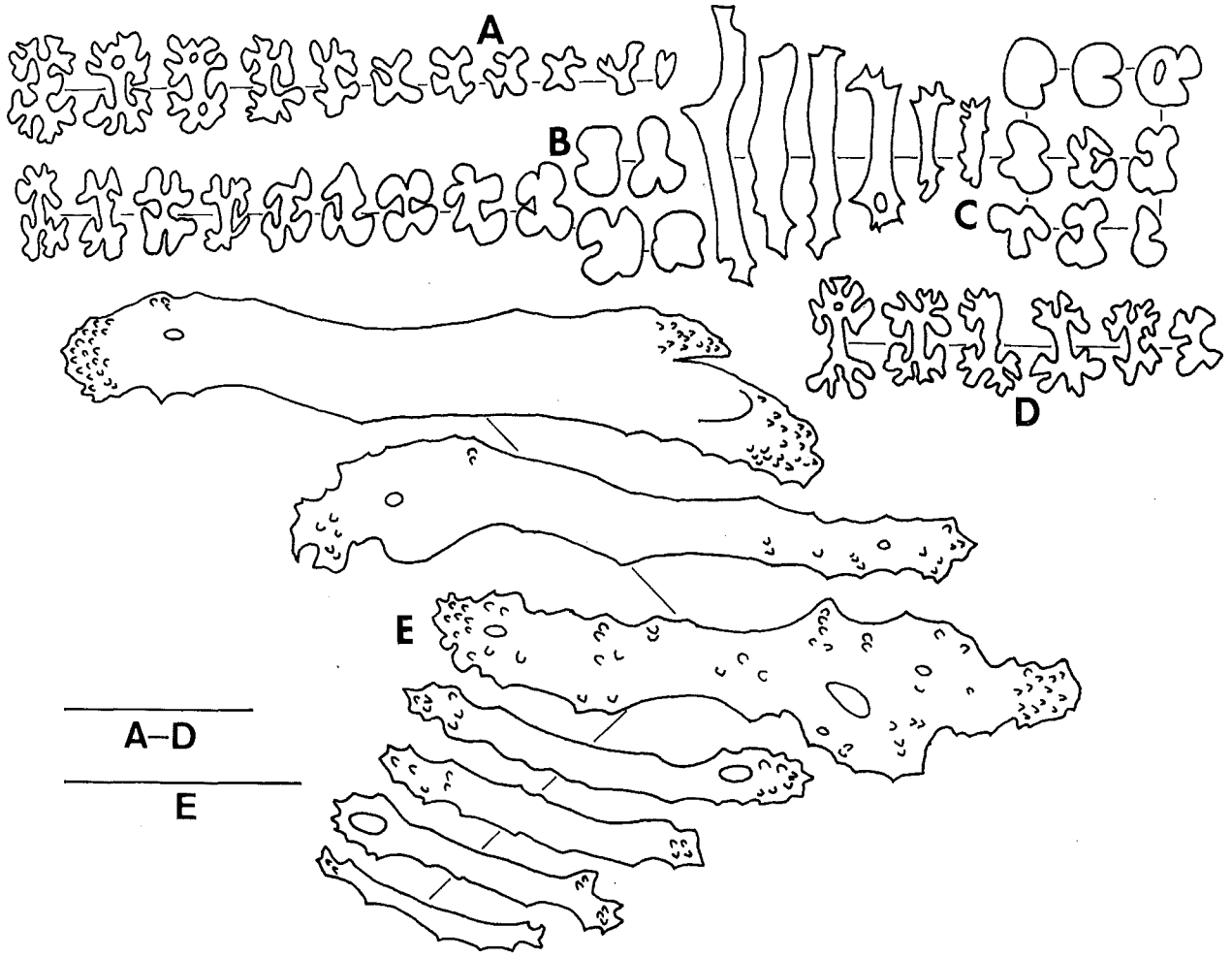


FIG. 6 – *Bohadschia atra* MASSIN, RASOLOFONIRINA, CONAND & SAMYN, 1999. A. Rosettes and grains of dorsal body wall; B. Rosettes and grains of ventral body wall; C. Rods and grains of ventral tube feet; D. Rosettes of dorsal papillae; E. Rods of tentacle. Scale bar A-D represents 50 µm; scale bar E represents 100 µm.

Dorsal tube feet also scattered but, less numerous. Cuvierian tubules present and very readily ejected in large quantities. Single Polian vesicle. Single stone canal. Calcareous ring stout with radial pieces twice as large as the interradial pieces; radial pieces with an anterior median notch and two anterio-lateral holes, interradials with a pointed tooth (See MASSIN *et al.* 1999: 152, fig. 1).

Ossicles: Dorsal and ventral body wall with grains, granules, rosettes and rods (fig. 6A, B); morphology, size and abundance of each type dependent on the size of the specimen (see also MASSIN *et al.* 1999). Ventral tube feet with smooth rods, sometimes perforated at the extremities, and grains (fig. 6C). Dorsal papillae with rosettes (fig. 6D) and rods. Tentacles with spiny rods (fig. 6E).

DIAGNOSIS – See MASSIN *et al.* 1999: 15, figs 1, 2; pl.1.B, D.

ECOLOGY – *B. atra* dwells in shallow (up to 12 m depth) inner reefs, on sandy patches between coral heads and on the leeward-side of sea grass beds (mainly *Thalassodendron ciliata)*. *B. atra* has been observed feeding on sand; faeces of *B. atra* also composed of sand, no rubble.

DISTRIBUTION IN THE STUDY REGION – Fundu, Kiunga (See also SAMYN & VANDEN BERGHE 2000), Malindi, Mombasa, Shariani, Watamu.

GEOGRAPHIC DISTRIBUTION – Species restricted to the western Indian Ocean; not recorded from the Red Sea, nor from the Persian Gulf (See also MASSIN *et al.* 1999). Figure 51F shows the known global distribution in detail.

Bohadschia cousteaui CHERBONNIER, 1954 (fig. 7A-F, fig. 51G, pl. 1G)

Bohadschia cousteaui CHERBONNIER, 1954a: 252 (see also CHERBONNIER 1955: 133, pl. 23 figs a-k); CHERBONNIER 1963: 5; CHERBONNIER 1967: 55; CLARK & ROWE 1971: 176; TORTONESE 1977: 275; PRICE 1982: 10; CHERBONNIER 1988: 44; SAMYN 2000: 15 (tab. 1).

Bohadschia consteani; DANIEL & HALDER 1974: 417 (*lapsus calami*).

TYPE LOCATION – MNHNP.

TYPE LOCALITY – Red Sea (Al Lith, Saudi Arabia).

MATERIAL EXAMINED – KKan/9714 (one specimen); TFun/9895 (one specimen); TFun/9896 (one specimen).

GENERAL DESCRIPTION – The specimen from Kanamai (KKan/9714), recovered from the shelves of the Kenya Marine Fisheries and Research Institute, Mombasa, is in poor state for uncontrolled dissection has been performed on it. The specimen is 227 mm long and 77 mm wide. The two specimens from Fundu (TFun/9895-96) measure 224 x 60 and 186 x 56 mm. Body colour in alcohol is uniform dark brown, slightly lighter ventrally (pl. 1G). Body wall smooth to the touch, up to 5 mm thick. Mouth ventral surrounded by 15-20 brown stout tentacles. Anus large, subdorsal, unguarded by papillae. Tube feet on the ventral side short, brown, distributed without order over the ambulacral and interambulacral areas. Tube feet on the dorsal side similar, fewer in number, distributed over ambulacral and interambulacral areas. Cuvierian tubules abundant. Calcareous ring stout; radial pieces one and a half times broader than the interradial pieces (see CHERBONNIER 1988: 45, fig. 15K).

Ossicles: Ventral body wall with imperforated grains; rods and simple rosettes, up to 40 µm long (fig 7A). Dorsal body wall with cross-shaped rods, up to 45 µm long; and rosettes of a more complex nature, up to 30 µm long (fig 7B). Ventral tube feet with smooth, straight rods, sometimes perforated at their extremities, 50 to more than 200 µm long (fig. 7C); grains, and cross shaped rods (fig. 7D). Dorsal tube feet with long, smooth or spiny rods, up to 280 µm long; cross-shaped rods, 20-85 µm long; and some small rosettes of approximately 20 µm (fig. 7E). Tentacles with smooth or spiny rods, sometimes bifurcated, up to 260 µm long (fig. 7F).

DIAGNOSIS – See CHERBONNIER 1988: 44, fig. 15 p. 45

ECOLOGY – The Kanamai specimen was found intertidally, in a sea grass bed, on fine coralline sand. The specimens from Fundu were found on sandy patches, on coral rubble, ten to 14 m depth.

DISTRIBUTION IN THE STUDY REGION – Fundu, Kanamai.

GEOGRAPHIC DISTRIBUTION – Species for now only known from a handful of localities in the WIO: Gulf of Aqaba , Eilat, Aqaba (CHERBONNIER 1963; 1967; TORTONESE 1977; see also PRICE 1982); central Red Sea, Al Lith, Entedebir (CHERBONNIER 1954a; 1955, 1967; see also CLARK & ROWE 1971; DANIEL & HALDER 1974 as *B. consteani* CHERBONNIER (*lapsus calami*); PRICE 1982), Kenya, Kanamai (this work); Tanzania, Fundu (this work); Madagascar, Nosy Bé, Tuléar (CHERBONNIER 1988). Figure 51G shows the known global distribution in detail.

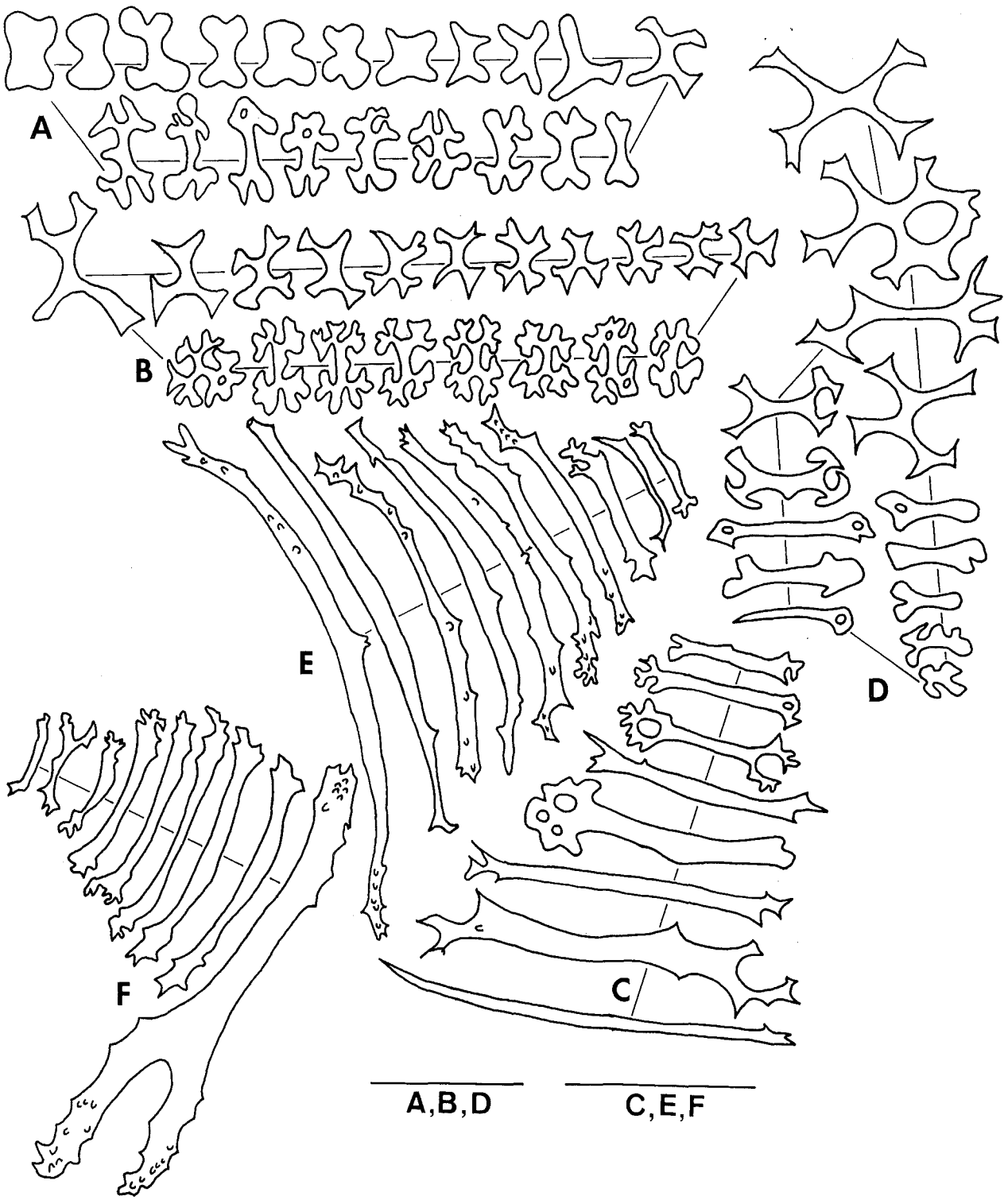


FIG. 7 – *Bohadschia cousteaui* CHERBONNIER, 1954. A. grains rods and rosettes of ventral body wall; B. Cross-shaped rods and rosettes of dorsal body wall; C. Rods of ventral tube feet; D. Grains and cross-shaped rods of ventral tube feet; E. Rods and rosettes of dorsal pedicels; F. Rods of tentacles. Scale bar A, B, D represents 50 μm; scale bar C, E, F represents 100 μm.

Bohadschia marmorata JAEGER, 1833
(fig. 8A-E, fig. 51H, pl. 1H)

Bohadschia marmorata JAEGER, 1833: 18, pl. 3 fig. 9.
Holothuria marmorata; DANIEL & HALDER 1974:428.
Holothuria (Bohadschia) marmorata; MORTENSEN 1937: 7; TORTONESE 1937-38: 180 (synonymy).
Bohadschia marmorata; TORTONESE 1936b: 11; LEVIN 1979: 19; SLOAN *et al.* 1979: 121; PRICE 1982: 10; HUMPHREYS 1981: 33; TAN TIU 1981: 69, 101 pl. 11; A.M. CLARK 1984: 87, 99; CANNON & SILVER 1986: 20, fig. 5d (colour drawing); CHERBONNIER 1988: 36, (synonymy); MUKHOPADHYAY 1991: 403, 412; MARSH *et al.* 1993: 63; ALLEN & STEENE 1994: 243 (colour picture, possibly not *B. marmorata*); ROWE & GATES 1995: 289; GOSLINER *et al.* 1996: 278 (colour picture); CONAND 1999: 12, 19, 20, 39; LANE *et al.* 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 21; MARSHALL *et al.* 2001: 46 (tab. 29), 58 (tab. 37).
Bohadschia tenuissima SEMPER 1868; LEVIN 1979: 20; PRICE 1982: 10; CHERBONNIER 1967: 55; FÉRAL & CHERBONNIER 1986: 78, 79 (colour picture); CHERBONNIER 1988: 46 (synonymy); CONAND 1999: 10.

STATUS AND LOCATION TYPE – Status and data of whereabouts undetermined (ROWE, *in* ROWE & GATES 1995).
TYPE LOCALITY – Sulawesi (as Celebes), Indonesia.
MATERIAL EXAMINED – KKiun/9925 (three specimens); KKiun/9926 (two specimens).
GENERAL DESCRIPTION – Large species; after preservation up to 300 mm long and 100 mm wide. Body colour yellow-white ventrally and laterally, brownish dorsally, spotted by numerous small brown spots corresponding to the tube feet. Transverse, dorsal banding is typical of the species (pl. 1H; see also GOSLINER *et al.* 1996: 278, colour picture), though not always clearly visible. Mouth ventral, surrounded by 20 light-brown, relatively small, tentacles that in turn are surrounded by a circle of brown tube feet. Anus terminal, relatively large, surrounded by a brown line. Ventral tube feet spread in the ambulacral and the interambulacral zones. Bivium covered by conical tube feet surrounded at their base by a small brownish circle. Cuvierian tubules present. Calcareous ring stout, radial pieces two and a half times as wide as the interradial pieces; radial pieces with a large anteriorly placed central notch and two lateral attachment sites for the longitudinal muscles; interradial pieces with an anterior tooth and a shallow concave posterior side (See CHERBONNIER 1988: 37, fig. 11L).

Ossicles: Tentacles with rods, up to 220 µm long, spiny at the extremities (fig. 8A). Ventral body wall with grains of various forms that can be perforated (fig. 8B). Dorsal body wall with rosettes and perforated grains (fig. 8C). Ventral and dorsal tube feet with bent, sometimes cruciform, rods and few rosettes (fig. 8D, E).
DIAGNOSIS – See JAEGER 1833: 18, pl. 3 fig. 9; CHERBONNIER 1988: 36-38, fig 11A-L.
ECOLOGY – Depth ranges from 0 to 36 m (LANE *et al.* 2000); detritus/deposit feeder on sandy areas in patchy coral reefs. The specimens here examined had very fine dark (anoxic?) sand in their guts.
DISTRIBUTION IN THE STUDY REGION – Mombasa, Kanamai, Kiunga (see also SAMYN & VANDEN BERGHE 2000).
GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific, except Hawaii (with the Red Sea, not recorded from the Persian Gulf) (see also ROWE & GATES 1995). Fig. 51H shows the known distribution in the WIO in detail.
REMARKS – Transverse dorsal banding is often the only field characteristic that makes *B. marmorata* distinguishable from the congeneric species *B. similis*, *B. vitiensis*, *B. tenuissima*, *B. bivittata* and *B. koellikeri*. As ROWE (*in* ROWE & GATES 1995) already noted, the species in the genus *Bohadschia* are in need of critical review. The ossicles of the examined specimens (see fig. 8) closely resemble the ones of *B. marmorata* described in CHERBONNIER (1988). However, the different *Bohadschia* species show a great variation in their ossicles (MASSIN 1996a: 1999), and overlap often occurs between the different valid species. This prompted THÉEL (1886), PEARSON (1903) and KOEHLER & VANEY (1908) to unite several species under the name *H. tenuissima* SEMPER, 1868 and later (PEARSON 1913) under *H. vitiensis* SEMPER, 1868. ROWE (*in* ROWE & GATES 1995) also used a 'sweeping synonymy' [sic] wherein *B. bivittata* (MITSIKURI, 1912), *B. koellikeri* (SEMPER, 1868), *B. similis* (SEMPER, 1868), *B. tenuissima* (SEMPER, 1868) and *B. vitiensis* (SEMPER, 1868) are put as synonyms of *B. marmorata*. I, however, feel that the type material of these supposed synonyms (type material for SEMPER'S species in ZMH, for MITSIKURI'S species in TIU) needs further detailed study and that at least *B. vitiensis* and *B. similis* must for now be regarded as valid species (see also MASSIN 1996a; 1999). I agree however with ROWE (*in* ROWE & GATES 1995) that much more material from different regions is needed to clarify the status of the taxa in the *Bohadschia* complex.

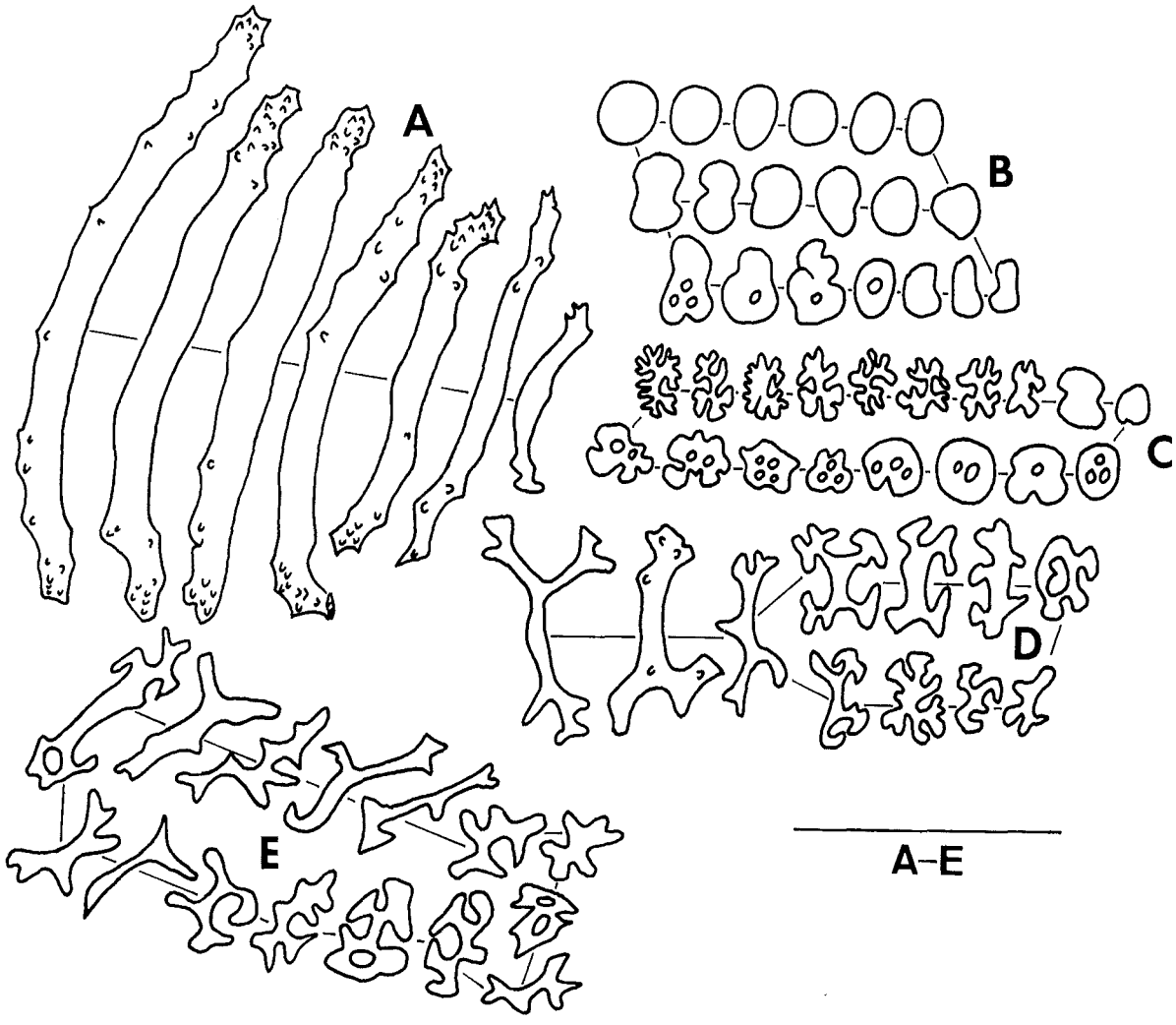


FIG. 8 – *Bohadschia marmorata* JAEGER, 1833. A. Rods of tentacles; B. Grains of ventral body wall; C. Perforated grains and rosettes of ventral tube feet; D. Rods of ventral tube feet; E. Rods of dorsal tube feet. Scale bar A-E represents 100 μm.

Bohadschia cf. *similis* (SEMPER, 1868)
(fig. 9A-E, fig. 52A, pl. 2A)

Holothuria similis SEMPER, 1868: 85, 277, pls 25, 30 pl., fig. 18.

Bohadschia similis; MASSIN 1996a: 14: fig. 8A-E (synonymy before 1996); CONAND 1998b: 1173; CONAND 1999: 10; SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488.

STATUS AND LOCATION TYPE – Holotype ZMH E.2640 (ROWE in ROWE & GATES 1995).

TYPE LOCALITY – Bohol (Philippines).

MATERIAL EXAMINED – KCi/9742 (one specimen).

GENERAL DESCRIPTION – The single preserved specimen at our deposition is 140 mm long and 45 mm wide and was retrieved from the shelves of the Kenya Marine and Research Institute. It is in bad shaped due to previous dissection, in which the calcareous ring was removed. The colour pattern in life is similar to the colour in alcohol (pl. 2A), although the latter is markedly lighter. Colouration in life: uniform yellow to light brown ventrally; brownish with numerous dark patches corresponding to the papillae dorsally. Mouth ventral, surrounded by 20 yellow to brown, short and small tentacles; surrounded at their base by a ring of small conical papillae. Anus large, dorsal. Brownish tube feet distributed over the radial and interradial areas ventrally. Dorsal papillae scattered over the total dorsal area. Cuvierian tubules present. Calcareous ring large with an anterior notch on the interradial pieces and with a single pointed tooth on the radial pieces (see MASSIN 1996a: 16, fig. 8A).

Ossicles: Ventral body wall with some perforated grains and numerous rosettes, 15 to 30 µm long (fig 9A). Dorsal body wall with rosettes of similar length (fig. 9B). Ventral tube feet with grains, rosettes and simple rods up to 65 µm in length (fig 9C). Dorsal papillae with simple rosettes (fig 9D). Tentacles with rods up to 230 µm long.

DIAGNOSIS – See PANNING 1929 [1931]: 112, fig. 3d, e.

ECOLOGY – The specimen was collected in a shallow sea grass bed of approximately 2 m depth. As the gut contents consist of fine sand we deduct that *B. similis* actively feeds on this substratum.

DISTRIBUTION IN THE STUDY REGION – Chale Island.

GEOGRAPHIC DISTRIBUTION – Ambon, Kenya, La Réunion, Mauritius, New Caledonia, Tahiti, the Philippines according to MASSIN (1996a), also known from the South China Sea according to LANE *et al.* (2000). Fig. 52A shows the known distribution in the WIO in detail, whereby it should be noted that the record for Kenya is new and that the record from La Réunion could not be tracked down (CLARK & ROWE 1971 list it from the Mascarene Islands; unspecified locality in CONAND 1999).

REMARKS – ROWE & DOTY (1977) and ROWE & GATES (1995) place *B. similis* as a junior synonym of *B. marmorata*, an opposite view to that of CHERBONNIER (1980, 1988), CHERBONNIER & FÉRAL (1984a), FÉRAL & CHERBONNIER (1986), CONAND (1989, 1998b), and MASSIN (1996a). As we have only a single specimen in our collection, intraspecific variation cannot be investigated now. Nevertheless, as the body wall of the specimen under investigation presents numerous rosettes together with few perforated grains and no imperforated grains; it has more affinity to *B. similis* then to *B. marmorata*. Moreover, the transverse banding, characteristic of *B. marmorata* was not visible in our specimen.

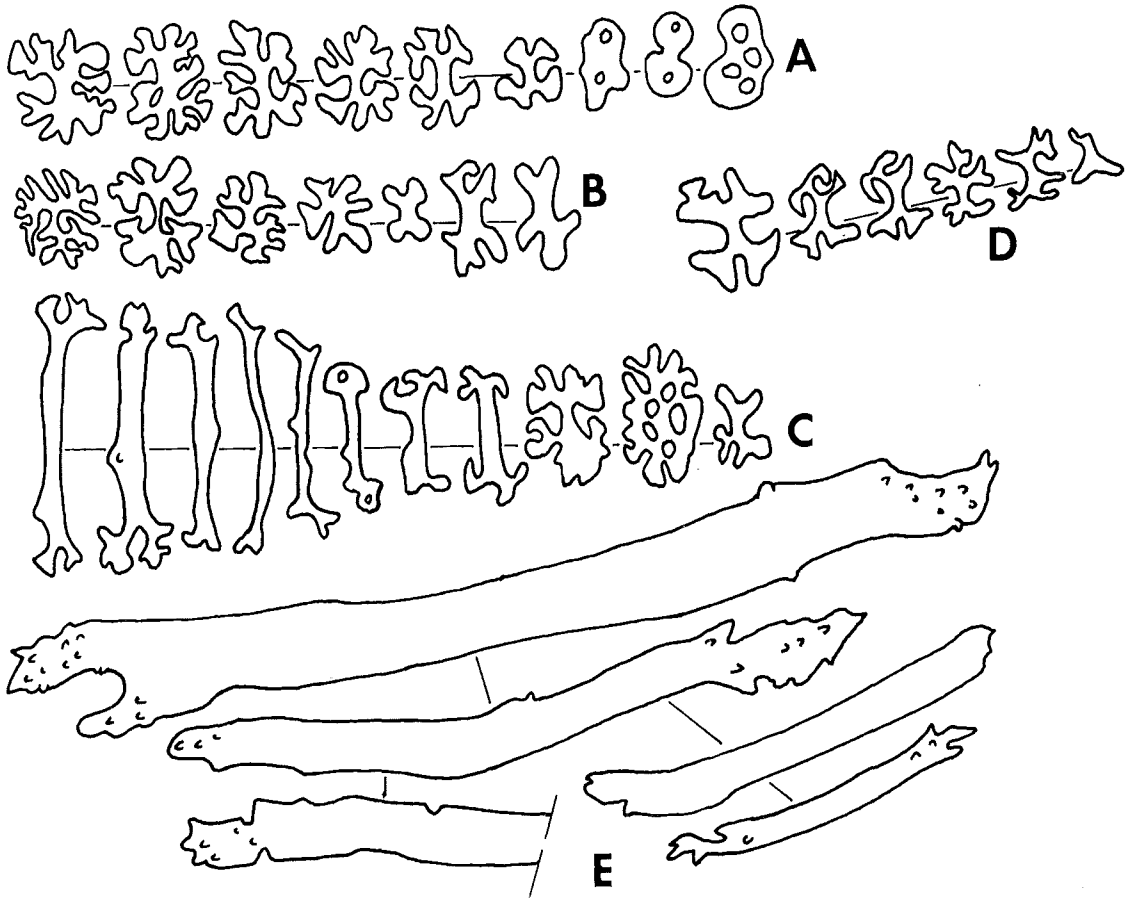


FIG. 9 – *Bohadschia* cf. *similis* (SEMPER, 1868). A. Rosettes of ventral body wall; B. Rosettes of dorsal body wall; C. Grains, rods and rosettes of ventral tube feet; D. Simple rosettes of dorsal pedicels; E. Large rods of tentacle. Scale bar A-E represents 100 µm.

Bohadschia subrubra (QUOY & GAIMARD, 1833) (fig. 10A-D, fig. 52B, pl. 2B)

Holothuria subrubra QUOY & GAIMARD, 1833: 136.
Bohadschia subrubra; MASSIN *et al.* 1999:155 (synonymy and records before 1999), figs. 3, 4, 5, pl. 1A,C, D (colour plate); CONAND 1999: 19, 20; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE, 2000: 5 (tab. 2), 17 (tab. 4), 20; MARSHALL *et al.* 2001: 46 (tab. 29).
Bohadschia aff. *subrubra*; CONAND 1999: pl. 2 (colour picture with *B. subrubra* on top)
Bohadschia cf. *subrubra*; CONAND 1999: 12, 39.
?Holothuria kollikeri; DANIEL & HALDER 1974: 423 (*non H. koellikeri* SEMPER 1868) (*lapsus calami*).
?Bohadschia koellikeri; HUMPHREYS 1981: 33 (*non H. koellikeri* SEMPER 1868).

STATUS AND LOCATION TYPE – Faculty of Sciences Lyon (CHERBONNIER 1952b).
TYPE LOCALITY – Ile aux Cerfs (Mauritius).
MATERIAL EXAMINED – IRSNB IG 28 628/Shar10 (one specimen); IRSNB IG 28 628/Mom89-92-93-94 (four specimens); IRSNB IG 28 628/Fun7 (one specimen).
GENERAL DESCRIPTION – Species up to 350 mm long and 130 mm wide. Bivium brown to orange with unevenly distributed dark brown to black areas. Trivium white, with tiny black spots between the tube feet (pl. 2B). Bivium clearly separated from the trivium by a brown line with dark brown triangular areas. Body wall smooth, 2-5 mm thick. Mouth ventral, surrounded by 18 stout, white tentacles. Anus dorsal, unguarded by anal teeth or papillae. Numerous ventral tube feet, white, very long, and scattered over the whole surface. Dorsal tube feet less numerous, scattered, white, clearly visible against the orange to brown dorsal body colour. Cuvierian tubules present, white, very readily ejected in large quantities. Single Polian vesicle. Single stone canal. Calcareous ring stout with radial pieces twice as high and wide as the interradial pieces; radial pieces with a deep central notch and two lateral hollows (see MASSIN *et al.* 1999: 155, fig. 3)
Ossicles: Body wall with rosettes (fig. 10B, C). Tube feet with rods, rosettes (fig. 10D) and a very large endplate (up to 450-500 µm across). Tentacles with large spiny rods (fig. 10A). (See also illustrations MASSIN *et al.* 1999).
DIAGNOSIS – See MASSIN *et al.* 1999: 155, figs 3-5; pl.1.A, C.
ECOLOGY – Found on sandy patches in patch reefs, also on coral rubble and sometimes on dead coral. Species often covers itself with pieces of algae and sea grass, and occasionally with shell fragments.
DISTRIBUTION IN THE STUDY REGION – Kiunga, Malindi, Watamu, Shariani, Kanamai, Mombasa, Chale Island, Shimoni, Vanga, Fundu.
GEOGRAPHIC DISTRIBUTION – Kenya, Kiunga, Sharianai, Kanamai, Mombasa, Chale Island, Malindi, Watamu, Vanga; Madagascar, Tuléar, Nosy Bé (MASSIN *et al.* 1999), Mauritius, Ile aux Cerfs (MASSIN *et al.* 1999); Republic of South Africa, Sodwana Bay and Bhanga Nek, KwaZulu-Natal (pers observ.), Tanzania, Pemba Island, Fundu North Reef (this work). Fig. 52B shows the known global distribution in detail.
REMARKS – Although this species was only recently re-described (MASSIN *et al.* 1999), it is one of the most ubiquitous aspidochirotid holothurians to be found in the shallow reef waters of East and South-East Africa (ROWE *in* ROWE & RICHMOND 1997; pers. observ.). HUMPHREYS (1981) described *B. koellikeri* (SEMPER, 1868) from Kenya, but his description makes me believe (SAMYN & VANDEN BERGHE 2000) that this specimen is in fact *B. subrubra*. Unfortunately the voucher specimens could not be found in any of the three museums: MRAC (pers observ.), NHM (pers. observ.) and NMK (VANDEN BERGHE, pers. comm.) where HUMPHREYS deposited his samples.

Table three lists the other *Bohadschia* species 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.

Genus *Labidodemas* SELENKA, 1867

DIAGNOSIS (retaken from MASSIN *et al.* in press) [Type species: *Labidodemas semperianum* SELENKA, 1867 by monotypy].
Size medium to moderate (100 to 200 mm long); body has two distinct morphotypes: vermiform or more cylindrical; ventral tube feet mainly in ambulacral areas, in one to four rows (sometimes also spread into the interambulacral areas); dorsal papillae and tube feet in ambulacral and often also in interambulacral areas, or altogether

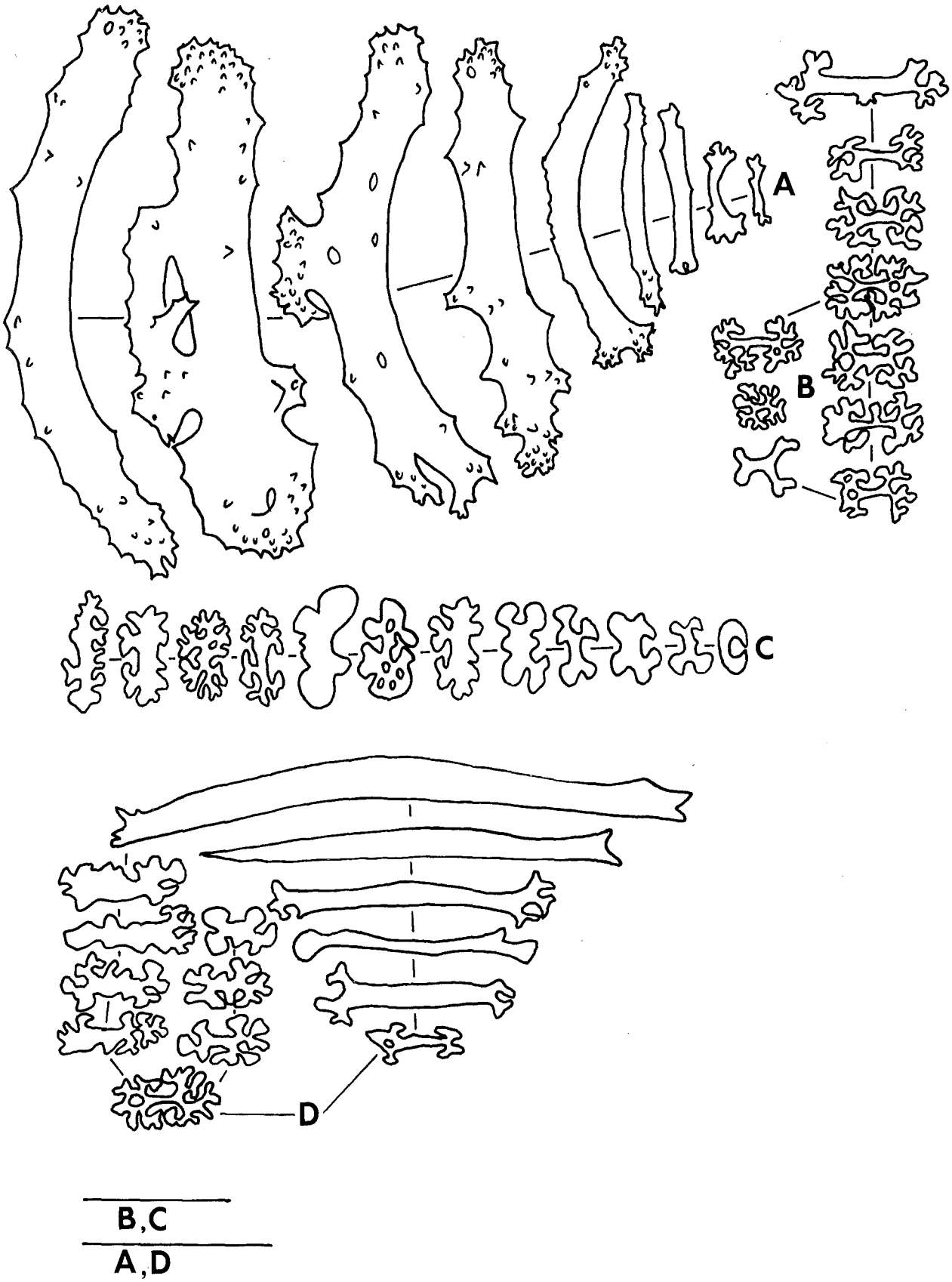


FIG. 10 – *Bohadschia subrubra* (QUOY & GAIMARD, 1833) A. Rods of tentacles; B. Rosettes of dorsal body wall; C. Rosettes of ventral body wall; D. Rods and rosettes of ventral tube feet. Scale bar B, C represents 100 µm; scale bar A, D represents 50 µm.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
B. argus JAEGER, 1833 (see also discussion)	Tanzania	MARSHALL *et al.* 2001
	Seychelles	LAMPERT 1885; MITSIKURI 1912; PANNING 1944
	Madagascar (Nosy Bé, Tuléar)	CHERBONNIER 1988; CONAND 1999
B. maculisparsa CHERBONNIER, 1980 (see also discussion)	SW Indian Ocean (unspecified)	CONAND 1999
B. mitsioensis CHERBONNIER, 1988 (see also discussion)	Madagascar (Nosy Bé)	CHERBONNIER 1988
B. steinitzi CHERBONNIER, 1963	Gulf of Aqaba (Eilat, Aqaba)	CHERBONNIER 1963; 1967; TORTONESE 1977; PRICE 1982
B. vitiensis (SEMPER, 1868)	Madagascar (Nosy Bé, Ile St. Marie, Tuléar)	CHERBONNIER 1988; CONAND 1999
	Eastern Africa	ROWE & RICHMOND 1997
	Kenya (Kiunga Marine Reserve)	OBURA *et al.* 1998
	Mauritius (Trou aux Biches, Riambel)	ARAKAKI & FAGOONEE 1996; CONAND 1999
	La Réunion	CONAND 1999
	Seychelles (Mahé: Ste. Anne Marine Park)	ARAKAKI & FAGOONEE 1996; CONAND 1999

TABLE 3 – Other species within the genus *Bohadschia* known to occur in the shallow-waters of the WIO.

absent; anal papillae present or absent. Species fugitive or fossorial, with thin body wall and 20 terminally placed tentacles. Calcareous ring with massive radial pieces and narrow ribbon-like interradial pieces. Body wall ossicles variously developed tables, either with disc reduced and spire low, ending in a cluster of firm, often bifurcate, spines frequently longer than radius of table disc, or with disc well developed and with low to moderate spire ending in a cluster of firm spines or a wide, centrally perforated crown; buttons (when present), usually with rim smooth to slightly knobbed, some buttons spiny, often irregular and incompletely formed; minute, occasionally perforate, branching or curved rods. Tube feet ossicles similar to those of body wall, with in addition rounded plates apparently derived from buttons. Tentacles always with small, smooth to slightly spiny rods. Longitudinal muscles devoid of ossicles. Cuvierian tubules present only in the central East Pacific *L. americanum*.

Until recently four species were recognized as being valid: *Labidodemas americanum* DEICHMANN, 1958; *L. pertinax* (LUDWIG, 1875); *L. rugosum* (LUDWIG, 1875), *L. semperianum* SELENKA, 1867. A recent revision (MASSIN *et al.* in press) of the genus resulted in several species new to science. Only *L. pertinax* is known to occur in the shallow-waters of Kenya as HUMPHREYS' (1981) voucher specimen of *L. semperianum* from Watamu proved to be *L. pertinax* (MASSIN *et al.* in press).

Labidodemas pertinax (LUDWIG, 1875) (fig. 11A-E, fig. 52C)

Holothuria pertinax LUDWIG, 1875: 24, pl. 7 fig. 50.
Labidodemas pertinax; MASSIN *et al.* in press (synonymy and records before 2002).

STATUS AND LOCATION TYPE – Holotype ZMH E.2608.
TYPE LOCALITY – Samoa (as Navigator Islands).
MATERIAL EXAMINED – KKiun/9919 (one specimen); KKiun/9920 (two specimens); Kenya (Watamu), 20.viii.1969, coll. W. Humphreys, NHM 1979.2.5.229 (one specimen identified as *L. semperianum*) (see also MASSIN *et al.* in press for a representative list of examined specimens coming from the complete distribution area).
GENERAL DESCRIPTION – Small to medium-sized species; preserved specimens from 70 to 105 mm long and 7-14 mm wide. Body cylindrical, tapering, with mouth and anus terminal. Body colour in life similar as colour after preservation (pl. 2C): uniform white dorsally with a very faint yellow to pinkish shine ventrally; mouth surrounded by a 5 mm wide dark-purple to brown ring in the largest specimen (1 mm wide in the smallest specimens). Skin thin but rather gritty to the touch. Mouth surrounded by 20 (occasionally fewer), small, dirty white, tentacles. Trivium with long, cylindrical, yellow to brown tube feet in the radial areas (in two rows in the median ambulacrum);

bivium with fewer, short, whitish tube feet spread over the ambulacral and interambulacral areas. Cuvierian tubules absent. Calcareous ring slender and ribbon-like with the radial pieces twice as wide as the interradial ones (see MASSIN *et al.* in press).

Ossicles: Tentacles with simple, smooth rods, 25-50 µm long (fig 11A). Dorsal and ventral body wall with simple or branching rods up to 200 µm long, and stout tables with spinose disc and crown (fig 11B, C). Tables with disc 40-65 µm across, perforated by four central holes and occasionally some small peripheral holes (see CHERBONNIER 1988: 52, fig. 18A, B, D, H); rim of disc regularly spiny; height of spire lower then width of disc; spire with no or single cross beam ending in a crown with a wide central opening; diameter of crown 60-90 % of disc diameter. Rods more abundant in ventral than in dorsal body wall; the reverse for the tables. Ventral tube feet with rods similar to those of the body wall and some ill-formed tables (fig. 11E). Dorsal tube feet comprise the same ossicle-assemblage as that of the ventral tube feet (fig. 11D).

DIAGNOSIS – See CHERBONNIER 1988: 51, fig. 18; MASSIN *et al.* in press.

ECOLOGY – Shallow water (only few meters deep); deposit/detritus feeder; hides under coral slabs in and on coarse coral debris.

DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000).

GEOGRAPHIC DISTRIBUTION – Tropical Indo-Pacific Ocean from the East coast of Africa (South Africa and Kenya) to Tahiti and from South Africa (KwaZulu-Natal) to China, however not recorded from the Red Sea and the Persian Gulf (see also global distribution map in MASSIN *et al.* in press). Figure 52C shows the WIO distribution in detail.

Table four gives the other *Labidodemas* species 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.

Genus *Holothuria* LINNAEUS, 1767

DIAGNOSIS (after ROWE, 1969: 133) [Type species: *Holothuria tremula* LINNAEUS, 1767 by monotypy]. Size very variable from small to very large; body morphology very variable, from slender vermiform to thick cylindrical, sometimes with a distinct flattened trivium; covered by tube feet and papillae which can be distributed over the ambulacral and the interambulacral areas of the dorsal and ventral sides; mostly 20 tentacles; calcareous ring well developed with the radial pieces two to three times as long as the interradial pieces; mouth often ventral, though sometimes terminal; anus dorso-terminal mostly without calcified papillae but often guarded by anal papillae. Ossicles: mostly with well-developed tables (except in the subgenus *Selenkothuria* and some species of the subgenus *Theelothuria*); smooth, perforated rods and plates or spinose rods; buttons often present.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
L.semperianum SELENKA, 1867	Gulf of Aqaba (Aqaba, Eilat)	TORTONESE 1977[1]; CHERBONNIER 1967[1]; PRICE 1982[1]
	Persian Gulf (Jurayd Islands)?	PRICE 1981; 1982
	Mauritius (Ile aux Cerfs, Albion, Blue Bay)?	ARAKAKI & FAGOONEE 1996
L. rugosum (LUDWIG, 1875) (see also discussion)	Somalia (Gesira)	TORTONESE 1980
	Seychelles (unspecified)	A.M. CLARK 1984
	Seychelles (Aldabra)	SLOAN *et al.* 1979
	Madagascar (Glorious Islands, Nosy Bé)	CHERBONNIER 1988
	South Africa (KwaZulu-Natal)	MASSIN *et al.* in press

TABLE 4 – Other species within the genus *Labidodemas* known to occur in the shallow-waters of the WIO. The records of *L. semperianum* from Mauritius (ARAKAKI & FAGOONEE 1996) and the Persian Gulf (PRICE 1981; 1982) are uncertain and might be misidentified individuals of *L. pertinax* (MASSIN *et al.* in press). [1] Cited as *Holothuria proceraspina* CHERBONNIER.

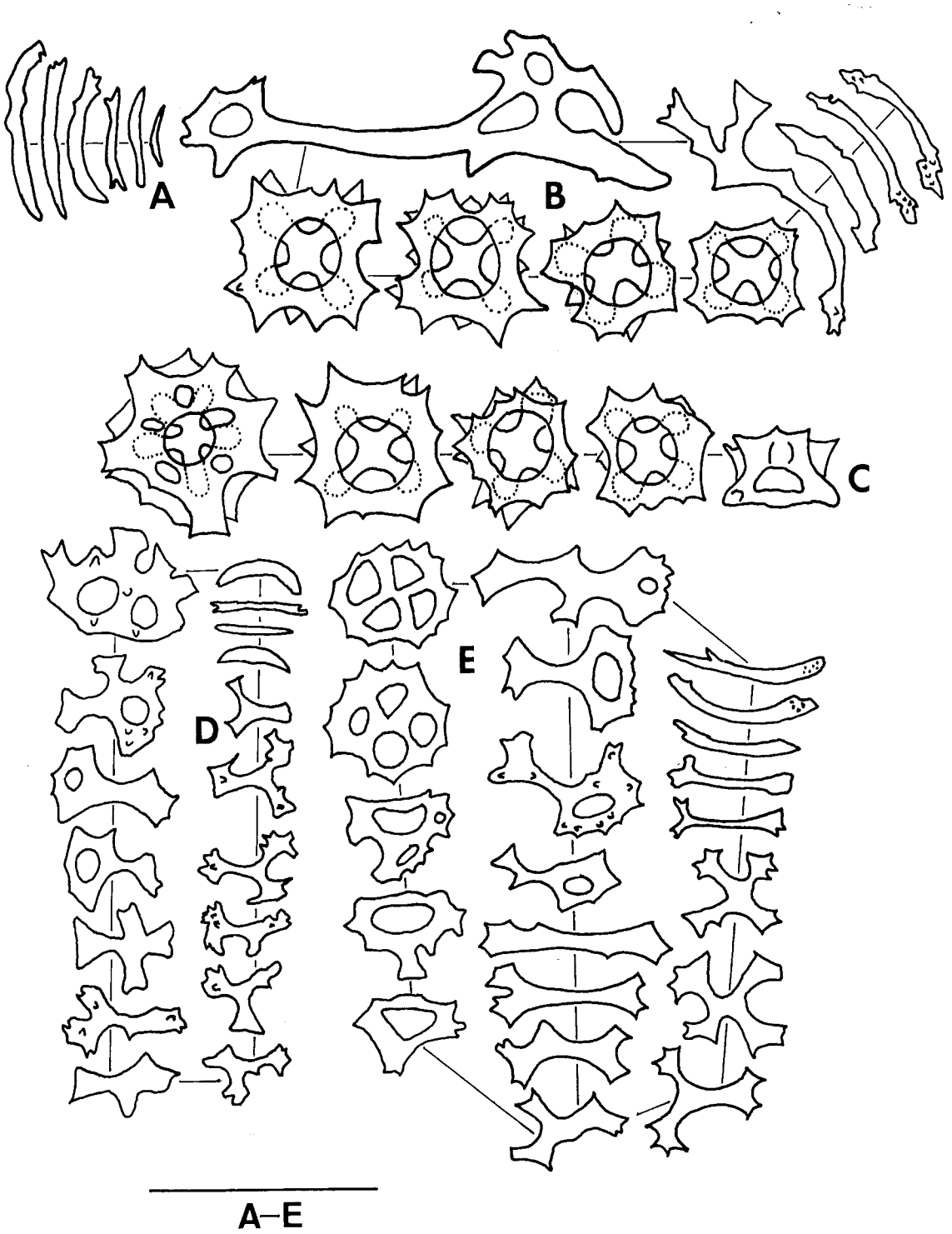


FIG. 11 – *Labidodemas pertinax* LUDWIG, 1875. A. Rods of tentacles; B. Tables and rods of dorsal body wall; C. Tables of ventral body wall; D. Rods of dorsal tube feet; E. Plates and rods of ventral tube feet. Scale bar A-E represents 100 μm.

