Sublittoral and bathyal sea cucumbers (Echinodermata: Holothuroidea) from the Northern Mozambique Channel with description of six new species

YVES SAMYN1,3 & DIDIER VANDEN SPIEGEL2
1Invertebrates Collections, Royal Belgian Institute of Natural Sciences, Vautierstraat 29, B-1000 Brussels, Belgium
2Department of Invertebrates, Royal Museum for Central Africa, Leuvensesteenweg 13, B-3080 Tervuren, Belgium
3Corresponding author. E-mail: yves.samyn@naturalsciences.be

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The 2009 expedition with the research vessel Miriky sampled the sublittoral and bathyal waters of the northern Mozambique Channel. This exploration campaign resulted in a small, but very diverse collection of holothuroids comprising 174 specimens representing 31 species, 18 genera, 10 families and 5 orders. Of these species, many were hitherto unknown for Madagascar or even for the Indian Ocean, and six, Orphnurgus natalasper (Cherbonnier, 1988) sp. nov., are new to science.

This contribution provides an illustrated and annotated overview of the poorly known, highly biodiverse, sublittoral and bathyal sea cucumber fauna of the northern Mozambique Channel. Our findings demonstrate how ignorant we are about the poorly explored habitats of our planet and therefore stress the urgent need for more explorations to such regions.

Key words: taxonomy, new records, new species, new combination, Madagascar

Introduction

The holothuroids of the shallow-waters of Madagascar are reasonably well known thanks to the efforts of several workers (Bell, 1984; Cherbonnier, 1970, 1988; Ludwig, 1883; Massin et al., 1999, Theel, 1886). Nearby shallow-waters have also been prospected (Clark & Rowe, 1971), some very recently. For instance, Rowe & Richmond (2004) provided an account on the littoral echinoderms of Rodrigues Island, Samyn et al. (2005, 2006) documented the sea cucumbers of the Comoros, Conand et al. (2010) did the same for the holothuroids of Reunion Island and most recently Conand et al. (2013) for the Scattered Islands of the Glorioso Archipelago in the Mozambique Channel.

The sublittoral and bathyal (50–2000 m depth) depths of Madagascar on the other hand have largely remained

This paper provides detailed descriptions of the holothuroids we recognize as new to science and gives annotated taxonomic accounts of the other species sampled by the Miriky.

**Materials and methods**

The specimens here studied were collected by Bouchet, Kantor, Puillandre and Richer from 25 June to 14 July 2009 on board of the vessel Miriky of the ‘Société des Pêcheries de Nosy Be’. Depending on the collection site, samples were collected either using a beam trawl (CP for Chalut à Perche) or a dredge (DW for Drague Warren) at depths up to 1020 m. Depth, geographical coordinates, gear and station number are given in table 1; habitat was not provided to the authors.

Map 1 shows the stations where samples were taken.

Specimens were directly fixed in 80 % ethanol which was replaced after 15 days, and again after the specimens arrived at the Muséum National d’Histoire naturelle in Paris, France (MNHN).

Material was trusted to us for study by Dr M. Eléaume and N. Améziane, curators of the echinoderm collection of the MNHN.
**TABLE 1.** Depth, geographical coordinates, gear and station number of the collection sites.