KEY TO THE SUBGENERA OF KENYA (WITH PEMBA ISLAND) (after ROWE 1969: 126)

1. Tables said to be present in some species, but if so always reduced in form and sparsely distributed in the body wall; mostly perforated plates and rods only . . . . . ***Selenkothuria*** **DEICHMANN, 1958**
1'. Tables always present; usually well developed; alone or in combination with buttons, pseudobuttons, rods or rosettes **2**
2. Tables usually well developed; always in combination with buttons or pseudobuttons; never with rosettes or rods in the body wall. **5**
2'. Tables variously developed; always in combination with rods or rosettes; never with buttons or pseudobuttons. **3**
3. Tables in combination with rosettes only, never with rods in the body wall. **4**
3'. Tables in combination with spinose rods, never with rosettes. . . . . ***Semperothuria*** **DEICHMANN, 1958**
4. Tables with reduced disc, spire as high as the disc diameter is wide (occasionally higher) and spire ending in a few spines forming a Maltese cross when viewed from above . . . . . ***Halodeima*** **PEARSON, 1914**
4'. Table with well developed spinose disc; it's rim often turned to give a 'cup and saucer' appearance to the table in lateral view . . . . . ***Acanthotrapeza*** **ROWE, 1969**
5. Table disc usually squarish or octogonal in outline, perforated by a large centrally placed cruciform hole and a variable number of regular peripheral holes; buttons present . . . . . ***Stauropora*** **ROWE, 1969**
5'. Tables variously developed, disc never perforated by a large centrally-placed cruciform hole **6**
6. Buttons of the body wall knobbed or rugose **7**
6'. Buttons of the body wall generally smooth. **10**
7. Squat-or tack like tables usually present. . **8**
7'. Tables never squat or tack-like, always very robust. **9**
8. Tables squat-like; disc usually knobbed; buttons simple with large regularly or irregularly arranged knobs . . . . . ***Cystipus*** **HAACKE, 1880**
8'. Tack-like tables usually present; table disc spinose, slightly knobbed . . . . . ***Theelothuria*** **DEICHMANN, 1958**
9. Table disc smooth, spire variable in length terminating in a dense crown of spines; buttons mostly modified into hollow fenestrated ellipsoids, some simple knobbed buttons may also be present. . . . ***Microthele*** **BRANDT, 1835**
9'. Buttons never modified into spheres; buttons simple with moderate-sized irregularly arranged knobs and 3-6 pairs of relatively large holes . . . . . ***Metriatyla*** **ROWE, 1969**
10. Table disc smooth, buttons smooth, regular in outline **11**
10'. Table disc spinose; buttons generally more irregular, often twisted **12**
11. Buttons without optical discontinuity . . . . . ***Thymiosycia*** **PEARSON, 1914**
11'. Buttons very thin; with optical discontinuity . . . . . ***Platyperona*** **ROWE, 1969**
12. Tables stellate; buttons twisted; longitudinal muscles without ossicles whatsoever . . . . . ***Lessonothuria*** **DEICHMANN, 1958**
12'. Tables poorly developed; buttons irregular, perforated by 3-6 pairs of holes; ventral tube feet with rods, buttons and wide plates; longitudinal muscles with rods, buttons and oblong rings . . . . . ***Mertensiothuria*** **DEICHMANN, 1958**

Subgenus *Acanthotrapeza* ROWE, 1969

DIAGNOSIS – (See ROWE 1969: 138) [Type-species: *Holothuria pyxis* SELENKA, 1867 by original designation].

Four species are currently recognized as being valid: *Holothuria (Acanthotrapeza) coluber* SEMPER, 1868; *H. (A.) kubaryi* LUDWIG, 1875[4]; *H. (A.) pyxis* SELENKA, 1867 and *H. (A.) tripilata* MASSIN, 1987.

Table five gives the only record (*H. (A.) pyxis*) within the subgenus *Acanthotrapeza* that is known to occur in the shallow-waters of the WIO. I hesitate in placing this species between the WIO records, because LEVIN's (1979) record from Mombasa (see also fig. 53C) is hard to verify since the mention of the species is without description and without drawings. Moreover, the species has not been recorded from the western side of the Indian Ocean (CLARK & ROWE 1971)

[4] F.W.E. ROWE (pers. comm.) remarks that *H. (A.) kubaryi* might be a synonym of *H. (Cystipus) rigida* (SELENKA, 1867).

prior to LEVIN's (1979) observation. For completeness, it must be noted that CONAND (1999) mentions *H. (A.) coluber* SEMPER, 1868 from the South East Indian Ocean. However, as the distribution map of MASSIN (1999: fig 12, p. 19) gives a rather narrow East Indo-West Pacific Ocean distribution for this species, it is not considered here.

Subgenus *Cystipus* HAACKE, 1880

DIAGNOSIS (after ROWE 1969: 155) [Type-species: *Cystipus pleuripus* HAACKE, 1880 (= *Stichopus rigidus* SELENKA, 1867) by original designation] Size variable, usually moderate, sometimes up to 200 mm long; body usually vermiform in shape; tube feet in the ventral area restrained more or less to the ambulacral areas; small papillae evenly distributed dorsally; mouth ventral, surrounded by twenty tentacles; calcareous ring well-developed with radial pieces about twice as long as the interradial pieces; anus terminal; body wall thin but rough to the touch. Ossicles: body wall presents tables with large, regularly knobbed disc and low spiny spire; buttons with four to six holes, regularly knobbed, often with a distinct knob at the median extremities of the buttons; ventral tube feet with elongated smooth buttons; dorsal papillae with centrally enlarged plates.

Eleven species are currently recognized as being valid: *Holothuria (Cystipus) cubana* LUDWIG, 1875; *H. (C.) dura* CHERBONNIER & FÉRAL, 1981; *H. (C.) inhabilis* SELENKA, 1867; *H. (C). jousseaumei* CHERBONNIER, 1955; *H. (C.) mammosa* CERBONNIER, 1988; *H. (C.) occidentalis* LUDWIG, 1875; *H. (C.) pseudofossor* DEICHMANN, 1930; *H. (C.) rigida* (SELENKA, 1867); *H. (C.) sucosa* ERWE, 1919; *H. (C.) sulcata* LUDWIG, 1875; *H. (C.) turrisimperfecta* CHERBONNIER, 1964.

It must, however, be stressed that this subgenus is in critical need of review. ROWE's (1969) notes on *H. rigida* (compared to *H. cubana, H. inhabilis, H. jousseaumei,* and *H. pseudofossor*), in combination with CHERBONNIER's observations (1988) on *H. rigida, H. cubana* and *H. inhabilis* might serve as a guide to establish synonyms in this ill-studied group. In this context, it is noteworthy that (i) *H. cubana, H. jousseaumei* and *H. rigida* are the only ones in *Cystipus* which present hollow fenestrated spheres, (ii) ROWE (1969, partially based on DEICHMANN 1958) suspects that *H. rigida* & *H. jousseaumei* and *H. pseudofossor* & *H. inhabilis* might be conspecific[5]; (iii) CHERBONNIER (1988) observed that SELENKA's (1867) description of *H. rigida* was based upon specimens originating from Zanzibar, Society Islands and Florida even as the ones from the latter locality are most probably conspecific with *H. cubana* (= *H. fossor* DEICHMANN, 1926 according to DEICHMANN 1958 and CHERBONNIER 1988); (iv) CHERBONNIER (1988) suspects that *H. inhabilis* from the Society and Hawaiian Islands are conspecific with *H. rigida.*

Holothuria (Cystipus) rigida (SELENKA, 1867) (fig. 12A-E, fig. 52D, pl. 2C)

Stichopus rigidus SELENKA, 1867: 317, pl. 18, figs. 30-31 (*partim*).

Stichopus rigidus; DANIEL & HALDER 1974: 423.

Holothuria rigida; SEMPER 1868: 79; SEMPER 1869: 120; LAMPERT 1885: 76; THÉEL 1886: 231; DANIEL & HALDER 1974: 427; HICKMAN 1998: 55 (colour picture).

Cystipus rigidus HAACKE, 1880: 47.

Holothuria pleuripus; DANIEL & HALDER 1974: 423.

Holothuria (Cystipus) rigida; HUGHES & GAMBLE 1977: 355; SLOAN *et al.* 1979: 121; PRICE 1981: 9; TAN TIU 1981: 81, 109 pl.23; PRICE 1982: 10; PRICE 1983: 89; A.M. CLARK 1984: 99; CANNON & SILVER 1986: 22, figs 3e, 6b (colour drawing); PRICE & REID 1985: 4; FÉRAL & CHERBONNIER 1986: 80 (colour picture), 81; CHERBONNIER 1988: 126 (synonymy); MUKHOPADHYAY 1991: 413; ROWE & GATES 1995:290; LANE *et al.* 2000: 488; SAMYN 2000: 15 (tab. 1); SAMYN & VANDEN BERGHE 2000:

[5] Examination of *H. (C.) jousseaumei* specimens from the Seychelles deposited in the MRAC showed that the species is definitely valid.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Acanthotrapeza) pyxis SELENKA, 1867	Mombasa	LEVIN 1979

TABLE 5 – *Holothuria (Acanthotrapeza) pyxis* SELENKA, 1867, the only species within *Acanthotrapeza* known to occur in the shallow-waters of the WIO.

5 (tab. 2), 17 (tab. 4), 21, pl. 1H (colour picture).
Holothuria (Cystipus) rigida?; ARAKAKI & FAGOONEE 1996: 122.

STATUS AND LOCATION TYPE – Lectotype MCZ 694 (ROWE & GATES 1995).
TYPE LOCALITY – Society Islands.
MATERIAL EXAMINED – KKiun/9948 (one specimen).
GENERAL DESCRIPTION – Medium sized species, 125 mm long and 25 mm wide after preservation. Body colour in life white to yellow ventrally and somewhat lighter dorsally (pl. 2C). Body wall thin but gritty to the touch. Mouth ventral, surrounded by 20 small, yellowish brown tentacles. Anus terminal, surrounded by conical papillae. Tube feet in trivium evenly distributed in radial and interradial areas; conical papillae in bivium in radial areas only. Cuvierian tubules absent. Calcareous ring with radial pieces twice the size of the interradials; radial plate with a large central notch anteriorly, interradial plate toothed anteriorly (see CHERBONNIER 1988: 127, fig. 51L)
Ossicles: Tentacles with spinose rods, up to 180 μm long (fig 12A). Ventral and dorsal body wall with similar tables and buttons (fig. 12B). Tables (fig.12B): disc knobbed at the periphery, perforated by up to 18 holes, up to 100 μm across; pillars short, united by no or a single cross beam, ending in a narrow crown of spines. Buttons (fig. 12C): knobbed regularly, often with a characteristic terminal knob at the median extremities. Ventral tube feet with elongated buttons and narrow plates (fig 12D) in addition to tables that are less developed as those from the body wall. Dorsal papillae with rods and rod-like plates up to 200 μm long (fig 12E).
DIAGNOSIS – See CHERBONNIER 1988: 126-129, fig.51.
ECOLOGY – Eulittoral species, in Kenya found in shallow water; H.L. CLARK (1946) reports *Holothuria rigida* from the Great Barrier Reef at depths of 20 m. Burrows under coral rubble.
DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve (See SAMYN & VANDEN BERGHE, 2000).
GEOGRAPHIC DISTRIBUTION – Indo Pacific Ocean, with the Red Sea and the Persian Gulf (CLARK & ROWE 1971; CHERBONNIER 1988). SELENKA (1867), SEMPER (1868), LAMPERT (1885) and THÉEL (1886) also reported the species from Florida; but these records are probably misidentified *H. (C.) cubana* LUDWIG, 1875. Figure 52D gives the known WIO distribution in detail.
REMARKS – H.L. CLARK (1946) noted that it was recognized long ago that several species [*i.e. H. rigida* (SELENKA, 1867) (based on SEMPER's (1868) figures) and *H. inhabilis* SELENKA, 1867] were included under SELENKA's types of *Stichopus rigidus* (see also DEICHMANN 1958: 321). In the original description of *Stichopus rigidus,* SELENKA (1867: 317) described Cuvierian tubules ('am Grunde des rechten Lungesbaumes Cuvier'sche Organe in Büscheln, deren Schläuche getheilt sind' [Sic.]), although it is not certain on which specimen(s) SELENKA based his description. It is interesting to note, that in the same paper, SELENKA (1867: 333) described *H. inhabilis* that apparently has no Cuvierian tubules ('Cuvier'sche Organe nicht gesehen' [Sic.]). In 1946, H.L. CLARK stated that the specific status of *H. inhabilis* and *H. rigida* may be open to question but that 'in my [his] opinion they are distinct and can be told apart by the tables, though each species may have atrophied or hypertrophied tables resembling those normal to the other [Sic.]', an opinion that subsequently was magnified by DEICHMANN (1958) who created the genus *Fossothuria* for *rigida* and the genus *Jaegerothuria* for *inhabilis*. ROWE (1969: 156, 157) emended this generic division and put *Fossothuria* and *Jaegerothuria* as synonyms of *Cystipus* HAACKE, 1880; a name available under the rules of the Code (A.M. CLARK & ROWE 1967). Even though ROWE (1969) puts a different taxonomic weight to the species, he kept them apart without too much doubt. In my interpretation of ROWE's writing, this division was mainly based on distribution (Indo-Pacific for *H. rigida*, while East Indies, Pacific and Panamic for *H. inhabilis*) rather than on morphological criteria. A different view to this problem came from CHERBONNIER (1988) who stated that SELENKA's (1867) type series included *H. rigida* specimens (with Indo-Pacific distribution) and *H. cubana* LUDWIG, 1875 (with eastern Atlantic distribution). In addition, CHERBONNIER (1988) put forward the hypothesis (without testing it) that *H. inhabilis* and *H. rigida* might be conspecific for SELENKA (1867) might have missed the presence of Cuvierian tubules in the former. The one specimen, currently at my disposition fits well with the available descriptions of *H. (C.) rigida*, even though I fail to report Cuvierian tubules.

In conclusion, it is clear that only an in depth examination of the type material of *H. inhabilis* (which, according to SELENKA'S description, does not present Cuvierian tubules) compared to the type material of *H. rigida* will bring certainty to this matter. As up to-date, only *H. (C.) rigida* has been reported from the WIO, I believe a conservative attitude is best, and identify the present specimen as *H. (C.) rigida.*

Holothuria (Cystipus) cf. rigida (SELENKA, 1867)
(fig. 13A-J, pl. 2D)

STATUS AND LOCATION TYPE – See *H. (Cystipus) rigida.*

TYPE LOCALITY – See *H. (Cystipus) rigida.*

MATERIAL EXAMINED – KCi/9760 (one specimen).

GENERAL DESCRIPTION – The single specimen at our disposition is in very bad shape; completely eviscerated apart from the right respiratory tree that reaches almost to the buccal end of the animal. Calcareous ring and tentacles have been cut out. Medium sized species, 200 mm long and 54 mm wide after preservation. Body colour in life white dorsally and orange ventrally (pl. 2D); posterior side with a wide (3 cm) white ring. Body wall 3 mm thick, gritty to the touch. Mouth ventral, surrounded by 15(?) small tentacles, white at base, yellowish distally. Anus terminal, surrounded by five white uncalcified conical papillae. Tube feet in trivium distributed in radial areas; tube feet in bivium very sparsely spread without order over

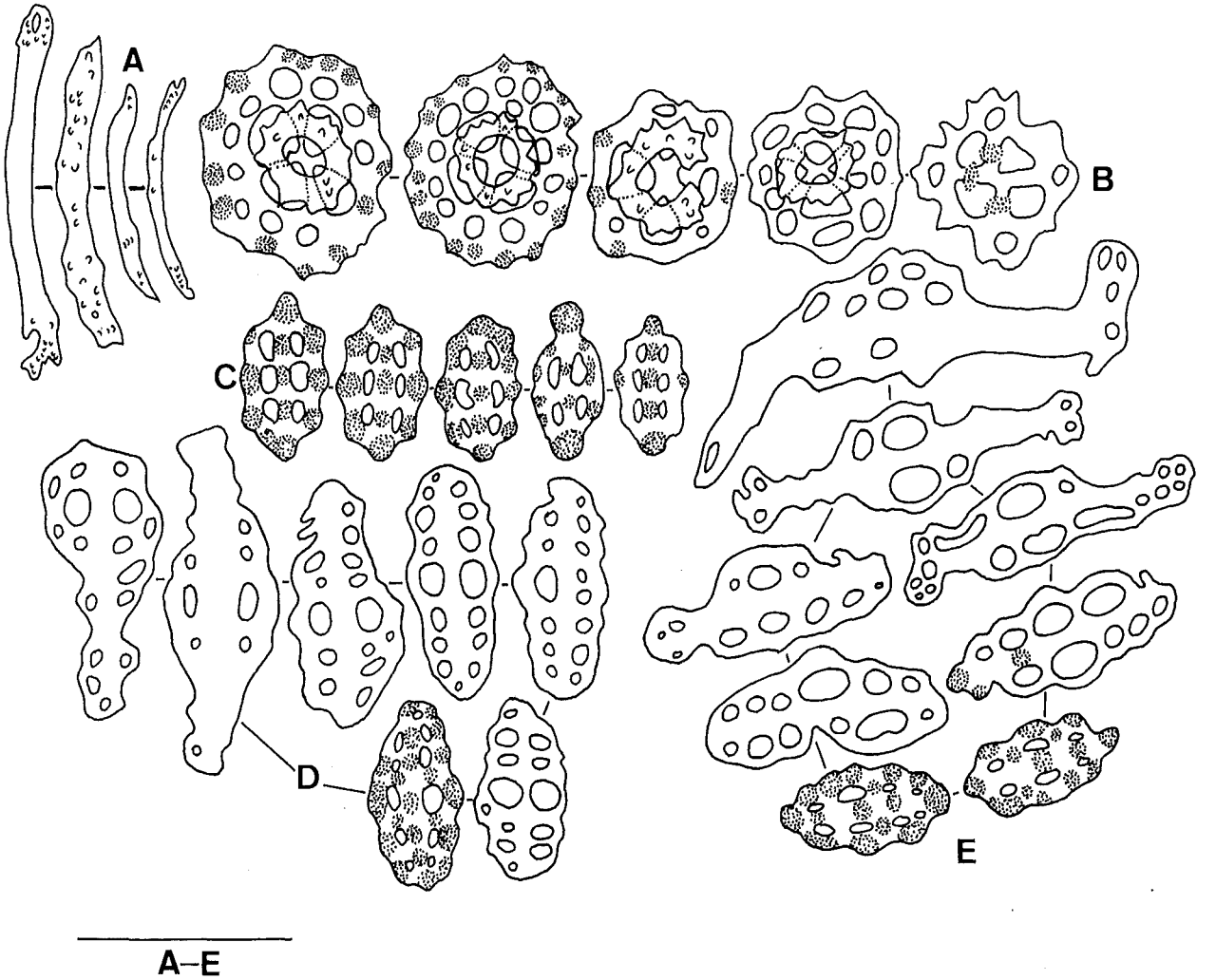


FIG. 12 – *Holothuria (Cystipus) rigida* (SELENKA, 1867). A. Rods of tentacles; B. Tables of body wall; C. Buttons of body wall; D. Buttons and narrow plates of ventral tube feet; E. Buttons and plate-like rods of dorsal papillae. Scale bar A-E represents 100 μm.

the total surface. Presence of Cuvierian tubules could not be ascertained as only the right respiratory tree remains). Number of Polian vesicle(s) and stone canal(s) not determinable. Calcareous ring similar as the one described for *H. (C.) rigida.*

Ossicles: Tentacles with spinose rods up to 200 µm long (fig 13A). Ventral and dorsal body wall with similar tables and buttons (fig. 13B-E). Tables numerous, rim of disc undulating to spiny, disc often knobbed at the edge, 60-75 µm across, perforated by four central and few peripheral holes, pillars short (no cross beam) ending in a spiny crown (fig. 13B, E). Buttons very numerous, three to five pairs of small holes, knobbed at the rim and in the centre, 55-110 µm long; occasionally some unknobbed plate-like rods also present (fig. 13C, D). Dorsal tube feet with tables and buttons similar to the ones of the body wall, oblong or pear-shaped plates, 100-150 µm long (fig. 13G), and perforated rods, up to 210 µm long (fig. 13F). Ventral tube feet with buttons and tables similar to the ones from the body wall; rods, 115-220 µm long, curved to straight, with or without median thickening and perforations (fig. 13H) and plate-like buttons (fig.13J)

DIAGNOSIS – See *H. (Cystipus) rigida.*

ECOLOGY – Unknown.

DISTRIBUTION IN THE STUDY REGION – Chale Island only.

GEOGRAPHIC DISTRIBUTION – See *H. (Cystipus) rigida.*

REMARKS – The gritty touch of the body wall, the absence of a collar of papillae around the base of the tentacles, the tables with knobbed disc and low spire and none to a single cross beam, and the immensity of large-size knobs on the buttons, perforated by three to five small holes, are characters reminiscent of the subgenus *Cystipus.* However, as we have only one, poorly preserved, specimen at our disposition, identification to the species level is difficult. The regular arrangement of the knobs on the buttons, the knobbed table discs and the low spire presented by the specimen under study, bears closest resemblance to *H. (C.) rigida.* However, it differs from the specimen described above by its colouration, the thickness of the body wall and the presence of pear-shaped plates in the dorsal tube feet (see also remarks with the previous species).

Table six gives the other species in the holothurian subgenus *Cystipus* 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 distribution in the WIO, while column three provides the reference wherein the record(s) appeared. DANIEL & HALDER (1974) put *H. (Cystipus) occidentalis* LUDWIG, 1875 between the species from the South-West Indian Ocean (locality mentioned is E. coast of Africa); however, I cannot agree with this locality for this species is known only from the Atlantic Ocean (see LUDWIG 1875; THÉEL 1886; DEICHMANN 1930; PANNING 1935d). It seems that DANIEL & HALDER (1974) have confused the ancient name "West Indies" (*i.e.* Caribbean and the North Coast of South America) with West Indian. PRICE's (1982) record of *H. (C.) inhabilis* SELENKA, 1867 from South East Arabia is likewise not considered in the present study for this species is only known from the tropical, east and west central Pacific Ocean (ROWE & GATES 1995). To add to the confusion CLARK & ROWE (1971) mention VANEY's (1905) paper for records from S.E. Arabia. However, VANEY (1905) dealt with the holothurians of Djibouti (côte Française des Somalis), whereby *H. (C.) inhabilis* was not mentioned.

Subgenus *Halodeima* PEARSON, 1914

DIAGNOSIS (after ROWE 1969: 137-138) [Type-species: *Holothuria atra* JAEGER, 1833 by original designation].

Size moderate to large, up to 350 mm long; body elongated, as good as cylindrical; tube feet distributed over the total body surface, more numerous on the ventral side than on the dorsal side, mostly not clearly arranged in rows; mouth ventral surrounded by twenty tentacles; calcareous ring stout, radial pieces up to three times the length of the interradial pieces; anus dorso-terminal. Ossicles consist of tables with reduced, sometimes spiny disc, moderate or high spire, forming a Maltese cross when viewed from above, rosettes, plates and pseudo-plates. Large flattened or spinose rods are never present in the body wall. Eleven species are currently recognized as being valid: *Holothuria (Halodeima) atra* JAEGER, 1833; *H. (H.) chilensis* SEMPER, 1868; *H. (H.) edulis* LESSON, 1830; *H. (H.) floridana* POURTALÈS,

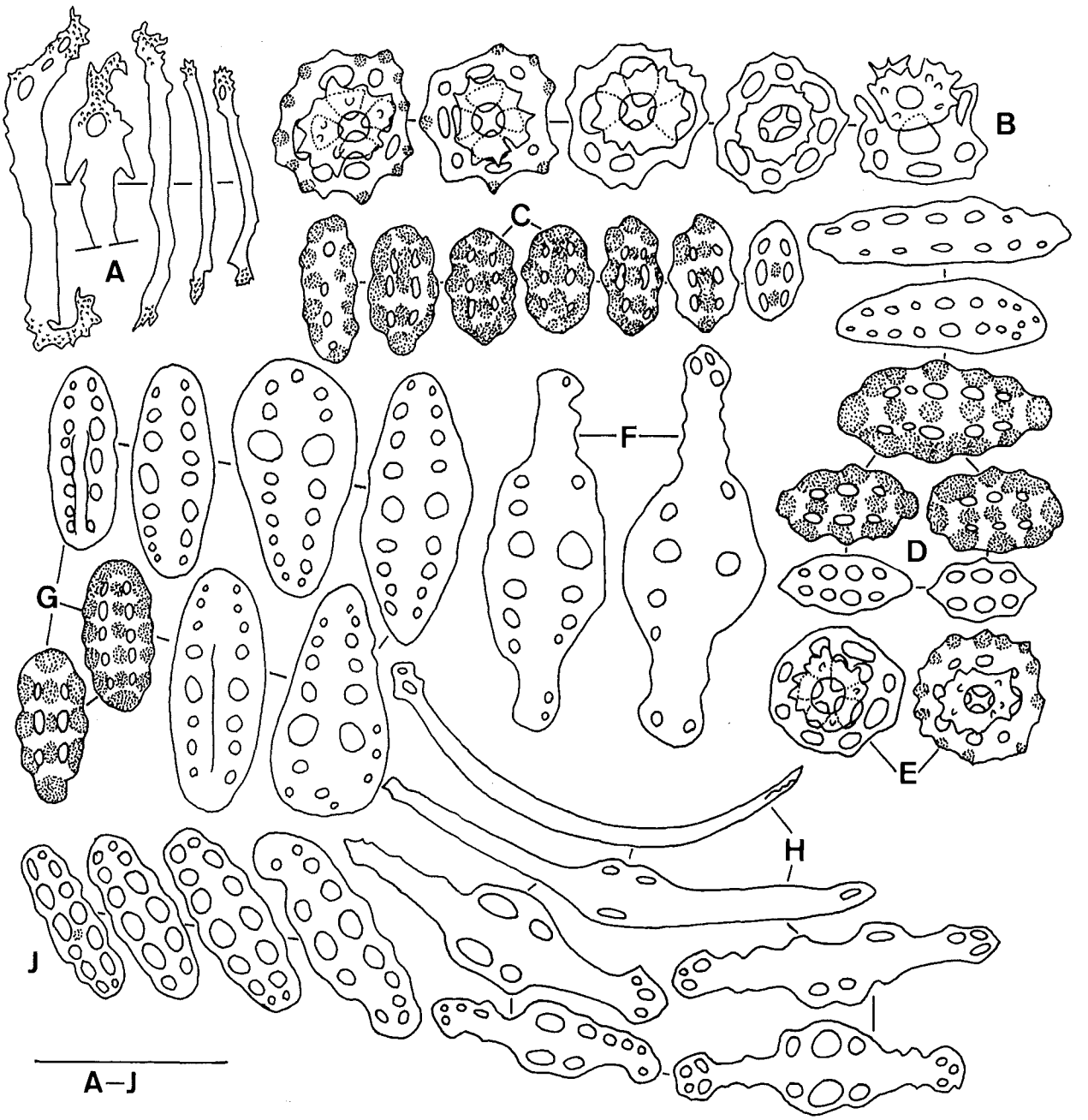


FIG. 13 – *Holothuria (Cystipus)* cf. *rigida* (Selenka, 1867). A. Rods of tenatcles; B. Tables of ventral body wall; C. Buttons of ventral body wall; D. Buttons of dorsal body wall; E. Tables of dorsal body wall; F. Perforated rods of dorsal tube feet; G. Plates and buttons of dorsal tube feet; H. Rods of ventral tube feet; J. Buttons of ventral tube feet. Scale bar A-J represents 100 μm.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Cystipus) jousseaumei CHERBONNIER, 1954 (see also discussion)	Gulf of Aden (Djibouti)	CHERBONNIER 1954a; 1955
	Red Sea (Entedebir)	CHERBONNIER 1954a; 1955; 1967; DANIEL & HALDER 1974
	Gulf of Aqaba (Aqaba)	TORTONESE 1977
	Seychelles (Mahé)	MRAC record (pers. observ.)
	Madagascar (Nosy Bé)	CHERBONNIER 1988
H. (Cystipus) mammosa CHERBONNIER, 1988	Red Sea (Massaua, Entedebir Isl.)	TORTONESE 1936a[1]; CLARK & ROWE 1971
H. (Cystipus) sucosa Erwe, 1919 (see also discussion)	Gulf of Suez (Gimsay Bay, Tor)	HELFER 1912[2]; ERWE 1919; PRICE 1982
	Gulf of Aqaba (Dahab, Aqaba)	A.M. CLARK 1952; TORTONESE 1977; DANIEL & HALDER 1974; PRICE 1982

TABLE 6 – Other species within the holothurian subgenus *Cystipus* known to occur in the shallow-waters of the WIO. [1] Cited as *Holothuria ocellata* JÄGER; [2] as *Cucumaria hartmeyeri* HELFER.

1851; *H. (H.) grisea* SELENKA, 1867; *H. (H.) kefersteinii* (SELENKA, 1867); *H. (H.) manningi* PAWSON, 1978; H. *(H.) mexicana* LUDWIG, 1874; *H. (H.) pulla* SELENKA, 1867, *H. (H.) signata* LUDWIG, 1875 and *H. (H.) stocki* CHERBONNIER, 1964. Two other species: *H. dicorona* HEDING, 1934 and *H. pseudoimitans* CHERBONNIER, 1951 are also listed under *Halodeima* (SMILEY & PAWSON unpublished manuscript), but the taxonomic position of these is *terra incognita* to me. *H. (H.) atra, H. (H.) edulis, H. (H.) floridana* and *H. (H.) pulla* are reported from the western Indian Ocean; but as the identification or the validity of the latter two species is doubtful only *H. (H.) atra* and *H. (H.) edulis* are keyed hereunder.

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

1. Body colour in life completely black. Tables: disc small; rim smooth, sometimes spiny; perforated by four central and four peripheral holes. Rosettes mostly incomplete, with two to four holes. Tube feet with tables with spire very reduced, simple rosettes and large pseudo-plates. . . . . ***Holothuria (Halodeima) atra* JAEGER, 1833**

1'. Body colour in life chocolate brown to dark-grey dorsally; salmon pink to red ventrally.. Tables: disc perforated by one central hole. Button-like rosettes, with up to ten holes. Tube feet without tables, with rods, large pseudobuttons and large perforated plates . . ***Holothuria (Halodeima) edulis* LESSON, 1830**

Holothuria (Halodeima) atra JAEGER, 1833 (fig. 14A-D, fig. 52E, pl. 2E)

Holothuria atra JAEGER, 1833: 22; TORTONESE 1936b: 13; TORTONESE 1953a: 40; KALK 1954: 113 (from THANDAR 1984); KALK 1958: 216; MACNAE & KALK 1958: 43, 99, 101, 104, 107, 130 (from THANDAR 1984); KALK 1959: 5; MACNAE & KALK 1962: 108, 112, 118; CHERBONNIER 1963: 5; CHERBONNIER 1967: 56; DANIEL & HALDER 1974: 428; BRANCH & BRANCH 1981: 248 (from THANDAR 1984); HICKMAN 1998: 45 (colour plates); BRANCH *et al.* 1999: 204; CONAND 1999: 10, 12; MARSHALL *et al.* 2001: 46 (tab. 29), 47, 58 (tab. 37).

Holothuria atra ambonensis THÉEL, 1886; DANIEL & HALDER 1974: 423.

Halodeima atra; HEDING 1940a: 113; A.M. CLARK 1952: 204; CHERBONNIER 1979a: 861; CONAND 1999: 10, 12, 18, 39, pl. 2 (colour picture).

Holothuria (Halodeima) atra; MUKHOPADHYAY 1991: 404, 413; ARAKAKI & FAGOONEE 1996: 122; MASSIN 1999: 20 (synonymy and records before 1999), fig. 13 (distribution); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 22, 23 (tab. 5).

Holothuria floridana; SELENKA 1867: 324 (non *H. floridana* POURTALES); DANIEL & HALDER 1974: 423 (non *H. floridana* POURTALES).

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

TYPE LOCALITY – Sulawesi (as Celebes), Indonesia.

MATERIAL EXAMINED – KKiun/9929 (one specimen); KKiun/9930 (five specimens); KKan/9705 (one specimen); KKan/9706 (one specimen); KKan/9707 (one

specimen); KCi/9747 (one specimen); KCi/9748 (one specimen); KShar/9733 (one specimen); KMom/9825 (one specimen); KMal/9883 (one specimen); TFun/9826 (one specimen); TFun/9827 (one specimen).

General description – Body cylindrical, up to 300 mm long and 70 mm wide, after preservation. Body colouration after preservation similar to colour in life: uniform black (pl. 2E). Body wall relatively thin, smooth, often covered with fine sand, leaving bare some isolated patches. Mouth ventral, surrounded by 20 short, black tentacles. Anus terminal, unguarded. Ventral tube feet, short, black, distributed in radial and interradial areas; dorsal tube feet short, black, distributed over the total surface. Cuvierian tubules absent. Several stone canals (8-10) positioned in two clusters. Several Polian vesicles of which one or two are markedly longer. Calcareous ring stout with the radial pieces three times as long as the interradial pieces (see Cherbonnier 1988: 74, fig. 28J).

Ossicles: Tentacles with simple rods (fig. 14A). Ventral and dorsal body wall with similar tables and rosettes. Tables from the ventral body wall with a larger, more spinose disc than tables from the dorsal body wall (fig. 14B, C). Table disc perforated by four central and four peripheral holes, with high spire ending in a Maltese cross (fig. 14B). Rosettes simple, more numerous in the dorsal then the ventral body wall, 20-25 µm long. (fig.14C). Tube feet with pseudo-plates, 75-100 µm long, and rosettes of similar size as those presented in the body wall (fig. 14D).

Diagnosis – See Jaeger 1833: 22; Panning 1935a: 30, fig. 22a-f.

Ecology – *H. (H.) atra* can be found on sandy patches within the shallow reef flat or in seagrass beds; highest densities however on reef flats. Macnae & Kalk (1962) and Rowe & Richmond (1997) note that *H. (H.) atra* lives commensal with the polychaete *Gastrolepidia clavigera* (Schmarda).

Distribution in the study region – Found in large numbers in virtually all the localities visited, making it one of the most abundant holothurians from the study region.

Geographic distribution – Very well known species from the tropical and subtropical Indo-Pacific (with the Red Sea and the Persian Gulf). The distribution map as drawn by Massin (1999: 21, fig. 13) gives the global distrubution, but the following localities have to be added: Gulf of Suez (Semper 1868; 1869, as *Holothuria maxima* Forskål, 1757; Lampert 1885, as *H. maxima*; Cherbonnier 1955, as *Halodeima atra* Jaeger, 1833; Price 1982); Eritrea, Assab (Ludwig 1886; Mitsikuri 1912), Dobar Island (Tortonese 1936b), Nocra Island (Tortonese 1953a), Harmil and Entedebir (Cherbonnier 1967, as *Halodeima atra*); Gulf of Aden, Djibouti (Cherbonnier 1955, as *Halodeima atra*); Madagascar, Ile St. Marie and Tuléar (Cherbonnier 1988); La Réunion (Conand 1999) and southern Mozambique, Inhaca (Kalk 1958; Thandar 1984; MRAC record pers. observ.). Fig. 52E shows the known distribution in the WIO in detail.

Holothuria (Halodeima) edulis Lesson, 1830 (fig. 15A-E, fig. 52F, pl. 2F)

Holothuria edulis Lesson, 1830: 125, pl. 46, fig. 2; Macnae & Kalk 1962: 108; Daniel & Halder 1974: 428; Weinberg 1997: 245 (colour picture); Conand 1999: 10, 12, 18, 39, pl. 2 (colour picture); Marshall *et al.* 2001: 46 (tab. 29), 47, 54.

Halodeima edulis; Cherbonnier 1963: 5; Cherbonnier 1979a: 861.

Holothuria (Halodeima) edulis; Price 1981: 9; Massin 1999: 21 (synonymy and records before 1999), figs. 14 (distribution), 110d (colour picture); Samyn 2000: 15 (tab. 1); Lane *et al.* 2000: 488; Samyn & Vanden Berghe 2000: 5 (tab. 2), 17 (tab. 4), 22.

Status and location type – Holotype, MNHNP (number not given) (Rowe & Gates, 1995).

Type locality – Moluccas Islands, Indonesia.

Material examined – TFun/9801 (one specimen); TFun/9802 (one specimen); KKiun/9931 (one specimen).

General description – Medium to large species; preserved specimens up to 300 mm long and 50 mm wide. Body elongated and slender; somewhat wrinkled in alcohol. Body colour in life: dorsally marked with large chocolate brown to dark-grey patches (pl. 2F); ventrally, salmon pink to red. Body colour in alcohol: grey-brown dorsally and grey-white ventrally. Body wall 3-5 mm thick, more rough to the touch then *H. (Halodeima) atra.* Mouth ventral, surrounded by 20 yellow to light-pink tentacles. Anus dorso-terminal, unguarded by teeth or papillae, fringed by a dark-pink circle. Trivium covered by short tube feet, scattered over both ambulacral and interambulacral areas.

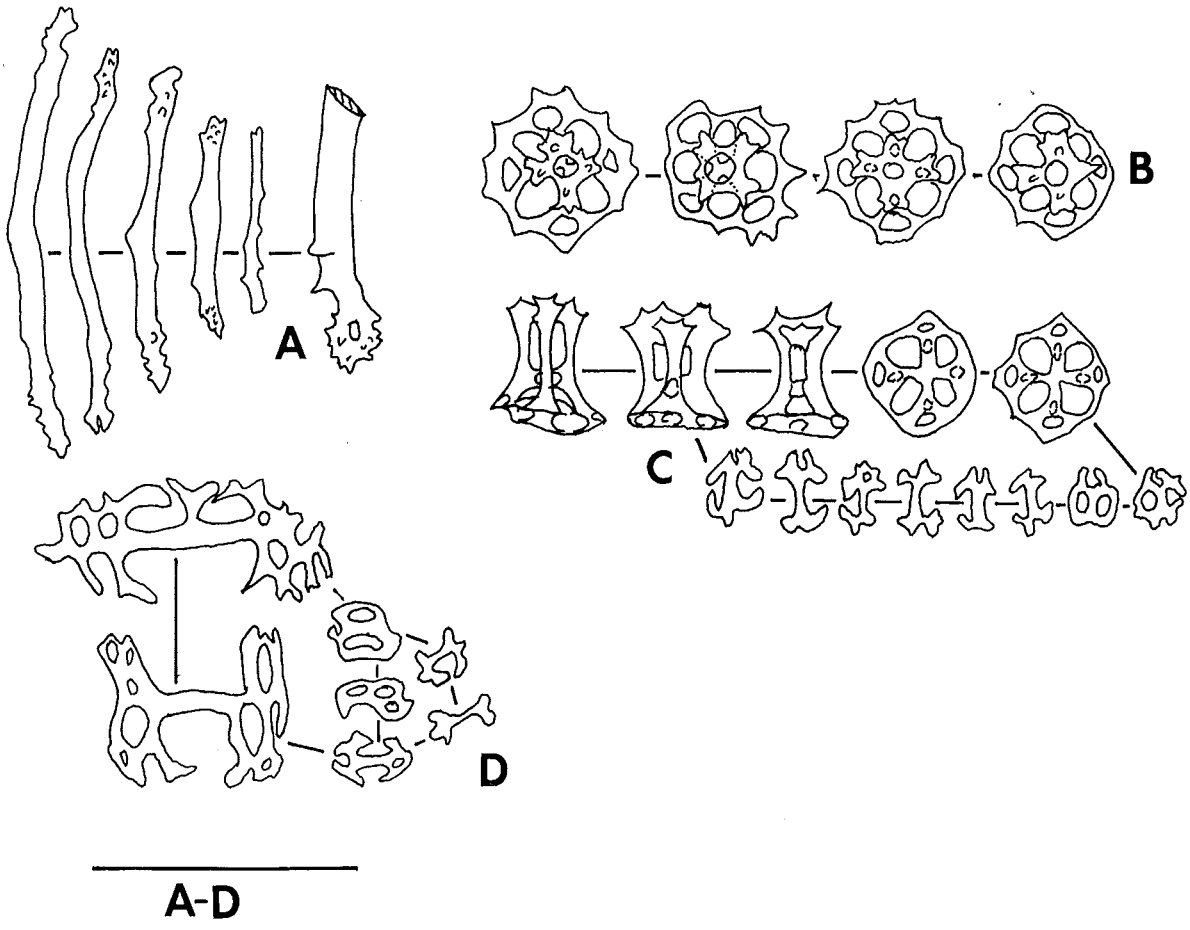


FIG. 14 – *Holothuria (Halodeima) atra* JAEGER, 1833. A. Rods of tentacles; B. Tables of ventral body wall; C. Tables and rosettes of dorsal body wall; D. Pseudo-plates and rosettes of tube feet. Scale bar A-D represents 100 μm.

Bivium with few tube feet distributed over the total area. Cuvierian tubules absent. Calcareous ring with very large radial pieces, up to three times as wide as the pointed interradial pieces (see CHERBONNIER 1988: 76, fig. 29I).

Ossicles: Tentacles with well-developed rods, up to 180 μm long, spiny at the extremities (fig. 15A). Body wall with tables and button-like rosettes, similar in size and shape ventrally and dorsally (fig. 15B, C). Tables with disc strongly reduced, four pillars united by a single cross beam, pillars ending in four points each forming a Maltese cross (fig. 15B, C). Button-like rosettes, perforated by 4-10 uneven holes, 30-70 μm long, rim of rosettes irregular, (fig. 15B, C). Ventral tube feet with plates, 100-140 μm long, and rods (fig. 15D). Dorsal tube feet with large rods (fig. 15E).

DIAGNOSIS – See PANNING 1935a: 30, fig. 36a-d.

ECOLOGY – *H. (Halodeima) edulis* is found up to 29 m depth, on sand or coral rubble, often partially hidden under coral.

DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000); Watamu; Mombasa; Gazi Bay; Fundu.

GEOGRAPHIC DISTRIBUTION – Similar to *H. (Halodeima) atra*, but not recorded on the eastern side of the Indo-Pacific barrier. For global distribution, see also map as drawn by MASSIN (1999: 22, fig. 14), but note that the following localities have to be added in the shallow-waters of the WIO: Gulf of Suez, Shab Mahmoud (CHERBONNIER 1955, as *Halodeima edulis* (LESSON, 1830)) (see also ERWE 1919; PRICE 1982 for unspecified localities from the Gulf of Suez); Gulf of Aqaba, Eilat (CHERBONNIER 1963; 1967, as *Halodeima edulis*), Aqaba (TORTONESE 1977; CHERBONNIER 1979a, as *Halodeima edulis*), Dahab (A.M. CLARK 1952; CHERBONNIER 1955; both as *Halodeima edulis*),

Abu Zabad (A.M. CLARK 1952, as *Halodeima edulis*) (see also DANIEL & HALDER 1974; PRICE 1982 for unspecified localities from the Gulf of Aqaba); Eritrea, Entedebir (CHERBONNIER 1967, as *Halodeima edulis*); Kenya, Mombasa, Chale Island, Watamu Marine Park (this work), Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000); Tanzania, Fundu (this work); southern Mozambique, Inhaca (THANDAR 1984; MRAC record pers. observ.) and Madagascar, Tuléar (CHERBONNIER 1988). Figure 52F shows the known distribution in the WIO in detail.

Table seven gives another species within the subgenus *Halodeima* that is known to occur in the shallow waters of the WIO, but that for now has 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. It should however be noted that *H. (H.) pulla* seems to differ from *H. (H.) atra* only by having Cuvierian tubules. However, SELENKA'S (1867) description of the Cuvierian tubules [Cuvier'sche Organen blinddarmförmig, rothbraun] could as well refer to a part of the respiratory tree. Unfortunately, the type specimen of *H. (H.) pulla* is currently untraceable as the labels of the specimens in the collection of the ZMG have turned unreadable due to a flooding accident (HAUDE pers. comm.). *H. (H.) floridana* was reported from Zanzibar by SELENKA (1867) and by DANIEL & HALDER (1974); ROWE (1969) gives West Indian as distribution. THANDAR (1984) regards *H. (H.) floridana* as a synonym of *H. (H.) mexicana*. For the latter species ROWE (1969) again gives a West Indian distribution, while THANDAR (1984) states that it has a tropical West Atlantic distribution and that it would be best not to consider it as belonging to the fauna of eastern Africa. HENDLER *et al.* (1995) on the other hand list *H. floridana* as a valid species from the Carribean. Be as it may; as I have not seen type material of *H. mexicana* or *H. floridana*, I am not in a position to judge on the status of these species, but I believe the specimens from Zanzibar are nothing but misidentified individuals of *H. atra*.

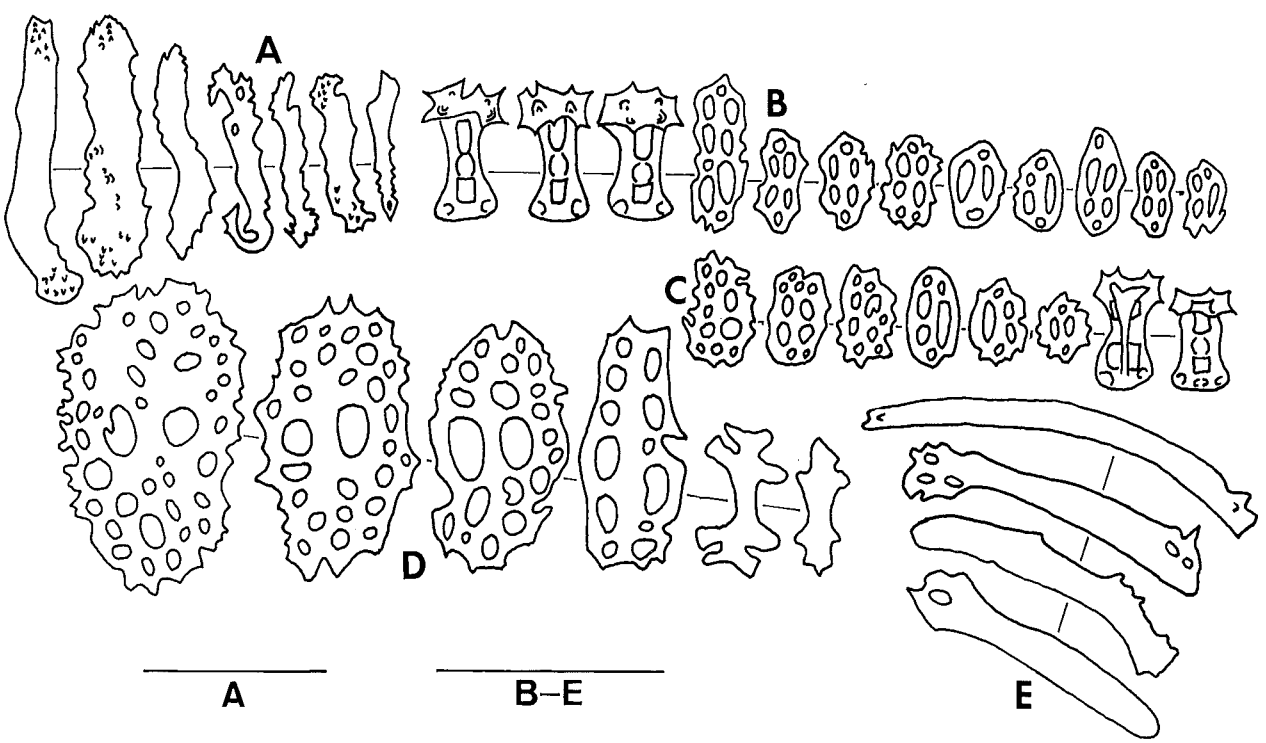


FIG. 15 – *Holothuria (Halodeima) edulis* LESSON, 1830. A. Rods of tentacles; B. Buttons and tables of dorsal body wall; C. Buttons and tables of ventral body wall; D. Plates and rods of ventral tube feet; E. Rods of dorsal tube feet. Scale bar A represents 200 μm; scale bar B-E represents 100 μm.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Halodeima) pulla SELENKA, 1867	Indo-Pacific (unspecified)	PANNING 1944
	East coast of Africa (unspecified)	DANIEL & HALDER 1974
	?Mozambique	LAMPERT 1885[1]; BELL 1884; THANDAR 1984

TABLE 7 – *Holothuria (Halodeima) pulla* SELENKA, 1867, the third species within *Halodeima* known to occur in the shallow-waters of the WIO. The validity of this species remains however debatable (synonym of *H. (Halodeima) atra*?). Cited as [1] *Holothuria aethiops* BRANDT.

Subgenus *Holothuria* LINNAEUS, 1767

DIAGNOSIS – (See ROWE 1969: 133) [Type-species: *Holothuria tubulosa* GMELIN, 1790; validated opinion 80, 1924: 17-18]

Eight species are currently recognized as being valid: *Holothuria (Holothuria) caparti* CHERBONNIER, 1965; *H. (H.) dakarensis* PANNING, 1939; *H. (H.) fungosa* HELFER, 1912; *H. (H.) helleri* VON MARENELLER, 1877; *H. (H.) mammata* GRUBE, 1840; *H. (H.) massaspicula* CHERBONNIER, 1954; *H. (H.) stellati* DELLE CHIAJE, 1823; *H. (H.) tubulosa* GMELIN, 1790. ROWE (pers. comm.) suspects that *H. (H.) massaspicula* is a junior synonym of *H. (H.) fungosa*; as I have not been able to study any of these species, I refrain from commenting on this point of view. Table eight gives the only records within the subgenus *Holothuria* that are known to occur in the shallow-waters of the WIO, but have *hitherto* not been reported in Kenya (with Pemba Island). Column two gives the known distribution in the WIO, while column three provides the reference wherein the record appeared. The subgenus is here included for completeness only.

Subgenus *Lessonothuria* DEICHMANN, 1958

DIAGNOSIS (after ROWE, 1969: 149) [Type species: *Holothuria pardalis* SELENKA, 1867 by original designation]

Small to moderate species, cylindrical body reaching lengths up to 150 mm; tube feet and papillae more or less irregularly arranged in both trivium and bivium; 17-30 tentacles fringed by a collar of conical papillae; anus terminal, mostly guarded by some kind of papillae; calcareous ring relatively well developed with the radial pieces about twice as long as the interradial pieces. Ossicles comprise tables with smooth or toothed disc, spire of moderate height, ending in a narrow spiny ring; smooth buttons and pseudobuttons abundantly present.

Ten species are currently recognized as being valid: *Holothuria (Lessonothuria) cavans* MASSIN, 1996; *H. (L.) cumulus* CLARK, 1921; *H. (L.) duoturricula* CHERBONNIER, 1988; *H. (L.) glandifera* CHERBONNIER, 1955; *H. (L.) hawaiiensis* FISHER, 1907; *H. (L.) insignis* LUDWIG, 1875; *H. (L.) lineata* LUDWIG, 1875; *H. (L.) multipilula* L. YULIN, 1975; *H. (L.) pardalis* SELENKA, 1867 and *H. (L.) verrucosa* SELENKA, 1867. Only *H. (L.) pardalis* and *H. (L.) verrucosa* are present in Kenya (with Pemba Island), they are keyed hereunder.

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

1. 17-20 Tentacles. Buttons and pseudobuttons of the body wall rather regular, smooth, perforated by four to ten holes..... ***Holothuria (Lessonothuria) pardalis* SELENKA, 1867**
2. More than 20 Tentacles. Buttons and pseudobuttons very irregular, often knobbed, perfo-

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Holothuria) fungosa HELFER, 1912	Gulf of Suez (Um el Jerman)	HELFER 1912; ERWE 1919; DANIEL & HALDER 1974; PRICE 1982
H. (Holothuria) massaspicula CHERBONNIER, 1954	Red Sea (unspecified)	ERWE 1919[1]; DANIEL & HALDER 1974
	Gulf of Suez (Suez)	CHERBONNIER 1954a; 1955; PRICE 1982

TABLE 8 – Other species within the holothurian subgenus *Holothuria* known to occur in the WIO. The validity of *H. (H.) massaspicula* remains however debatable (synonym of *H. (H.) fungosa*?). Cited as [1] *Holothuria tubulosa* GMELIN.

rated by two to five pairs of holes often reduced to one row of holes. . . . . ***Holothuria (Lessonothuria) verrucosa*** **SELENKA, 1867**

Holothuria (Lessonothuria) pardalis
SELENKA, 1867
(fig. 16A-F, fig. 52G, pl. 2G)

Holothuria pardalis SELENKA, 1867: 336, pl. 19 fig. 85 (partim); PEARSON 1910: 179 (non *H. lineata* LUDWIG); KALK 1958: 212; JAMES & PEARSE 1969: 106; DANIEL & HALDER 1974: 428; HUGHES & GAMBLE 1977: 335, 336, 337, 338, 355; HICKMAN 1998: 48 (colour plates).

Holothuria (Lessonothuria) pardalis; MUKHOPADHYAY 1991: 404; MASSIN 1999: 25 (synonymy and records before 1999), fig. 19 (distribution); SAMYN 2000: 15, tab. 1; LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 23.

STATUS AND LOCATION TYPE – SELENKA (1867) did not select a holotype in the series he had before him, ROWE (*in* ROWE & GATES 1995) could not establish presence of any of SELENKA's specimens in Germany, thus decided to select a specimen from the MCZ (N°677 partim; includes six specimens which are *H. (Lessonothuria) lineata*) as lectotype; as paralectotypes the four specimens belonging to vial MCZ 676 were chosen. These specimens now define *H. (L.) pardalis* SELENKA, 1867.

TYPE LOCALITY – Hawaiian Islands.

MATERIAL EXAMINED – KKiun/9934 (one specimen); KKiun/9935 (one specimen); KKiun/9936 (one specimen); KKiun/9937 (one specimen).

GENERAL DESCRIPTION – Small to moderate species, up to 100 mm long and 40 mm wide after preservation; cylindrical in shape. Dorsal body wall white-yellow, with two rows of conspicuous dark areas and with copious small yellow areas giving the animal a speckled appearance (pl. 2G); ventral side lighter in colouration. Body wall only few mm thick. Rough bivium clearly separated from the smoother trivium. Mouth ventral to terminal, surrounded by 17-20 tentacles, fringed at their base by long conical papillae. Anus terminal, surrounded by conical papillae. Bivium with small homogeneously spread papillae, that are more numerous at the posterior side. Trivium with long tube feet in the radial areas (two to three rows laterally; four to five rows in the median area), however with some spreading into the interambulacral areas. Cuvierian tubules absent. Two Polian vesicles. Single stone canal. Calcareous ring slender with radial pieces three times as wide as the interradial pieces, the radial plates have a deep anterior notch (see MASSIN 1999: 26, fig. 18a).

Ossicles: Ventral and dorsal body wall with similar tables and buttons (fig 16A-D). Tables: rim of disc smooth, undulating or toothed, 50-80 µm across, perforated by four, large central holes and four to twelve peripheral holes; spire low to high, narrow, ending in a small spiny crown. Buttons 40-70 µm long, smooth, with three to ten holes (fig 16A-D). Ventral tube feet with large plates up to 150 µm long (fig. 16E, F), in addition to tables and buttons similar to those of the body wall (fig. 16G). In the dorsal papillae large rods perforated at the extremities and plates, buttons and tables similar to those of the ventral tube feet (fig. 16H, J). Tentacles with rods up to 180 µm (fig. 16K)

DIAGNOSIS – See PANNING 1935d: 3, fig. 106a-x.

ECOLOGY – Species known from shallow water; hiding its total body under coral debris and under dead coral blocks.

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

GEOGRAPHIC DISTRIBUTION – Very well known species from the tropical and subtropical Indo-Pacific Ocean with the Red Sea (and possibly the Persian Gulf) as is shown on the global distribution map drawn by MASSIN (1999: 27, fig. 19). In the shallow-waters of the WIO the following localities have to be added to this map: Gulf of Suez, Tor (HELFER 1912; CHERBONNIER 1967), Ras el Millan (HELFER 1913, as *Holothuria tenuicornis* HELFER, 1913), Shab Suleim (CHERBONNIER 1955), Wadi el Dom (JAMES 1969; JAMES & PEARSE 1969) (see also ERWE 1919; CHERBONNIER 1955; DANIEL & HALDER 1974; PRICE 1982 for unspecified localities from the Gulf of Suez); Gulf of Aqaba, Graa (A.M. CLARK 1952), Aqaba (TORTONESE 1977; 1979), Dahab (A.M. CLARK 1952) (see also DANIEL & HALDER 1974; PRICE 1982 for unspecified localities from the Gulf of Aqaba); Saudi Arabia, Abulat Island (CHERBONNIER 1955), Jeddah (TORTONESE 1979); Eritrea, Mitsiwa Island (LUDWIG 1886), Ras Benas, Massaua (TORTONESE 1936a), Entedebir (CHERBONNIER 1967); Djibouti (VANEY 1905; CHERBONNIER 1955) (see also SEMPER 1868; 1869; LUDWIG 1877 [1880]; LAMPERT 1885; THÉEL 1886;

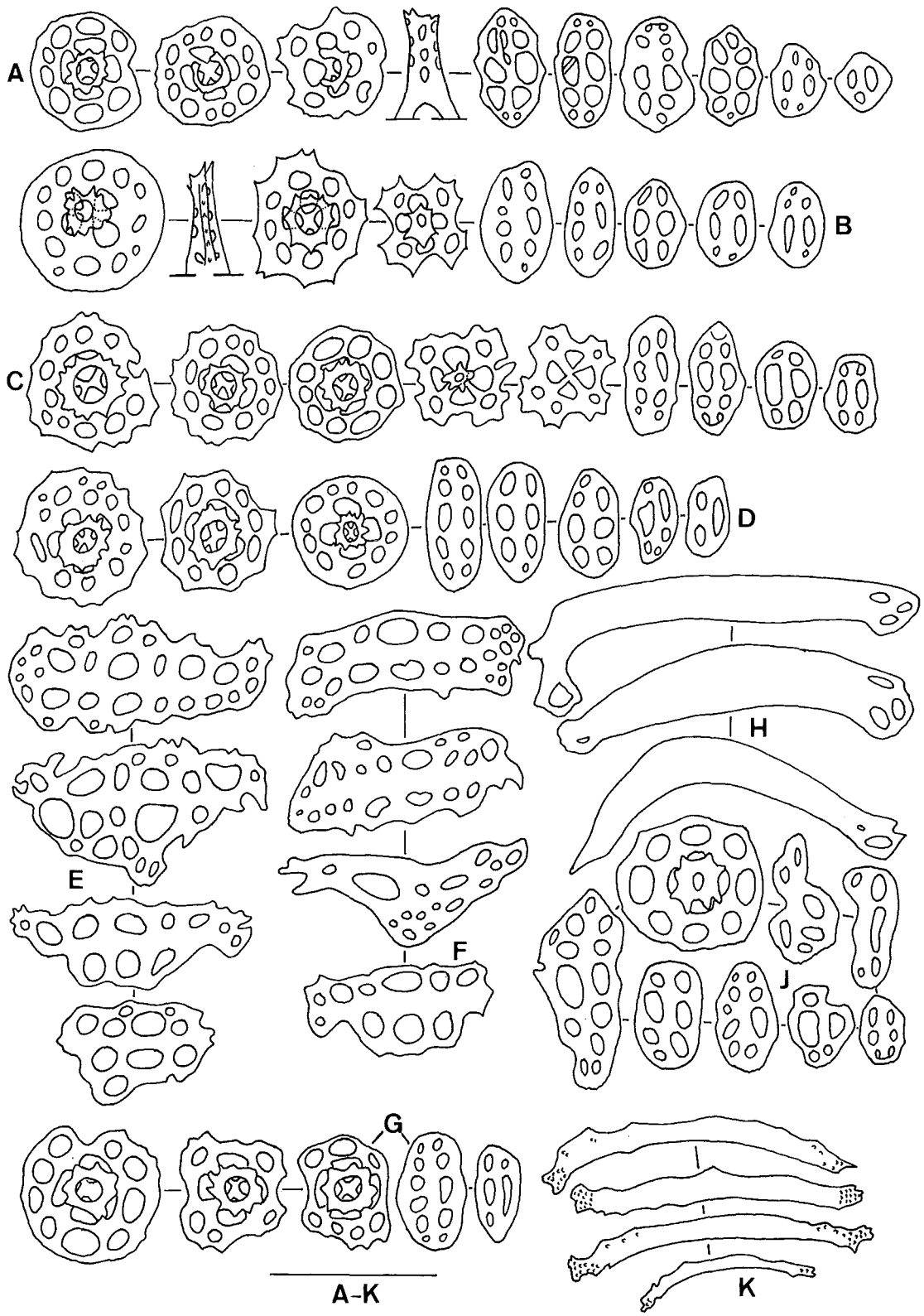


FIG. 16 – *Holothuria (Lessonothuria) pardalis* SELENKA, 1867. A. Tables and buttons of dorsal body wall (L=50 mm); B. Tables and buttons of dorsal body wall (L=85 mm); C. Tables and buttons of ventral body wall (L=50 mm); D. Tables and buttons of ventral body wall (L=85 mm); E. Perforated plates of ventral tube feet (L=50 mm); F. Perforated plates of ventral tube feet (L=85 mm); G. Tables and buttons of ventral tube feet (L=50 mm); H. Rods of dorsal papillae (L=50 mm); J. Tables, plates and buttons of dorsal papillae (L=50 mm); K. Rods of tentacles (L=85 mm). Scale bar A-K represents 100 μm.

MITSIKURI 1912; CLARK & ROWE 1971; DANIEL & HALDER 1974; PRICE 1982 for unspecified records from the Red Sea); Persian Gulf? (DANIEL & HALDER 1974); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000); Mozambique, Inhaca (MRAC records, pers. observ.; see also KALK 1958; THANDAR 1984); Madagascar, Antisarana, Fort Dauphin, Tuléar (CHERBONNIER 1988); Republic of South Africa, Sodwana Bay (SAMYN pers. observ.). Figure 52G gives the known WIO distribution in detail.

REMARKS – *Holothuria insignis* was described by LUDWIG in 1875 [and recognised as such by LAMPERT (1885) and THÉEL (1886)], but later LUDWIG (1887; see also 1877 [1880]; 1883) listed *H. insignis* LUDWIG, 1875 (together with *H. lineata* LUDWIG, 1875 and *H. peregrina* LUDWIG, 1875) as synonyms of *H. pardalis* SELENKA, 1867, however, without providing a satisfactory explanation for this judgment. LUDWIG's judgement was partially followed by SLUITER (1889, from PANNING 1951) who put *H. insignis* as a variety of *H. pardalis*. Then again, HÉROUARD (1893) respected LUDWIG's (1887) decision and identified a specimen from the Red Sea as *H. pardalis*, even though he noted that the specimen under study corresponded very well with that of LUDWIG's (1875) *H. insignis*. LAMPERT (1896) (and later HELFER 1912; MITSUKURI 1912; PEARSON 1913; ERWE 1919; PANNING 1935d; H.L. CLARK 1938 and CHERBONNIER 1951a) also followed LUDWIG and continued to see *H. insignis* as the junior synonym of *H. pardalis*. Nevertheless, LAMPERT deserves the credit of noting that buttons with a single row of holes are typical of *H. insignis*, while buttons with a double row of holes are characteristic for *H. pardalis*. However, his observation that both types of buttons can occur in the same individual restrained him from reviving *H. insignis* as a valid species. In a brave attempt to resolve this issue, ROWE (*in* ROWE & GATES 1995) examined the type series of *H. (L.) pardalis* (MCZ 677) and concluded that six specimens are referable to *H. (L.) lineata* [which thus was resurrected as a valid species (see also THÉEL 1886; PEARSON 1910)], but at the same time (after examination of extant type specimens and extensive museum collections), he (*in* ROWE & GATES 1995) respected LUDWIG'S (1887) judgement that *H. peregrina* and *H. insignis* are junior synonyms of *H. pardalis*. ROWE's decision is contrary to the viewpoint of HEDING (1934), PANNING (1951) and more recently THANDAR (1984) and MASSIN (pers. comm.) who argued that *H. (L.) insignis* should be regarded as a valid species (*H. peregrina* on the other hand, and here everyone *does* agree, remains in the synonymy of *H. pardalis*). Examination of material from the Republic of South Africa (KwaZulu-Natal) allowed me to substantiate the hypothesis that *H. insignis* is indeed a valid species. From these observations it is now clear that HÉROUARD's (1893) specimen is *H. (L.) insignis* rather then *H. (L.) pardalis*. As a consequence *H. (L.) insignis* is here reported for the first time from the Red Sea [PANNING's (1951) record is the second] and LAMPERT's (1896) record most probably is the first record from East Africa (Zanzibar).

Regarding the status of *Holothuria subditiva*, LUDWIG (1887) disagreed with THÉEL (1886) in that SELENKA's (1867) species is also a synonym of *H. pardalis*. Today, the status of *H. subditiva* remains unresolved. SELENKA's (1867) brief description lets me suspect that several species are present in his type series: while his figure (SELENKA 1867: pl. 19, fig. 87) and part of his description of the ossicle assemblage ('Die glatten schnallenförmigen Gebilde der Bindfaserschicht sind 0.04-0.06 Mm. Lang, in den Fusswandungen ein weiniger grösser' [*Sic.*]) is reminiscent of *H. (Thymiosycia) arenicola* SEMPER, 1868, SELENKA also mentioned that the ossicles are reminiscent of those found in *H. pardalis*. SELENKA's statement that Cuvierian tubules are present in *H. subditiva* necessitates yet another species, SMILEY & PAWSON (±1991, unpublished manuscript) believe that this third species might be *H. (Semperothuria) surinamensis* LUDWIG, 1875. As the type material of SELENKA (1867) is currently unavailable (TROESTER, pers. comm.), I am unfortunately not in the position to reject or defend SMILEY & PAWSON's judgement.

Holothuria (Lessonothuria) verrucosa SELENKA, 1867
(fig. 17A-H, fig. 52H)

Holothuria verrucosa SELENKA, 1867: 338, pl. 19, fig. 88; LUDWIG 1882:136; DANIEL & HALDER 1974: 427.

Holothuria collaris HAACKE, 1880; DANIEL & HALDER 1974: 423.

Holothuria immobilis SEMPER, 1868; LUDWIG 1883: 172; CHERBONNIER 1967: 56; DANIEL & HALDER 1974: 423.

Holothuria (Lessonothuria) verrucosa; SLOAN *et al.* 1979: 122; A.M. CLARK 1984: 99; CANNON & SILVER 1986: 22; FÉRAL & CHERBONNIER 1986: 82 (colour picture), 83; CHERBONNIER 1988: 121 (synonymy).

STATUS AND LOCATION TYPE – Holotype MCZ (ROWE & GATES, 1995).
TYPE LOCALITY – Hawaiian Islands (as Sandwich Islands).
MATERIAL EXAMINED – TMes/9899 (one specimen).
GENERAL DESCRIPTION – The only specimen at our disposal measures 118 mm in length and 22 mm in width, after preservation; it is completely eviscerated apart from the anterior part of the gut and the right respiratory tree. Dorsal body wall variegated brown-beige with some irregular dark-brown blotches and numerous small yellowish dots giving the animal a speckled appearance; ventral body wall yellowish with two longitudinal brown lines. Mouth ventral, surrounded by 21 small, beige (spotted with brown on the stalk) tentacles, surrounded at the base by a simple ring of whitish papillae. Anus terminal surrounded by non-calcified papillae that are positioned in groups of three to four. Tube feet distributed in longitudinal lines in the radial and interradial areas, dorsally less numerous. Cuvierian tubules not observed. Calcareous ring very small, with high, well-sculpted radial and short interradial pieces (see CHERBONNIER 1988: 122, fig. 49M). Longitudinal muscles well developed, wide and bifid but very thin.
Ossicles: Tentacles with narrow straight to slightly curved rods that can be slightly spiny at the extremities, 45-125 µm long (fig. 17A). Ventral and dorsal body wall with numerous irregular buttons, pseudobuttons and tables (fig. 17B, C). Tables with disc 60-75 µm across, rim of disc spiny, perforated by four central holes and five to eight peripheral holes, four pillars united by no or a single cross beam terminating in a small crown of eight to ten spines (fig. 17B). Buttons and pseudobuttons very irregular in outline, perforated by two to eight holes, sometimes knobbed, 45-75 µm long and 15-25 µm wide (fig. 17C). Dorsal tube feet with tables similar to the ones from the body wall, though disc up to 85 µm across (fig. 17D); buttons and pseudobuttons longer than those from the body wall (fig. 17E) and smooth rods, curved, often perforated by a small number of holes at the distal extremities, 80-225 µm long (fig. 17F). Ventral tube feet with tables and pseudobuttons similar to the ones from the body wall (fig. 17G); and plate-like rods, perforated mainly at the extremities, 85-145 µm long (fig. 17H).
DIAGNOSIS – See CHERBONNIER 1988: 121, fig. 49A-M; present note (see also remarks).
ECOLOGY – The only specimen was found on coarse coralline sand, at a depth of 21 m.
DISTRIBUTION IN THE STUDY REGION – Only found at Mesali Reef, Pemba Island, Tanzania.
GEOGRAPHIC DISTRIBUTION – Tropical Indo-West Pacific, from Kenya to Hawaii and from China to New Caledonia (MASSIN 1996a; see also CHERBONNIER & FÉRAL 1984a). Also reported from Eritrea, Um Aabak and Nocra Island. (CHERBONNIER 1967), but not from the Persian Gulf. Figure 52H gives the known distribution in the WIO in detail.
REMARKS – *H. (L.) verrucosa* has been reported from a number of localities in East Africa (see fig.55D), and has recently been found by CHERBONNIER (1988) from Madagascar (Nosy Bé), hence this species is also expected to occur in Kenya. However, it is with some hesitation that this single specimen was identified as *H. (L.) verrucosa* as two observations do not fit completely with CHERBONNIER'S (1988) description. First: tables with six pillars cannot be found in our specimen; and second, the large plates that CHERBONNIER (1988) described of the tube feet of his specimens are absent in our specimen. However, SELENKA'S (1867) concise and not too accurate description does not exclude my specimen, as SELENKA (1867) stated that the tube feet contain spiny rods *or* perforated plates ['in allen Fusswandungen, nahe dem Endscheibchen, zahlreiche gedornte oder zu durchlöcherten Platten ausgebreitete Stützstäbe']. Unfortunately, SELENKA (1867) never gave the dimensions of the specimens he described, so without examination of the type-series it is impossible to state if presence or absence of plates in the tube feet is size dependent. In the same regard, it should be noted that MASSIN (1996a) also failed to describe the wide plates in the ventral tube feet of a juvenile of *H. (L.) verrucosa*, and that the plates depicted in CHERBONNIER & FÉRAL, 1984a) are only 125 µm long, while those described in CHERBONNIER (1980) and CHERBONNIER (1988) range from 250 to 500 µm.

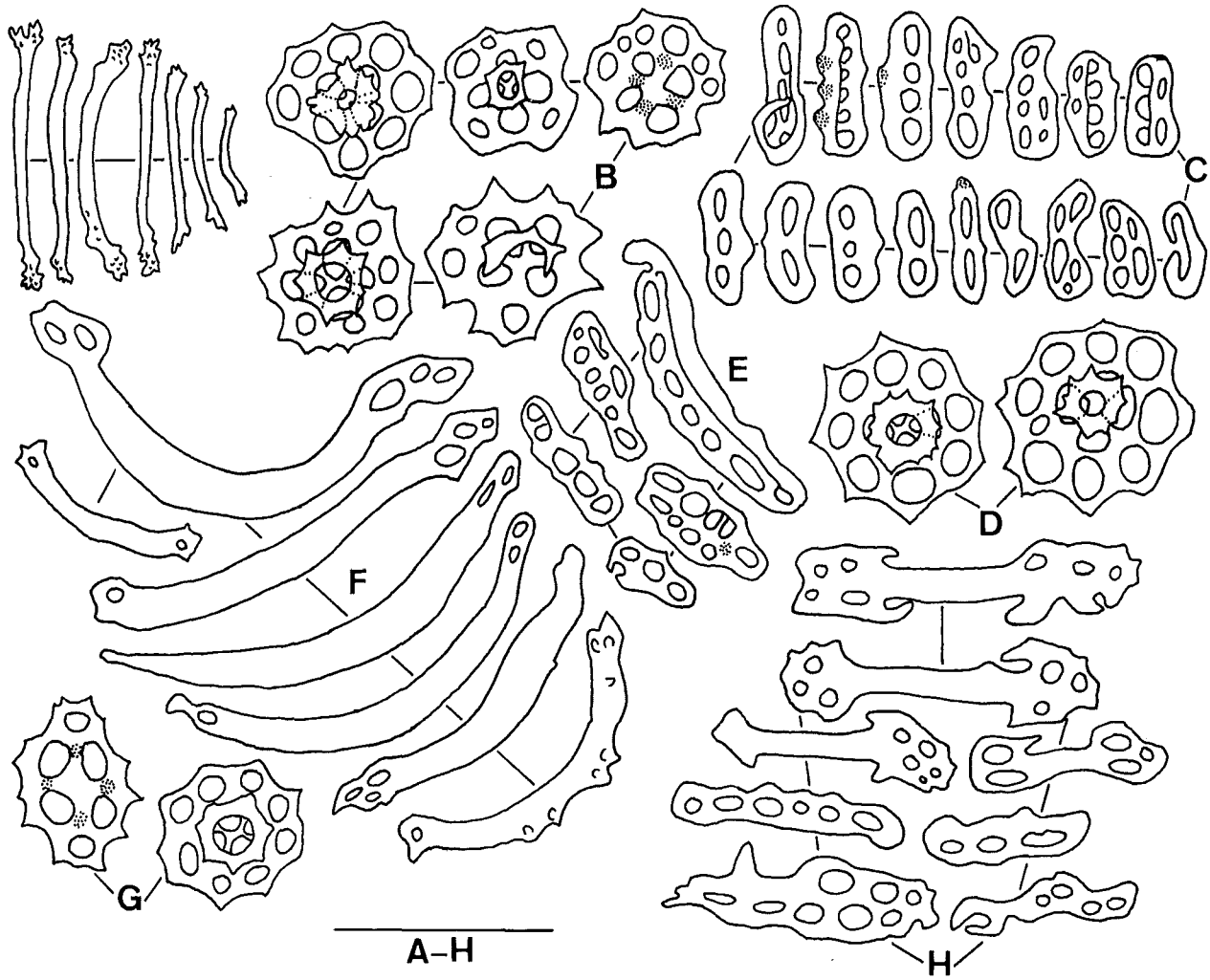


FIG. 17 – *Holothuria (Lessonothuria) verrucosa* SELENKA, 1867. A. rods of tentacles; B. Tables of body wall; C. Buttons and pseudobuttons of body wall; D. Tables of dorsal tube feet; E. Pseudobuttons of dorsal tube feet; F. Rods of dorsal tube feet; G. Tables of ventral tube feet; H. Plates and rods of ventral tube feet. Scale bar A-H represents 100 μm.

Table nine lists the other species within the subgenus *Lessonothuria* 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 distribution in the shallow-waters of the WIO, while column three provides the reference(s) wherein the record appeared.

KALK (1959) and MACNAE & KALK (1958, from THANDAR 1984; 1962) are the only authors who mention *H. cumulus* H.L. CLARK, 1921 from the western Indian Ocean (Mozambique); however, even though THANDAR (1984) states that the identification of some of these specimens was done by CHERBONNIER, it seems very unlikely that *H. (L.) cumulus* is found in the western Indian Ocean for H.L. CLARK (1921; 1946) and ROWE & GATES (1995) mention it only from northern Australia (Mer, Murray Islands). The taxonomy of *H. cumulus* deserves a few additional comments. ROWE (1969, see also ROWE & GATES 1995) suggested that *H. cumulus* might belong to the subgenus *Lessonothuria* (possibly because H.L. CLARK (1921) himseld noted that it is not impossible that *H. cumulus* is a young *H. pardalis*); in 1984, THANDAR suggested that *H. cumulus* might be very close to *H. (Thymiosycia) truncata* LAMPERT, 1885 [= *H. (T.) impatiens* FORSKÅL, 1775 according to ROWE & GATES (1995)] and *H. (Thymiosycia) arenicola* BRANDT, 1835 for the

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Lessonothuria) duoturricula CHERBONNIER, 1988	Madagascar (Nosy Bé)	CHERBONNIER 1988
H. (Lessonothuria) hawaiiensis Fisher, 1907	Red Sea (Aqaba)	CHERBONNIER 1979a
	Madagascar (Tuléar)	Cherbonnier 1988
H. (Lessonothuria) lineata LUDWIG, 1875	Red Sea (Kosseir)	LUDWIG 1880; LAMPERT 1885; THÉEL 1886
(see also discussion)	Mauritius (Reef Fouquets)	HAACKE 1880[1]; LUDWIG 1883; LAMPERT 1885; THÉEL 1886
	Arabian Sea	DANIEL & HALDER 1974
	South West Indian Ocean	DANIEL & HALDER 1974

TABLE 9 – Other species within the holothurian subgenus *Lessonothuria* known to occur in shallow-waters of the western Indian Ocean. The records of DANIEL & HALDER (1974) for *H. (L.) lineata* could not be verified for they only appear in a list. Cited as [1] *Labidodemas punctulatum* HAACKE.

buttons of the body wall are regular and smooth and the tables of the body wall have a round, smooth disc. H.L. CLARK (1921) however, noted that the pedicels of *H. cumulus* present straight or curved rods, a character typical of *Lessonothuria* and not of *Thymiosycia*. The latter subgenus is characterised by tube feet that present rods with the central and distal part widened and perforated by relatively large holes. MASSIN & TOMASICK (1996) however, after examination of the type species, regard *H. cumulus* as a valid species and put it in *Lessonothuria.* After examination of the ossicle assemblage of the type specimen (type specimen in MCZ; preparations of the ossicles in IRSNB), I agree with the latter judgment.

Subgenus *Mertensiothuria* DEICHMANN, 1958

DIAGNOSIS (See SAMYN & MASSIN in press) [Type species: *Stichopus leucospilota* BRANDT, 1833 by original designation]

A recent revision of this subgenus retained only six valid species (SAMYN & MASSIN in press): *H. (M.) albofusca* CHERBONNIER, 1988; *H. (M.) aphanes* LAMPERT, 1885; *H. (M.) fuscorubra* THÉEL, 1886; *H. (M.) hilla*LESSON, 1830; *H. (M.) leucospilota* (BRANDT, 1835) and *H. (M.) papillifera* HEDING *in* MORTENSEN, 1938. Two of these (*Holothuria hilla* and *Holothuria aphanes*) were transferred from the subgenus *Thymiosycia* to *Mertensiothuria*, while four other species formerly referred to *Mertensiothuria* (*H. arenacava* SAMYN, MASSIN & MUTHIGA, 2001, *H. artensis* CHERBONNIER & FÉRAL, 1984, *H. exilis* KOEHLER & VANEY, 1908 and *H. platei* LUDWIG, 1898) were removed from *Mertensiothuria* and temporarily not allocated to a given subgenus (SAMYN & MASSIN in press). Three of these species are present in the littoral waters of Kenya (with Pemba Island), a key to all the *Mertensiothuria* species can be found in SAMYN & MASSIN (in press).

Holothuria (Mertensiothuria) hilla LESSON, 1830 (fig. 53A)

Holothuria hilla LESSON, 1830; 226, pl. 78; MACNAE & KALK 1958: 36, 42, 99, 107, 117, 130 (from THANDAR 1984); KALK 1958: 213, 214, 338; KALK 1959: 7, 22; MACNAE & KALK 1962: 104, 112, 115; BRANCH & BRANCH 1981: 249 (from THANDAR 1984); WEINBERG 1997: 246 (colour picture); HICKMAN 1998: 47 (colour plates); CONAND 1999: 10, 12, 21.

Holothuria monacaria; DANIEL & HALDER 1974: 428.

Holothuria macleari; DANIEL & HALDER 1974: 423.

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

Holothuria (Thymiosycia) hilla; MUKHOPADHYAY 1991: 407; MASSIN 1999: 55, figs. 44, 111d (colour plate) (synonyms and records before 1999); LANE *et al.*, 2000: 489.

Holothuria (Mertensiothuria) hilla; SAMYN & MASSIN in press (synonymy and records before 2002, colour plate).

STATUS AND LOCATION TYPE – Holotype; MNHNP EcHh542.

TYPE LOCALITY – Society Islands (Borabora).

MATERIAL EXAMINED – KKiun/9942 (one specimen); KKiun/9943 (three specimens); KMom/9857 (one specimen); KKis/98102 (one specimen).

General description – See Samyn & Massin in press.
Diagnosis – See Samyn & Massin in press.
Ecology – See Samyn & Massin in press. Macnae & Kalk (1962) noted that specimens from Inhaca might also live in muddy sand; a behaviour not observed in Kenya.
Distribution in the study region – Kiunga Marine Reserve, Mombasa Marine Park, Kisite Marine Park, Mesali.
Geographic distribution – Massin (1999: 56, fig. 44) gives the known global distribution but the following localities have to be added: Gulf of Suez (Erwe 1919, as *Holothuria monacaria* (Lesson, 1830); Panning 1951, as *H. monacaria*; Price 1982, as *H. (Thymiosycia) hilla*); Eritrea, Entedebir (Cherbonnier 1967), Noccra Island (Tortonese 1953a; Cherbonnier 1967), Ingal (Tortonese 1936b, as *H. monacaria*); Kenya, Mombasa, Kisite Marine Park (this work); Tanzania, Mesali (this work); southern Mozambique (Kalk 1958; Thandar 1984); Republic of South Africa, Sodwana Bay (Samyn pers. observ.); Madagascar, Tuléar (Cherbonnier 1988, as *H. (T.) hilla*); La Réunion (Conand 1999, as *H. (T.) hilla*). Fig. 53 A gives the known WIO distribution in detail.
Remarks – Although *H. (M.) hilla* is a well-known, easy identifiable species from the tropical Indo-Pacific, its taxonomic position was only changed recently (Samyn & Massin in press). The species is now placed in the subgenus *Mertensiothuria* for the presence of C-shape ossicles, rings and small smooth buttons in the longitudinal muscles is diagnostic to this subgenus. Moreover, the form and distribution of the other ossicles in the different body parts (especially the large plates in the tube feet) agree better with the diagnosis of *Mertensiothuria* than of the subgenus *Thymiosycia* in which it was formerly placed. It is further most remarkable that the huge (reaching lengths of approximately 2 m), Caribbean coral reef inhabiting species, *H. (T.) thomasi* Pawson & Caycedo, 1980, has ossicles that are almost identical to the ones of *H. (M.) hilla*. Investigation of the holotype of *H. thomasi* leaves however no doubt that it is a valid species within the holothurian subgenus *Thymiosycia*.

Holothuria (Mertensiothuria) leucospilota
(Brandt, 1835)
(fig. 53B)

Stichopus (Gymnochirota) leucospilota Brandt, 1835: 51.
Holothuria vagabunda Selenka 1867; Eyre & Stephenson 1938: 43; Stephenson 1944: 277, 306, 348 (from Thandar 1984).
Holothuria leucospilota; Macnae & Kalk 1958: 205, 238 (from Thandar 1984); Branch & Branch 1981: 248 (from Thandar 1984); Hickman 1998: 49 (colour plates); Conand 1999: 10, 12, 21, 39; Marshall *et al.* 2001: 46 (tab. 29).
Holothuria (Mertensiothuria) leucospilota; Arakaki & Fagoonee 1996: 122; Samyn & Massin in press (synonymy and records before 2002).

Type – *Holothuria leucospilota* Brandt, 1835.
Status and location type – Neotype, NHM 1968.7.3.105-6 (Samyn & Massin in press).
Type locality – Solomon Islands.
Material examined – KKan/9701 (one specimen); KKan/9702 (one specimen); KKan/9703 (one specimen); KKan/9704 (one specimen); KShar/9741 (one specimen); TMes/9954 (one specimen); TMes/9955 (one specimen); TMes/9956 (one specimen); KKiun/9932 (one specimen); KKiun/9933 (one specimen).
General description – See Samyn & Massin in press.
Diagnosis – See Samyn & Massin in press.
Ecology – See Samyn & Massin in press.
Distribution in the study region – *H. leucospilota* is perhaps the most common sea cucumber in the region, it was found on virtually every sampling locality (in shallow waters), sometimes with a density of 5 / m^2.
Geographic distribution – Tropical and subtropical Indo-Pacific Ocean (with the Red Sea and the Arabian Gulf) (see also distribution map Massin 1999: 29, fig. 21). The following locations have to be added to Massin's (1999) distribution-map: Gulf of Suez, Suez (Cherbonnier 1955, as *Holothuria vagabunda* Selenka, 1867) (see also Erwe, 1919, as *H. vagabunda*; Cherbonnier 1955, as *H. vagabunda*; Price 1982 for unspecified records from the Gulf of Suez); Gulf of Aqaba, Aqaba (Tortonese 1977) (see also Daniel & Halder 1974, as *H. vagabunda*; Price 1982 for unspecified records from the Gulf of Aqaba); Eritrea, Assab (Ludwig 1886, as *Holothuria lagoena* Haacke, 1880), Massaua (Tortonese

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Mertensiothuria) albofusca CHERBONNIER, 1988	Madagascar (Nosy Bé; Tuléar) Republic South Africa (KwaZulu-Natal)	CHERBONNIER 1988 Pers. observ.; THANDAR pers comm.
H. (Mertensiothuria) aphanes LAMPERT, 1885	Gulf of Aqaba (Aqaba) Gulf of Suez (unspecified) Red Sea (Kosseir) Gulf of Aden (Djibouti) Arabian Sea	TORTONESE 1977; PRICE 1982 PRICE 1982 LAMPERT 1885; THÉEL 1886; PRICE 1982 CHERBONNIER 1955: DANIEL & HALDER 1974 PRICE 1982
H. (Mertensiothuria) fuscorubra THÉEL, 1886 (see also discussion)	Persian Gulf (Bahrein) Indo-Pacific (not specified) Mozambique (Inhaca)	HEDING 1940b[1]; PRICE 1982[2] PEARSON 1913; ROWE & RICHMOND 1997 MRAC record, pers. observ.
H. (Mertensiothuria) papillifera HEDING *in* MORTENSEN, 1938 (see also discussion)	Red Sea (Hurghada) Zanzibar	SAMYN & MASSIN in press MRAC record, pers. observ.[3]

TABLE 10 – Other species within the holothurian subgenus *Mertensiothuria* known to occur in the shallow-waters of the WIO. Cited [1] as *Holothuria pardalis* SELENKA; [2] as *Holothuria (Lessonothuria) glandifera* CHERBONNIER; [3] as *Holothuria impatiens* (FORSKÅL).

1936b), Nocra Island (TORTONESE 1953a), Entedebir (CHERBONNIER 1967, as *H. vagabunda*); Yemen, Derom Island (CHERBONNIER 1963; 1967, as *H. vagabunda*); Persian Gulf, Jez Shit War (HEDING 1940b, as *H. vagabunda*), Damman Channel (PRICE 1981; 1983), Jurayd Island (PRICE 1983) (see also KOEHLER & VANEY 1908, as *H. vagabunda* and PRICE 1982 for unspecified records from the Persian Gulf); Kenya, Kiunga Marine Reserve (SAMYN & VANDEN BERGHE 2000), Malindi, Shariani, Kanamai, Mombasa, Chale Island (this work); Tanzania, Mesali (this work); Madagascar, Madirokely, Antisarana, Nosy Lava, Tuléar, Fort Dauphin (CHERBONNIER 1988); Mozambique, Inhaca (KALK 1958; THANDAR 1984; MRAC records pers. observ.); Republic of South Africa, Sodwana Bay (pers. observ.), Transkei (THANDAR 1984); Réunion (CONAND 1999). Fig. 53B gives the known WIO distribution in detail.

Table ten lists the other species within the subgenus *Mertensiothuria* 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 distribution in the WIO, while column three provides the references wherein the record appeared.

Subgenus *Metriatyla* ROWE, 1969

DIAGNOSIS (See ROWE 1969: 160) [Type species: *Holothuria scabra* JAEGER, 1833 by original designation]

Eleven species are currently recognized as being valid: *H. (M.) albiventer* SEMPER, 1868; *H. (M.) brauni* HELFER, 1911; *H. (M.) conica* H.L. CLARK, 1938; *H. (M.) fuligina* CHERBONNIER, 1988; *H. (M.) horrida* MASSIN, 1987; *H. (M.) martensi* SEMPER, 1868; *H. (M.) ocellata* JAEGER, 1833; *H. (M.) scabra* JAEGER, 1833; *H. (M.) submersa* SLUITER, 1901; *H. (M.) timana* LESSON, 1830 and *H. (M.) tortonesei* CHERBONNIER, 1979. In addition, one variety [*H. (M.) scabra* var. *versicolor* (CONAND, 1986)] has been described, but no consensus has been reached over its validity. Three of these and the variety *versicolor* are found in the waters of Kenya (with Pemba Island); they are keyed hereunder.

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

1. Distinct rows of conical extensions on ventral and dorsal body wall. . . . . ***Holothuria (Metriatyla) albiventer* SEMPER, 1868**

1'. No distinct rows of conical extensions on ventral and dorsal body wall. **2**

2. Colouration of body wall very variable: dorsally ranging from brownish-green to greyish to black, with black and white spots or patches, transverse white band may also be present. Ossicles of dorsal tube feet with plates.
   a. Found in waters less than 10 m deep. . . . . ***H. (Metriatyla) scabra* JAEGER, 1833**
   b. Found in waters deeper than 20 m . . . . . ***H. (Metriatyla) scabra* var. *versicolor* (CONAND, 1986)**

2'. Colouration of the body wall: dorsally brownish, ventrally white-yellow. Ossicles of dorsal tube feet without plates . . . . . ***Holothuria (Metriatyla) timana* LESSON, 1830**

Holothuria (Metriatyla) albiventer SEMPER, 1868 (fig. 18A-E, fig. 53C, pl. 2H)

Holothuria albiventer SEMPER, 1868: 83, pl. 30 fig 14, pl. 35 fig. 5; CHERBONNIER 1963: 5; CHERBONNIER 1967: 56; JAMES 1969: 62; JAMES & PEARSE 1969: 108; DANIEL & HALDER 1974: 428.

Holothuria (Metriatyla) albiventer; PRICE 1982: 11; CANNON & SILVER 1986: 23; CHERBONNIER 1988:129 (synonymy before 1988); ROWE & GATES 1995: 293; LANE *et al.* 2000: 489.

Holothuria (Metriatyla) sp. cf. *albiventer*; MARSH *et al.* 1993: 64.

STATUS AND LOCATION TYPE – Syntypes, whereabouts undetermined (?ZMH) ((ROWE & GATES 1995).

TYPE LOCALITY – Bohol (Philippines).

MATERIAL EXAMINED – KVan/9780 (one specimen); KVan97/81 (one specimen).

GENERAL DESCRIPTION – Two specimens measuring in alcohol 37 x 13 mm and 64 x 20 mm respectively. The largest specimen, found on the shelves of the Kenya Marine Fisheries and Research Institute (Mombasa), is devoid of its calcareous ring and intestine. The smaller specimen eviscerated on collection, but is well preserved. Colour in alcohol similar to colour in life (pl. 2H): ventral side greyish with large, whitish, conical extensions, each of them bearing a whitish grey podium; dorsal side variegated white-grey with conical extensions similar in shape, but not in size and colouration, to the ones on the trivium, each of the extensions bears a whitish podium. Body wall up to 3 mm thick, inner side with conspicuous dark brown to black spots. Mouth ventral, surrounded by 20 small beige tentacles, surrounded at their base by a ring of small papillae of the same colouration as the body wall. Anus terminal, surrounded by some papillae. Tube feet on the bivium and trivium more or less arranged in rows. Presence or absence of Cuvierian tubules could not be ascertained. Single Polian vesicle. Single stone canal. Calcareous ring relatively stout, with the radial pieces twice as wide as the interradial pieces; radial plate with a deep anterior notch and a scalloped posterior side (see CHERBONNIER 1988: 128, fig. 52H).

Ossicles: Tentacles with rods ranging from 55 to 335 µm in length, sometimes slightly spiny (fig. 18A). of the ventral and dorsal body wall consist of numerous, similar tables and buttons (fig. 18B, C). Buttons from 45 to 95 µm long; rim of button smooth but irregular; perforated by three to four (occasionally five) regular holes; knobbed medianly by two to three knobs and peripherically by some knobs (fig. 18B,C). Tables with disc 100 to 120 µm across, rim of disc undulating, smooth, perforated by four to six central holes and up to 15 peripheral holes; four to six pillars ending in a spiny crown which often is not perforated (fig. 18B, C). Ventral tube feet with plate-like rods and some tables (fig. 18D); rods 85 to 215 µm long; widened centrally, with two to four irregular holes; tables similar to the ones in the body wall, but slightly smaller and rim of disc occasionally knobbed. Dorsal papillae with rods similar in size to the ones in the ventral tube feet, but with perforations over the total length (fig. 18E).

DIAGNOSIS – See SEMPER 1868: 67, 248, 277, pl. 30, fig. 14.

ECOLOGY – Generally found intertidally and in shallow waters (up to 2 m), but ROWE (*in* ROWE & GATES 1995) reports it up to 36 m deep. This species is always found on sand.

DISTRIBUTION IN THE STUDY REGION – Vanga only.

GEOGRAPHIC DISTRIBUTION – Well known species from the tropical Indo-west Pacific Ocean (see also CHERBONNIER 1988; ROWE & GATES 1995), also reported from the Red Sea (SEMPER 1868, 1869; LAMPERT 1885; THÉEL 1886; HÉROUARD 1893; LAMPERT 1896; ERWE 1919; CHERBONNIER 1955, 1967; JAMES 1969; JAMES & PEARSE 1969; CLARK & ROWE 1971; DANIEL & HALDER 1974; PRICE 1982), but not from the Persian Gulf. Figure 53C shows the known distribution in the WIO in detail. The records reported here are new to the Kenyan fauna.

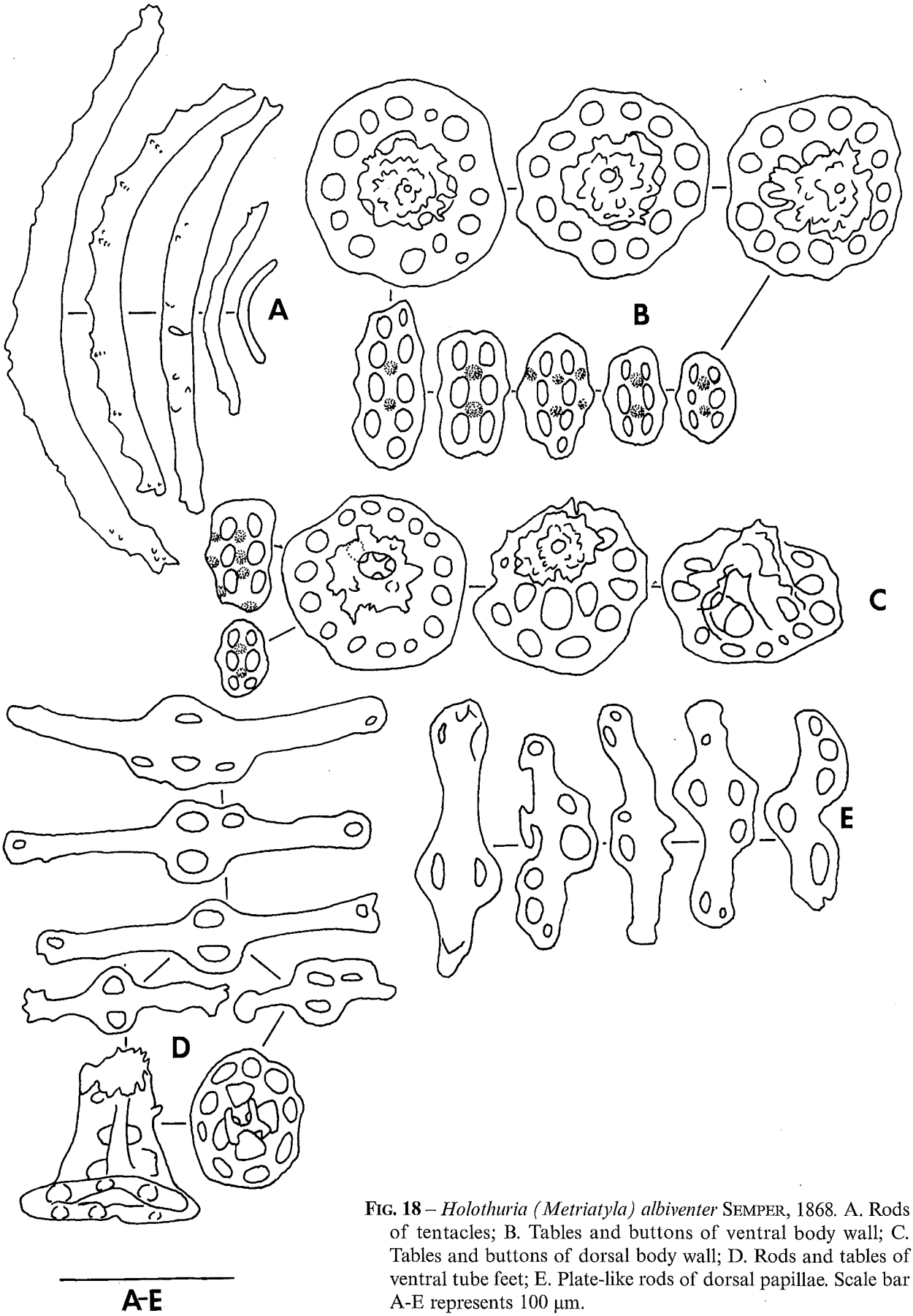


FIG. 18 – *Holothuria (Metriatyla) albiventer* SEMPER, 1868. A. Rods of tentacles; B. Tables and buttons of ventral body wall; C. Tables and buttons of dorsal body wall; D. Rods and tables of ventral tube feet; E. Plate-like rods of dorsal papillae. Scale bar A-E represents 100 μm.

REMARKS – The presence of Cuvierian tubules in the present specimens could not be ascertained due to the eviscerated state. Nevertheless, CHERBONNIER's description (1988) ('Trés gros tubes de Cuvier blanc laiteux' [Sic.]) leaves no doubt on their presence.

Holothuria (Metriatyla) scabra JAEGER, 1833
(fig. 19A-E, fig. 53D, pl. 3A)

Holothuria scabra JAEGER, 1833: 23; CHERBONNIER 1952a: 504; KALK 1954: 113 (from THANDAR 1984); DAY & MORGANS 1956: 274, 278 (from THANDAR 1984); KALK 1959: 22; MACNAE & KALK 1958: 43, 99, 101, 107, 117, 130 (from THANDAR 1984); MACNAE & KALK 1962: 105, 112, 119; BRANCH & BRANCH 1981: 248 (from THANDAR 1984); DAY 1974a: 192 (from THANDAR 1984); DAY 1974b: 54, 59, 94 (from THANDAR 1984); DANIEL & HALDER 1974: 429; BRANCH *et al.* 1999: 204; CONAND 1999: 10, 12, 15, 24, 39, pl. 1 (colour picture); MARSHALL *et al.* 2001: 45, 46 (tab. 29), 47, 50, 53, 54, 58 (tab. 37), 59, 61.

Holothuria (Metriatyla) scabra; MASSIN 1999: 30 (synonymy and records before 1999), figs. 22a-l, 23, 110 f (colour picture); MASSIN *et al.* 2000: 77, figs. 1-14; SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 24; HAMEL *et al.* 2001: 129-223.

Holothuria tigris; SELENKA 1867: 333, pl. 19, figs 70-72.

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

TYPE LOCALITY – Sulawesi (as Celebes), Indonesia.

MATERIAL EXAMINED – KVan/9769 (one specimen); KVan/9770 (one specimen); KVan/9771 (one specimen); KVan/9772 (one specimen); KVan/9773 (one specimens); KCi/9756 (one specimen); KCi/9757 (one specimen); KCi/9758 (one specimen); KCi/9759 (one specimen); KKan/9863 (one specimen); KKan/9864 (one specimen); KKan/9865 (one specimen); KKiun/9939 (one specimen).