<table>
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<tr>
<th>Taxon</th>
<th>Collection date</th>
<th>Collection number</th>
<th>Station code</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Depth (in m)</th>
<th>N° of specimens</th>
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<td><strong>ASPIDOCHIROTIDA Grube, 1840</strong></td>
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<th>Longitude</th>
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<th>N° of specimens</th>
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<td>257</td>
<td>3</td>
</tr>
<tr>
<td><em>Psolidum acorbulum</em> Thandar, 2006</td>
<td>28.VI.2009</td>
<td>IE-2007-770</td>
<td>CP3201</td>
<td>12°05'S</td>
<td>48°49'E</td>
<td>930</td>
<td>1</td>
</tr>
<tr>
<td><em>ELASIPODIDA THEEL, 1881</em></td>
<td></td>
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<tr>
<td>Deimatidae Ekman, 1926</td>
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<tr>
<td><em>Orphnurgus natalasper</em> Thandar, 1992</td>
<td>27.VI.2009</td>
<td>IE-2007-820</td>
<td>CP3194</td>
<td>12°19'S</td>
<td>48°12'E</td>
<td>704</td>
<td>1</td>
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<tr>
<td><em>MOLPADIDA Haeckel, 1896</em></td>
<td></td>
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<td>Molpadidae Müller, 1850</td>
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<tr>
<td><em>Molpadiadna thandari</em> sp.nov.</td>
<td>14.VII.2009</td>
<td>IE-2007-806</td>
<td>CP3289</td>
<td>14°29'S</td>
<td>47°26'E</td>
<td>379</td>
<td>1</td>
</tr>
<tr>
<td><em>Molpadiadna thandari</em> sp.nov.</td>
<td>14.VII.2009</td>
<td>IE-2007-759</td>
<td>CP3289</td>
<td>14°29'S</td>
<td>47°26'E</td>
<td>379</td>
<td>1</td>
</tr>
</tbody>
</table>
Ossicles were removed from various tissues in household bleach and were observed with light and scanning electron microscopy (Samyn et al. 2006; 2007). For light microscopy, no permanent slides were made. For SEM, samples were dried and mounted on aluminium stubs, coated with gold in a sputter coater, and observed with a JEOL JSM-5400LV.

Studied specimens have been divided between the collections of the MNHN, the Royal Museum for Central Africa (MRAC) and the Royal Belgian Institute of Natural Sciences (RBINS). The scanning electron microscopy stubs with ossicles have been deposited in the collection of the MRAC.

Species new to science are described and illustrated. Other species are provided with a comprehensive synonymy (or reference to such), illustrations, remarks on their taxonomy, and their geographical and bathymetric distribution.

Results

Table 1 lists the collected specimens together with their original collection numbers, collection dates, collection depths and locality information.

Systematic account

Order Aspidochirotida Grube, 1840

Family Holothuriidae Ludwig, 1894

Genus Bohadschia Jaeger, 1833

Bohadschia cousteauí Cherbonnier, 1954

(Fig. 1 A–B)


![Figure 1](image)

**Figure 1.** Bohadschia cousteauí Cherbonnier, 1954. A–B: SEM photos of ossicles from ventral (A) and dorsal (B) body wall. Scale bars: 20µm.

Material examined. Non-type material: IE 2007-816 (1 specimen, collected near Cape Saint-Sébastien).

Remarks. B. cousteauí was previously known only from very shallow waters 0–9 m (Samyn et al. 2006). The present dark brown specimen was sampled at 60 m depth. It had a small Carapus mourlani (Petit, 1934) pearlfish entangled in its dirty white to light brown Cuvierian tubules.
Genus *Holothuria* Linnaeus, 1767

Subgenus *Cystipus* Haacke, 1880

*Holothuria (Cystipus) yann* Samyn sp. nov.  
(Fig. 2 A–H)

**Material examined.** *Type material: IE2007-764* (holotype & 2 paratypes, collected in front of Mahajamba Bay)  
**Comparative type material.** *EchH 3550* (holotype of *Holothuria (Cystipus) mammosa* Cherbonnier, 1988; Nossi-Bé, Ambaro Bay, Madagascar, coll. Crosnier, 4.XII.1964, 24 m depth).  
**Type locality.** Madagascar, in front of Mahajamba Bay, Station CP3282 (Decimal coordinates: -14.87; 46.97).  
**Etymology.** This species is named after Yann Samyn, twin-daughter of Reen Tallon and Yves Samyn, in recognition of her patience when her dad is writing up some taxonomic work at home. The species epithet has been put in apposition.  
**Known geographical distribution.** For now only known from the type locality.  