GENERAL DESCRIPTION – 13 specimens measuring in alcohol from 50 to 160 mm in length and from

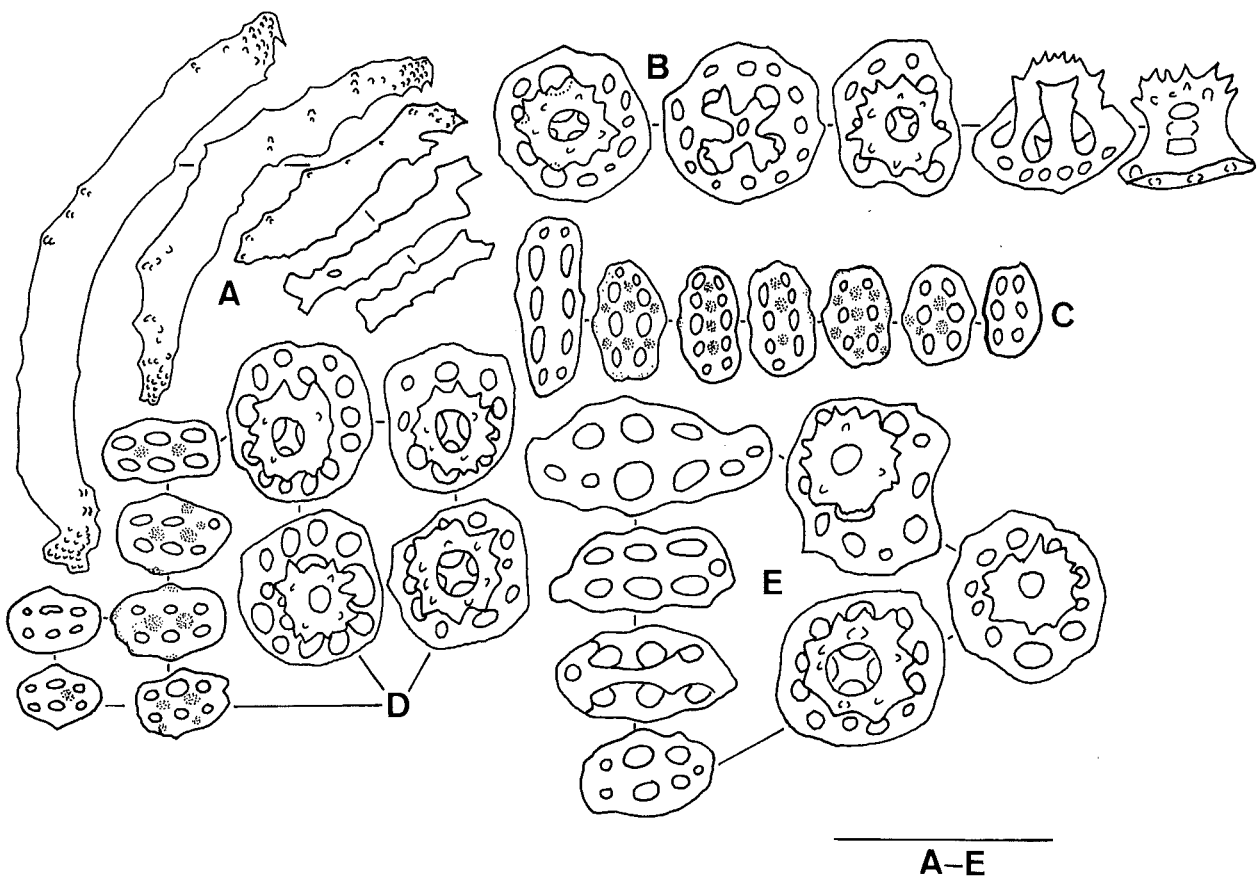


FIG. 19 – *Holothuria (Metriatyla) scabra* JAEGER, 1833. A. Rods of tentacles; B. Tables of dorsal body wall; C. Buttons of dorsal body wall; D. Tables and buttons of ventral body wall; E. Buttons and tables of tube feet. Scale bar A-E represents 100 μm.

18 to 98 mm in width. The specimens from Chale Island are very contracted due to immediate transfer to formalin, three of them eviscerated. Colour in alcohol is the same as the colour in life (pl. 3A): ventral side white-grey with numerous grey spots, dorsally grey with black spots and patches, in the largest specimen white transverse bands and patches are visible. Body strongly contracted with deep transverse folds running from bivium through trivium. Thickness body wall up to 15 mm; the dorsal side being markedly thicker than the ventral side. Mouth ventral surrounded by 15-20 relatively small grey tentacles with distinct dark spots and a white base, surrounded by a ring of modified papillae with white-grey dots. Anus terminal. Grey tube feet on bivium and trivium, in radial and interradial areas. Bivium also with dark-grey conical papillae surrounded at the base by a light grey band. Lateral papillae without grey at the base. Cuvierian tubules absent. Single long Polian vesicle. Single stone canal. Ring of numerous white Tiedemann's bodies. Calcareous ring high; radial pieces twice as broad as the interradial pieces; radial pieces with deep anterior notch; interradial pieces with abrupt anterior tooth (see MASSIN 1999: 31, fig. 22a).

Ossicles: Tentacles with rods ranging from 80 µm to 260 µm in length (fig 19A). Dorsal body wall with tables, buttons and rods. Tables with disc on average 80 µm across, perforated by one to four central and eight to ten peripheral holes, rim of disc undulating; spire low, ending in a simple spiny crown (fig. 19B). Buttons smooth to knobbed, perforated by three to six evenly distributed regular holes (fig. 19C). Ventral body wall with similar ossicles (fig. 19D), but smaller buttons more numerous. Tube feet with buttons and tables (fig. 19E) similar to those of the body wall.

DIAGNOSIS – See CHERBONNIER 1988: 135-137, fig. 55, p. 136 (see also MASSIN *et al.* 2000 for a detailed description of the ossicle change with age).

ECOLOGY – Shallow water species (up to 10 m), often found in sea-grass beds, occasionally in coral gardens.

DISTRIBUTION IN THE STUDY REGION – Kanamai, Chale Island, Vanga, Malindi, Kiunga.

GEOGRAPHIC DISTRIBUTION – Very well known species from the tropical and sub-tropical Indo-west Pacific Ocean, also recorded from the Red Sea, but not from the Persian Gulf. The distribution map as drawn by MASSIN (1999: 32, fig. 23) gives the global distribution, but the following localities in the shallow-waters of the WIO have to be added: Gulf of Suez? (PRICE 1982); Saudi Arabia, Jeddah (TORTONESE 1979); Djibouti (CHERBONNIER 1955); Kenya, Kiunga Marine RESERVE (SAMYN & VANDEN BERGHE 2000), Kanamai, Chale Island, Vanga (this work); Mozambique, Beira (PANNING 1944), southern coast (H.L. CLARK 1923; THANDAR 1984); Madagascar, Mitsio Island, Ile St. Marie, Tuléar (CHERBONNIER 1988). A long list of localities were *H. scabra* has ever been reported is provided by HAMEL *et al.* (2001). Figure 53D shows the known distribution in the WIO in detail.

REMARKS – MASSIN *et al.* (2000) clearly demonstrated that the ossicles of *H. (M.) scabra* vary significantly with size; specimens shorter then 30 mm show typical juvenile characters: tables with tall spire and several cross beams (spire and number of cross beams lowers with increasing body size) and smooth to slightly nodose buttons. The present specimens neatly show the adult ossicles: nodose buttons in combination with tables with disc with an undulating rim, perforated by four central holes and one circle of ten to twelve peripheral holes.

Holothuria (Metriatyla) scabra var. *versicolor* (CONAND, 1986) (fig. 20A-E, fig. 53E)

Holothuria (Metriatyla) scabra var. *versicolor* (CONAND, 1986): 19; CONAND 1999: 10, 12, 15, 39, pl. 1 (colour picture).

STATUS AND LOCATION TYPE – See *H. (M.) scabra.*

TYPE LOCALITY – See *H. (M.) scabra*; the variety *versicolor* was described from New Caledonia.

MATERIAL EXAMINED – TMes/9898 (one specimen).

GENERAL DESCRIPTION – The single specimen at our disposition measures 72 mm in length and 22 mm in width, after preservation. Unfortunately, upon capture the specimen eviscerated; only the left respiratory tree and the anterior part of the gut remains. Colour in life similar to colour in alcohol: dorsal body wall beige to brown with eight, dark brown, large blotches and numerous dark tiny dots corresponding to the tube feet; ventral body wall uniform dirty yellow. Body wall only 1-2 mm thick, relatively rough to the touch.

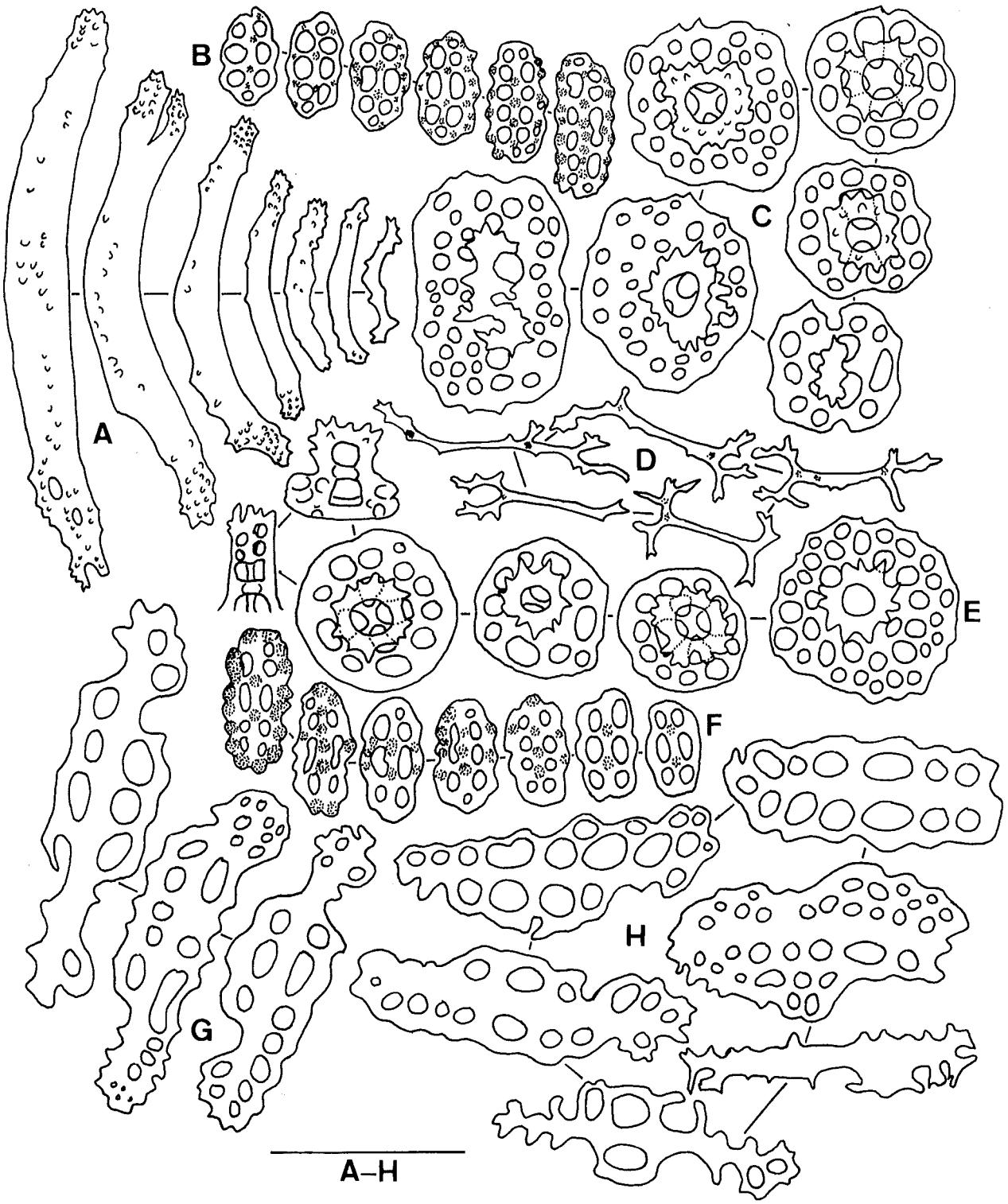


FIG. 20 – *Holothuria (Metriatyla) scabra* var. *versicolour* (CONAND, 1986). A. Rods of tentacles; B. Buttons of dorsal body wall; C. Tables of dorsal body wall; D. Rods of ventral body wall; E. Tables of ventral body wall; F. Buttons of ventral body wall; G. Plates of ventral tube feet; H. Plates of dorsal tube feet. Scale bar A-H represents 100 µm.

Mouth ventral, surrounded by 15 short, brown tentacles, surrounded at their base by conical papillae. Anus terminal, large. Dorsal tube feet homogeneously distributed over the total surface. Ventral tube feet restricted more or less to the ambulacral areas. Polian vesicle(s) not observed. Single narrow stone canal. Cuvierian tubules absent.

Ossicles: Tentacles with spiny rods, occasionally with some perforations, 70-305 µm long (fig. 20A). Ventral and dorsal body wall with nodose buttons, tables and rods (fig. 20B-F). Table discs 70-120 µm across, perforated by one to four large central holes and numerous smaller peripheral holes, positioned in one or several concentric circles; rim of disc undulating to spiny; four short pillars united by one cross beam ending in a spiny crown (fig. 20C, E). Buttons slightly to very nodose, 50-70 µm long, perforated by 3-6 pairs of holes (fig. 20B, F). Rods relatively rare, distally branching, occasionally with some knobs, 100-140 µm long (fig. 20D). Ventral tube feet with perforated rods, 165-215 µm long (fig. 20G), in addition to buttons and tables similar to the ones from the body wall. Dorsal tube feet with rods, perforated rods and plates (fig. 20H), in addition to buttons similar to the ones from the body wall.

DIAGNOSIS – See *H. (M.) scabra* in combination with CONAND 1986: 19; 1998: 1180.

ECOLOGY – The specimen was found at 21 m depth in a healthy coral reef, on coarse coralline sand.

DISTRIBUTION IN THE STUDY REGION – Only observed at Mesali reef, Pemba Island, Tanzania.

GEOGRAPHIC DISTRIBUTION – IN 1998, CONAND stated that *H. scabra* var. *versicolor* has a widespread tropical Pacific distribution (excluding coral reef islands); in 1999 she added Madagascar (exact location unspecified) to the distribution. The present record is new to Kenya. Figure 53E shows the known distribution in the WIO in detail.

REMARKS – The ossicle assemblage of the specimen under study agrees with that of a typical *H. (M.) scabra* (see also CONAND 1998b; MASSIN 1999). In 1986, CONAND proposed the variety *H. (M.) scabra versicolor* in order to substantiate the differences in colour pattern, biometric relations, reproduction and ecology between *H. (M.) scabra* var. *versicolor* and *H. (M.) scabra*. According to CONAND (1986), the bivium of *H. (M.) scabra* var. *versicolor* can have all the intermediates between light beige and black and some individuals are speckled with moderate to large black areas; *H. (M.) scabra* on the other hand, presents a bivium that is light to dark gray and shows transverse whitish bands and small black spots. In this context it must, however, be stressed that the colour pattern of *H. (M.) scabra*, as observed by several authors (FÉRAL & CHERBONNIER 1986; CONAND 1989; MASSIN 1999; HAMEL *et al.* 2001) is so variable that it can hardly serve as a criterion to distinguish the two forms. Of greater importance is perhaps the observation that *H. (M.) scabra* var. *versicolor* is generally larger and heavier then *H. (M.) scabra* (CONAND 1986; HAMEL *et al.* 2001). From an ecological point of view, CONAND (1998b) noted that *H. (M.) scabra* var. *versicolor* is generally found in waters deeper than 20 m, while *H. (M.) scabra* is rarely found in water of more than 10 m. In terms of reproduction, the differences between *H. (M.) scabra* and *H. (M.) scabra* var. *versicolor* (*scabra* showing two peaks of sexual maturation *per annum*, while only one maturation *per annum* for *versicolor*), as presented by CONAND (1986), seem inconclusive to me, a finding sustained by CONAND's (1986) personnal observation that interannual variation most probably exists in the New Caledonia population of *H. (M.) scabra*.

As only a single specimen is available in the present collection, it is imprudent to discuss the taxonomic status of *H. (M.) scabra* var. *versicolor*, but in the light of the evidence of the observed convergences in ossicle morphology of other *Holothuria* species (e.g. *H. (T.) thomasi* versus *H. (M.) hilla*; see remarks with the latter species); more samples from different areas might warrant it a specific status, but it is more likely that *H. (M.) scabra* var. *versicolor* is nothing but a colour-variant of *H. (M.) scabra*.

Holothuria (Metriatyla) timana LESSON, 1830 (fig. 21A-E, fig. 53F, pl. 3B)

Holothuria timana LESSON, 1830: 118, pl. 43.
Holothuria (Metriatyla) timana; ROWE & GATES 1995: 295 (synonymy, partim).
Holothuria aculeata SEMPER, 1868: 84, pls 24, 30 fig. 19; CHERBONNIER 1951b (1re note): 298.

STATUS AND LOCATION TYPE – Holotype lost (ROWE & GATES 1995).

TYPE LOCALITY – Waigiou Island, Offack Bay (South Pacific).

MATERIAL EXAMINED – KKan/9717 (one specimen); KKan/9718 (one specimen), KVan/9774 (one specimen).

GENERAL DESCRIPTION – Three specimens measuring 155-209 mm in length and 68-94 mm in width, after preservation. Body colour in alcohol is preserved: ventrally and laterally yellow-white; dorsally brownish, spotted with numerous small brown spots corresponding to the tube feet (pl. 3B). Largest specimen with deep transverse furrows over the total body; the two smaller specimens only moderately contracted. Thickness of body wall, after preservation, up to 10 mm ventrally and up to 15 mm dorsally. Mouth ventral, surrounded by 20 light-brown, relatively small tentacles, surrounded at their base by a circle of brown tube feet. Anus terminal, relatively large, surrounded by a brown line. Ventral tube feet

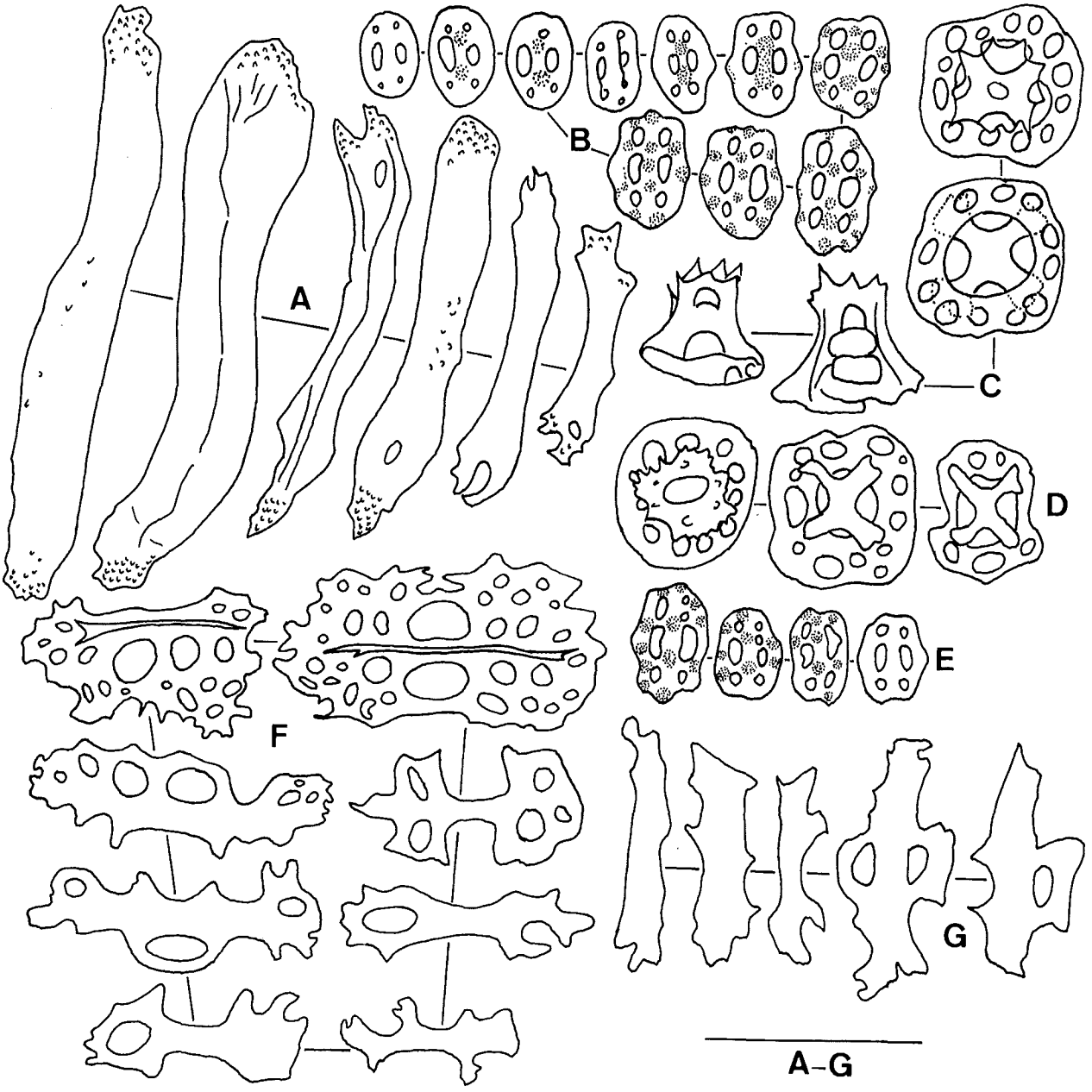


FIG. 21 – *Holothuria (Metriatyla) timana* LESSON, 1830. A. Rods of tentacles; B. Buttons of dorsal body wall; C. Tables of dorsal body wall; D. Tables of ventral body wall; E. Buttons of ventral body wall; F. Tables and rods of ventral tube feet; G. Rods of dorsal tube feet. Scale bar A-G represents 100 μm.

spread in the ambulacral and the interambulacral zones. Bivium covered by tube feet surrounded at their base by a small brownish circle. Cuvierian tubules absent. Gonad white and very developed. Single Polian vesicle. Tentacle ampullae up to 4 cm long. Longitudinal muscles bifid and well developed. Calcareous ring stout with large radial and small straight interradial pieces.

Ossicles: Tentacles present stout rods, 115-295 µm long, slightly spiny at the extremities (fig. 21A). Ventral and dorsal body wall with similar buttons and tables (fig. 21B-E). Buttons occasionally smooth, but generally knobbed medially and peripherically, 40-70 µm long, perforated by six to eight regular holes (fig. 21B, E). Tables: disc on average 80 µm across, rim of disc smooth to undulating, low spire with single cross beam ending in simple spiny crown (fig. 21C, D). Ventral tube feet with plates up to 140 µm long and perforated rods, 60-120 µm long (fig. 21F). Dorsal tube feet with similar but simpler rods up to 100 µm long (fig. 21G).

DIAGNOSIS – CHERBONNIER 1951b: 396 (from ROWE & GATES 1995).

ECOLOGY – *H. (M.) timana* is a typical shallow water species, it has never been recorded deeper then 6 m. In Kenya it can be found during the day in shallow sea-grass beds, on sand or on fine coral rubble. Gut content is composed of a sand-rubble mixture.

DISTRIBUTION IN THE STUDY REGION – Kanamai and Vanga.

GEOGRAPHIC DISTRIBUTION – CLARK & ROWE (1971) record it (as *Holothuria (Metriatyla) aculeata* SEMPER, 1868) from the East Indies and the Philippine Islands. ROWE & GATES (1995) list it as a tropical, east Indo-west Pacific species. As *H. tigris* SELENKA, 1867 (from Zanzibar) clearly is a synonym of *H. scabra* JAEGER, 1833 and not of *H. timana* as ROWE & GATES (1995) suspected, the present records are to be considered as new to the western Indian Ocean [compare SELENKA's (1867) pl. 19 fig. 70 with figs 53E, F in the present work].

Table eleven lists the other species within the subgenus *Metriatyla* 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.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Metriatyla) brauni HELFER, 1911	Gulf of Suez (Suez)	HELFER 1911; PRICE 1982
	Red Sea (Safaga)	Pers. observ.
H. (Metriatyla) fuligina CHERBONNIER, 1988	Madagascar (Tuléar)	CHERBONNIER 1988
	Republic of South Africa (Bangha Nek)	Pers. observ.
H. (Metriatyla) horrida MASSIN, 1987 (see also discussion)	Madagascar (Tuléar)	CHERBONNIER 1988[1]
H. (Metriatyla) martensi SEMPER, 1868	Gulf of Aqaba (Aqaba)	CHERBONNIER 1979a; PRICE 1982
	Gulf of Aden (Djibouti)	CHERBONNIER 1955
	Mozambique (Pekawi)	PEARSON 1910; THANDAR 1984
	Madagascar (Antisarane, Tuléar)	CHERBONNIER 1988
	Arabian Sea?	PRICE 1982
H. (Metriatyla) ocellata JAEGER, 1833	Gulf of Suez?	PRICE 1982
	Red Sea (Massaua)	CHERBONNIER 1963[2]; ERWE 1919; PRICE 1982[2]
	Arabian Sea?	DANIEL & HALDER 1974[2]
	Seychelles (unspecified)	PEARSON 1913
	South West Indian Ocean?	DANIEL & HALDER 1974
H. (Metriatyla) tortonesei CHERBONNIER 1979	Red Sea (Jeddah)	CHERBONNIER 1979b; PRICE 1982

TABLE 11 – Other species within the holothurian subgenus *Metriatyla* known to occur in the shallow-waters of the WIO. Cited [1] as *Holothuria (Metriatyla)* sp. [2] as *Holothuria kurti* LUDWIG (non LAMPERT).

Subgenus *Microthele* BRANDT, 1835

DIAGNOSIS (after ROWE 1969: 162) [Type species: *Holothuria (Microthele) maculata* BRANDT, 1835 (= *Muelleria nobilis* SELENKA, 1867) by subsequent designation].

Large, massive species reaching lengths of over 600 mm and widths up to 200 mm; body wall very thick, up to 12 mm; pedicels in ventral and dorsal area distributed over the ambulacral and interambulacral areas; mouth ventral, surrounded by twenty tentacles; anus dorsal, often surrounded by five anal teeth; calcareous ring massive, with radial and interradial pieces squarish, radial pieces twice as long as the pointed interradial pieces. Ossicles comprise well developed tables and buttons; tables with squarish, unknobbed disc, spire of moderate height, united by a single cross beam, terminating in a massive spiny crown; buttons heavily knobbed, perforated by up to ten holes, often modified into fenestrated ellipsoids.

Only three species are currently recognized as being valid: *Holothuria (Microthele) fuscopunctata* JAEGER, 1833; *H. (M.) nobilis* (SELENKA, 1867) and *H. (M.) whitmaei* BELL, 1887. The first two species are reported from the littoral waters of Kenya (with Pemba Island) and are keyed hereunder.

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

1. Bivium grey to black with some white-cream areas; laterally a row of five to six prominent large papillae (commonly referred to as *teats*) present.... ***H. (M.) nobilis* (SELENKA, 1867)**

1'. Bivium yellow to light brown with numerous brown areas around the tube feet; laterally teats absent..... ***H. (M.) fuscopunctata* JAEGER, 1833**

Holothuria (Microthele) fuscopunctata JAEGER, 1833 (fig. 22A-E, fig. 53G, pl. 3C)

Holothuria fuscopunctata JAEGER, 1833: 23; CONAND 1998b: 1182; CONAND 1999: 10, 12, 19, 39, pl. 1 (colour picture); MARSHALL *et al.* 2001: 46 (tab. 29), 47.

Holothuria (Microthele) fuscopunctata; CHERBONNIER 1980: 623 (synonymy before 1980); FÉRAL & CHERBONNIER 1986: 88, 89 (colour picture); CHERBONNIER 1988: 144 (synonymy); ALLEN & STEENE 1994: 244 (colour plate); GOSLINER *et al.* 1996: 280 (colour plate); SAMYN 2000: 15 (tab.1); LANE *et al.* 2000: 489.

Holothuria (Microthele) fusco-punctata; MARSH *et al.* 1993: 64.

TYPE – *Holothuria fuscopunctata* JAEGER, 1833.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined according to ROWE (*in* ROWE & GATES 1995), who thus disregards CHERBONNIER's (1980) proposal to regard the specimen deposited in RMNH and described by LUDWIG (1882) as neotype. I see no reason to disdain CHERBONNIER's stabilizing decision.

TYPE LOCALITY – Sulawesi (Indonesia).

MATERIAL EXAMINED – TFun/9806 (one specimen).

GENERAL DESCRIPTION – Large, massive species. The single specimen at our disposition measures 380 x 132 mm, after preservation. Dorsal side rounded with deep transverse scars; ventral side flattened. Body colour in alcohol similar as life colouration: dorsal body wall yellow to light brown with numerous darker brown spots corresponding to tube feet which are scattered over the ambulacral and interambulacral areas (pl. 3C); ventral body wall faint yellow with numerous brown tube feet distributed over the total surface. Body wall up to 10 mm thick, smooth to the touch. Mouth ventral, surrounded by twenty stout, uniform brown tentacles. Anus dorsal, wide, brown, unguarded by papillae. Cuvierian tubules absent. Calcareous ring with radial pieces twice as wide as the interradial pieces; radial and interradial pieces about the same height; radial pieces with shallow anterior notch; interradial pieces with anterior tooth (see also CHERBONNIER 1988: 145, fig. 59P).

Ossicles: Tentacles with straight rods, 30-150 µm long, slightly spiny, imperforated; the smaller ones occasionally curved, not spiny (fig. 22A). Dorsal and ventral body wall with numerous tables and ellipsoids (fig. 22B, C); ventral side present in addition some smooth to slightly knobbed buttons (fig. 22B). Tables with disc small, 35-55 µm across; rim irregular, spiny; disc perforated by four large central holes and few peripheral ones; four pillars united by a single cross beam ending in a moderately spiny crown (often incomplete) with a large central opening (fig. 22B,C). Ellipsoids very numerous; perforated 4-6 pairs of holes

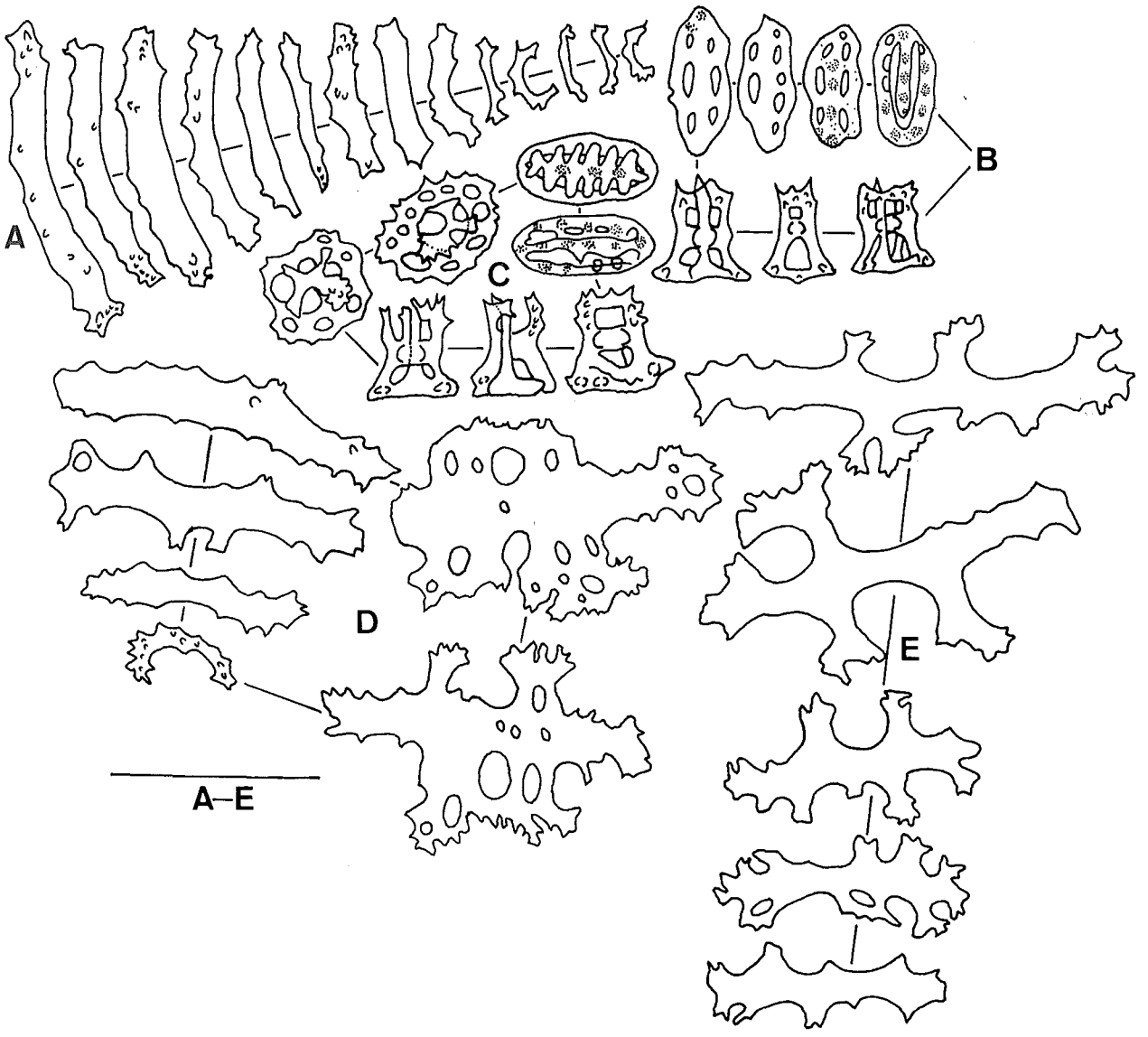


FIG. 22 – *Holothuria (Microthele) fuscopunctata* JAEGER, 1833. A. Rods of tentacles; B. Tables, buttons and ellipsoids of ventral body wall; C. Tables and ellipsoid buttons of dorsal body wall; D. Plates and rods of dorsal tube feet; E. Modified rods of ventral tube feet. Scale bar A-E represents 100 μm.

(fig. 22B, C); occasionally simple buttons which can be either smooth or slightly knobbed, with three to four pairs of holes (fig. 22B). Dorsal and ventral tube feet with spiny plates and branching rods (fig. 22 D, E).

DIAGNOSIS – See CHERBONNIER 1980: 623-626, fig. 5.

ECOLOGY – The single specimen was found on the western side of Pemba Island (Fundu) on a large sand flat next to the reef slope at 32 m depth, three more specimens were seen at the same locality. CONAND (1998b) and FÉRAL and CHERBONNIER (1986) note that in New Caledonia this species can also be seen in shallow sea-grass beds and from 5 to 20 m depth, always on clear coralline sand. CHERBONNIER (1988) found his specimens in the shallow sea grass beds of Nosy Bé. CONAND (1998b) further remarks the low potential fecundity and late sexual maturity of this species.

DISTRIBUTION IN THE STUDY REGION – Only found on one location, Fundu, where it was known to live by our local divemaster.

GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific Ocean (ROWE & GATES 1995). Figure 53G gives the only records from WIO: Madagascar,

Nosy Bé (CHERBONNIER 1988; but see also CONAND 1999 for an unspecified locality in Madagascar); Tanzania, Fundu (MARSHALL *et al.* 2001; this work).

Holothuria (Microthele) nobilis (SELENKA, 1867) (figs 23A-K, 24A-B, 25A-C, fig. 53H, pl. 3D)

Muelleria nobilis SELENKA, 1867: 313, pl. 17 figs 13-15.

Holothuria nobilis; CONAND 1999: 8, 9, 10, 12, 13, 39, pl. 1 (colour picture); MARSHALL *et al.* 2001: 46 (tab. 29), 47, 50, 53, 54, 58 (tab. 37).

Holothuria (Microthele) nobilis; HUGHES & GAMBLE 1977: 355; CHERBONNIER 1979a: 861; MUKHOPADHYAY 1991: 406; ARAKAKI & FAGOONEE 1996: 122; MASSIN 1999: 33 (synonymy and records before 1999),110 g, h (colour plates) SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 25.

Microthele nobilis; CLARK 1952: 204; JAMES & PEARSE 1969: 103; CHERBONNIER 1963: 5; DANIEL & HALDER 1974: 427.

Holothuria (Microthele) fuscogilva CHERBONNIER 1980: 628, fig. 7A-L, pl. I,C.

Holothuria fuscogilva; CONAND 1999: 10, 12, 13, 39, pl. 1 (colour picture); MARSHALL *et al.* 2001: 46 (tab. 29), 47, 58 (tab. 37).

STATUS AND LOCATION TYPE – Lectotype MCZ 819 (ROWE & GATES, 1995).

TYPE LOCALITY – Zanzibar.

MATERIAL EXAMINED – Specimens *sensu 'nobilis'* KMom/9845-46 (two specimens); KKiun/9940 (two specimens); specimens *sensu 'fuscogilva'* KVan/9776 (one specimen); TFun/9820 (one specimen); TFun/9821 (one specimen).

GENERAL DESCRIPTION – Large, massive species; the specimens at our disposition range from 180-250 mm in length and from 80-120 mm in width, after preservation. Colour in life similar to colour in alcohol (although slightly faded): dorsal side grey to black, with in between some brownish areas (pl. 3D); ventral side flattened, uniform white to grey with a few black spots. Large lateral papillae, the so called *teats*, separate the trivium from the bivium. Body wall approximately 10 mm thick, often covered with sand. Mouth ventral, surrounded by twenty large white tentacles with brown spots on the stalk. Anus dorsal surrounded by five small white anal teeth. Grey tube feet with brown sucking disk scattered all over the ambulacral and interambulacral areas of the trivium; dark brown to black tube feet with brown sucking disk and few minute, blackish papillae spread scarcely over the ambulacral and interambulacral areas of bivium. Calcareous ring with very large radial pieces with conspicuous anterior notch; interradial pieces narrow, pointed anteriorly (see also MASSIN 1999: 34, fig. 24a). Cuvierian tubules present in the Mombasa specimens, but not found in one of the specimens from Kiunga. Single Polian vesicle, single stone canal. Pearlfish were present in the eviscerate of some specimens; two species could be discerned *Encheliophis mourlani* (PETIT, 1934) and *E. homei* (RICHARDSON, 1844) (PARMENTIER, pers. comm.).

Ossicles: Tentacles with straight or slightly curved rods, 50-650 µm long, spiny at the extremities, occasionally with distal perforations (fig. 23A); tables reduced to the disc with some knobs, 40-60 µm across (fig. 23B); tables reduced to the disc without knobs, 40-65 µm across (fig 23C). Ventral and dorsal body wall present tables and ellipsoids. Tables: table disc 55-85 µm across; rim of disc smooth to slightly undulating, perforated by four large central holes and four to twelve peripheral holes; four pillars forming a short spire united by a single cross beam ending in a dense crown of spines; central hole of the crown sometimes obscured by spines (fig 23D). Ellipsoids: very numerous; 55-90 µm long; knobbed; six to ten pairs of holes (fig. 23E); in general dorsal ellipsoids more complex than the ventral ones (fig. 23F). Smooth to slightly knobbed buttons present in the ventral body wall of some specimens, 70-110 µm long (fig. 23G). Ventral tube feet present some tables of similar size and shape as those found in the body wall; buttons 60-100 µm long; similar to those found in the body wall; smooth to slightly knobbed perforated elongated plates, 100-125 µm long (fig. 23H); irregular long plates derived from rods, 150-350 µm long (fig. 23I), and large multiperforated plates, 130-180 µm long and 65-140 µm wide (fig. 23K); endplate ± 600 µm across. Dorsal tube feet with rods, elongated plates, buttons and tables; their dimensions comparable to those found in the ventral tube feet (fig. 24A). Dorsal papillae present elongated regular plates 140-200 µm long (fig. 24B), in addition to tables and ellipsoids similar to those in the body wall.

DIAGNOSIS – See MASSIN 1999: 33-38, figs 24, 26, 27.

ECOLOGY – *H. (Microthele) nobilis* is typically found at greater depths (up to 45 m) in the outer

reef, on sand flats and on detritus piles.

DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve, Mombasa, Malindi, Watamu, Shimoni, Vanga, Fundu (see also SAMYN & VANDEN BERGHE 2000).

GEOGRAPHIC DISTRIBUTION – Well-known species throughout the tropical and subtropical Indo-Pacific Ocean; also reported from the Red Sea. The distribution map as drawn by MASSIN (1999: 38, fig 27) gives the global distribution, but the following localities have to be added: Gulf of Suez, Suez (PANNING 1944); Gulf of Aqaba, Eilat (CHERBONNIER 1963; 1967, both as *Microthele nobilis* (SELENKA, 1867)), Aqaba (TORTONESE 1977; CHERBONNIER 1979a) (see also PRICE 1982 for unspecified record from the Gulf of Aqaba); Arabian Sea, unspecified locality (DANIEL & HALDER 1974, as *Microthele nobilis*); Kenya, Kiunga Marine Reseve (SAMYN & VANDEN BERGHE 2000), Malindi; Mombasa, Shimoni, Vanga (this work); Tanzania, Fundu (this work); Madagascar, Tuléar (CHERBONNIER 1988); Mozambique Channel (CHERBONNIER 1988); Mozambique, Beira and Port Amelia (PANNING 1944, as *Microthele nobilis*); La Réunion (CONAND 1999); Republic of South Africa, Banhga Nek and Sodwana Bay (SAMYN pers. observ.). Figure 53H shows the known distribution in the WIO in detail.

REMARKS – ROWE (in ROWE & GATES 1995), after examination of extant type specimens, was the first to regard *H. (M.) fuscogilva* as a junior synonym of *H. (M.) nobilis*. Later MASSIN (1999) analysed four specimens from Sulawesi and conclusively showed that *H. (M.) nobilis* is a highly variable species in terms of body colour and ossicles. His analysis showed that the differences employed by CHERBONNIER (1980) to distinguish the two forms of teatfish are artefacts. The specimens collected in Kenya allow testing of this hypothesis as we have three specimens *sensu fuscogilva* and five specimens *sensu nobilis.* All specimens were collected in similar habitats, *i.e.* between 10-30 m deep, on coarse sand between dead and live coral.

Table 12 lists the characters that CHERBONNIER (1980) used to distinguish the two forms of teatfish. According to CHERBONNIER (1980), *H. (M.) fuscogilva* has a beige to greyish brown colouration, lacks Cuvierian tubules, and presents ossicles which differ from those found in *H. (M.) nobilis* in having tables with a larger more spiny crown, a disc which can be knobbed (tables from the dorsal body wall) and button-like ossicles which consist of simple rugose buttons together with rugose ellipsoids in the ventral body wall, while the dorsal body wall presents rugose ellipsoids only, *H. (M.) nobilis* on the other hand has a grey to black colouration with the lateral teats whitish, always presents Cuvierian tubules and presents ossicles which differ to those of *H. (M.) fuscogilva* in having much smaller rods, plates and pseudo-plates in the tentacles; only ellipsoids (in stead of ellipsoids and rugose buttons for *H. (M.) fuscogilva)* in the ventral body wall; and in addition to plates also presents large spiny rods in the ventral tube feet. CHERBONNIER (1980) also noted that the two species occur in a different habitat; *H. (M.) nobilis* can be found from 0-30 m deep, *H. (M.) fuscogilva* has a narrower depth range of 10-20 m; *H. (M.) nobilis* feeds on coarser sediment and dead coral while *H. (M.) fuscogilva* has only fine sand in its intestine.

The present analysis confirms the high variability as noted by ROWE (*in* ROWE & GATES 1995) and MASSIN (1999). The two colour forms of teatfish can easily be distinguished in our samples: the *nobilis* forms invariably present a grey to black dorsal side, with in between some brownish areas and a flattened, uniform white to grey with a few black spots ventral side; the *fuscogilva* forms are greyish-brown dorsally, grey to dirty white with tiny brown spots near the large lateral teats laterally, and greyish-brown ventrally. In terms of presence of Cuvierian tubules, in two out of five, and one out of three specimens of *nobilis* and *fuscogilva* respectively Cuvierian tubules can be found, which illustrates that Cuvierian tubules are not always easy to observe in preserved specimens rather than that they are absent or present in the two colour forms. In terms of ossicles some discrepancies between the ossicles can be found, although it seems that these differences are intra-rather then interspecific. The teatfish *sensu H. (M.) nobilis* always present pseudo-plates and small knobbed plates (fig. 23C, D) in their tentacles, whereas teatfish *sensu H. (M.) fuscogilva* only presents rods of approximately the same size and shape, although it could be argued that the rods in the latter form are more complex at the extremities (fig. 25A). The body wall ossicles in teatfish *sensu fuscogilva* and *sensu nobilis* are very alike: the tables are alike in the two forms (fig. 23D versus

CHARACTER	*H. (M.) nobilis*	*H. (M.) fuscogilva*
Colour pattern		
• trivium	black	very light chestnut brown
• bivium	black with some light brown to grey patches	yellow to chocolate brown with beige blotches
Tube feet – ventral		
• distribution	numerous, in radial and interradial areas	numerous, in radial and interradial areas
• colour	overall colour not specified; yellowish sucking discs	dark yellow; brown sucking disc
• size	thin, short, cylindrical	short, cylindrical
• size endplate	680-700 µm across	600-610 µm across
Tube feet – dorsal		
• distribution	few; in radial and interradial areas	Few; in the brown blotches
• colour	Blackish; yellowish sucking disc	grey to white
• size	Short; cylindrical	very small
• size endplate	210-220 µm across	420-450 µm across
Papillae – dorsal		
• distribution	not specified	not specified
• colour	not specified	whitish
• size	not specified	not specified
Papillae – lateral		
• distribution	ten conical extensions on each side	five to six conical extensions each side
• colour	not specified	surrounded by a black ring
• size	very small	very small
Mouth		
1. position	ventral	ventral
2. number of tentacles	20	20
• colour of tentacles	yellow to grey	light chestnut-brown
• circle of papillae	in double circle, long, chestnut brown	long, yellow
Anus		
(1) position	not specified	terminal
(2) anal teeth	present as strong rectangular teeth	present as strong rectangular teeth
• circle of papillae	present; short, conical, yellowish	not specified
Calcareous ring		
• size radial pieces (R), interradial pieces (IR)	R twice as large as IR; R and IR about the same height	R twice as large as IR; R and IR about the same height
• size radial pieces (R), interradial pieces (IR)	R with central notch and two lateral indents, posterior side scalloped IR with anterior tooth	R with central notch and two lateral indents, posterior side scalloped IR with anterior tooth, posterior somewhat scalloped
Tentacle ampullae		
• number	20	20
• size	1/5 of body length	1/4-1/5 of body length
• colour	black at the tips (contenant une bouillie noirâtre [Sic.])	not specified
Polian vesicle		
• number	two	one
• size	one large, one small	1/5 of body length
Stone canal	single, very short	single; very short (2 mm)
Madreporic plate	large, spheric	large
Gonad	single tuft of simple, fine, long tubes	single tuft of simple, fine, long tubes
Longitudinal muscles	large with curled edges	large with curled edges
Respiratory trees	not specified	highly branched, reaching up to the calcareous ring
Cuvierian tubules	numerous	absent
Spicules – tentacles		
• shape	arched, spiny rods; pseudo-plates; small slightly knobbed plates; plates with relief	rods, spiny at the extrimities
• size	rods up to 125 µm long; pseudo-plates up to 120 µm long; small slightly knobbed plates 55-70 µm long; plates with relief ± 75 µm long	rods up to 700 µm

CHARACTER	*H. (M.) nobilis*	*H. (M.) fuscogilva*
Spicules – ventral body wall		
• shape tables	disc with more or less rounded rim, unknobbed; four central holes; 12-16 peripheric holes; spire: 4-6 (exceptionally) pillars; single cross-beam; spiny crown	disc irregular with more or less rounded rim; unknobbed; four central holes; 10-15 peripheric holes; spire: 4 pillars; single cross beam; spiny crown
• size tables	disc up to 70 µm across	disc up to 70 µm across
• shape buttons	fenestrated ellipsoids, knobbed	simple buttons with rim irregular, four to five pairs of holes; slightly knobbed fenestrated ellipsoids
• size buttons	longer (65-100 µm) than wide (35-40 µm)	simple buttons: 65-80 µm long, 35-40 mm wide; ellipsoids: 65-75 µm long, 35-40 µm wide
Spicules – dorsal body wall		
• shape tables	same as ventral body wall	disc irregular with more or less rounded rim; knobbed disc; perforated by four central holes and +15 peripheric ones; four to six pillars; single cross beam; spiny, massive crown
• size tables	same as ventral body wall	disc up to 100 µm across
• shape buttons	fenestrated ellipsoids, knobbed	ellipsoids only, always knobbed
• size buttons	ellipsoids: 65-75 µm long, 40-50 µm wide	ellipsoids: 65-75 µm long, 35-40 µm wide
Spicules – ventral tube feet		
• shape	large plates with irregular rim and spiny rods	large plates with irregular rim
• size	plates 195 µm long, 95 µm wide; rods up to 250 µm long	plates up to 165 µm long and 85 µm wide
Spicules – dorsal tube feet	dissimilar to those of the ventral tube feet	same as ventral tube feet
• shape	large plates, rim irregular	same as ventral tube feet
• size	plates up to 250 µm long	same as ventral tube feet
Spicules – lateral papillae		
• shape	not specified	not specified
• size	not specified	not specified
Spicules – dorsal papillae		
• shape	not specified	not specified
• size	not specified	not specified
Habitat	0-30 m; currents not specified; on coral rubble and on dead corals, close to sand substrate	10-20 m; high currents; not abundant on loose sediments

TABLE 12 – Diagnostic characters allowing to separate *H. (M.) nobilis* from *H. (M.) fuscogilva* according to CHERBONNIER (1980).

fig. 25B); two specimens in the *fuscogilva* group present, in addition to rugose ellipsoids, numerous smooth to slightly rugose buttons in the ventral body wall (fig. 25C), while the third specimen in that same group presents no smooth buttons whatsoever; two specimens in the *nobilis* group alo present some smooth buttons (fig. 23G). The tables, plates and rods presented in the tube feet of the *fuscogilva* specimens are similar to those presented in the *nobilis* specimens.

Thus, the present study seems to further support that *H. (M.) fuscogilva* should be regarded as junior synonym of *H. (M.) nobilis* (ROWE, *in* ROWE & GATES 1995; MASSIN 1999). However, CONAND (1981, 1993) investigated the population and reproductive biology of both forms in New Caledonia and discovered that the white teatfish (*H. (M.) fuscogilva*) reproduces in the warm season, while the black teatfish[6] (*H. (M.) nobilis)* reproduces in the cold season. Although CONAND's results are quite conclusive it can be argued that she mixed up the two forms as she indicates that the black form varies in colour with age. Moreover, MORTENSEN (1938; see also CONAND 1980) found that *H. (M.) nobilis* individuals from the Red Sea reproduce during the warm rather then during the cold season.

[6] ROWE (pers. comm.) believes the black teatfish might be *H. (M.) whitmaei* BELL, 1887.

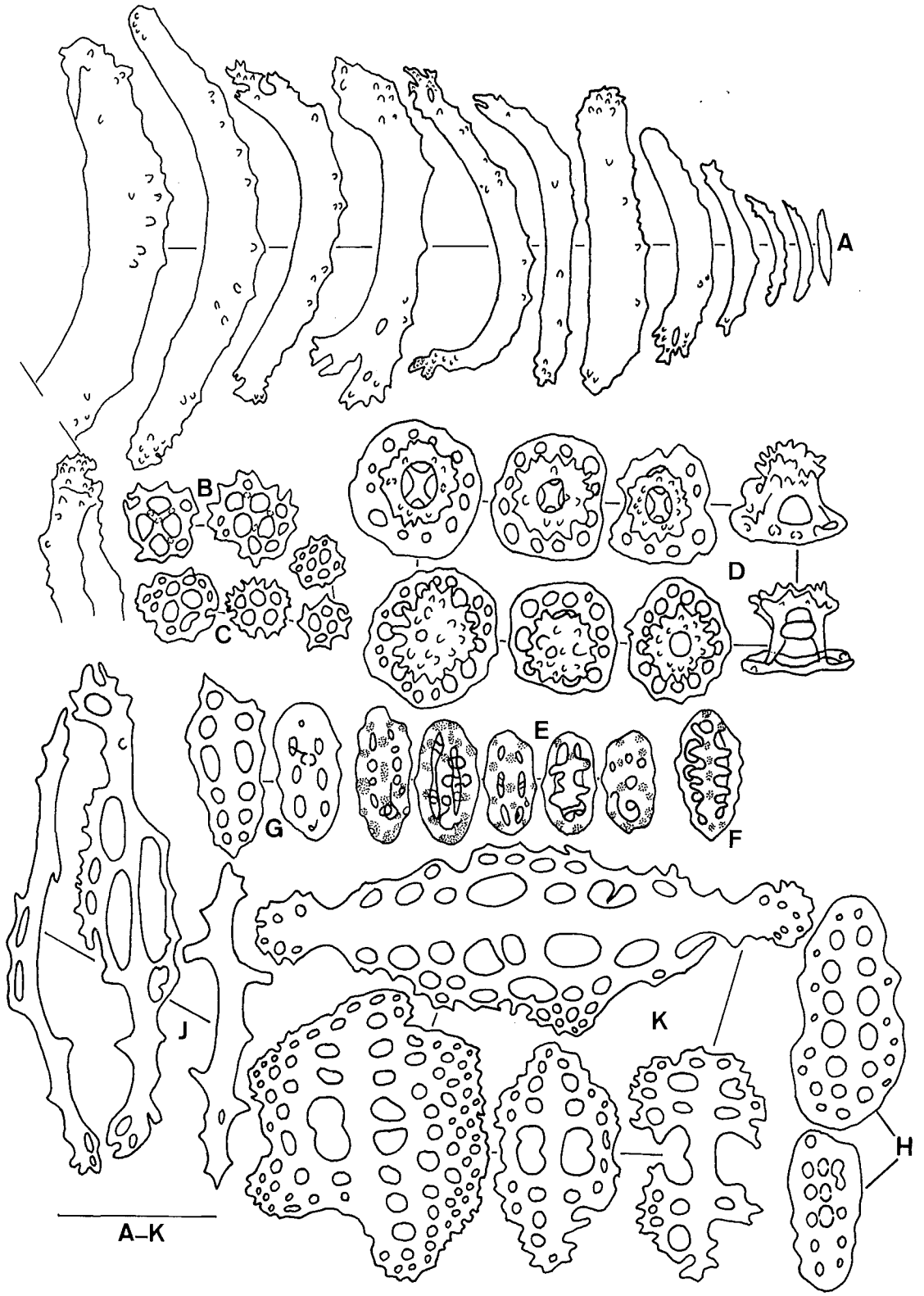


FIG. 23 – *Holothuria (Microthele) nobilis* (SELENKA, 1867). A. Rods of tentacles; B. Tables (reduced to the disc with some knobs) of tentacles; C. Tables (reduced to disc without knobs) of tentacles; D. Tables of body wall; E. Rugose ellipsoids of body wall; F. Complex rugose ellpsoid of dorsal body wall; G. Smooth to slightly knobbed buttons of ventral body wall; H. Smooth to slightly knobbed elongated plates of ventral tube feet; J. Rod-like plates of ventral tube feet; K. Large multiperforated plates of tube feet. Scale bar A-K represents 100 μm.

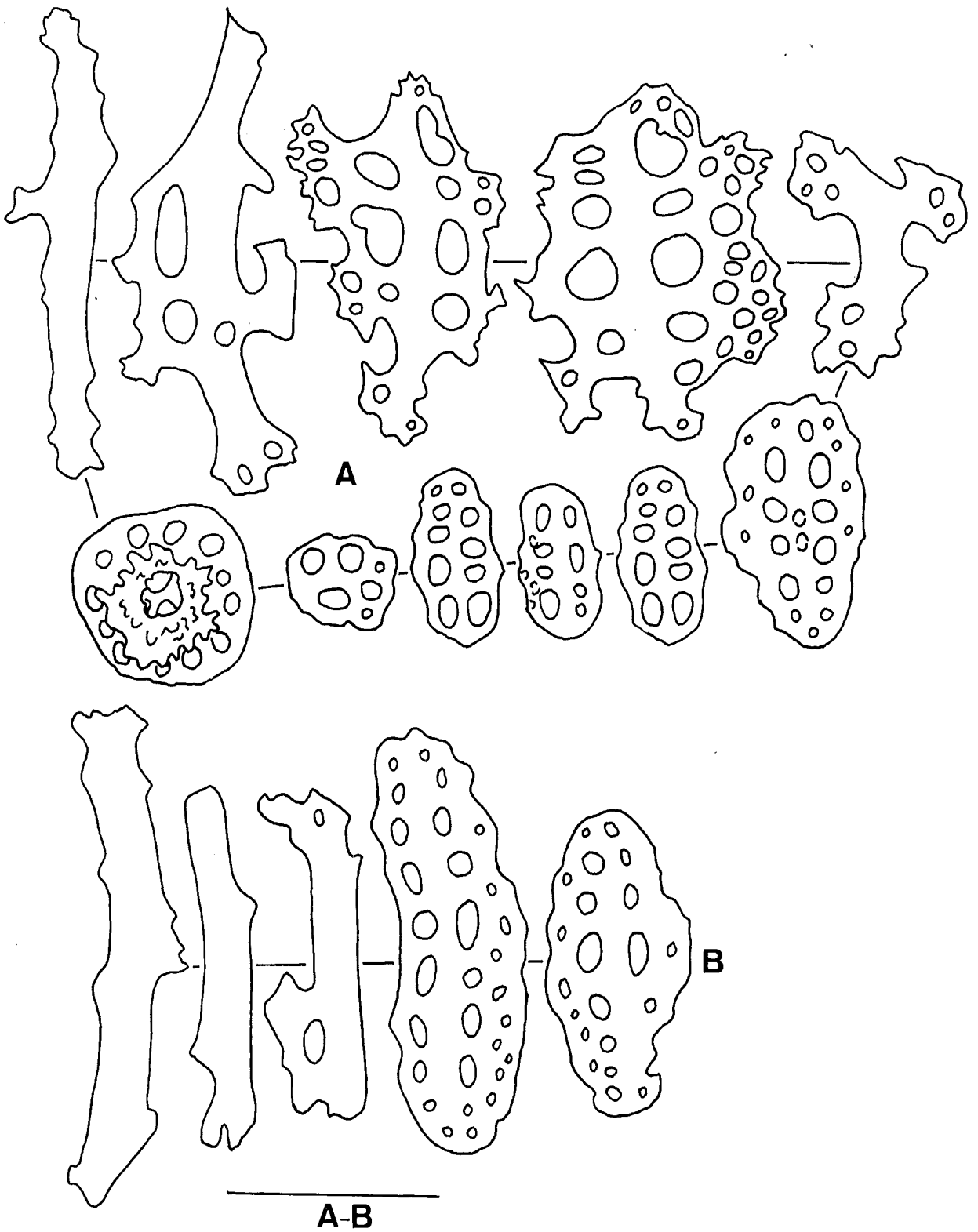


FIG. 24 – *Holothuria (Microthele) nobilis* (SELENKA, 1867). A. Rod-like plates, multiperforated plates, buttons and table of ventral tube feet; B. Rods and elongated plates of dorsal papillae. Scale bar A, B represents 100 µm.

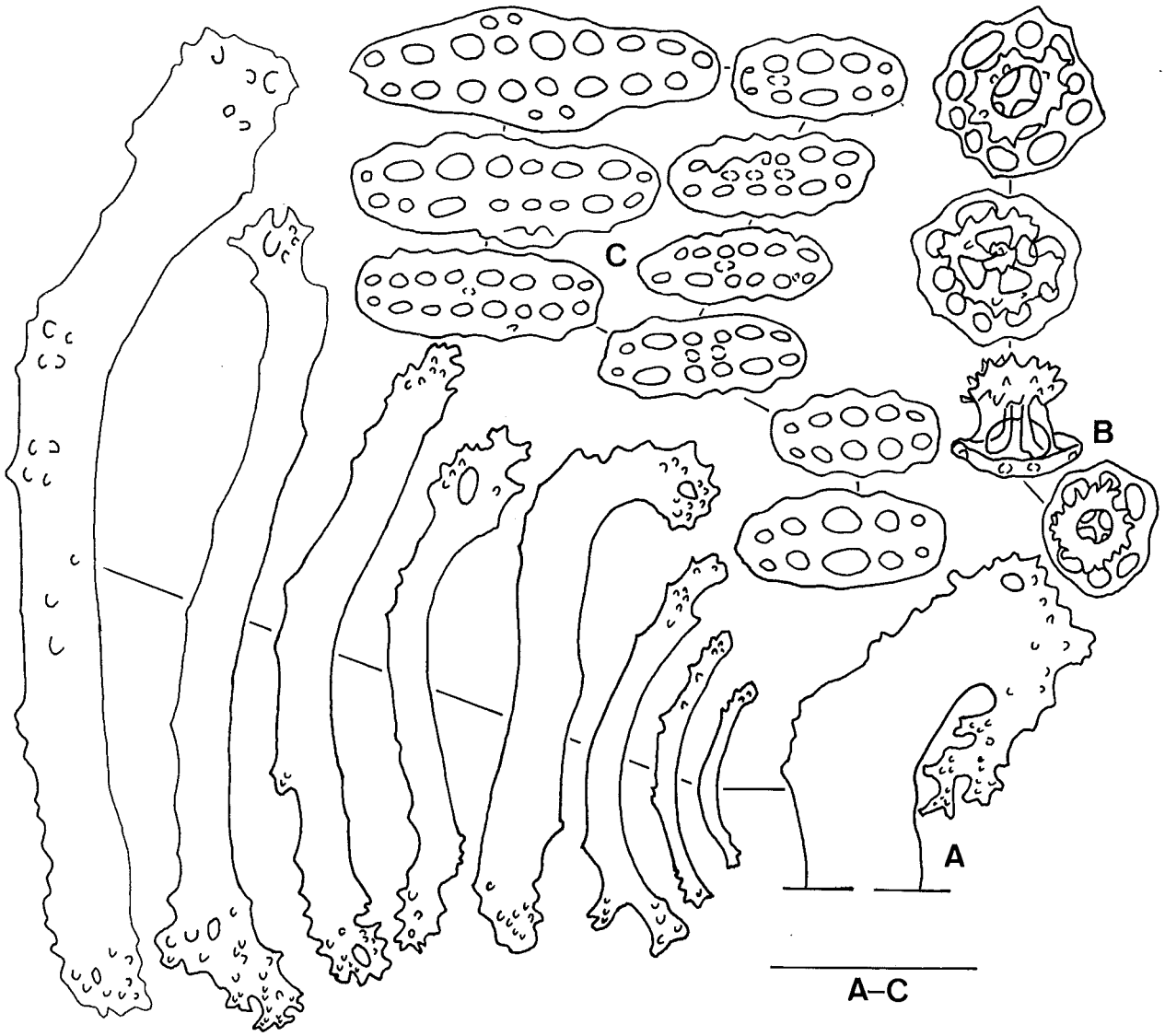


FIG. 25 – *Holothuria (Microthele) nobilis* (SELENKA, 1867). A. Rods of tentacles; B. Tables of body wall; C. Smooth to slightly rugose buttons and plates of ventral body wall. Scale bar A-C represents 100 μm.

REICHENBACH (1999) analysed the reproductive cycle of *H. (M.) fuscogilva* thriving in the Maldives and found that onset of spawning started in December and that the majority of mature individuals are found from December to March, though mature individuals are present throughout the year. To add to the complexity, a recent study by RAMOFAFIA *et al.* (2000) demonstrates that the white teatfish thriving in the Solomon Islands has mature gametes in August and that spawning occurs from August to October. RAMOFAFIA *et al.* (2000) state that temperature changes can hardly affect timing of the reproductive cycle as temperature fluctuations in the Solomon Islands are minimal. It could be incidental, but the spawning period of *H. (M.) fuscogilva* reported by RAMOFAFIA *et al.* (2000) coincides neatly with that of *H. (M.) nobilis* reported by CONAND (1981) in New Caledonia. Adding to that suspicion is the fact that RAMOFAFIA *et al.* (2000) named the white teatfish *H. fuscogilva* (SELENKA, 1867) rather than *H. (M.) fuscogilva* CHERBONNIER, 1980.

Clearly more material from different localities needs to be examined in a statistical way in order to unambiguously determine the possible synonymous nature of *H. (M.) nobilis* and *H. (M.) fuscogilva*. For now, I agree with ROWE (in ROWE & GATES 1995) and MASSIN (1999) in keeping *H. (M.) fuscogilva* CHERBONNIER, 1988 as junior synonym of *H. (M.) nobilis* (SELENKA, 1867).

In addition to the reservations given above, ROWE (pers. comm.) added the following supportive arguments: "SELENKA (1867: 313) described two colour forms – a mottled form (=*H. nobilis*) from Zanzibar [type locality according to Rowe (*in* ROWE & GATES 1995)] and a black form (=*Holothuria whitmaei* BELL, 1887) from Samoa [type locality according to ROWE (*in* ROWE & GATES 1995)]. As well as reproductive differences I [F.W.E. ROWE] also think the two differ in shape, an observation that helps justify two species: *H. nobilis* and *H. whitmaei*".

Table 13 gives another species within the subgenus *Microthele* that is 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.

Subgenus *Platyperona* ROWE, 1969

DIAGNOSIS (See ROWE 1969: 144) [Type species: *Holothuria discrepans* SEMPER, 1868 by original designation]
Currently eight species are regarded as being valid[7]: *Holothuria (Platyperona) crosnieri* CHERBONNIER, 1988; *H. (P.) difficilis* SEMPER, 1868; *H. (P.) excellens* LUDWIG, 1875; *H. (P.) insolita* CHERBONNIER, 1988; *H. (P.) parvula* (SELENKA, 1867); *H. (P.) rowei* PAWSON & GUST, 1981; *H. (P.) samoana* LUDWIG, 1875; *H. (P.) sanctori* DELLE CHIAJE, 1823. It must be noted that CHERBONNIER (1988) proposed to place *H. strigosa* SELENKA, 1867 under *Platyperona* rather then under *Thymiosycia*. Only *H. (P.) difficilis* is found in the littoral waters of Kenya (with Pemba Island).

Holothuria (Platyperona) difficilis SEMPER, 1868
(fig. 26 A-C, fig. 54A)

Holothuria difficilis SEMPER, 1868: 92, pl. 30 fig. 21; KALK 1959: 5, 22; DANIEL & HALDER 1974: 426; HICKMAN 1998: 43 (colour plates, possibly not *H. difficilis*).
Microthele difficilis; JAMES 1961: 61; JAMES & PEARSE 1969: 104; CHERBONNIER 1967: 56, 57; DANIEL & HALDER 1974: 417.
Holothuria (Platyperona) difficilis; MUKHOPADHYAY 1991: 406, 412; MASSIN 1999: 38 (synonymy and records before 1999); fig. 29 (distribution); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 25.
Mülleria aegyptiana HELFER, 1912: 330, figs 9-16
Actinopyga aegyptiana; DANIEL & HALDER 1974: 417.
Holothuria aegyptiana; PRICE 1982: 11.
Mülleria parvula; LUDWIG 1899: 557; HELFER 1912: 330; ERWE 1919: 180, 187 [non *H. (P.) parvula* (SELENKA, 1867)].
Actinopyga parvula; FISHER 1907: 647, pl. 67 fig. 2; DANIEL & HALDER 1974: 426 [non *H. (P.) parvula* (SELENKA, 1867)].
Argiodia parvula; PEARSON 1914a: 173, 177, pl. 28 fig. 4; 1914b: 170 [non *H. (P.) parvula* (SELENKA, 1867)].

STATUS AND LOCATION TYPE – Holotype ZMH E.2546.
TYPE LOCALITY – Samoa (Navigator Islands).
MATERIAL EXAMINED – KKiun/9949 (one specimen).
DESCRIPTION – Medium sized species; the single specimen at our disposition measures 86 x 24 mm,

[7] It is tempting to list *Mülleria aegyptiana* HELFER, 1912 as another valid species in this subgenus; however it is best treated as a synonym of *H. difficilis*. Indeed, HELFER (1912: 330) himself noted that "Diese neue Form steht der *Mülleria parvula* SELENKA sehr nahe" and PANNING (1929 [1931]) observed that the ossicle assemblage of *aegyptiana* is very close to that of *H. difficilis* (this judgement is here respected). As *H. parvula* is considered a Caribbean species (type locality Florida) devoid of Cuvierian tubules (SELENKA 1867; see also ROWE 1969), *M. aegyptiana* (type locality Gulf of Suez) cannot be a synonym of it. In turn, the WIO records of *H. parvula* are most probably nothing but misidentified *H. difficilis*.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
Holothuria (Microthele) whitmaei BELL, 1887 (see also discussion)	western Indian Ocean (unspecified)	ROWE, *in* ROWE & RICHMOND 1997

TABLE 13 – *Holothuria (Microthele) whitmaei* BELL, 1887, the third species within *Microthele* thought to occur in the shallow-waters of the WIO.

after preservation. Body colour in alcohol similar to colour in life: bivium variegated purple-brown, trivium slightly lighter and more uniform in colouration. Body wall rough to the touch, 2-3 mm thick. Mouth ventral surrounded by 20 small, but firm, green-brown tentacles. Anus terminal guarded by five minute, brown, pointed calcified papillae. Ventral tube feet numerous, distributed mainly in the radial areas (especially posteriorly), in four to six rows, although some spreading into the interradial areas occurs. Dorsal papillae few, coloured dark brown, surrounded at their base by a brown ring-like area, distributed in the ambulacral and interambulacral areas. Cuvierian tubules well developed and very numerous, however they were not ejected upon collection. Single, large, club-shaped, Polian vesicle. Stone canal not observed. Tentacle ampullae relatively short, 20 in number. Calcareous ring with radial pieces slightly wider than the interradial ones, the latter ones with a distinct anterior tooth (see MASSIN 1999: 39, fig. 28a).
Ossicles: Tentacles with curved, spiny rods, 130-350 µm long (fig. 26D). Dorsal and ventral body wall with similar tables and buttons (fig. 26A, B). Tables with rim of disc smooth; disc 30-80 µm across, perforated by four central and eight to ten peripheral holes; four pillars forming a short spire united by a single cross beam that ends in a small spinose crown (fig. 26A). Buttons regular, rim smooth, 80-140 µm long; thin, oval, with three to six pairs holes and with a median longitudinal line (fig. 26B). Tube feet with elongated plates, up to 250 µm long; and perforated plates, 110-130 µm long and 70-100 µm wide (fig. 26C).
DIAGNOSIS – See MASSIN 1999: 38-40, figs 28, 29.
ECOLOGY – Our single specimen was found under a block of dead coral, hidden between coral debris.
DISTRIBUTION IN THE STUDY REGION – Kiunga Marine Reserve only (see also SAMYN & VANDEN BERGHE 2000).
GEOGRAPHIC DISTRIBUTION – The distribution map as drawn by MASSIN (1999: 40, fig. 29) gives a tropical and subtropical Indo-Pacific (with the Red Sea) distribution. However, the following localities in the WIO have to be added: Gulf of Suez, unspecified locality (PRICE 1982); Gulf of Aqaba, Abu Zabad and Dahab (A.M. CLARK 1952, as *Microthele difficilis*), Eilat (CHERBONNIER 1967, as *Microthele difficilis* (SEMPER, 1868)), Aqaba (TORTONESE 1977; CHERBONNIER 1979a, as *Holothuria (Stauropora) difficilis*) (see also DANIEL & HALDER 1974 and PRICE 1982 for unspecified records in the Gulf of Aqaba); Saudi Arabia, Jeddah (TORTONESE 1979); Eritrea, Entedebir (CHERBONNIER 1967, as *M. difficilis*) (see also CLARK & ROWE 1971; PRICE 1982 for unspecified records in the Red Sea); Kenya, Kiunga Marine RESERVE (SAMYN & VANDEN BERGHE 2000); northern Mozambique (THANDAR 1984), Mozambique Island (KALK 1959; THANDAR 1984) (see also H.L. CLARK 1923 for unspecified record of Mozambique); Republic of South Africa, Durban (THANDAR 1984); Madagascar, Tuléar, Fort Dauphin and Nosy Manitsy (CHERBONNIER 1988). Figure 54A shows the known distribution in the WIO in detail.

Table 14 lists the other species within the subgenus *Platyperona* 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)
H. (Platyperona) crosnieri CHERBONNIER, 1988	Madagascar (Tuléar)	CHERBONNIER 1988
H. (Platyperona) excellens LUDWIG, 1875	Madagascar (Nosy Bé)	CHERBONNIER 1988; CONAND 1999
H. (Platyperona) insolita CHERBONNIER, 1988	Madagascar (Tuléar)	CHERBONNIER 1988
H. (Platyperona) samoana LUDWIG, 1875	Red Sea (unspecified)	LAMPERT 1885
	Gulf of Aden?	DANIEL & HALDER 1974
	Madagascar (Glorious Isl, Nosy Bé, Tuléar)	CHERBONNIER 1988[1]
	Mauritius (Flic en Flac)	ARAKAKI & FAGOONEE 1996[2]

TABLE 14 – Other species within the subgenus *Platyperona* known to occur in the shallow-waters of the WIO. Cited [1] as *Holothuria (Platyperona) altimensis* H.L. CLARK; [2] as *Holothuria (Thyrmiosycia) altaturricula* CHERBONNIER & FÉRAL.

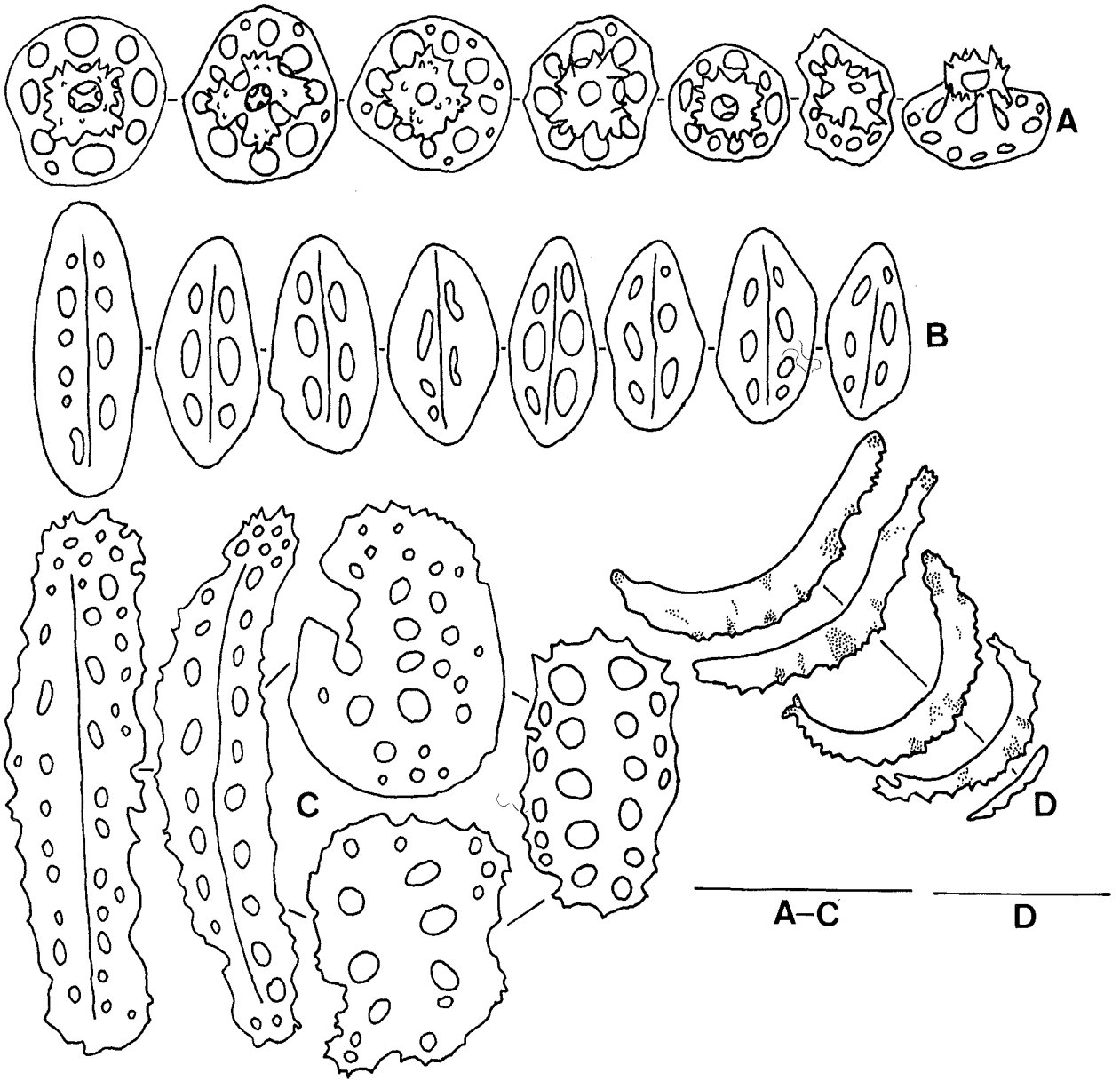


FIG. 26 – *Holothuria (Platyperona) difficilis* SEMPER, 1868. A. Tables of body wall; B. Buttons of body wall; C. Perforated plates of ventral tube feet; D. Rods of tentacles. Scale bar A-C represents 100 μm; scale bar D represents 200 μm.

Subgenus *Roweothuria* THANDAR, 1988

DIAGNOSIS (See THANDAR 1988: 48) [Type species: *Holothuria arguinensis* KOEHLER & VANEY, 1908 by original designation].

Currently three species are regarded as being valid: *Holothuria (Roweothuria) arguinensis* KOEHLER & VANEY, 1908; *H. (R.) poli* DELLE CHIAJE, 1823; *H. (R.) vemae* THANDAR, 1988. *H. (Roweothuria) poli* is the only species known from the shallow waters of the western Indian Ocean, Gulf of Suez (CHERBONNIER 1955; JAMES 1969; JAMES & PEARSE 1969; PRICE 1982). The subgenus is here included for completeness only. It is not found in Kenya (with Pemba Island).

Subgenus *Selenkothuria* DEICHMANN, 1958

DIAGNOSIS (after ROWE, 1969: 135) [Type species: *Holothuria lubrica* SELENKA, 1867 by original designation].

Size moderate to large (up to 200 mm); body with flattened ventral 'sole' and arched dorsal side,

body wall smooth to the touch, relatively thin (1-4 mm); papillae small, scattered over the radial and interradial areas of the bivium; tube feet distributed in three distinct rows on the trivium; 20 relatively large pelto-dendritic tentacles around the ventro-terminal mouth; calcareous ring with radial pieces up to three times as long as the interradial pieces, the latter usually with the outer surface slightly concave; anus terminal guarded by anal papillae. Ossicles: body wall: rugose, spinose or perforated rods, occasionally in combination with tables; tube feet: few rods similar to those of the body wall.

Currently eleven species[8] are regarded as being valid: *Holothuria (Selenkothuria) bacilla* CHERBONNIER, 1988; *H. (S.) erinacea* SEMPER, 1868; *H. (S.) glaberrima* SELENKA, 1867; *H. (S.) lubrica* SELENKA, 1867; *H. (S.) mactanensis* TAN TIU, 1981; *H. (S.) moebii* LUDWIG, 1883; *H. (S.) parva* LAMPERT, 1885; *H. (S.) portovallartensis* CASO, 1954; *H. (S.) sinica* LIAO, 1980; *H. (S.) theeli* DEICHMANN, 1938 and *H. (S.) vittalonga* CHERBONNIER, 1988. Only *H. (S.) erinacea* is found in the shallow waters of Kenya.

Holothuria (Selenkothuria) erinacea SEMPER, 1868 (fig. 27 A-E, 54B)

Holothuria erinacea SEMPER, 1868: 91, pl. 30 (23-24).
Holothuria (Selenkothuria) erinaceus; KALK 1959: 7, 22; CANNON & SILVER 1986: 24, figs 7c, 4d (colour drawing); CHERBONNIER 1988: 60 (synonymy); SAMYN & VANDEN BERGHE 2000: 5 (tab. 2).
Holothuria (Selenkothuria) erinacea; ROWE & GATES 1995: 297; LANE *et al.* 2000: 488.
Holothuria marenzelleri LUDWIG, 1883: 167.
? *Halodeima lubrica* var. *marenzelleri*; PANNING 1944: 65.

STATUS AND LOCATION TYPE – Syntypes ZMH E.2551 (ROWE & GATES 1995).
TYPE LOCALITY – Fiji (ROWE & GATES 1995).
MATERIAL EXAMINED – KMal/9866 (one specimen); KMal/9867 (one specimen); KMal/9868 (one specimen); KMal/9869 (one specimen); KMal/9870 (one specimen); KMal/9872 (one specimen).
GENERAL DESCRIPTION – Medium sized species; the specimens at our disposition range from 57-107 mm in length and from 13-80 mm in width, after preservation. Colour in life similar to colour after preservation: bivium beige to Bordeaux-red with some darker patches, near the anus beige speckled with brown; trivium markedly lighter in colouration with two conspicuous dark brown longitudinal bands. Bivium arched, well separated from flattened trivium. Body wall smooth to the touch; 2-4 mm thick. Mouth ventral, surrounded by 17-20 peltato-digitate tentacles. Anus terminal, surrounded by five groups of six to nine, long, non-calcified papillae. Ventral tube feet, uniform yellowish to beige, large and long, numerous, distributed more or less in rows on the radial areas (more or less absent posteriorly). Dorsal papillae short, uniform beige, sparsely distributed over the total surface. Cuvierian tubules present, very short and thin. Single short Polian vesicle. Single, long and straight stone canal. Tentacle ampullae short. Longitudinal muscles well developed, bifid. Calcareous ring with long and straight radial pieces twice as wide as the shorter anteriorly pointed interradial pieces (see CHERBONNIER 1988: 61, fig. 22F).
Ossicles: Tentacles present spinose rods, 75-125 µm long, distal extremities widened and very rugose (fig. 27A). Body wall with rods only (no buttons, no tables). Dorsal body wall with rods, 63-117 µm long; rim spiny; occasionally perforated by some holes (fig. 27B). Ventral body wall with similar but less spiny rods, 58-75 µm long (fig. 27C). Ventral tube feet with very few rods similar in size and shape to those of the ventral body wall (fig. 27D); endplate 400-425 µm across. Dorsal papillae with rods similar to those of the tentacles (fig. 27E).
DIAGNOSIS – See SEMPER 1868: 91, pl. 30 figs 23, 24.
ECOLOGY – Found mostly intertidally, but up to 5 m deep; under or between coral slabs over coarse to fine sand; firmly attached with the ventral side to the hard substratum.
DISTRIBUTION IN THE STUDY REGION – Only found at the Malindi Marine Park.
GEOGRAPHIC DISTRIBUTION – Tropical Indo-west Pacific Ocean (ROWE & GATES 1995), not recorded from the Red Sea nor the Persian Gulf. Figure 54B shows the known distribution in the WIO in detail.

[8] *H. (S.) spinea* CHERBONNIER, 1988, known only from the holotype currently is also listed as a valid species in the subgenus *Selenkothuria*. However, the presence of rare tables in combination with spinose rods does not completely fit with the diagnosis of *Selenkothuria*. ROWE (pers. comm.) believes the presence of tables is due to contamination. Only detailed investigation of the type will prove if ROWE's statement is correct or if the species must be allocated to another subgenus (*Semperothuria*?).

REMARKS – Although the species has been found in Somalia (TORTONESE 1980); northern Mozambique (KALK 1959; THANDAR 1984); Republic of South Africa, Durban area (THANDAR 1984) and Madagascar, Tuléar (CHERBONNIER 1988) it is the first record for Kenya.

Table 15 gives the other species within the subgenus *Selenkothuria* that are known to occur in the shallow waters of the WIO, but have for now not been reported from Kenya (with Pemba Island). Column two gives the known WIO distribution, while column three provides the references wherein the record appeared. DANIEL & HALDER (1974) list *H. (Selenkothuria) glaberrima* SELENKA, 1867 as a South West Indian Ocean species. However, the occurrence of this species in the shallow-waters of the WIO is considered improbable for the species is up till now only known from the Pacific Ocean (see MALUF 1988), as KOEHLER & VANEY's (1908) record from the Bay of Bengal must be referred to *H. (S.) erinacea* according to CHERBONNIER (1988). In this regard it must also be noted that ROWE's (1969) mention of *H. (S.) glaberrima* from the West Indies refers to the ancient locality "West Indies", *i.e.* the Caribbean and the North Coast of South America. Similarly, DANIEL & HALDER (1974) list *Holothuria lubrica* SELENKA, 1867 as a West Indian Ocean species (Arabian Sea included with doubt); records they copied from LUDWIG 1899 and/or PANNING 1944 [cited as *H. lubrica* var. *marenzelleri* (LUDWIG), here referred to the synonymy of *H. erinacea*]. However, as *H. lubrica* is known to be restricted to the eastern Pacific (DEICHMANN 1958; ROWE 1969), LUDWIG's (1899) record is obviously a misidentification; most probably it is *H. (Selenkothuria) parva* KRAUSS *in* LAMPERT, 1885.

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
H. (Selenkothuria) bacilla CHERBONNIER, 1988	Madagascar (Nosy Bé, Tuléar)	CHERBONNIER 1988
H. (Selenkothuria) moebii LUDWIG, 1883 (see also discussion)	Arabian Sea (Vizhingam)	JAMES 1969
	Mauritius	THÉEL 1886; MITSIKURI 1912; DEICHMANN 1958
	Seychelles (Aldabra)	SLOAN *et al.* 1979; A.M. CLARK 1984
	East Coast of Africa?	DANIEL & HALDER 1974
H. (Selenkothuria) parva KRAUSS *in* LAMPERT, 1885	Red Sea (unspecified)	CHERBONNIER 1955; PRICE 1982
	Gulf of Aden (Djibouti, Obok)	CHERBONNIER 1955
	Persian Gulf (Bushire, Qism Tavila)	HEDING 1940b; PRICE 1982; KOEHLER & VANEY 1908
	Gulf of Oman (Muscat)	PRICE & REID 1985
	Arabian Sea (unspecified)	CLARK & ROWE 1971; DANIEL & HALDER 1974 (1); PRICE 1982
	Somalia (Bender Mtoni)	TORTONESE 1980
	Zanzibar	LUDWIG, 1899 (2); MITSIKURI 1912
	Tanzania (Ras Muhesa, Pangani)	MARSHALL *et al.* 2001; LAMPERT 1896; MITSIKURI 1912
	Comores	CHERBONNIER 1988
	Seychelles (Aldabra)	SLOAN *et al.* 1979; A.M. CLARK 1984
	Madagascar (Antisarana, Nosy Bé, Tuléar)	CLARK & ROWE 1971; CHERBONNIER 1988
	Mozambique (North and South Coast)	KALK 1959; THANDAR 1984
	South Africa (KwaZulu-Natal; Transkei)	LAMPERT 1885; THÉEL 1886; MITSIKURI 1912; DEICHMANN 1948; CHERBONNIER 1952a; THANDAR 1977(3); 1984
	West Indian Ocean (unspecified)	ROWE *in* ROWE & RICHMOND 1997; DANIEL & HALDER 1974 (4)
H. (Selenkothuria) spinea CHERBONNIER, 1988	Madagascar (Nosy Bé)	CHERBONNIER 1988
H. (Selenkothuria) vittalonga CHERBONNIER, 1988	Madagascar (Tuléar)	CHERBONNIER 1988

TABLE 15 – Other species within the holothurian subgenus *Selenkothuria* known to occur in the shallow-waters of the WIO. Cited as (1) *Holothuria parva* and as *H. lubrica* SELENKA; (2) *H. lubrica;* (3) *H. (Selenkothuria) perrieri* THANDAR; (4) *Holothuria parva* and as *H. lubrica.*

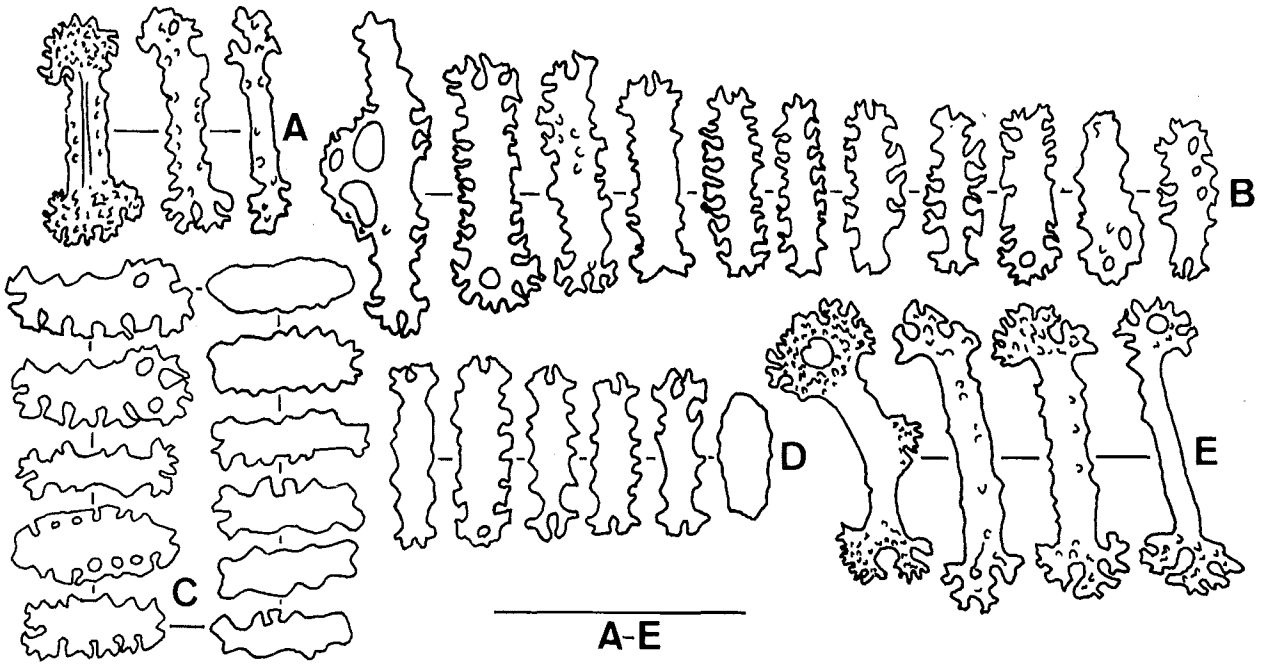


FIG. 27 – *Holothuria (Selenkothuria) erinacea* SEMPER, 1868. A. Rods of tentacles; B. Rods of dorsal body wall; C. Rods of ventral body wall; D. Rods of ventral tube feet; E. Rods of dorsal papillae. Scale bar A-E represents 100 μm.

Subgenus *Semperothuria* DEICHMANN, 1958

DIAGNOSIS (after ROWE 1969: 135) [Type species: *Holothuria languens* SELENKA, 1867 by original designation].

Size moderate to large (200 mm); slender and cylindrical body with relatively thin (1-4 mm), smooth body wall; covered by numerous tube feet, mostly in the ambulacral areas of the trivium and by less numerous papillae all over the bivium; 20 (sometimes 22) relatively large tentacles surrounding ventral to terminal mouth; calcareous ring with radial pieces one-and-a-half to three times as long as the interradial pieces and with an undulating posterior side; anus terminal sometimes surrounded by anal papillae. Ossicles of body wall comprise tables in combination with rods (buttons and rosettes always absent); tables with disc reduced, spire longer than disc diameter, four pillars of spire united by single cross beam ending in a crown of spines forming a single or double Maltese cross when viewed from above; rods massive and spinose. Ossicles of tube feet: with large perforated plates in addition to tables and rods similar to those of the body wall.

Currently seven species are regarded as being valid: *Holothuria (Semperothuria) cinerascens* (BRANDT, 1835); *H. (S.) flavomaculata* SEMPER, 1868; *H. (S.) granosa* CHERBONNIER, 1988; *H. (S.) imitans* LUDWIG, 1875; *H. (S.) languens* SELENKA, 1867; *H. (S.) pseudoimitans* CHERBONNIER, 1951; *H. (S.) surinamensis* LUDWIG, 1875.

Only *H. (S.) cinerascens* is found in the shallow waters of Kenya (with Pemba island).

Holothuria (Semperothuria) cinerascens
(BRANDT, 1835)
(fig. 28 A-D, fig 54C, pl. 3E)

Stichopus (Gymnochirota) cinerascens BRANDT, 1835: 51.

Holothuria pulchella SELENKA, 1867: 329, pl. 18 figs 61, 62; DANIEL & HALDER 1974: 427.

Holothuria cinerascens; EYRE & STEPHENSON 1938: 38, 43; EYRE *et al.* 1938: 105; STEPHENSON 1944: 277, 306, 348; DEICHMANN 1948: 339; MACNAE & KALK 1958: 34, 99, 107, 120, 130 (from THANDAR 1984); KALK 1958: 198, 238; KALK 1959: 22; MACNAE 1962: 208; DANIEL & HALDER 1974: 428; DAY 1974a: 192; JACKSON 1976: 15; TORTONESE 1977: 275; BRANCH & BRANCH 1981: 248 (from THANDAR

1984); BRANCH *et al.* 1999: 204, 205 (colour picture); CONAND 1999: 9, 10, 12, 21, 39; MARSHALL *et al.* 2001: 46 (tab. 29).

Holothuria (Semperothuria) cenerascens; MUKHOPADHYAY 1991: 412 (*lapsus calami*).

Holothuria (Semperothuria) cinerascens; LEVIN 1979: 21; HUMPHREYS 1981: 35; PRICE 1982: 11; A.M. CLARK 1984: 90, 99; MUKHOPADHYAY 1991: 406; MASSIN 1996b: 155 (synonymy before 1996), pl. 1A (colour plate); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 26.

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

TYPE LOCALITY – 'inter lapides in insulis Boninsimensibus' (NW Pacific) (BRANDT 1835, *in* ROWE & GATES 1995).

MATERIAL EXAMINED – KMom/9859 (one specimen); KMal/9871 (one specimen); KKiun/9941 (one specimen).

GENERAL DESCRIPTION – Three specimens ranging from 107-131 mm in length, and from 24-40 mm in width, after preservation. Colour in alcohol fainter, but similar to the colour in live: ventral side uniform dark red to brown; dorsal side uniform dark red to brown, however with some lighter yellow to orange conical extensions (pl. 3E). Mouth terminal; surrounded by 20 well developed; variegated orange-red-brown, bushy tentacles; surrounded dorsally by few small conical papillae. Anus terminal; surrounded by thin and soft papillae in groups of two to three. Tube feet on trivium very numerous; cylindrical, light chestnut brown with end plate somewhat darker, distributed evenly over the ambulacral and the interambulacral areas. Tube feet on bivium also numerous, but fewer in number than on the trivium; same colouration and shape, though at their base sometimes surrounded by a ring of lighter colouration; distributed over the ambulacral and interambulacral areas. Tentacle ampullae very long (up to half the body length); yellowish; spotted with brown. One to several long stone canals, with the madreporic plate elongated. Several Polian vesicles; one very large (up to one third of body length). Gonad whitish, consisting of a simple tuft of tubules. Cuvierian tubules absent. Body wall smooth to the touch; up to five mm thick. Longitudinal muscles well developed; bifid. Calcareous ring with radial pieces almost as wide as the interradial ones, radial pieces with an anterior central depression, interradial ones anteriorly toothed in such a way that the pieces become triangular (see also CHERBONNIER 1988: 71, fig. 27D).

Ossicles: Dorsal and ventral body wall with similar tables and rods (fig. 28A, C). Tables more numerous in dorsal than ventral body wall, however slightly larger and stouter in the dorsal body wall. Disc of table in dorsal body wall 40-55 µm across, rim of disc smooth, sometimes slightly spinose, perforated by four large central and in most cases no peripheral holes; spire very stout, pillars united by a single cross beam ending in a large crown forming a spiny Maltese cross when seen from above; crown almost as wide as the disc (fig. 28A). Disc of tables of ventral body wall 35-55 µm across, spire somewhat lower than in the tables of the dorsal body wall (fig. 28C). Rods of dorsal body wall very spinose, 65-100 µm long (fig. 28B). Rods of ventral body wall comparable in size and shape, but less spinose (fig. 28D). Dorsal tube feet (fig. 28E) with perforated plates, up to 120 µm long; massive, up to 165 µm long, extremely rugose rods which can bifurcate at the edges, to small, slender rods only 15 µm long. Ventral tube feet (fig. 28F) with similar rods, though generally smaller and less rugose. Tentacles with rods (fig. 28G), 60 to 140 µm long, finely rugose at the sides.

DIAGNOSIS – See PANNING 1935a: 37, fig. 32.

ECOLOGY – This species thrives preferentially in shallow to intertidal pools, encrusts itself often with coral debris and sand, and firmly attaches itself between coral slabs.

DISTRIBUTION IN THE STUDY REGION – Only found at Malindi, Mombasa and the Kiunga Marine Reserve (see also SAMYN & VANDEN BERGHE 2000).

GEOGRAPHIC DISTRIBUTION – Well known species from the Indo-west-central Pacific Ocean (ROWE & GATES 1995). The distribution map as drawn by MASSIN (1996b: 174, map 2) gives the global distribution, but the following localities in the WIO have to be added: Gulf of Aqaba, Abu Zabad (A.M. CLARK 1952, as *Halodeima cinerascens*), Aqaba (TORTONESE 1977) (see also DANIEL & HALDER 1974 and PRICE 1982 for unspecified records from the Gulf of Aqaba); northern Red Sea, Egypt (LAMPERT 1885), Kosseir (MITSIKURI 1912); Djibouti (CHERBONNIER 1955 as *Halodeima cinerascens*); South Yemen, Soccotra (LEVIN 1979); Arabian Sea, unspecified locality (CLARK & ROWE 1971; PRICE 1982;

DANIEL & HALDER 1974 as *Holothuria pulchella* SELENKA, 1867); Somalia, Bender Mtoni (TORTONESE 1980); Kenya, Kiunga (SAMYN & VANDEN BERGHE 2000), Kibirijini Point and Mida Creek (HUMPHREYS 1981), Mombasa (LEVIN 1979; this work); Seychelles, Mahé (LUDWIG 1899; MRAC records) (see also LAMPERT 1885; FISHER 1907; MITSIKURI 1912; PEARSON 1913; DANIEL & HALDER 1974; A.M. CLARK 1984); Mozambique, North coast (KALK 1959; THANDAR 1984), South coast (KALK 1958; THANDAR 1984); Madagascar, Fort Dauphin, Ile St. Marie, St. Augustin, Tuléar (CHERBONNIER 1988); La Réunion (CONAND 1999); Republic of South Africa, KwaZulu-Natal (H.L. CLARK, 1923; DEICHMANN 1948; DANIEL & HALDER 1974; THANDAR 1984; this work), Transkei (THANDAR 1984). Figure 54C shows the known distribution in the WIO in detail.