**Taxonomic description (holotype and paratypes).**

*External anatomy*—Holotype 110 mm long and 20–50 mm wide, with maximum circumference of 120 mm. First paratype 100 mm long and 15–40 mm wide, with maximum circumference of 115 mm. Second paratype 112 mm long and 20–30 mm wide with maximum circumference of 85 mm (fig. 2A,B). Body tapering towards both ends, but especially posteriorly. Body wall heavily wrinkled, both dorsally and ventrally. Very gritty to the touch. Bivium convex, high. Trivium flat. Bivium separated from trivium by regular row of small lateral papillae. Mouth ventral, surrounded by collar of small papillae which are very reduced ventrally. Number of tentacles in holotype and paratypes could not be counted due to contraction. Anus subdorsal, narrow, not surrounded by papillae. Color in alcohol: bivium beige, marked with parallel irregular brown lines that become thicker mid-dorsally; trivium beige, also marked with irregular brown lines. Ventral tube feet very scarce, only some in ambulacral areas, posteriorly in two uneven rows. Dorsal podia slightly more numerous and spread over complete surface. Podia and lateral papillae white.

*Internal anatomy* (paratypes, holotype not dissected)—Calcereous ring with interradial pieces nearly as wide and slightly less long than radial ones; radial pieces with anterior notch, interradial ones slightly convex posteriorly. Stone canal not observed, Polian vesicle single, 20–25 mm long. Tentacle ampullae small; 8–10 mm long, 12 counted. Gonad not observed. Gut filled with fine muddy sediment. Right respiratory tree well developed reaching oral end of body; left respiratory tree poorly developed going up to mid body. Longitudinal muscles, bifid and flat, 6 mm wide, edges attached. Cuvierian tubules present, extremely thick and positioned in a contracted ball like structure.  

**Ossicles**—Tentacles with spinose rods up to 250 µm long (fig. 2C), ventral and dorsal body wall with similar tables and buttons (fig. 2D,E). Tables numerous, rim of disc undulating to spiny, disc knobbed at edge, up to 100 µm across, perforated by four central and up to 16 small peripheral holes, pillars short (30–45µm high), with 0–1 cross beams, smooth and ending in a spiny crown. Buttons very numerous, nodulous centrally and at rim, 40 to 110 µm long, generally 3 to 4 pairs of holes, but with up to 7 pairs of holes in those from ventral body wall; holes relatively small and often obscured by numerous knobs; few buttons modified into fenestrated ellipsoids (fig 2D,E). Dorsal tube feet, ventral tube feet and lateral papillae with elongated plates up to 180 µm in addition to tables and buttons that are similar to those of body wall (figs 2F–H). Longitudinal and suspensor muscles of cloaca, cloaca, gonad and respiratory trees devoid of ossicles.

**Remarks.** The ossicle assemblage, with tables with heavily knobbed disc and low spire and with buttons which are irregularly knobbed and which have narrow, sometimes nearly obliterated holes, places this species in the *Holothuria* subgenus *Cystipus* Haacke, 1880. In *Cystipus* twelve species are currently recognized (Laguerda-Figuera & Solis-Marin 2009). *H. (C.) yann* can easily be distinguished from the other species in *Cystipus* by its coloration pattern. Its ossicles resemble those of *H. (C.) mammosa* Cherbonnier, 1988, (Fig. 2) but *H. yann* can easily be differentiated from *H. mammosa* because the cloaca of the latter holds perforated rods (new observation by authors) whereas *H. yann* has no ossicles in the cloaca. Moreover, *H. mammosa* is characterized by having large conical papillae over the complete body wall whereas *H. yann* only has reduced lateral papillae. *H. mammosa*, known only from the holotype, was collected at 24 m depth, whereas the three known specimens of *H. yann* were collected at 261 m depth, making it the deepest *Cystipus* species ever collected.
FIGURE 2. Holothuria (Cystipus) yann sp. nov. A–B. Dorsal view (A) and ventral view (B) of paratypes. C–G: SEM photos of ossicles from tentacles (C), dorsal (D) and ventral (E) body wall, dorsal tube feet (F), lateral papillae (G) and ventral tube feet. A,B = 1 cm; C = 50 µm; D–H = 20 µm.
Subgenus *Metriatyla* Rowe, 1969

*Holothuria (Metriatyla) alex* Samyn sp.nov.