REMARKS – Although we only observed this species in three localities we expect it along the total Kenyan Coast, wherever a suitable habitat is present. Our findings complement those by LEVIN (1979) and HUMPHREYS (1981) (see also SAMYN & VANDEN BERGHE 2000). THANDAR (1984) urges for a study on the intraspecific variation of this species, for he noted that the ossicles FISHER (1907) described in his Hawaii specimens are significantly larger than the ones presented in specimens not from Hawaii (table disc up to 86 µm for FISHER's specimens compared to 40 µm for the specimens from Kenya and the rest of the world; rods up to 300 µm for FISHER's specimens compared to 165-215 µm for the rest of the world). MASSIN (1996b) on the other hand, described a collection of nine specimens from Easter Island, whereby he notes that the variation between specimens from Madagascar (CHERBONNIER 1988), the Red Sea (CHERBONNIER 1955) and Hawaii (FISHER 1907) is acceptable to regard the Hawaii specimens as geographic variants of *H. (S.) cinerascens*. The three East African specimens discussed here, can however not shed light on this issue, since the varia-

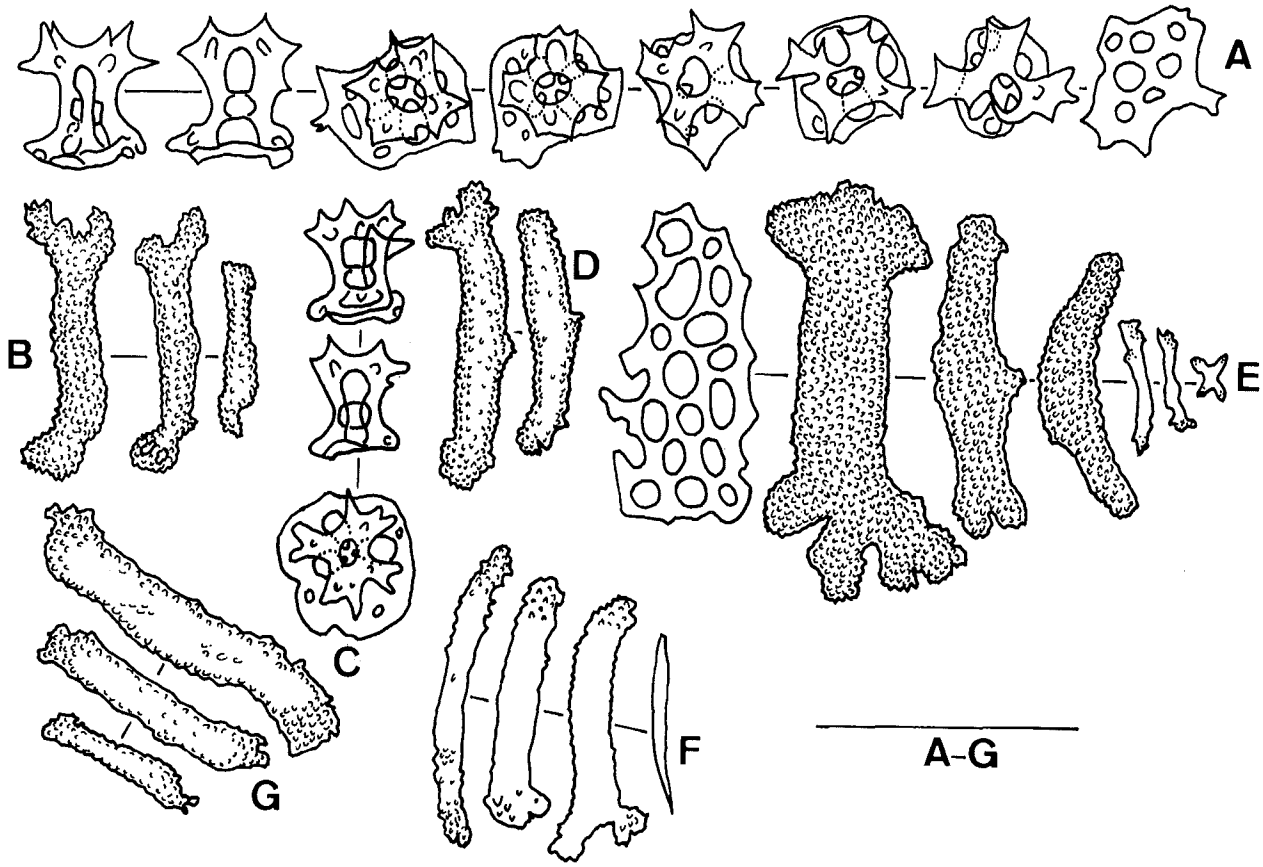


FIG. 28 – *Holothuria (Semperothuria) cinerascens* (BRANDT, 1835). A. Tables of dorsal body wall; B. Rods of dorsal body wall; C. Tables of ventral body wall; D. Rods of ventral body wall; E. Plate and rods of dorsal tube feet; F. Rods of ventral tube feet; G. Rods of tentacles. Scale bar A-G represents 100 µm.

tion presented here corresponds to the variation as described by others than FISHER (1907) (CHERBONNIER 1955, 1988; THANDAR 1984; MASSIN 1996b). Undoubtedly only examination of FISHER's specimens will settle the matter, but it is not improbable that THANDAR's (1984) observations on the size of the ossicles are nothing but results of erroneous measurements done by FISHER (1907) (interestingly FISHER's measurements are more or less the double of those made by subsequent authors). For now, even though I have never seen specimens from that region, I feel quite confident that the specimens from Hawaii are true *H. cinerascens*.

Table 16 gives the other species within the subgenus *Semperothuria* that are known to occur in the shallow waters of the WIO, but have for now not been reported from 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)
H. (Semperothuria) granosa CHERBONNIER, 1988	Madagascar (Fort Dauphin)	CHERBONNIER 1988
H. (Semperothuria) flavomaculata SEMPER, 1868	Red Sea (Entedebir, Nocra Island, Um Aabak)	CHERBONNIER 1967; TORTONESE 1953a; PRICE 1982
	Seychelles (Mahé)	LUDWIG 1899; DANIEL & HALDER 1974; MRAC record, pers. observ.
	Madagascar (Nosy Bé; Tuléar)	CHERBONNIER 1988
	West Indian Ocean to W. Pacific Ocean (with Red Sea)	ROWE *in* ROWE & RICHMOND 1997

TABLE 16 – Other species within the holothurian subgenus *Semperothuria* known to occur in the shallow-waters of the WIO.

Subgenus *Stauropora* ROWE, 1969

DIAGNOSIS (See ROWE 1969: 140) [Type species: *Holothuria discrepans* SEMPER, 1868 by original designation]
Currently eight species are regarded as being valid: *Holothuria (Stauropora) annulifera* FISHER, 1907; *H. (St.) discrepans* SEMPER, 1868; *H. (St.) dofleini* AUGUSTIN, 1908; *H. (St.) fuscocinerea* JAEGER, 1833; *H. (St.) modesta* LUDWIG, 1875; *H. (St.) olivacea* LUDWIG, 1888; *H. (St.) pervicax* SELENKA, 1867.
Two of these are reported from the littoral waters of Kenya (with Pemba Island) and are keyed hereunder.

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

1. Bivium light brown with several transverse dark brown to black bands; all over bivium sparsely distributed conical, yellow extension, each bearing a brownish papilla. Ossicles of the body wall with pseudobuttons. . . . . ***Holothuria (Stauropora) pervicax* SELENKA, 1867**

1'. Bivium mottled green-gray with dark spots that correspond to conical white-tipped papillae. Ossicles of the body wall with true, but irregular buttons. . . . . ***Holothuria (Stauropora) fuscocinerea* JAEGER, 1833**

Holothuria (Stauropora) fuscocinerea JAEGER, 1833 (fig. 29A-J, fig. 54D)

Holothuria fuscocinerea JAEGER, 1833: 22; HICKMAN 1998: 50 (colour plates); DANIEL & HALDER 1974: 428.
Holothuria curiosa LUDWIG, 1875: 34, pl. 7, fig. 29; CHERBONNIER 1963: 5; DANIEL & HALDER 1974: 426; CHERBONNIER 1967:56.
Holothuria (Mertensiothuria) fuscocinerea; MUKHOPADHYAY 1991: 405, 413.
Holothuria (Mertensiothuria) fusco-cinerea; MUKHOPADHYAY 1991: 412 (*lapsus calami*).
Holothuria (Stauropora) fuscocinerea; MASSIN 1999: 48 (synonomy and records before 1999), fig. 111c (colour picture); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDEN BERGHE 2000: 5 (tab. 2), 17 (tab. 4), 26.

STATUS AND LOCATION TYPE – Status and whereabouts undetermined (ROWE & GATES 1995).
TYPE LOCALITY – Java, Sulawesi (Indonesia).
MATERIAL EXAMINED – KKan/9730 (one specimen); KVan/9777 (one specimen); KMom/9858 (one specimen); TFun/9830 (one specimen); KKiun/9938 (one specimen); KKiun/9946 (one specimen)
GENERAL DESCRIPTION – Moderate to large species, specimens up to 200 mm long and 50 mm wide, after preservation. Body colour in life similar to colour in alcohol: bivium mottled green-grey with dark spots (white-tipped conical papillae distributed in the ambulacral and interambulacral areas); trivium grey-green with homogeneously distributed brown spots corresponding to cylindrical tube feet (with white sucking disc). Body wall smooth to the touch, thin. Mouth ventral surrounded by 20 yellow-green stout tentacles, base of the tentacles surrounded by a collar of small yellow conical papillae. Anus dorsal surrounded by a dark purple ring. Cuvierian tubules present, very thick, white and very readily ejected. Single Polian vesicle. Single stone canal. Calcareous ring stout, composed of massive radial pieces having a deep, narrow anterior notch (from MASSIN 1999: 49, fig. 38a, p. 50).
Ossicles: Tentacles present curved rods, 50-400 µm long, slightly rugose at the extremities (fig. 29A). Dorsal and ventral body wall with poorly developed tables and buttons (fig 29B, C). Tables: rim of disc round and smooth, 25-35 µm across, disc perforated by three to four large central holes and two to six small peripheral holes, spire low, consisting of four pillars, sometimes ending in an incomplete crown, tables sometimes without spire (fig. 29B). Buttons 25-40 µm long, rim smooth but often irregular, one to three pairs of holes (fig. 29C). Ventral tube feet with irregular, perforated rods, up to 235 µm long (fig. 29D); large perforated plates, 100-155 µm long (fig. 29E); buttons, up to 70 µm long (fig. 29F) and poorly developed tables with spire reduced to knobs on disc wich is 45-60 µm across (fig. 29G) Dorsal papillae with rods, perforated at the extremities, up to 300 µm long (fig. 29H), and some large tables with spire reduced to knobs (fig. 29J).
DIAGNOSIS – See DEICHMANN 1958: 300, pl. 3 figs 13-23.
ECOLOGY – Eulittoral, up to depths of about 8 m. Nocturnal, on coarse sand and on anoxic fine sand.
DISTRIBUTION IN THE STUDY REGION – Kanamai, Vanga, Mombasa; Kiunga Marine Reserve (see also SAMYN & VANDEN BERGHE 2000).
GEOGRAPHIC DISTRIBUTION – Well known tropical, Indo-west Pacific species according to ROWE & GATES 1995, but the global distribution map as drawn by MASSIN's (1999: 51 fig 39) also shows subtropical records (Xisha Islands, Gulf of California, southern East Australia, New Caledonia). To the latter map the following localities in the WIO have to be added: Madagascar, Tuléar (CHERBONNIER 1988) and the Seychelles (DANIEL & HALDER 1974). Figure 54D shows the known distribution in the WIO in detail.

Holothuria (Stauropora) pervicax SELENKA, 1867 (fig. 30A-D, fig. 54E, pl. 3F)

Holothuria pervicax SELENKA, 1867: 327, pl. 18 fig. 54; MACNAE & KALK 1958: 42, 43, 99, 107, 117, 130; (from THANDAR 1984); MACNAE & KALK 1962: 104, 108, 112, 115; KALK 1959: 4, 22; DANIEL & HALDER 1974: 427; TORTONESE 1977: 275; BRANCH & BRANCH 1981: 248; CONAND 1999: 10, 12.
Holothuria curiosa pervicax; DANIEL & HALDER 1974: 417
Holothuria curiosa var. *pervicax*; A.M. CLARK 1952: 204.
Holothuria fusco-cinerea var. *pervicax*; PANNING 1944: 73.
Holothuria mammiculata HAACKE 1880: 46, 48.
Holothuria mamiculata; DANIEL & HALDER 1974: 423 (*lapsus calami*).
Holothuria (Mertensiothuria) pervicax; LEVIN 1979: 21; SLOAN *et al.* 1979: 122; HUMPHREYS 1981: 34; PRICE 1982:11; A.M. CLARK 1984: 99; CANNON & SILVER 1986: 23, fig. 6h; FÉRAL & CHERBONNIER 1986: 84 (colour picture), 85; CHERBONNIER 1988: 107 (synonomy); MUKHOPADHYAY 1991: 405; ROWE & RICHMOND 1997: 304, 305 (colour drawing).
Holothuria (Stauropora) pervicax; MARSH *et al.* 1993: 64; ROWE & GATES 1995: 300 (synonymy); SAMYN 2000: 15 (tab. 1); LANE *et al.* 2000: 488; SAMYN & VANDENBERGHE 2000: 5 (tab. 2).

STATUS AND LOCATION TYPE – Lectotype and paralectotypes MCZ 1424 (ROWE & GATES 1995).
TYPE LOCALITY – Zanzibar.
MATERIAL EXAMINED – KKan/9722 (one specimen); KKan/9723 (one specimen).
GENERAL DESCRIPTION – Small to moderate species; the specimens at our disposition are eviscerated and strongly contracted due to inadequate preservation;

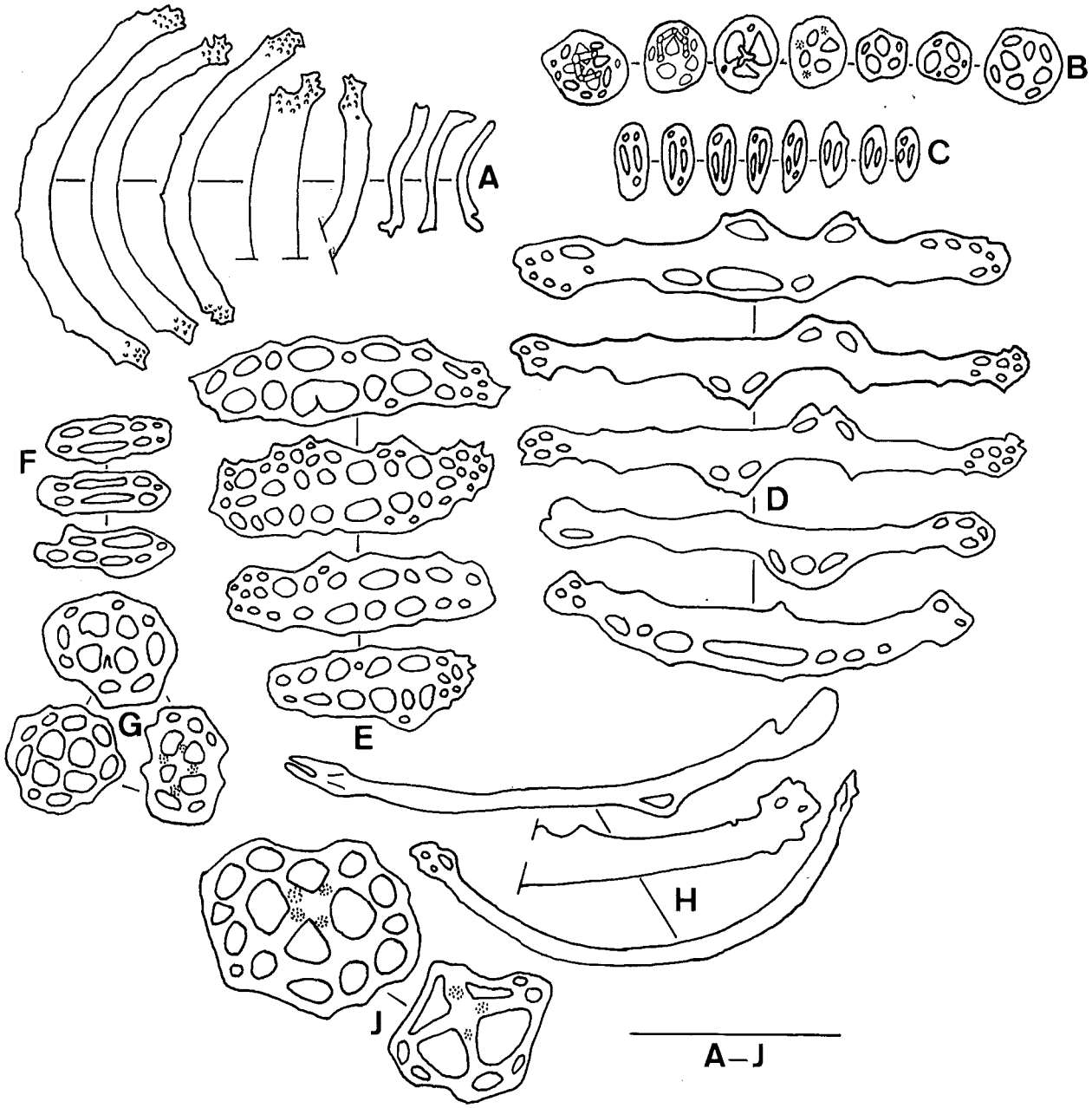


FIG. 29 – *Holothuria (Stauropora) fuscocinerea* JAEGER, 1833. A. Rods of tentacles; B. Tables of body wall; C. Buttons of body wall; D. Rods of ventral tube feet; E. Plates of ventral tube feet; F. Buttons of ventral tube feet; G. Reduced tables of ventral tube feet; H. Rods of dorsal papillae; J. Reduced tables of dorsal papillae. Scale bar A-J represents 100 μm.

size 115 x 21 mm and 26 x 15 mm, after preservation. Colour in alcohol same as colour in life, though somewhat faded: dorsal side light brown with four to six dark-brown, transverse bands (pl. 3F). All over the bivium sparsely distributed, large, yellowish extensions, each bearing a small and slender, brownish conical papilla, surrounded at its base by a dark brown ring. Ventral side light yellow, covered by numerous long cylindrical tube feet with similar colouration; tube feet distributed more or less evenly over the total surface. Mouth ventral, surrounded by 20 large, yellowish (spotted with brown) tentacles. Anus terminal, large, surrounded by a wide dark brown ring. Five groups of small white papillae surround the anal opening. Twenty short tentacle ampullae. Single, long Polian

vesicle (one third of body length). Single stone canal ending in a circular madreporic plate. Longitudinal muscles well developed, bifid. Cuvierian tubules well developed and readily ejected. Calcareous ring small with the radial pieces twice as wide and long as the interradial pieces (see also CHERBONNIER 1988: 109, fig. 43H).
Ossicles: Tentacles with rods, 150-375 µm long, the large ones, originating from the stalk, slightly spinose at the extremities; the small ones, derived from the crown, smooth (fig. 30A). Dorsal and ventral body wall present similar tables and pseudobuttons (fig. 30B, C). Tables: rim of disc undulating, 30-40 µm across, perforated by four central holes and one to three smaller peripheral holes; spire, if present, low, consists of four (sometimes only three) pillars united by a single cross beam, ending in a small, poorly formed crown (fig. 30B, C). Pseudobuttons of the dorsal body wall, 40-55 µm long (fig. 30B). Pseudobuttons of the ventral body wall 25-35 µm long, with some perforations (fig. 30C). Ventral tube feet with rods perforated laterally and at the extremities, 160-200 µm long, giving rise to irregular plates and elongated buttons, 35-140 µm long (fig. 30D). Dorsal papillae with simple to more complex rods, the latter similar to those in the ventral tube feet, giving rise to irregular perforated plates which can reach lengths of 190 µm (fig. 30E).
DIAGNOSIS – See CHERBONNIER and FÉRAL 1984a: 685-687, fig. 12.
ECOLOGY – In East Africa we observed this species between coral blocks on fine coralline sand; 20 m deep, but also in shallow, 2 m deep, water on coarse coral rubble overgrown with algae. In New-Caledonia, CHERBONNIER & FÉRAL (1984a) report depths up to 55 m and state that *H. (S.) pervicax* can thrive in colonies.
DISTRIBUTION IN THE STUDY REGION – Malindi, Kanamai, Mombasa, Chale Island.
GEOGRAPHIC DISTRIBUTION – Well-known tropical and subtropical Indo-west-Pacific (also recorded from the Red Sea, but not from the Persian Gulf) (CHERBONNIER & FÉRAL 1984a; CHERBONNIER 1988; ROWE & GATES 1995). Malindi, Kanamai, Mombasa and Chale Islands are new records for Kenya (this work). Figure 54E shows the known distribution in the WIO in detail.

Table 17 lists the other species within the subgenus *Stauropora* 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 *Theelothuria* DEICHMANN, 1958

DIAGNOSIS (after ROWE 1969: 157) [Type species: *Holothuria princeps* SELENKA, 1867 by original designation]
Size moderate to large (250 mm) with trivium distinctly flattened and bivium arched; tube feet irregularly arranged on the ventral surface; large wart-like papillae spread without order over the dorsal surface; mouth ventral, surrounded by 18-20 tentacles, with a collar of papillae at the base of the tentacles; anus terminal, anal papillae usually present; body wall can be up to 6,5 mm thick, gritty to the touch; calcareous ring stout, radial pieces with rounded anterior notch and large posterior bifurcations, radial pieces up to twice as long as the interradial pieces. Ossicles: body wall comprise well developed tables with

CURRENT SPECIES NAME	KNOWN WIO DISTRIBUTION	REFERENCE(S)
Holothuria (Stauropora) dofleinii AUGUSTIN, 1908	WIO, East Africa (unspecified)	ROWE *in* ROWE & RICHMOND 1997
	Mozambique (Tunghi Bay)	PEARSON 1910; 1913; DANIEL & HALDER 1974
	Zanzibar	PEARSON 1910; 1913; DANIEL & HALDER 1974
H. (Stauropora) modesta LUDWIG, 1875	Red Sea (Kosseir)	LAMPERT 1885; PRICE 1982
	Arabian Sea?	DANIEL & HALDER 1974
Holothuria (Stauropora) olivacea LUDWIG, 1888 (see also discussion)	Red Sea (Dissei Island)	TORTONESE 1953a[1]; PRICE 1982[1]
	Madagascar (Nosy Bé, Antsakoaba, Tuléar)	CHERBONNIER 1988

TABLE 17 – Other species within the holothurian subgenus *Stauropora* known to occur in the shallow-waters of the WIO. Cited as [1] *Holothuria fusco-olivacea* FISHER or *H. fuscoolivacea* FISHER.

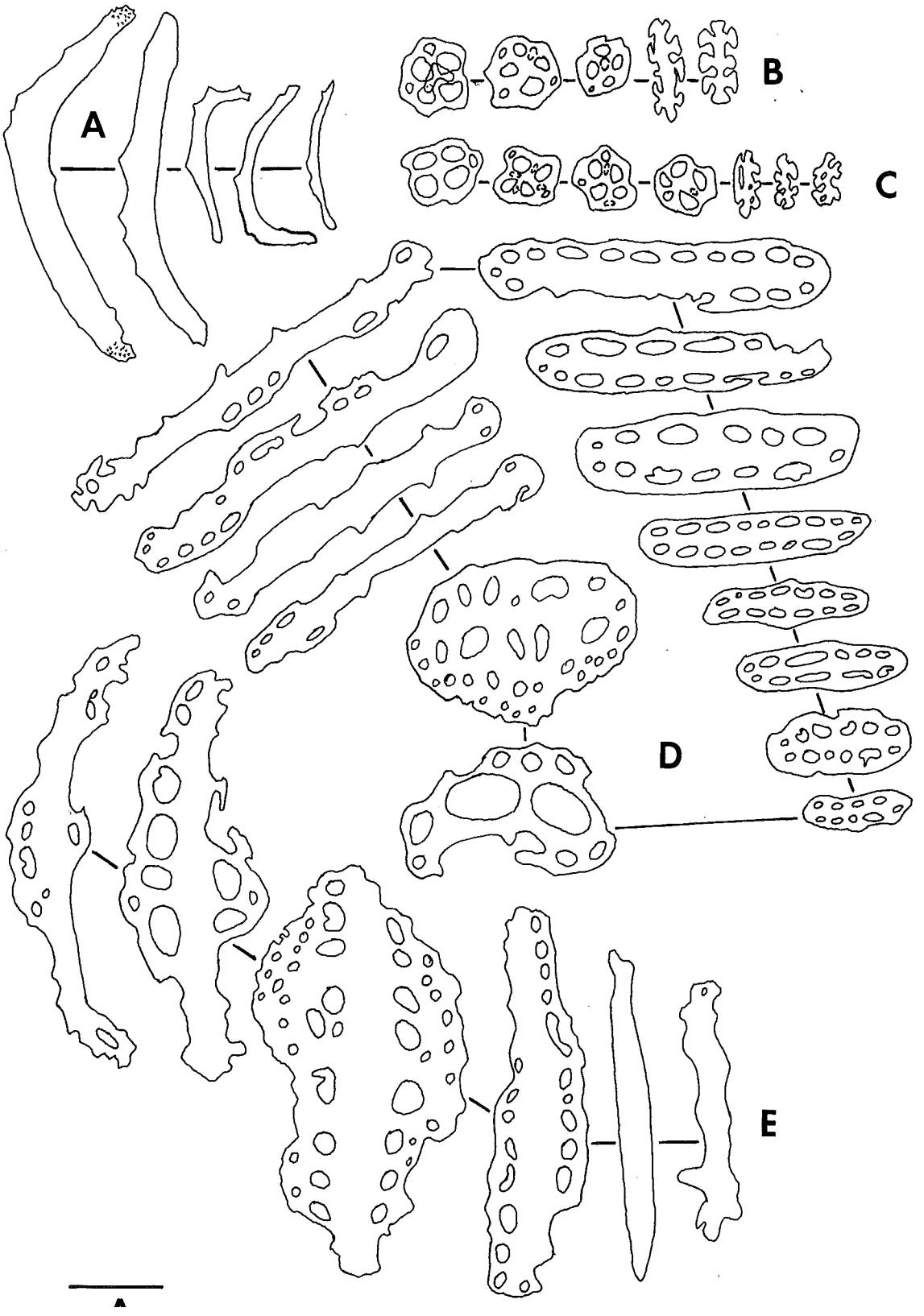


FIG. 30 – *Holothuria (Stauropora) pervicax* SELENKA, 1867. A. Rods of tentacles; B. Tables and pseudo-buttons of dorsal body wall; C. Tables and pseudo-buttons of ventral body wall; D. Rods, plates and buttons of ventral tube feet; E. Rods and plates of dorsal papillae. Scale bars A and B-E represent 100 μm.

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.

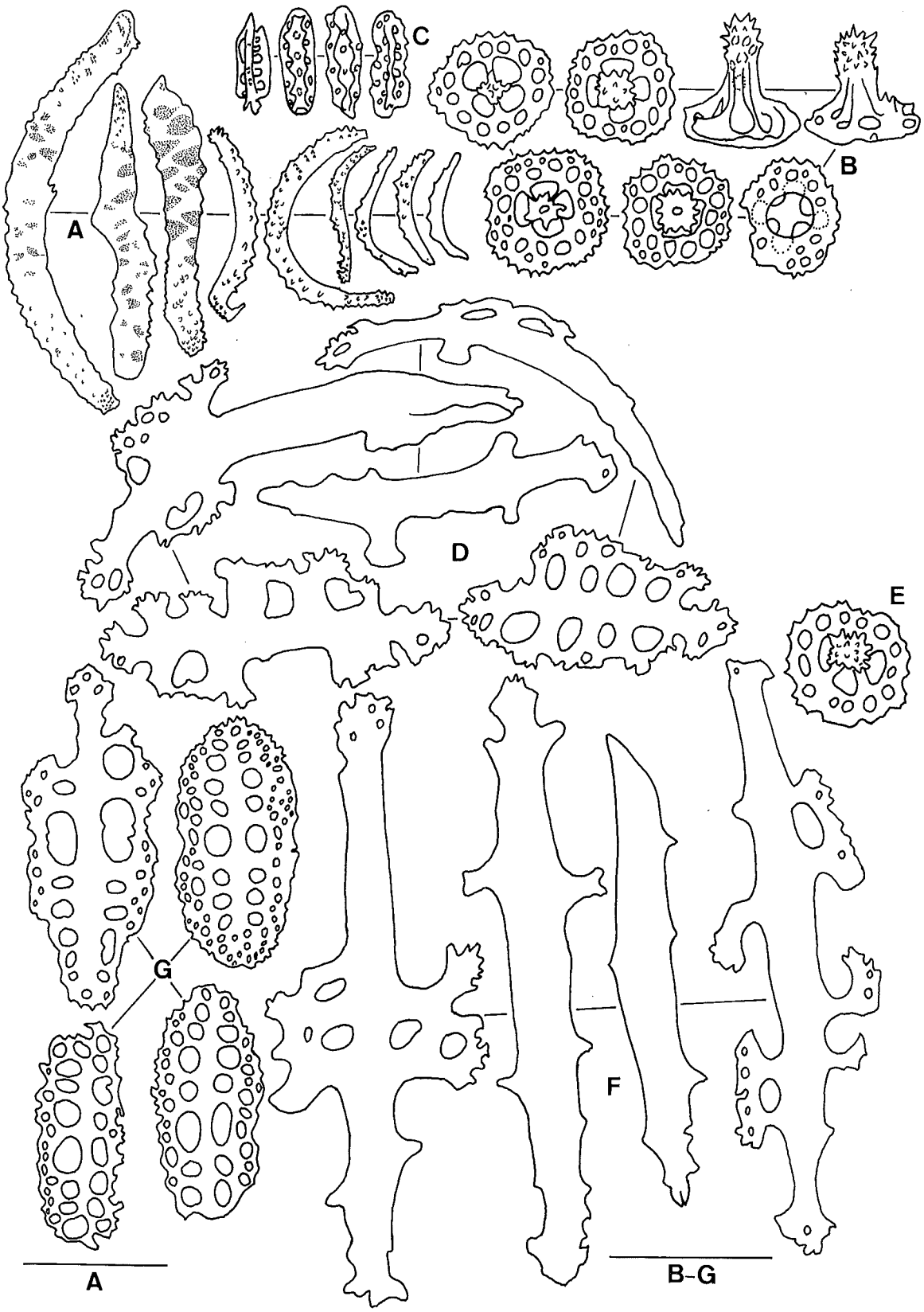


FIG. 31 – *Holothuria (Theelothuria) turriscelsa* CHERBONNIER, 1980. A. Rods of tentacles; B. Tables of body wall; C. Ellipsoids of body wall; D. Rods and plates of dorsal papillae; E. Table of ventral tube feet; F. Rods of ventral tube feet; G. Plate of ventral tube feet. Scale bar A represents 200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

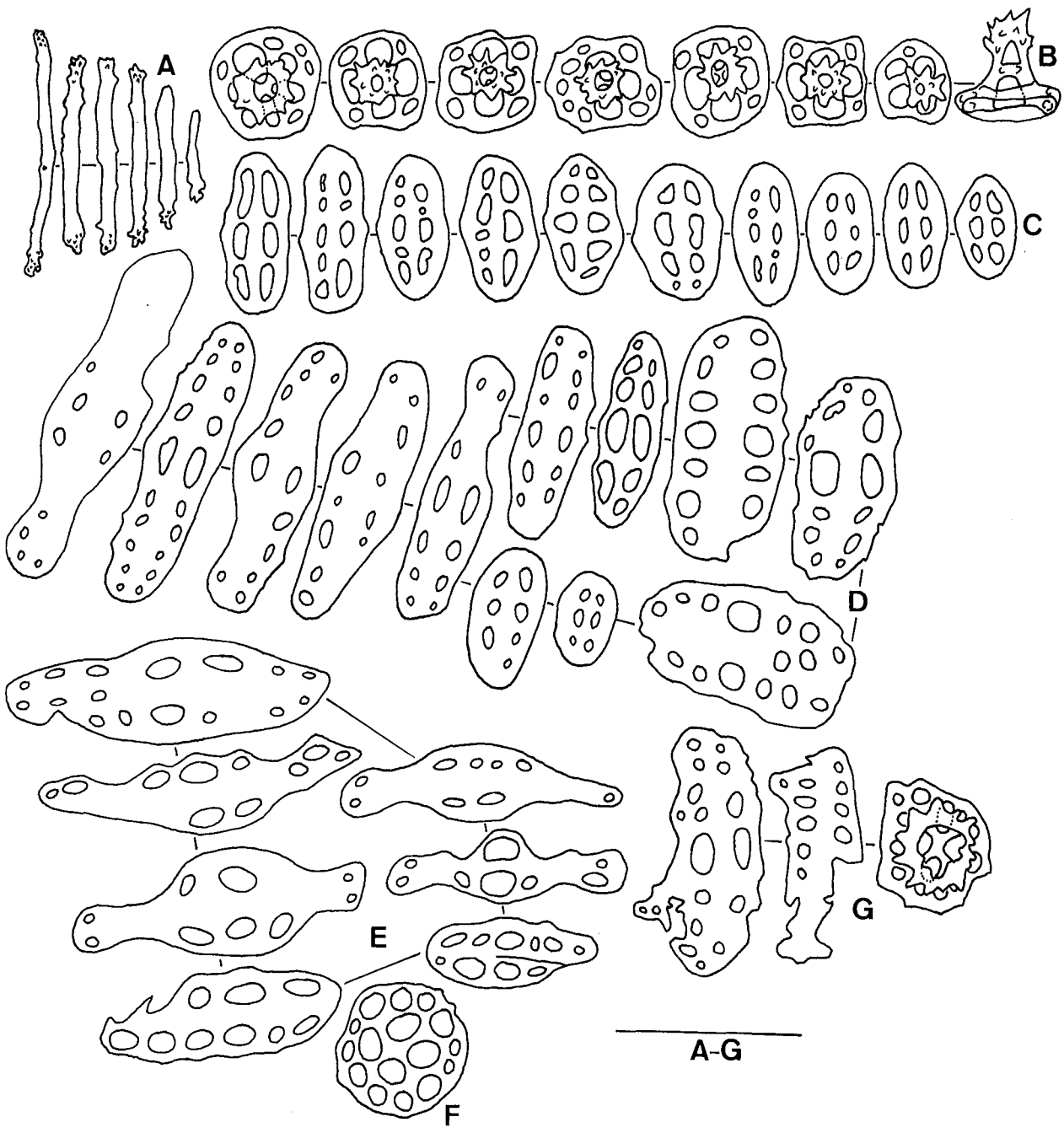


FIG. 32 – *Holothuria (Thymiosycia) arenicola* SEMPER, 1868. A. Rods of tentacles; B. Tables of body wall; C. Buttons of body wall; D. Elongated plates and buttons of ventral tube feet; E. Rod like plates of dorsal tube feet; F. Reduced table of dorsal tube feet; G. Rod-like plates and table of anal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

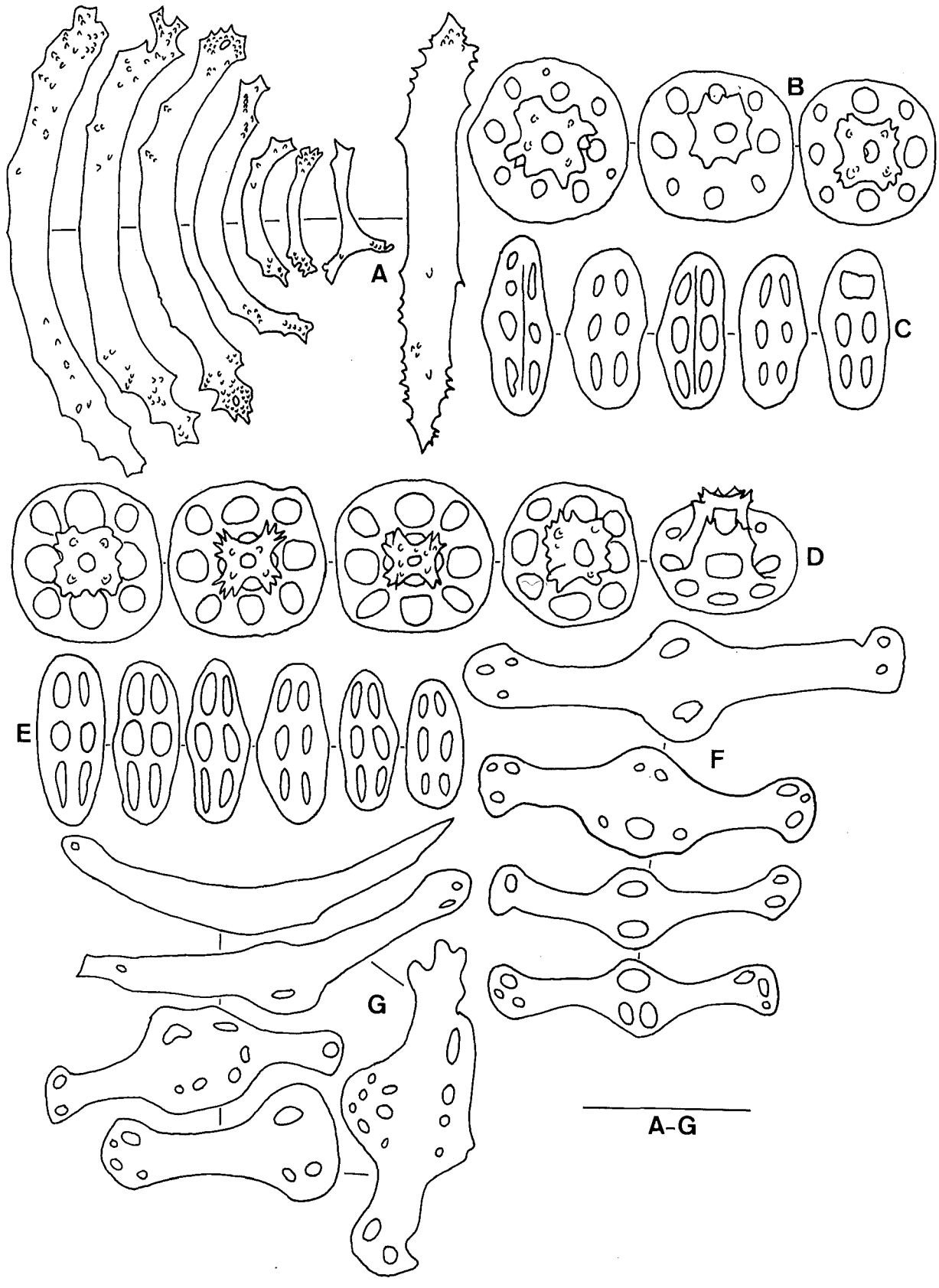


FIG. 33 – *Holothuria (Thymiosycia) impatiens* (FORSKÅL, 1775). A. Rods of tentacles; B. Tables of dorsal body wall; C. Buttons of dorsal body wall; D. Tables of ventral body wall. E. Buttons of ventral body wall; F. Rods of ventral tube feet; G. Rods of dorsal tube feet. Scale bar A-G represents 100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

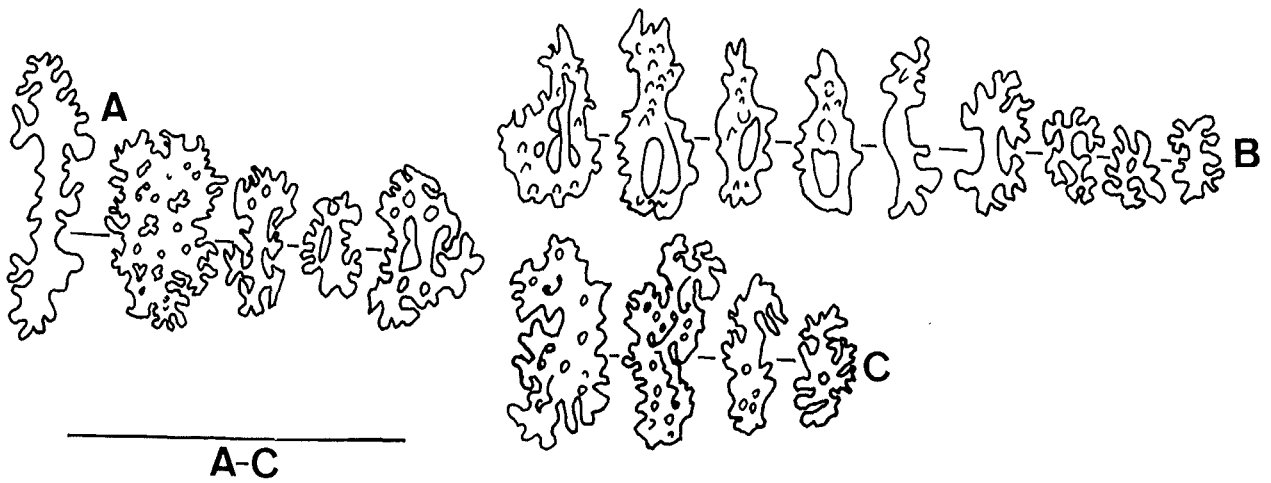


FIG. 34 – *Pearsonothuria graeffei* (SEMPER, 1868). A. Rosettes of tentacles; B. Pseudo-tables and rosettes of body wall; C. Rosettes of tube feet. Scale bar A-C represents 100 µm.

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.

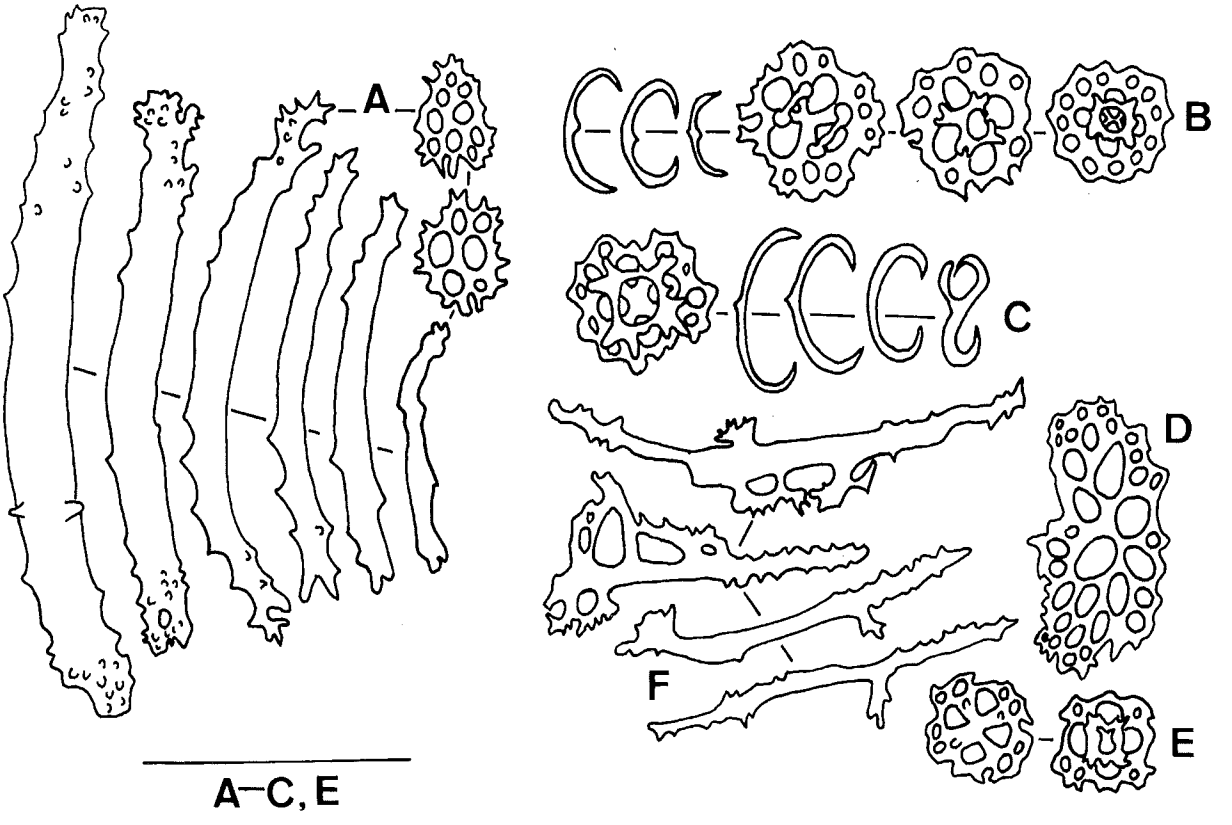


FIG. 35 – *Stichopus chloronotus* BRANDT, 1835. A. Rods and plates of tentacles; B. Tables and C-shaped rods of body wall; C. Tables and C-shaped rods of dorsal papillae; D. Perforated plate of ventral tube feet; E. Tables of ventral tube feet; F. Rods of ventral tube feet. Scale bar A-C, E represents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

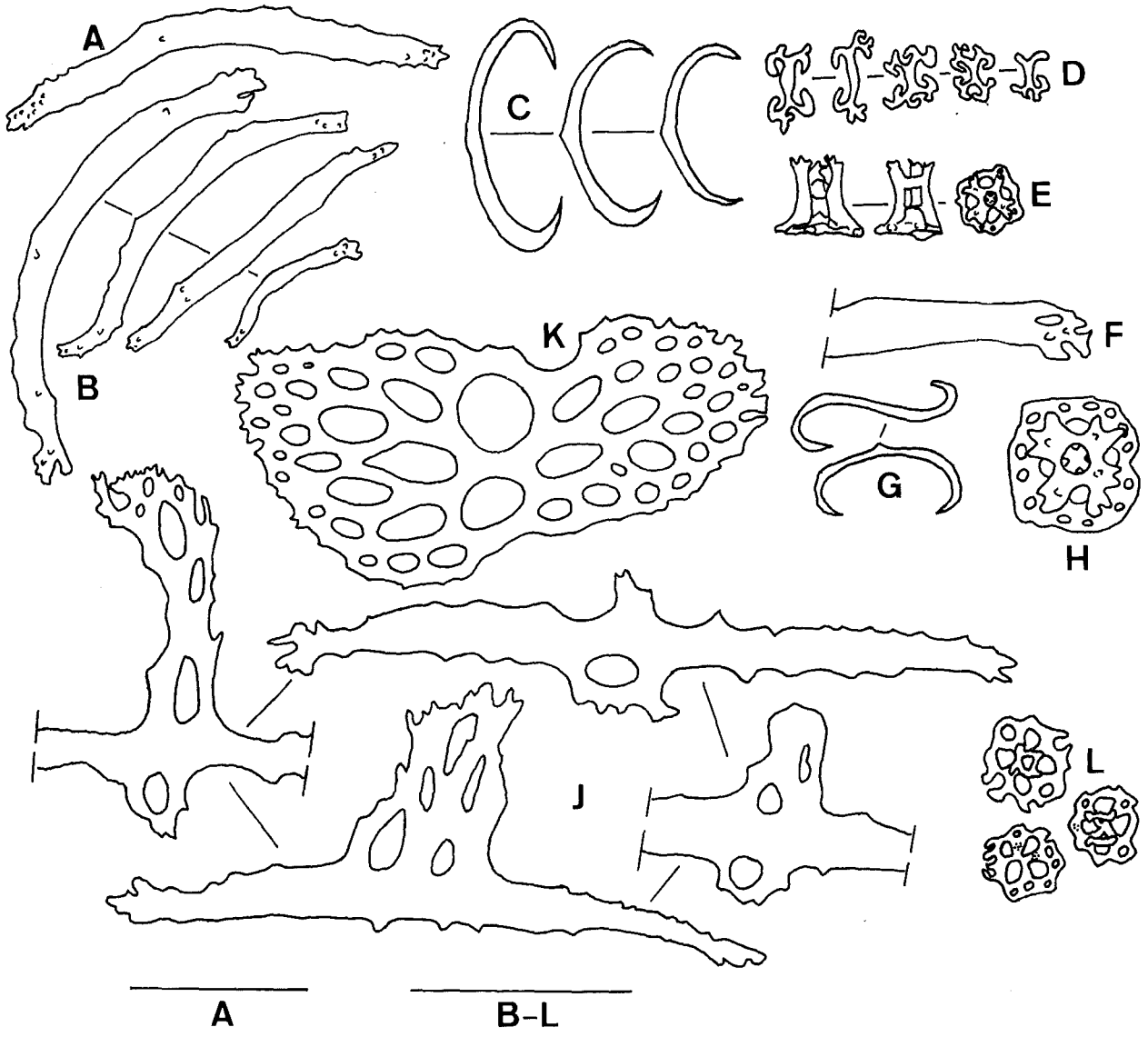


FIG. 36 – *Stichopus herrmanni* SEMPER, 1868. A. Large rod of tentacles; B. Rods of tentacles; C. C-shaped bodies of body wall; D. Rosettes of body wall; E. Tables of body wall; F. Rod of dorsal papillae; G. C-and S-shaped bodies of dorsal papillae; H. Table of dorsal papillae; J. Rods of ventral tube 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

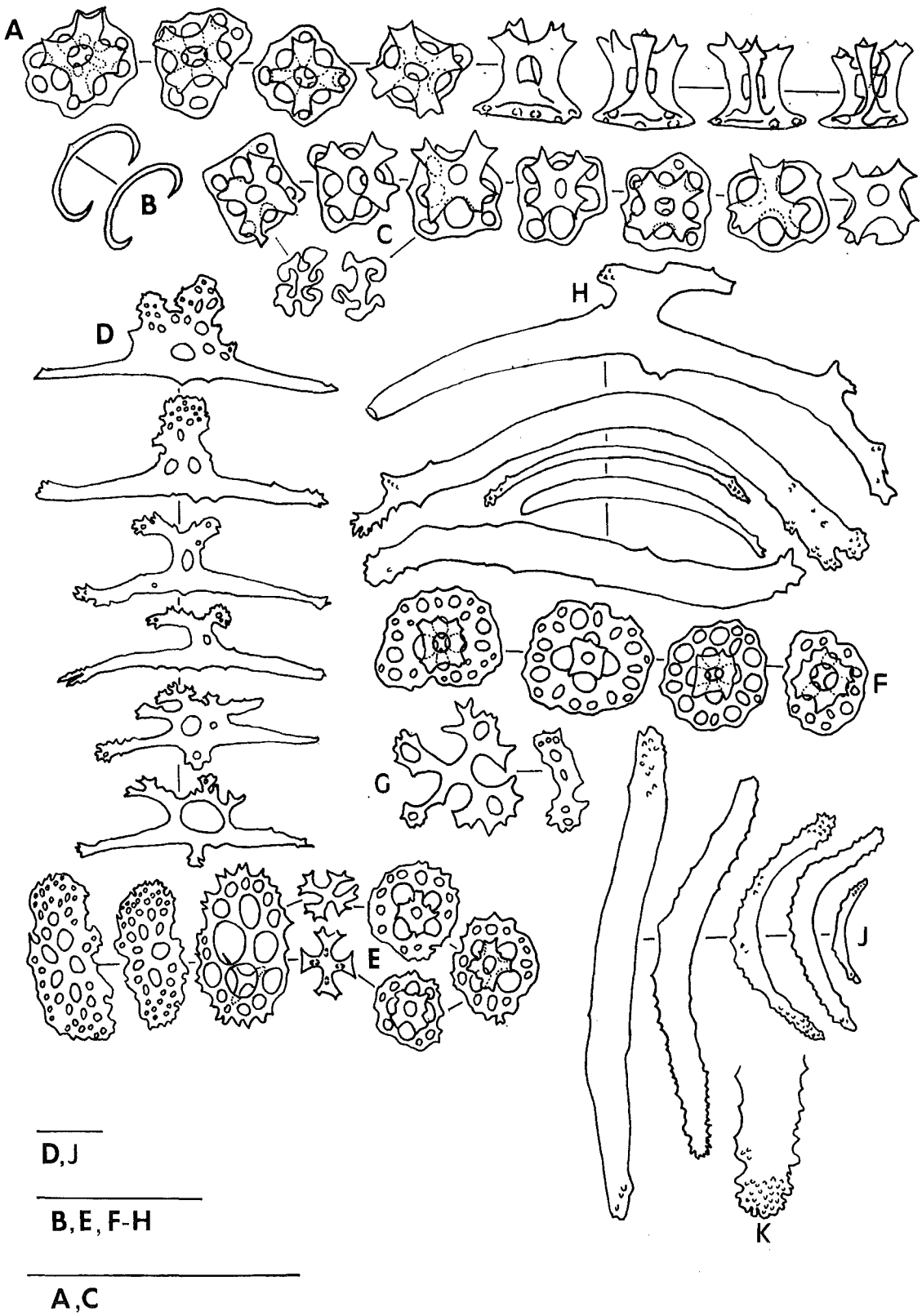


FIG. 37 – *Stichopus monotuberculatus* (QUOY & GAIMARD, 1833). A. Tables of ventral body wall; B. C-shaped rods of ventral body wall; C. Tables and rosette-like rods of dorsal body wall; D. Rods of ventral tube feet; E. Plates and tables of ventral tube feet; F. Tables of dorsal papillae; G. Table fragment 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

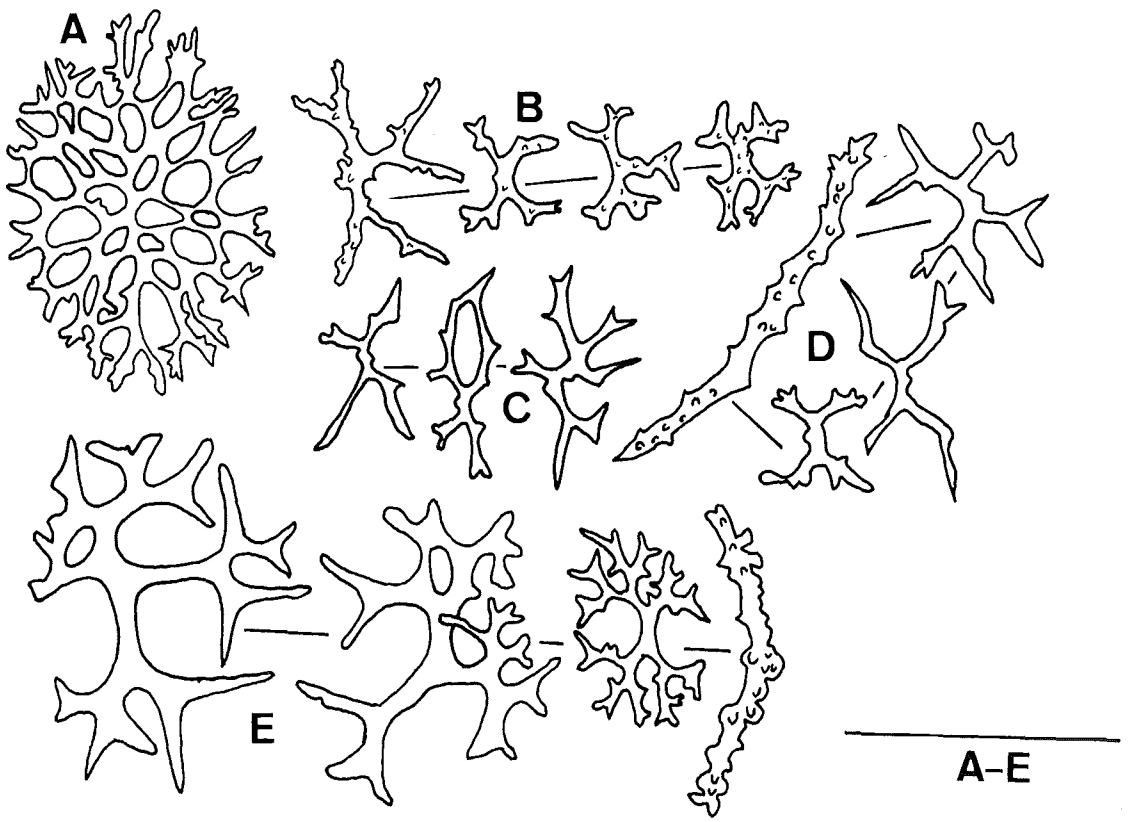


Fig. 38 – *Thelenota ananas* (Jaeger, 1833). A. Perforated plate of tentacle; B. Branched rods of dorsal body wall; C. Branched rods of ventral body wall; D. Branched and unbranched rods of dorsal papillae; E. Branched and unbranched rods of ventral tube feet. Scale bar A-E represents 100 µm.

(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**

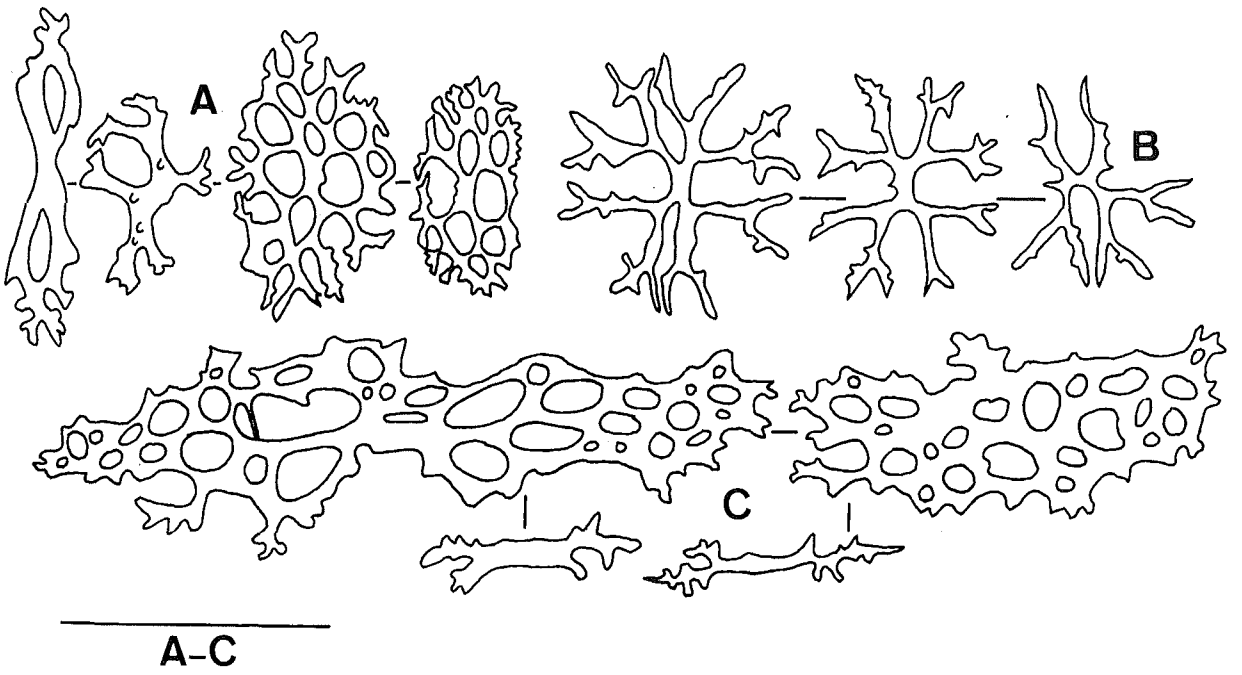


FIG. 39 – *Thelenota anax* H.L. Clark, 1921. A. Rods and perforated plates of tentacles; B. Rods of body wall; C. Rods and perforated plates of ventral tube feet. Scale bar A-C represents 100 µm.

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.

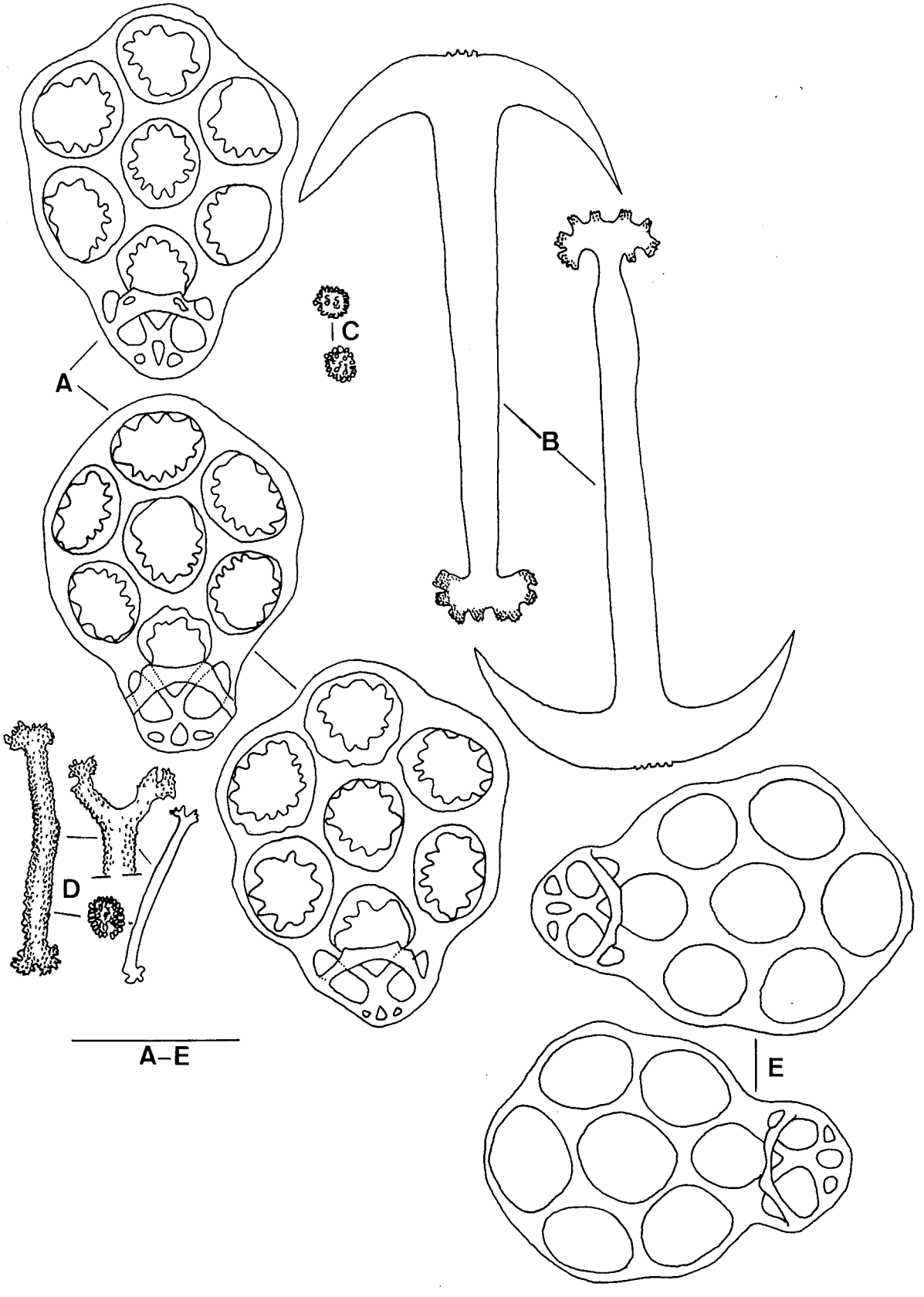


FIG. 40 – *Euapta godeffroyi* (SEMPER, 1868). A. Anchor-plates with serrated holes of body wall; B. Anchors of body wall; C. Miliary granules of body wall; D. Rods and miliary granule of tentacles; E. Anchor-plates with smooth holes of body wall. Scale bar A-E represents 100 μm.

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

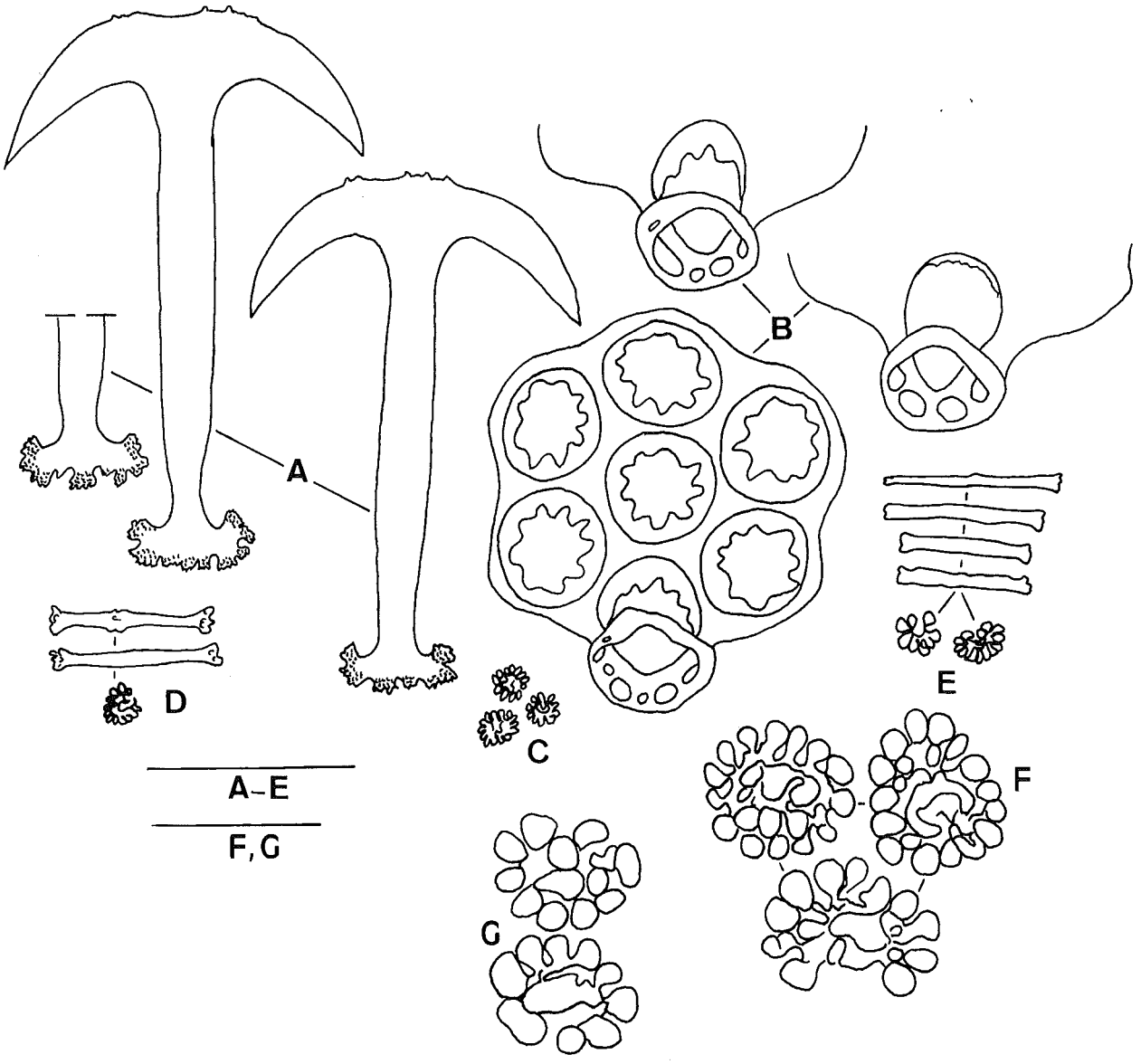


FIG. 41 – *Opheodesoma glabra* (SEMPER, 1868). A. Anchors of body wall; B. Anchor-plates of body wall; C & F. Miliary granules of body wall; D & G. Miliary granule and rods of tentacle; E & G Milary granules and rods of oral disc. Scale bar A-E represents 100 μm; scale bar F, G represents 20 μm.

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

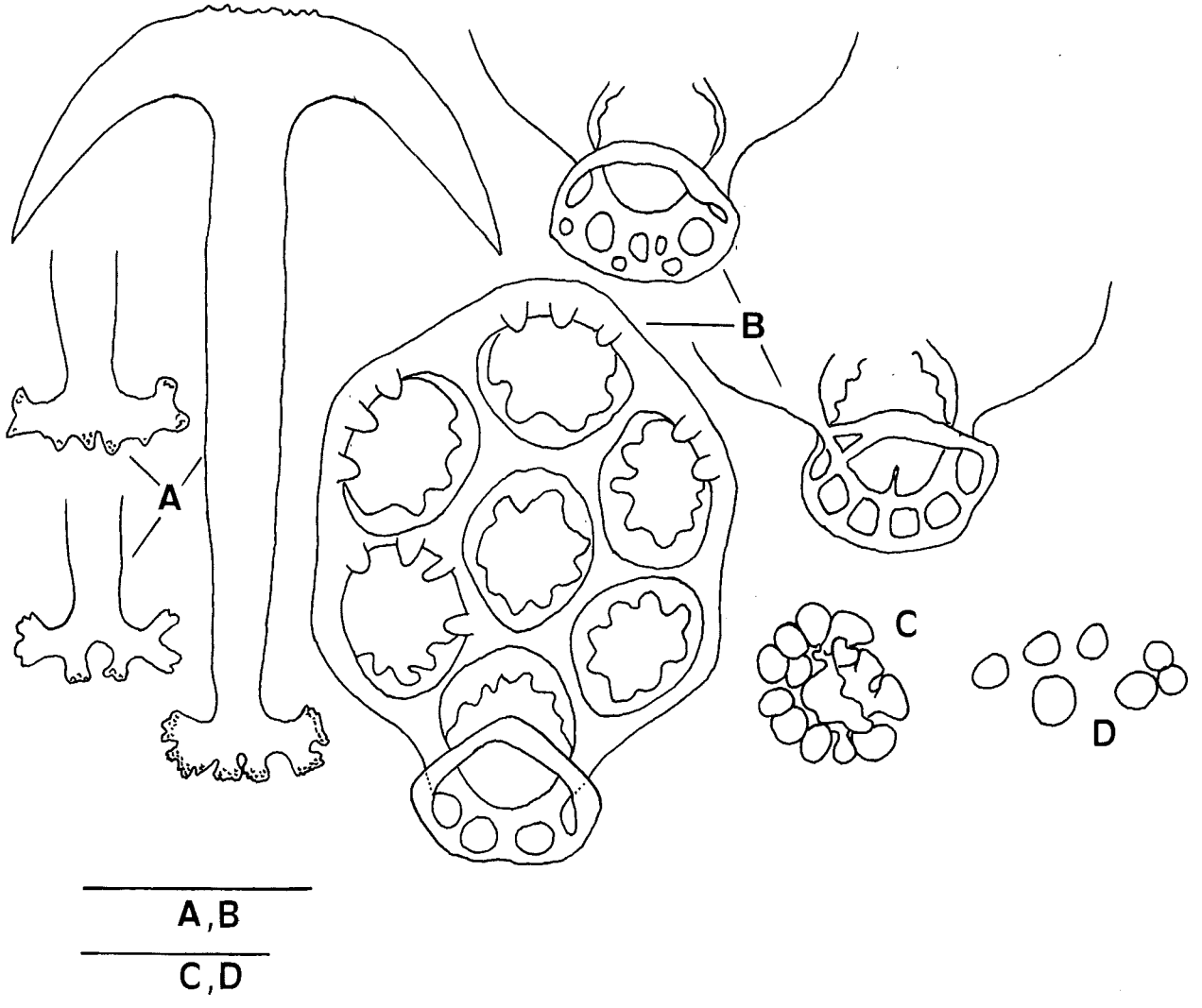


Fig. 42 – *Opheodesoma grisea* (Semper, 1868). A. Anchor of body wall; B. Anchor-plates of body wall; C. Miliary granule of body wall, D. Fragmented miliary granules of tentacles. Scale bar A & B represents 100 µm; scale bar D, E represents 20 µm.

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.*

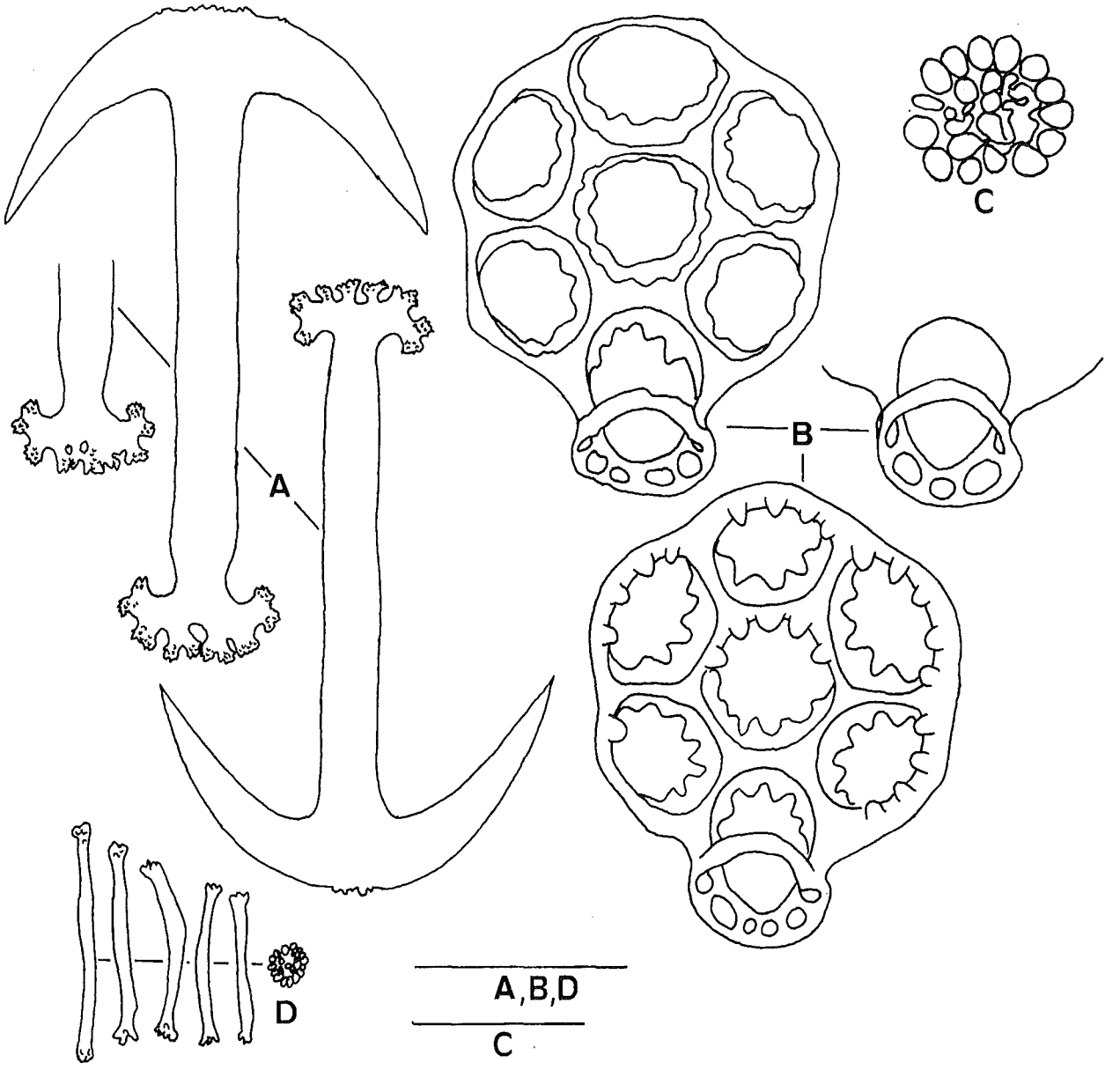


FIG. 43 – *Opheodesoma mauritiae* HEDING, 1928. A. Anchors of body wall; B. Anchor-plates of body wall; C. Miliary granules of body wall; D. Miliary granules and rods of tentacles and oral disc. Scale bar A, B, D represents 100 μm; scale bar C represents 20 μm.

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*

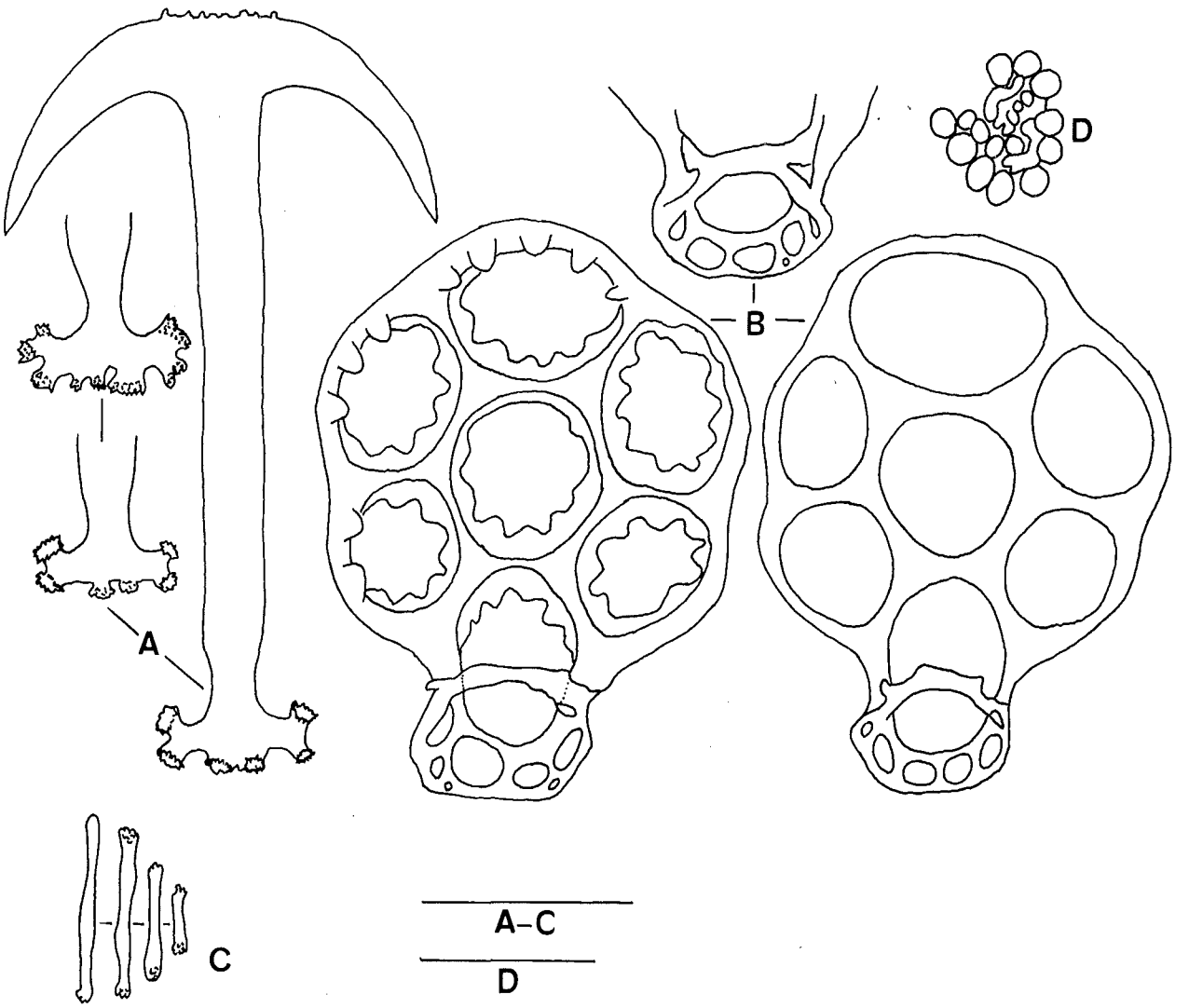


FIG. 44 – *Opheodesoma* cf. *mauritiae* HEDING, 1928. A. Anchors of body wall; B. Anchor-plates of body wall; C. Rods of oral disc; D. Miliary granule of tentacles. Scale bar A-C represents 100 μm; scale bar D represents 20 μm.

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.

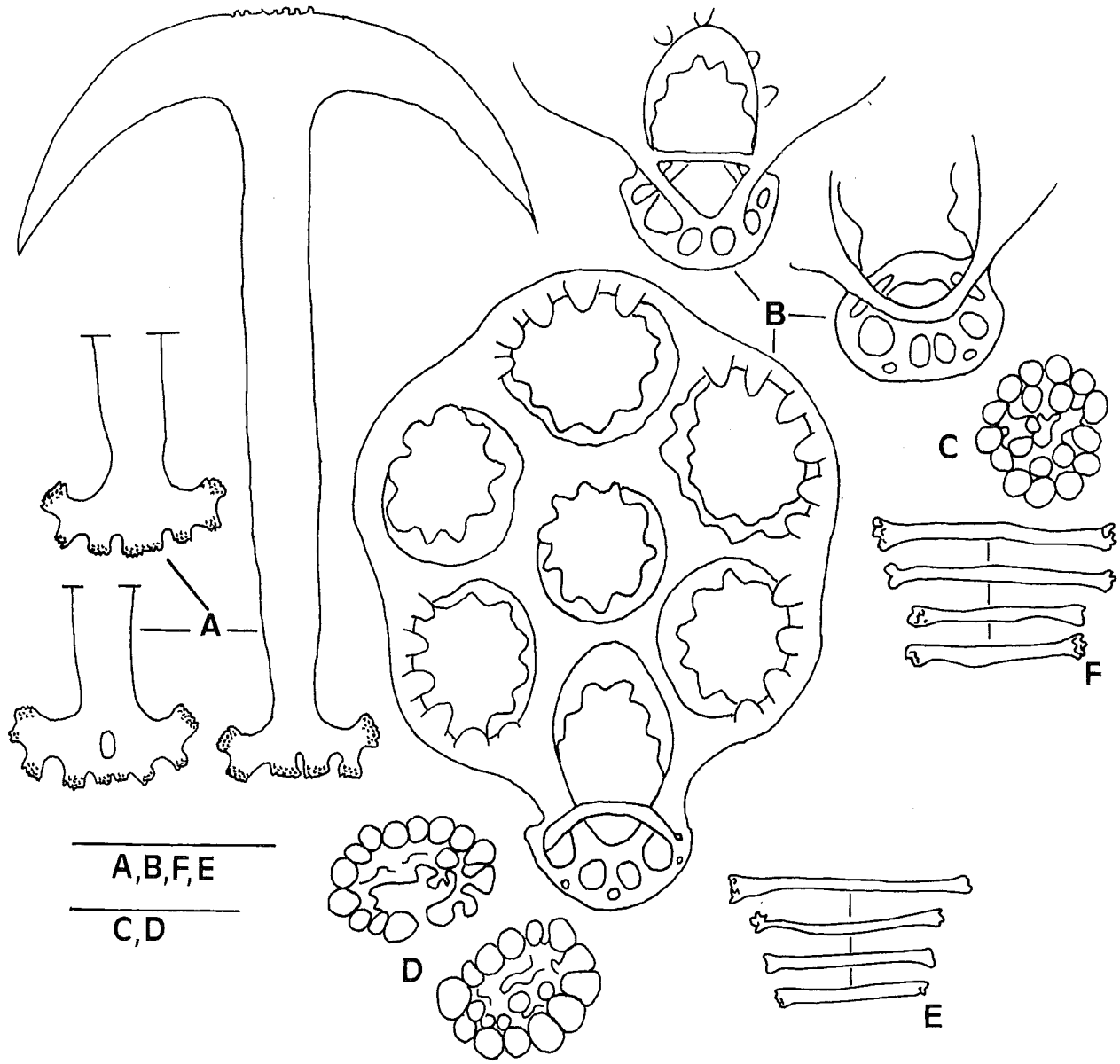


FIG. 45 – *Opheodesoma* sp. A. Anchors of body wall; B. Anchor-plates of body wall; C. Miliary granule of body wall; D. Miliary granule of tentacle; E. Rods of tentacle; F. Rods of oral disc. Scale bar A, B, F, E represents 100 μm; scale bar C, D represents 20 μm.

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.

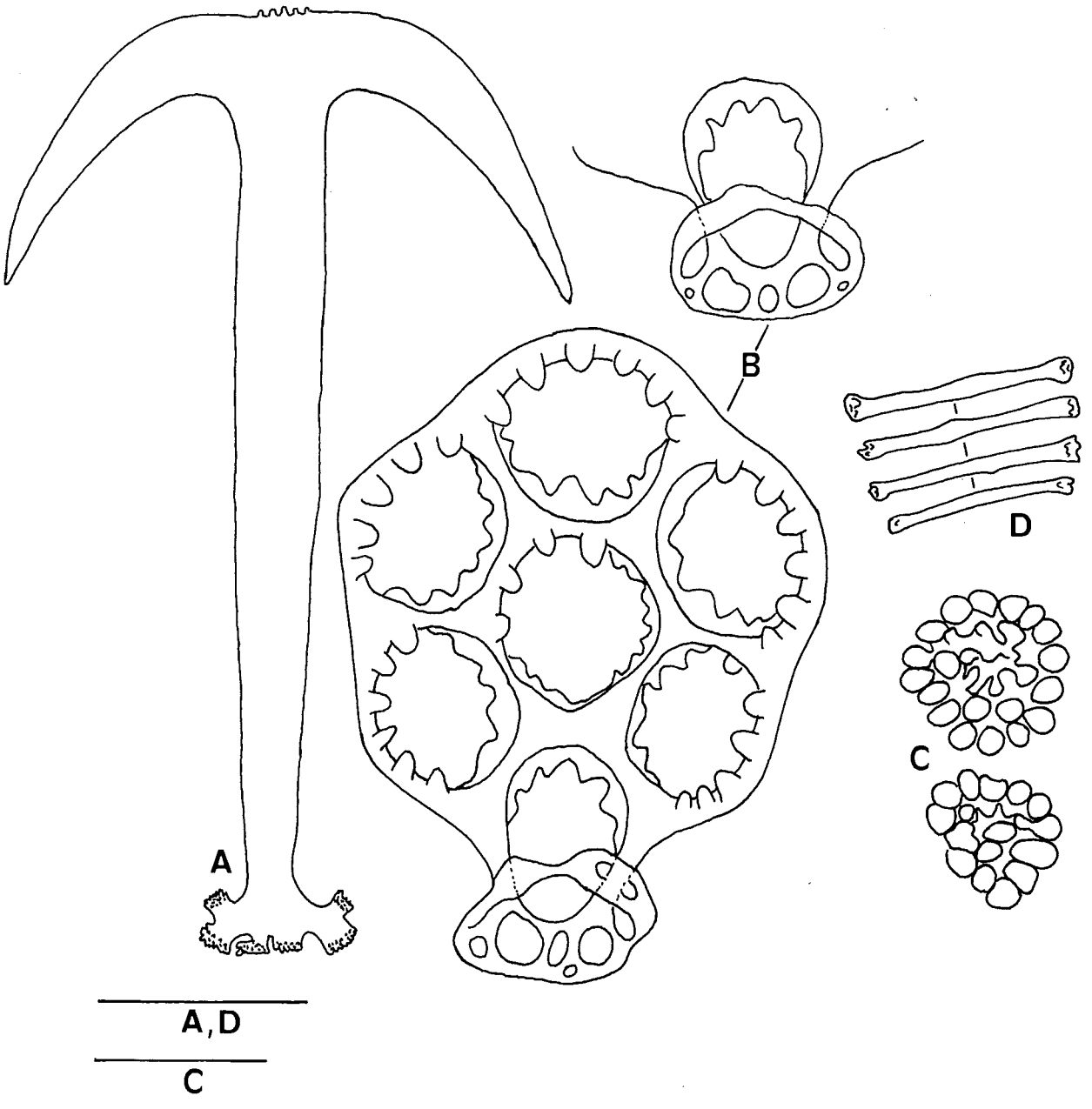


FIG. 46 – *Opheodesoma spectabilis* FISHER, 1907. A. Anchor of body wall; B. Anchor-plate of body wall; C. Miliary granule of tentacle; D. Rods of oral disc. Scale bar A, B, D represents 100 μm; scale bar C represents 20 μm.

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,

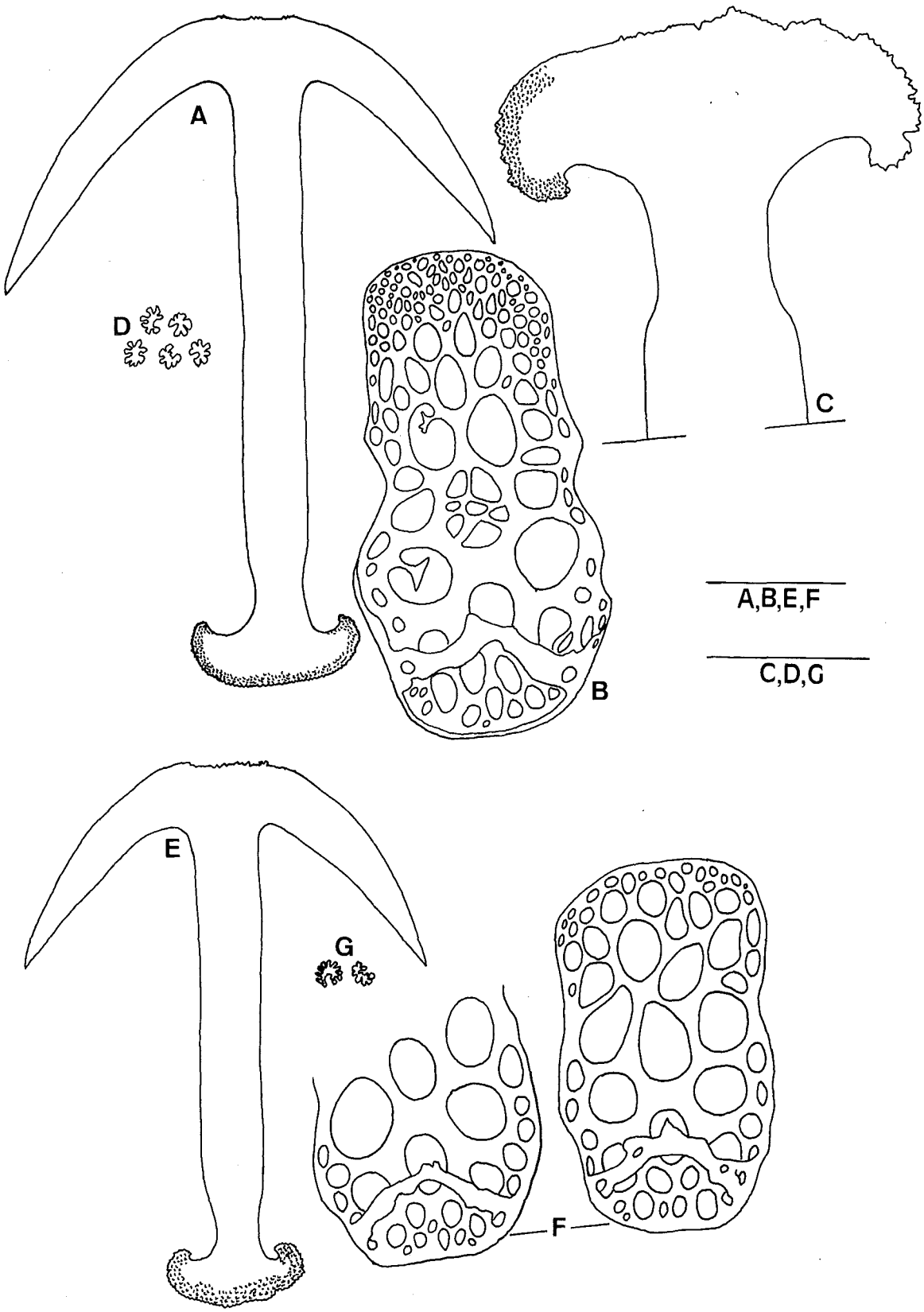


FIG. 47 – *Synapta maculata* (CHAMISSO & EYSENHARDT, 1821). A. Anchor of body wall (L=600 mm); B. Anchor-plate of body wall (L=600 mm); C. Detail of stock of anchor (L=600 mm); D. Miliary granules of body wall (L=600 mm); E. Anchor of body wall (L=87 mm); F. Anchor-plates of body wall (L=87 mm); G. Miliary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

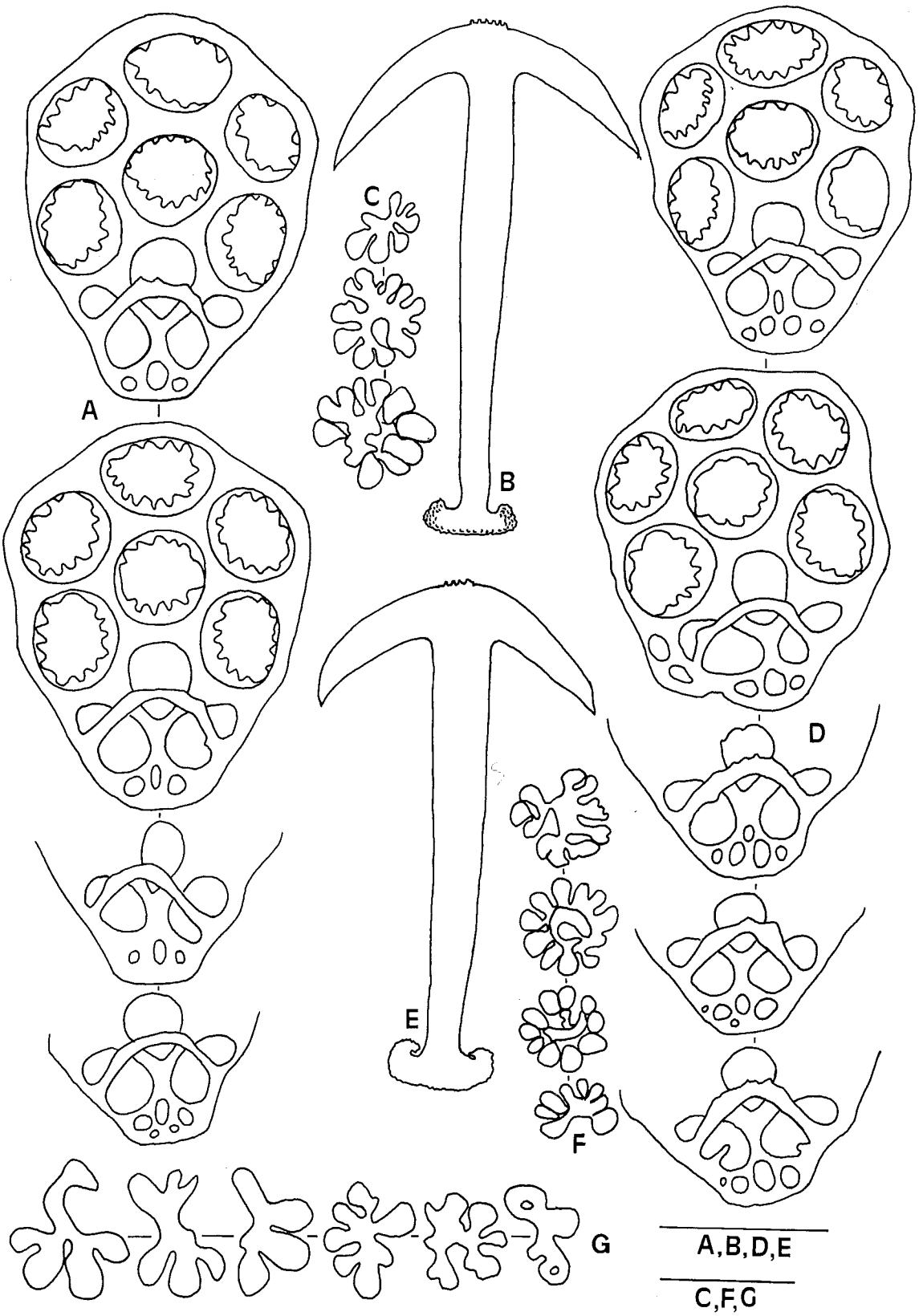


FIG. 48 – *Synaptula recta* (SEMPER, 1868). A. Anchor-plates of posterior body wall; B. Anchor of posterior body wall; C. Miliary granules of posterior body wall; D. Anchor-plates of anterior body wall; E. Anchor of anterior body wall; F. Miliary granules of anterior body wall; G. Miliary granules of 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).

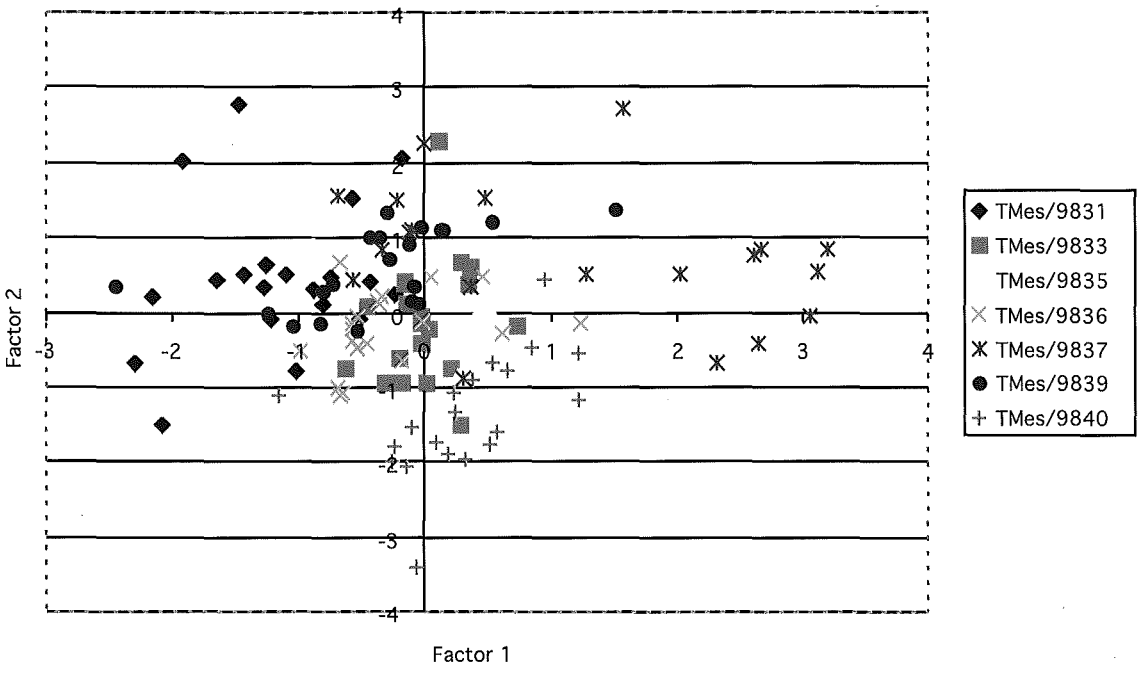


FIG. 49 – Factor analysis performed on the ossicle assemblage of the collected *Synaptula recta* specimens, with factor 1 explaining 36.17 % of the variation and factor 2 explaining 16.53 % of the variation. The observed variation thus seems to be intra-rather than interspecific.

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.