(Fig. 4 A–F)

Material examined. **Type material:** IE-2007-779 (holotype, sampled in front Mahajamba Bay)

**Comparative material examined.** ZMB Ech 1681 (holotype of *Holothuria (Metriatyla) martensii*; Semper, 1868 (Fig. 5); Ambon, Indonesia, leg. V. Martens, unknown depth); MNHN EchHh 3894 (*Holothuria (Metriatyla) horrida* Massin, 1987, erroneously identified as *H. martensii* Semper, 1868, Tuléar, Mahavatsy, Madagascar, coll. Thomassin, 15.IX.1962, unknown depth); MNHN EchHh 3906 (*Holothuria (Metriatyla) horrida* Massin, 1997, erroneously identified as *H. martensii* Semper, 1868, Tuléar, devant labo, st. 450, Madagascar, coll. Thomassin, 23.IX.1962, unknown depth); MNHN EchHh 7030 (*Bohadschia vitiensis* (Semper, 1868), erroneously identified as *H. martensii* Semper, 1868, Antsirane, Madagascar, coll. Decary, 1919, unknown depth).

**Type locality.** Madagascar, Mahajamba Bay, Station CP 3218 (Decimal coordinates: -14.97; 46.94)

**Etymology.** This very handsome species is named after Alex Samyn, first daughter of Reen Tallon and Yves Samyn, in recognition of her support, when her dad is writing up his taxonomic work at home. The species epithet has been put in apposition.

**Known geographical distribution.** For now only known from the type locality.

**Taxonomic description (holotype).** *External anatomy*—55 mm long and 24 mm wide at mid body, tapering acutely posteriorly. Trivium flat, separated from more convex bivium by fringe of well-developed lateral papillae (fig. 4A,B). Mouth ventral, surrounded by collar of reduced papillae, especially ventrally. Number of tentacles could not be determined due to contraction. Anus terminal, unguarded by papillae. Color in alcohol: bivium dark beige with some darker spots forming more or less two transversal lines with beige, evenly spread, papillae; trivium brown, with evenly scattered beige tube feet.

*Internal anatomy:* specimen partly eviscerated, leaving only part of the gut, the right respiratory tree and the oral structures. Calcareous ring narrow. Single short stone canal, 4 mm long, ending in spherical madreporite. Polian vesicles not observed. Gonad not observed. Gut filled with very fine mud. Longitudinal muscles very flat, bifid, only 3 mm wide. Cuvierian tubules not observed.
FIGURE 4. *Holothuria (Metriatyla) alex* sp. nov. A–B: Dorsal (A) and ventral (B) views of holotype; C–F: SEM photos of ossicles from tentacles (C), dorsal body wall (D), lateral papillae (E) and dorsal papillae (F). Scale bars: A,B = 1cm; C,E,F = 20µm; D = 10µm.
Ossicles: Tentacles with spiny rods, occasionally with some perforations, 110–480 µm long (fig. 4C). Ventral and dorsal body wall with tables, buttons and few fenestrated ellipsoids. Tables with disc on average 60 µm across, perforated by irregularly distributed central holes and 14 to 16 peripheral holes, rim of the disc undulating, edge smooth to spiny, spire low (1–2 cross beams) with four pillars (30–38µm high) ending in simple spiny crown (fig. 4D). Buttons very wide (31–48 µm wide and µm 50–68 long), smooth to knobbed with a central bridge (fig. 4D). Dorsal papillae with tables, plates and numerous ellipsoids (36–50µm wide, 45–53µm long); plates flat or tri-dimensional (123–185µm long,), tables similar to those of the body wall with a few tables with a higher spire (43–72µm, up to five cross beams, fig. 4F). Lateral papillae with numerous fenestrated ellipsoids in addition to plates and tables similar to those of the dorsal papillae (fig. 4E). Longitudinal muscles and cloaca devoid of ossicles.

Remarks. It is with some doubt that we assigned this species to the subgenus *Metriatyla* as its ossicle assemblage does not completely fit with the diagnosis of the subgenus. *H. alex* sp. nov. differs from the other species in *Metriatyla* in having tables with discs that, when the spire is low, are turned upwards and are nodulous. *H. alex* also presents fenestrated ellipsoids, whereas no other species in *Metriatyla* does so.