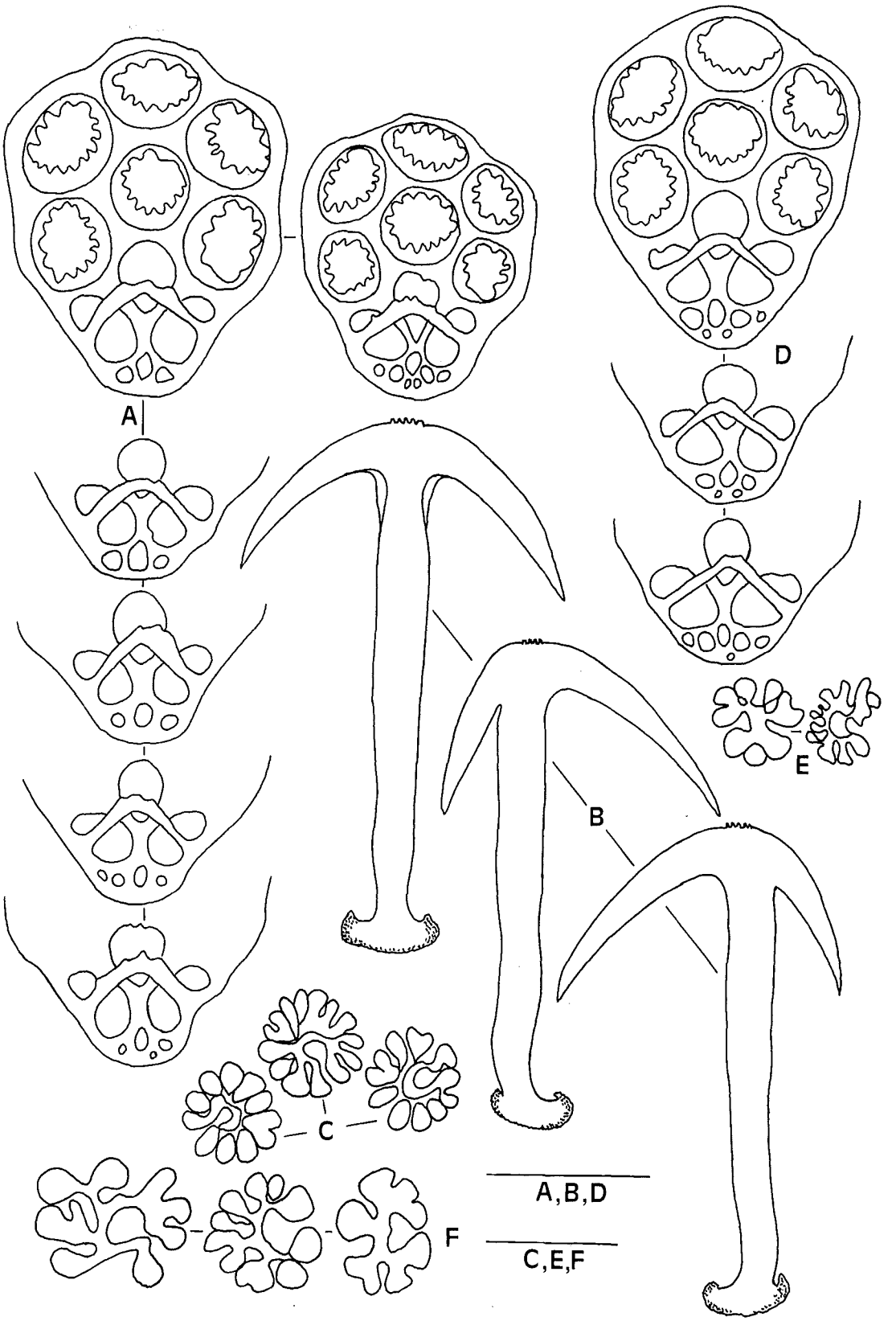


FIG. 50 – *Synaptula* cf. *recta* (SEMPER, 1868). A. Anchor-plates of posterior body wall; B. Anchors of posterior body wall; C. Miliary granules of posterior body wall; D. Anchor-plates of anterior body wall; E. Miliary granules of anterior body wall; F. Miliary granules of tentacle. Scale bar A, B,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

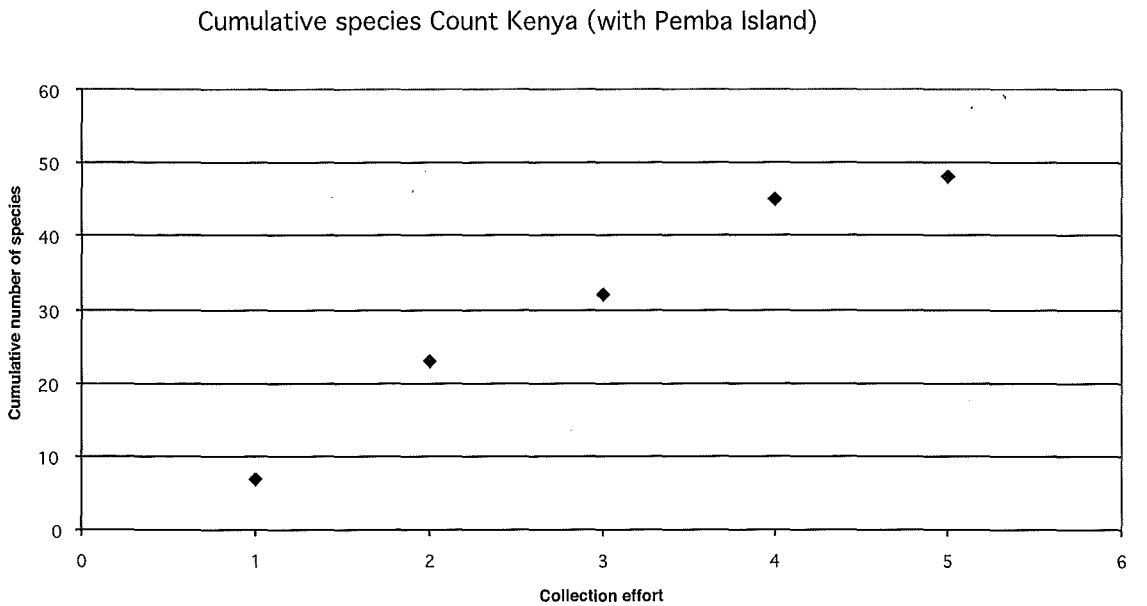


FIG. 57 – Estimating *holothuroid* species richness from Kenya (with Pemba Island) by constructing a cumulative count. 1 Denotes the cumulative count after PANNING (1941); 2 gives the known species after the former and LEVIN (1979); 3 after the former and HUMPHREYS (1981); 4 the former and the 1997 survey;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

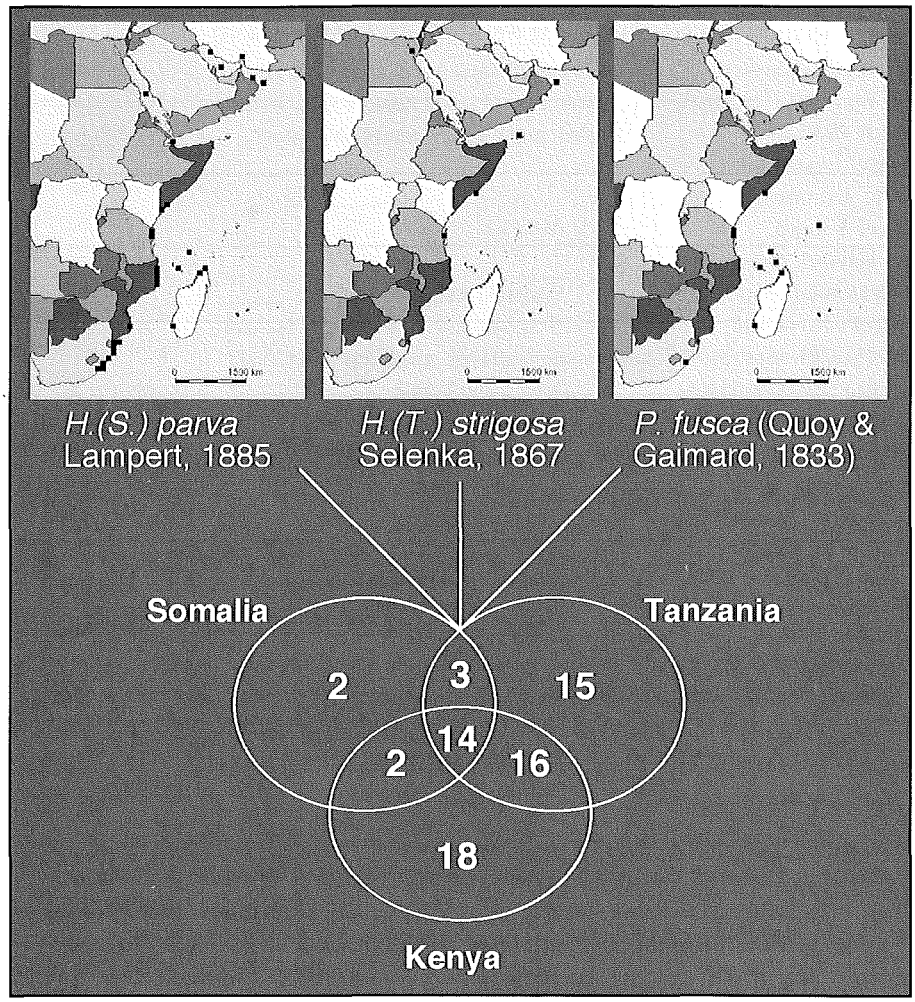


FIG. 58 – Gap analysis of the Somalian and the Tanzanian shallow-water Holothuroidea. Of the 17 species that are reported from both Somalia and Tanzania, only three [*Holothuria (Selenkothuria) parva* LAMPERT, 1885; *Holothuria (Thymiosycia) strigosa* SELENKA, 1867 and *Polycheira fusca* (QUOY & GAIMARD, 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

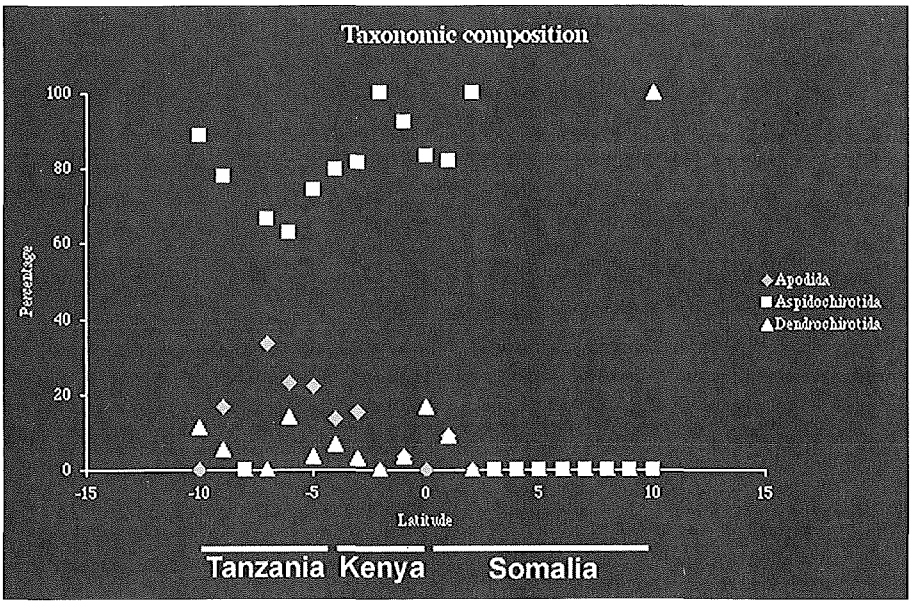


FIG. 60 – Taxonomic composition (at the level of the order) in the 10 °circum-tropical belt in the WIO reveals that dendrochirotids are underrepresented throughout the tropical WIO (the 100 % at 10°N represents only a single species).

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.

ACKNOWLEDGMENTS

It is with great pleasure that I thank the Drs C. Massin, F.W.E Rowe and A.S. Thandar for sharing their extensive knowledge on the Holothuroidea with me and for critically reviewing the early versions of the manuscript; two anonymous referees are also thanked for critically commenting on the manuscript; Dr. N. Ameziane Cominardi (MNHNP), Paris, for the loan of type and non type material of several *Holothuria* species; Dr. S. Halsey (NHM), London, for welcoming me at her museum and for the loan of type and non type material of several *Holothuria* and *Labidodemas* species; Dr. C. Ahearn (SI) for the loan of type material of *H. (Thymiosycia) thomasi*; Dr. D. VandenSpiegel (MRAC), Tervuren, for welcoming me at his museum and for the loan of specimens from the Seycelles and Inhaca; Dr. H. Ruhberg (ZMH), Hamburg, for welcoming me at her museum. Financial support came from the Flemish Fund for Scientific Research (project number G.0086.96), from the Research Council of the Free University Brussels and from the Flemish Community [Bilateral (international) scientific and technological cooperation; projects BIL98/84 and BIL01/46]. Clearance to work on the echinoderm fauna of Kenya came from the Office of the President through Mr. J.E. Ekirapa. Kenya Wildlife Services, WWF Kenya and KwaZulu-Natal Nature Conservation Service provide field support.

This work would not have been possible without the kind assistance of I. Tallon, who not only carefully constructed the framework of the *Filemaker Pro 5.5* database, but who also assisted in the automated plotting of the distributionrecords. The latter exercise was made easy thanks to the excellent freeware *imap* developed at the Lab of Plant Systematics at the K.U.Leuven (http://www.kuleuven.ac.be/bio/sys/imap/).

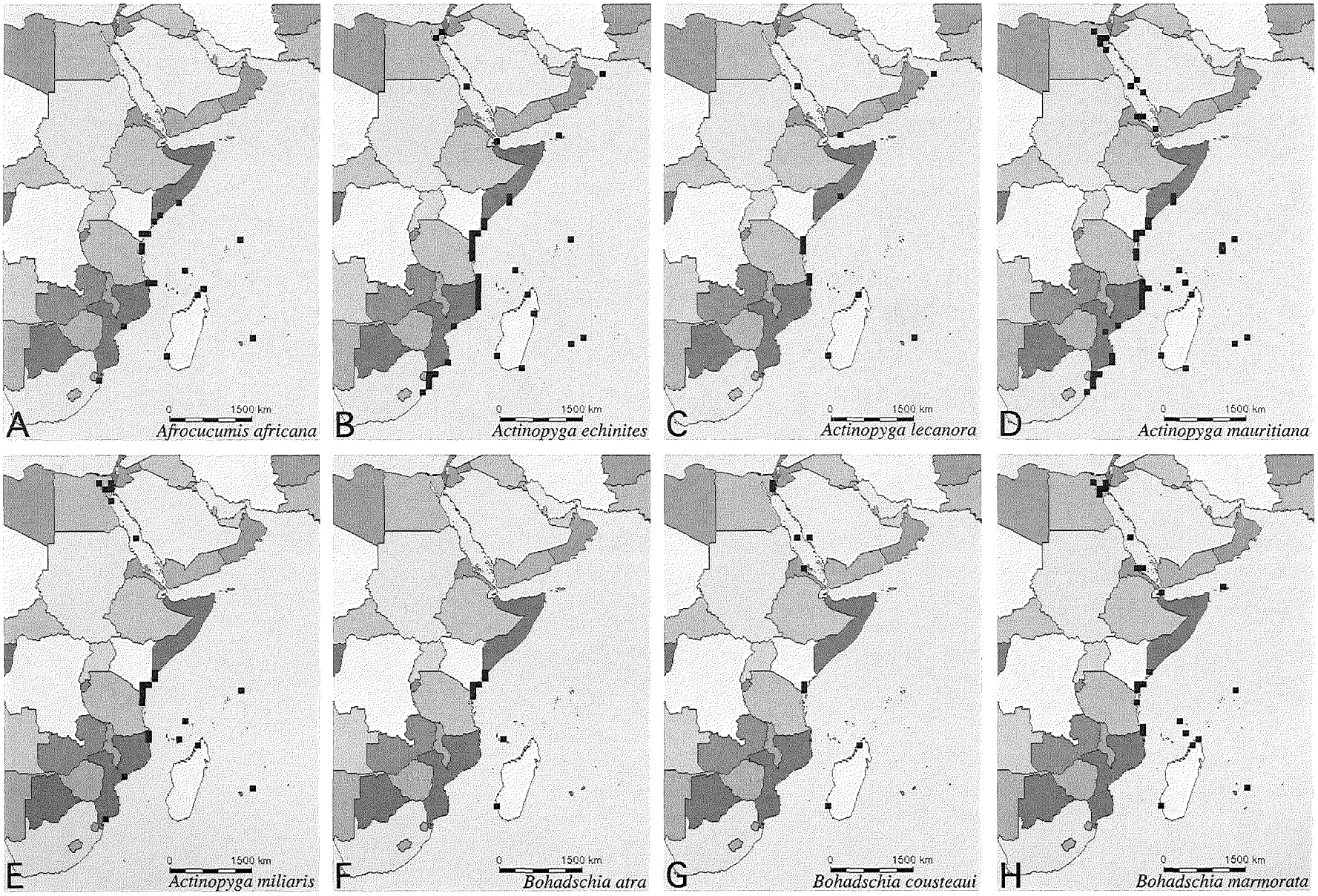


FIG. 51 – WIO distribution of shallow-water holothurians known from Kenya and/or Pemba Island. A. *Afrocucumis africana* (SEMPER, 1868); B. *Actinopyga echinites* (JAEGER, 1833); C. *Actinopyga lecanora* (JAEGER, 1833); D. *Actinopyga mauritiana* (QUOY & GAIMARD, 1833); E. *Actinopyga miliaris* (QUOY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

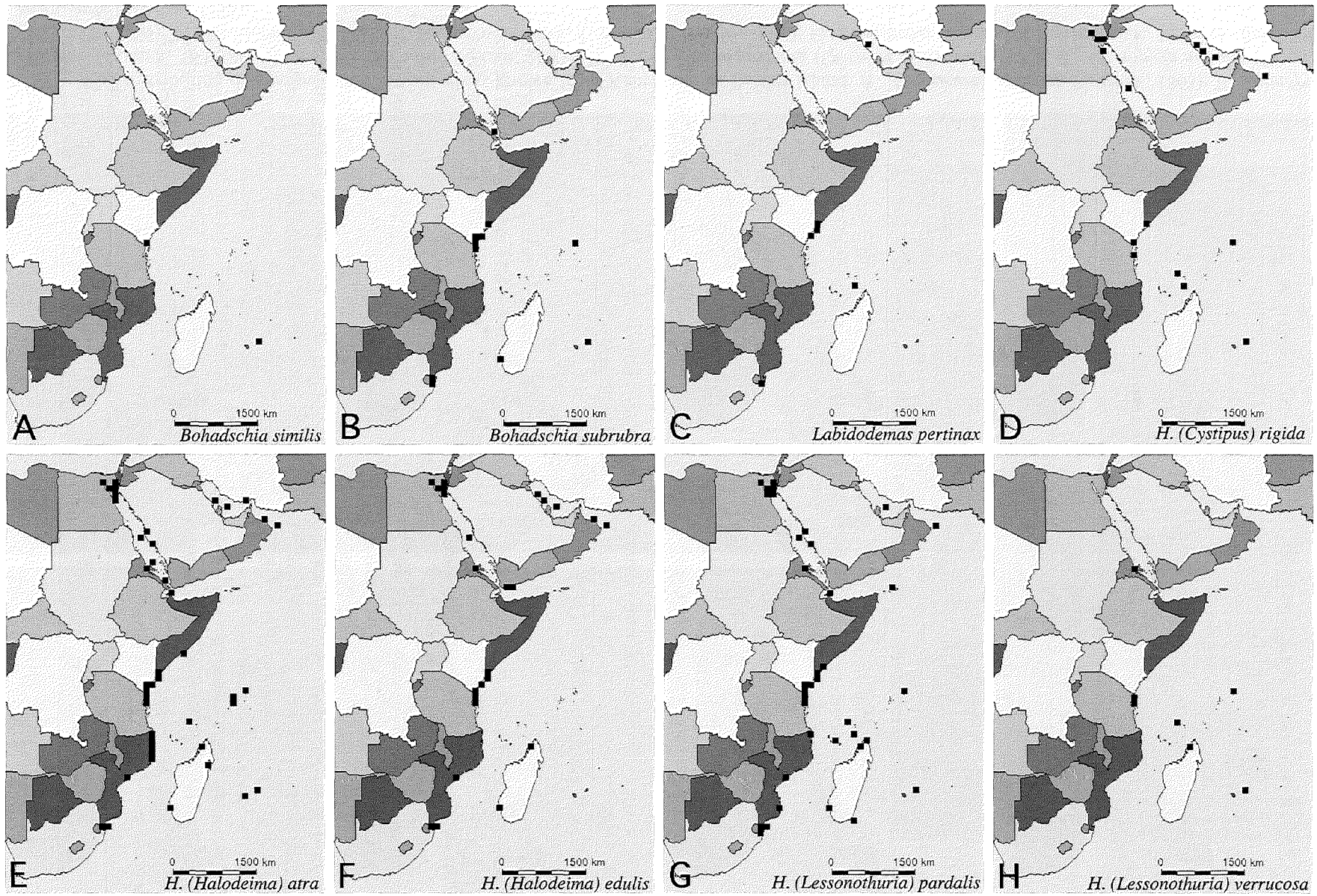


FIG. 52 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Bohadschia* cf. *similis* (SEMPER, 1868); B. *Bohadschia subrubra* (QUOY & GAIMARD, 1833); C. *Labidodemas pertinax* (LUDWIG, 1875); D. *Holothuria (Cystipus) rigida* (SELENKA, 1867); E. *Holothuria (Halodeima)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

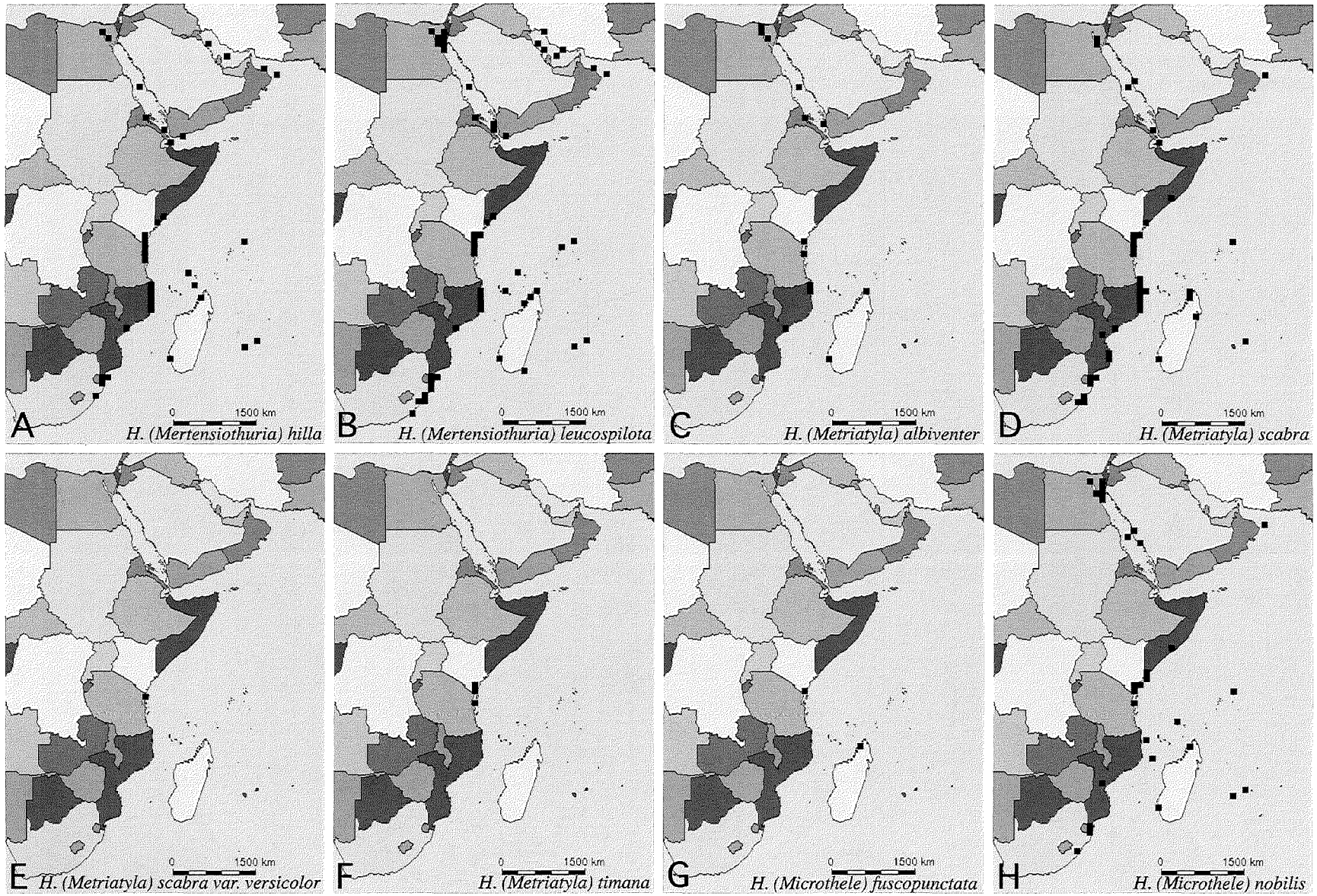


FIG. 53 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Holothuria (Mertensiothuria) hilla* LESSON, 1830; B. *Holothuria (Mertensiothuria) leucospilota* (BRANDT, 1835); C. *Holothuria (Metriatyla) albiventer* SEMPER, 1868; D. *Holothuria (Metriatyla) scabra* JAEGER, 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).

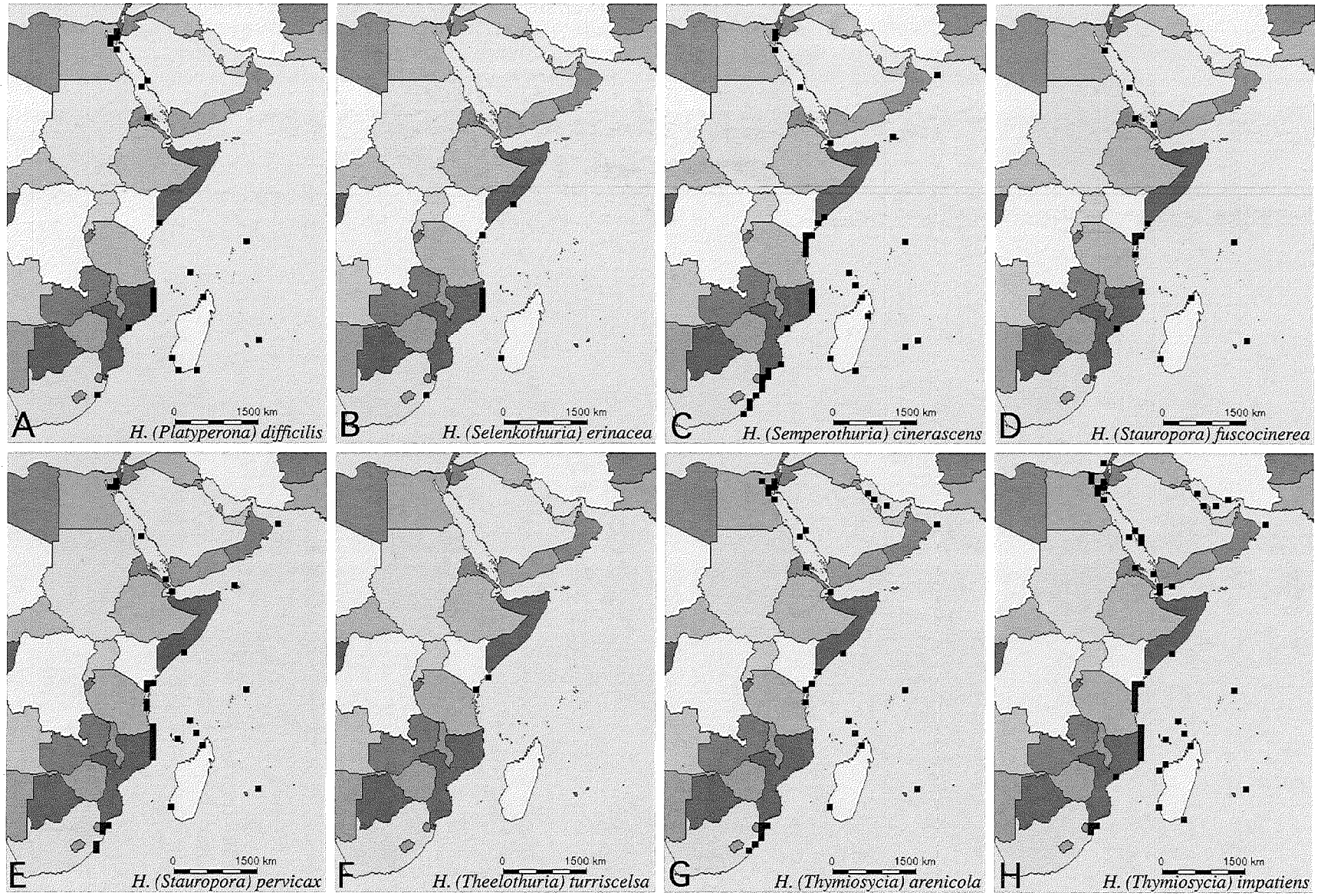


FIG. 54 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Holothuria (Platyperona) difficilis* SEMPER, 1868; B. *Holothuria (Selenkothuria) erinacea* SEMPER, 1868; C. *Holothuria (Semperothuria) cinerascens* (BRANDT, 1835); D. *Holothuria (Stauropora) fuscocinerea* 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).

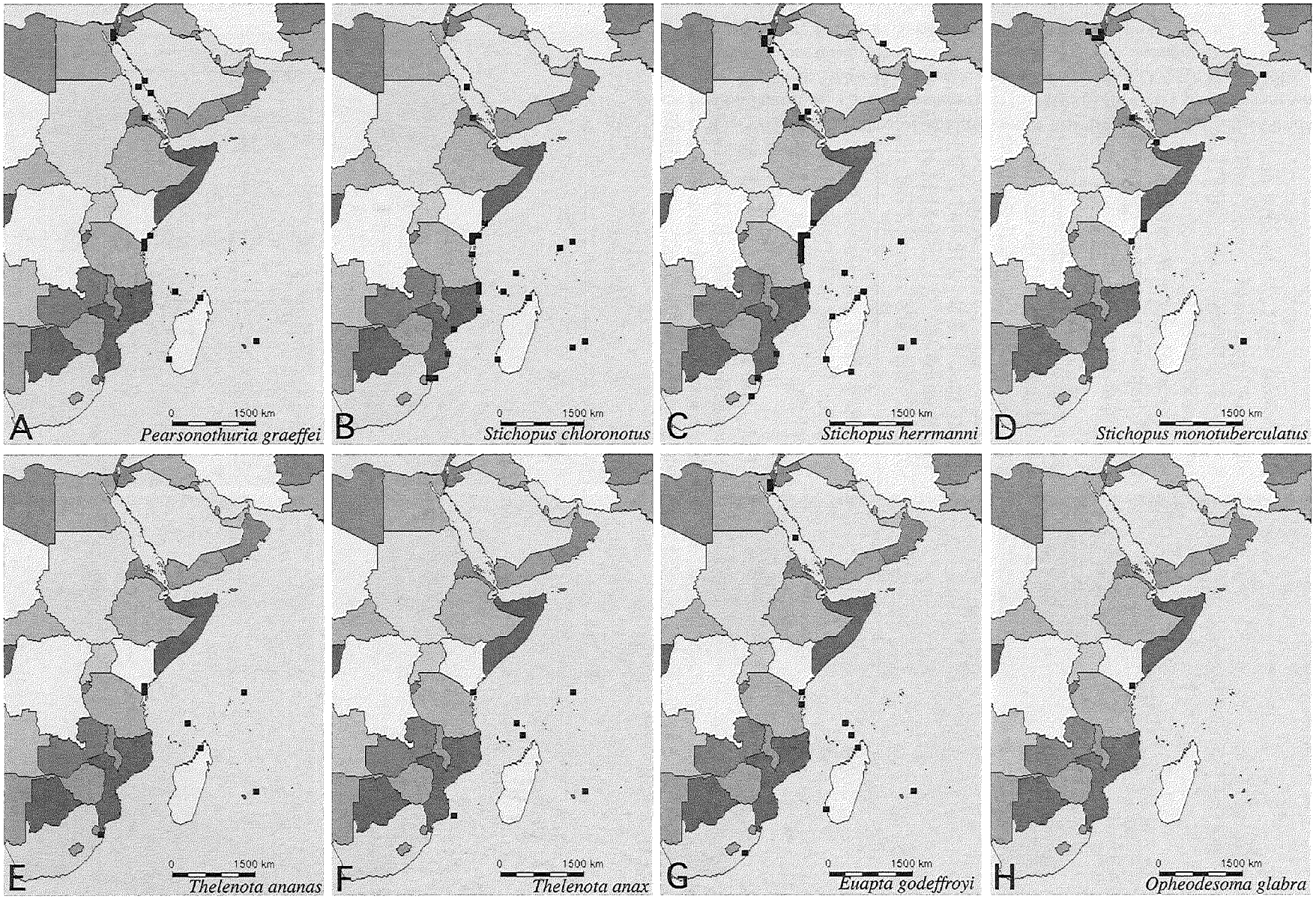


FIG. 55 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Pearsonothuria graeffei* (SEMPER, 1868); B. *Stichopus chloronotus* BRANDT, 1835; C. *Stichopus herrmanni* SEMPER, 1868; D. *Stichopus* cf. *monotuberculatus* (QUOY & GAIMARD, 1833); E. *Thelenota ananas* (JAEGER,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

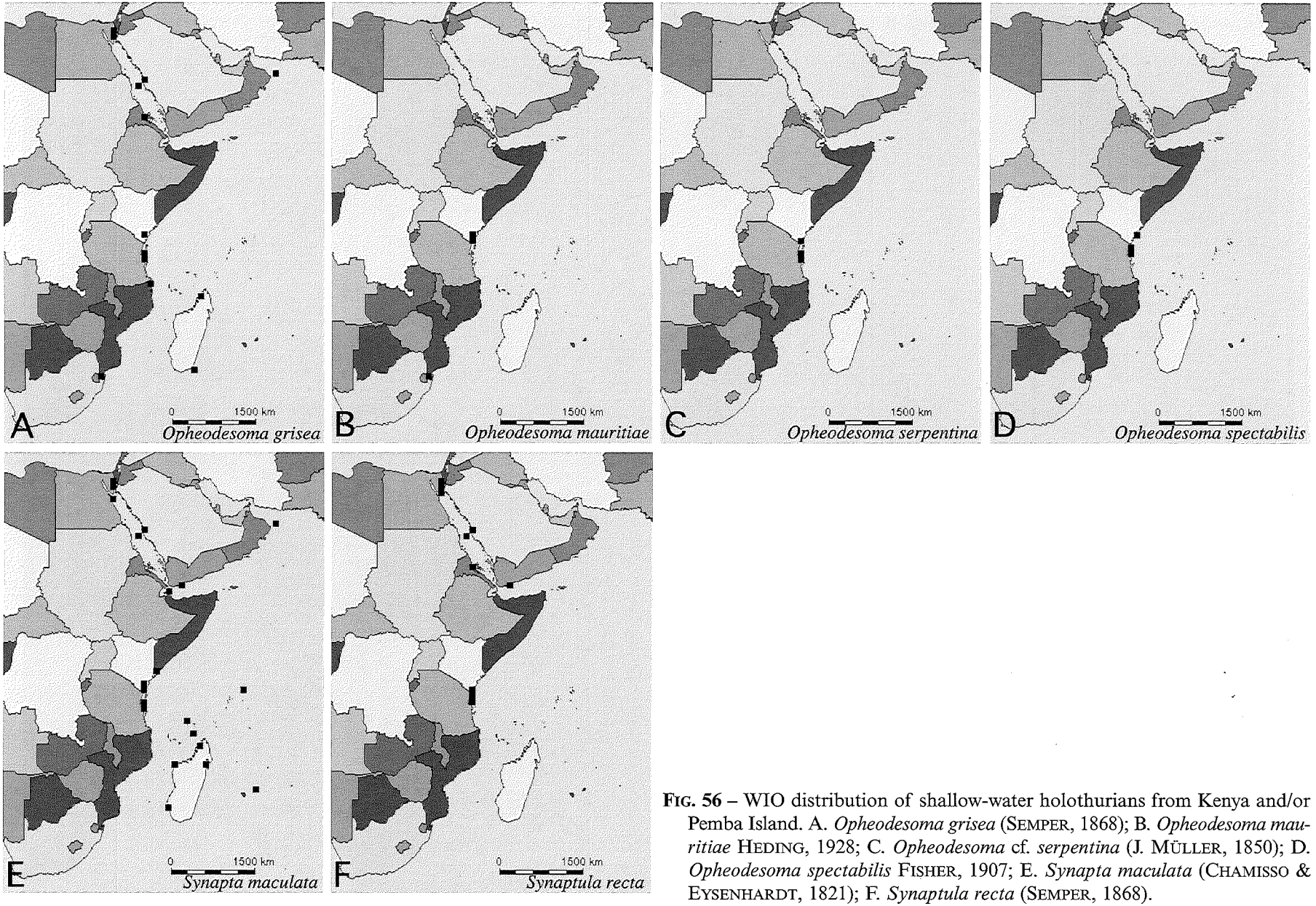


FIG. 56 – WIO distribution of shallow-water holothurians from Kenya and/or Pemba Island. A. *Opheodesoma grisea* (SEMPER, 1868); B. *Opheodesoma mauritiae* HEDING, 1928; C. *Opheodesoma* cf. *serpentina* (J. MÜLLER, 1850); D. *Opheodesoma spectabilis* FISHER, 1907; E. *Synapta maculata* (CHAMISSO & EYSENHARDT,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

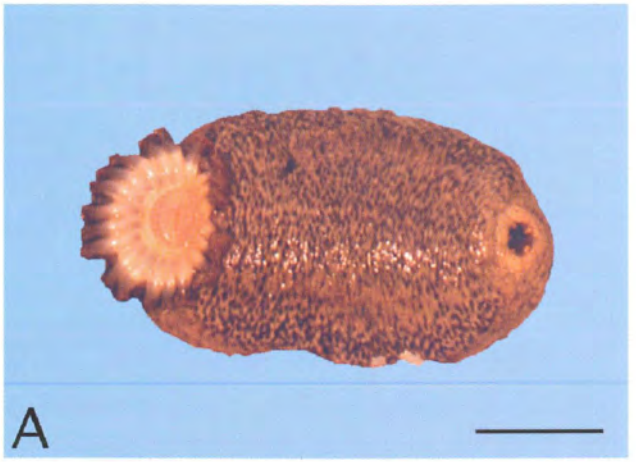
A. Dorsal view of *Holothuria (Metriatyla) scabra* JAEGER, 1833.
B. Dorsal view of *Holothuria (Metriatyla) timana* LESSON, 1830.
C. Dorsal view of *Holothuria (Microthele) fuscopunctata* JAEGER, 1833.
D. Dorsal view of *Holothuria (Microthele) nobilis* (SELENKA, 1867), inset picture shows the species *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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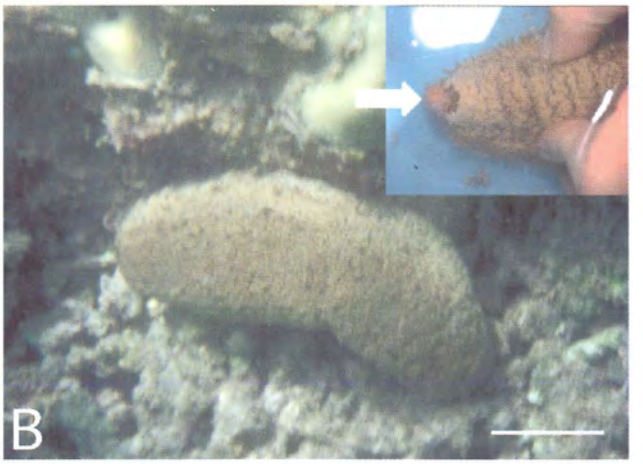
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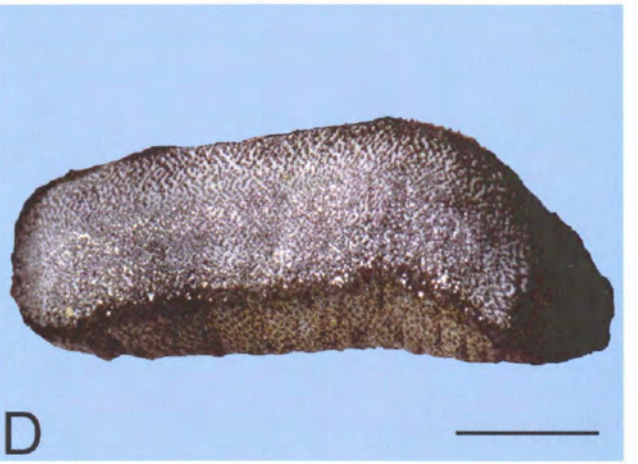
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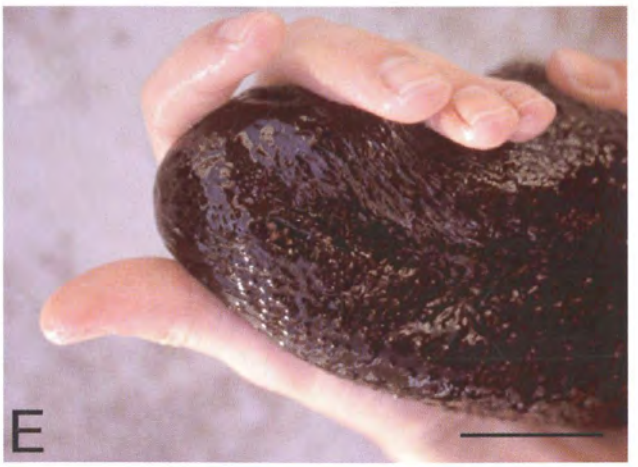
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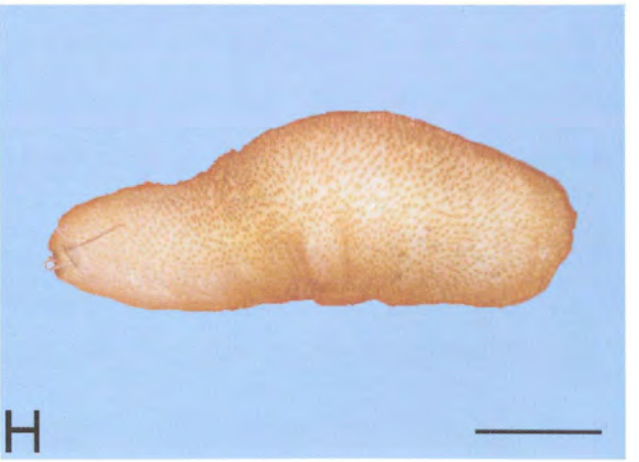
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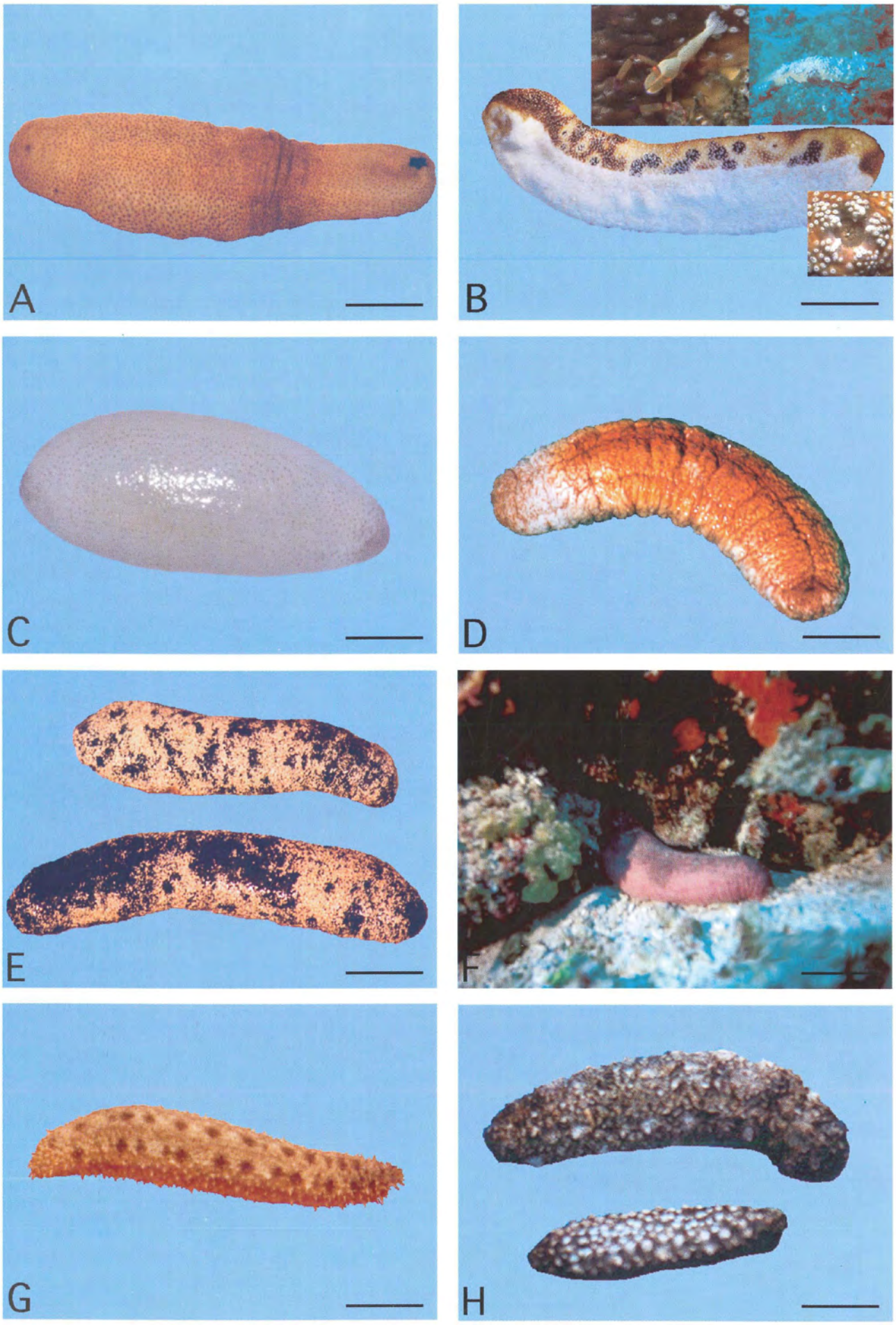
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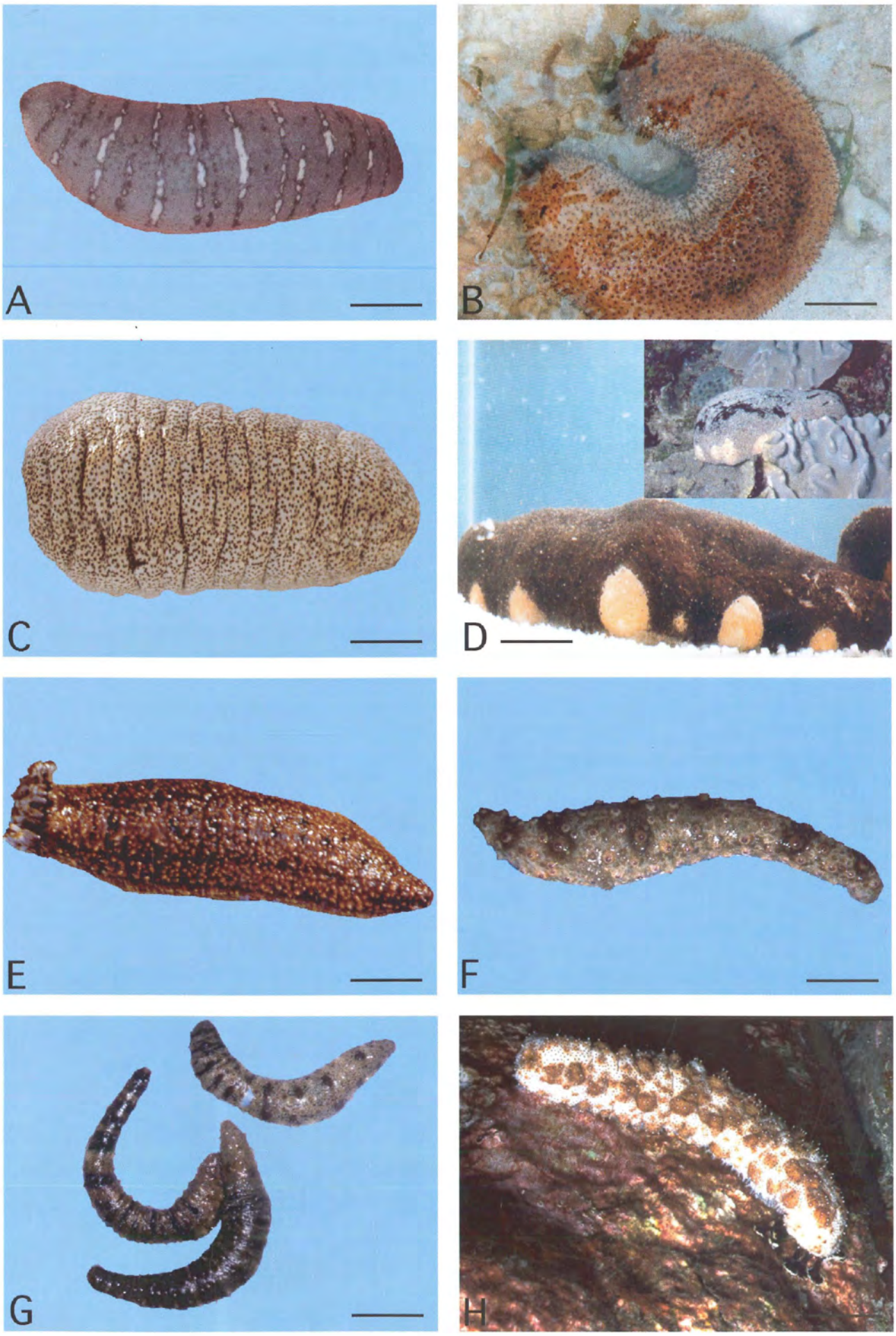
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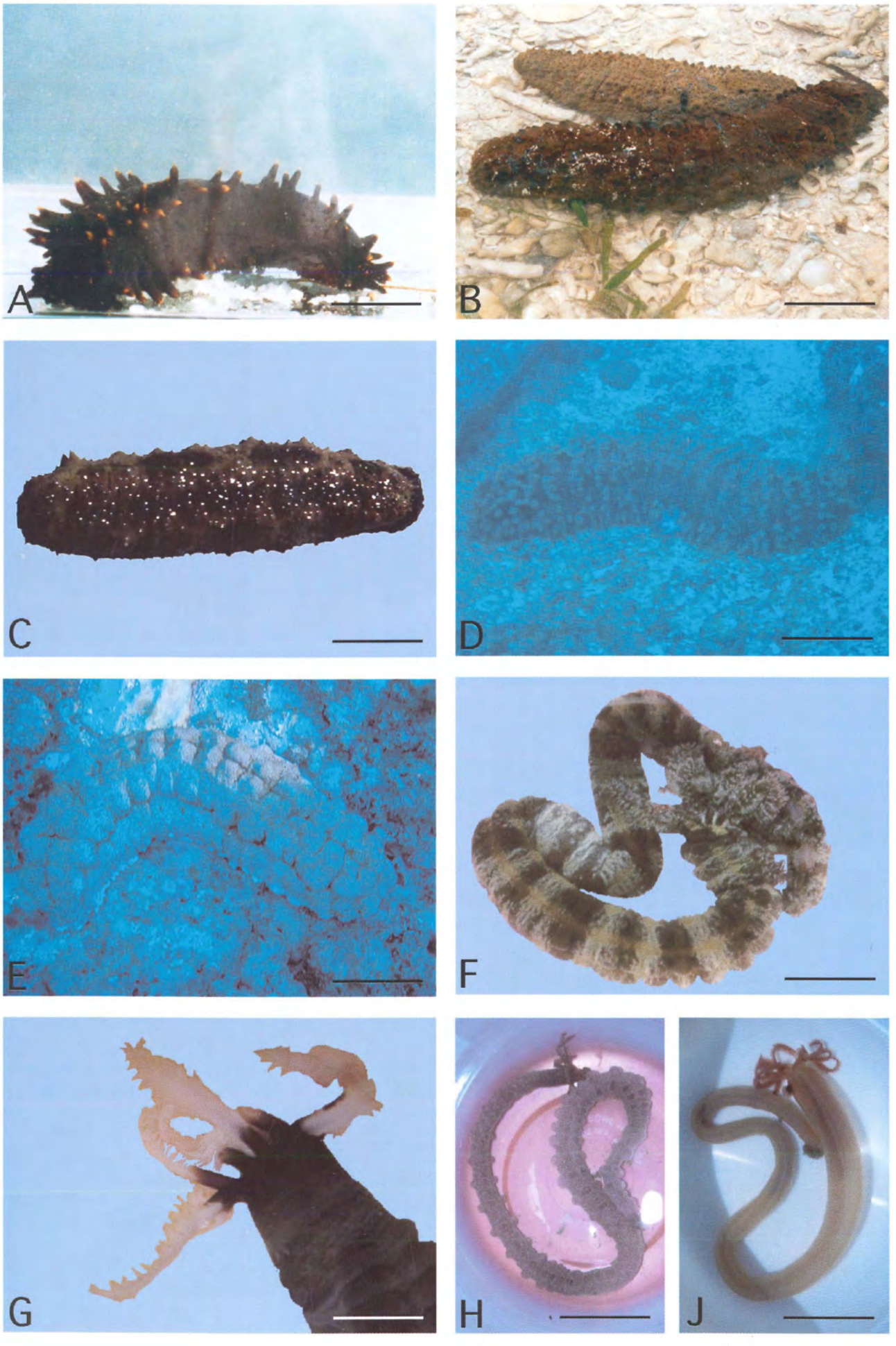
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APPENDIX

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.

C

D

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U

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

Koninklijk Museum voor Midden-Afrika
Musée royal de l'Afrique centrale

ISBN 90-75894-54-6

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