In terms of external morphology *H. (M.) alex* sp. nov. is close to *H. (M.) kurti* Ludwig, 1891 (see below for description). *H. alex* can however easily be separated from that species because it lacks the ‘spatulate’ tables that characterize *H. kurti* (cf fig. 7C) and because of its very characteristic ellipsoids (fig. 4 E,F) and wide buttons (fig. 4D) which are absent in *H. kurti*.

At a first glance one could also think that *H. alex* sp. nov. is just a juvenile form of the species described as *H. ocellata* (Jaeger, 1833) by Teo & Ng (2009). However, the coloration pattern (papillae surrounded by a dark ring in *H. ocellata* (sensu Teo & Ng 2009) which is not the case in *H. alex*), the form of the lateral rim of papillae (fused papillae in *H. ocellata* (sensu Teo & Ng 2009), not so in *H. alex*), and especially the ossicle assemblage (tack-like tables present in *H. ocellata* (sensu Teo & Ng, 2009), absent in *H. alex*) is significantly different.

*H. alex* sp. nov. also resembles *H. martensii* Semper, 1868 in presenting tables with reduced disc and with tall, smooth spires. We studied the ossicle assemblage of the holotype of *H. martensii* (fig. 5) and of three specimens from Madagascar which Cherbonnier (1988) identified as *H. martensii*. We came to the conclusion that *H. alex* is markedly different because it presents fenestrated spheres, tables with an upward turned disc and wide buttons. Of the three specimens Cherbonnier (1988) identified as *H. martensii*, one turned out to be *Bohadschia vitiensis* (Semper, 1868) and two *Holothuria (Metriatyla) horrida* Massin, 1987.

**Holothuria (Metriatyla) cyrielle** VandenSpiegel sp. nov.

(Fig. 6 A–G)

**Material examined.** *Type material:* IE-2007-752 (holotype and 1 paratype, sampled in front of Nazendry Bay)

Comparative material examined: ZMB Ech 1681 (holotype of *Holothuria (Metriatyla) martensii* Semper, 1868 (Fig. 5); Ambon, Indonesia; leg. V. Martens; unknown depth).

*Non-type material:* IE-2007-753 (1 specimen, dredged between Majunga and Cape Saint-André); IE-2007-810 (1 specimen, dredged between Nosy-Bé and Banc du Leven).

*Type locality.* Madagascar, in front of Nazendry Bay, Miriky St. CP3240 (Decimal coordinates: -14.5; 47.45)
FIGURE 6. Holothuria (Metriatyla) cyrielle sp. nov. A–B: dorsal (A) and ventral (B) views of holotype; C–G: SEM photos of ossicles from tentacles (C), dorsal body wall (D), ventral body wall (E), dorsal tube feet (F) and ventral tube feet (G). Scale bars: A,B = 1 cm; C = 100 µm; E–G = 20 µm.

Etymology. This species is named after Cyrielle VandenSpiegel, daughter of Joelle Dellis and D. VandenSpiegel, in recognition of her patience when her dad is writing up some taxonomic work at home. The species epithet has been put in apposition.

Known geographical distribution. Known from the type locality (Nazendry Bay), between Majunga & Cape Saint-André and between Nosy Be and ‘Banc du Leven’

Taxonomic description (holotype and paratype). External anatomy - Holotype 190 mm long and 30–60 mm wide, with maximum circumference of 170 mm. Paratype 210 mm long and 30–45 mm wide, with maximum
circumference at mid-body of 120 mm (fig. 6A,B). Body tapering towards both ends. Body wall heavily wrinkled, especially ventrally; very gritty to the touch. Bivium convex. Trivium flat. Bivium separated from trivium by irregular row of enlarged lateral papillae. Mouth ventral, surrounded by 18 small tentacles in paratype (number could not be determined in holotype). Anus terminal, 4 (holotype) to 13 (paratype) mm wide, surrounded by some ten evenly spaced papillae. Color in alcohol: bivium brownish, with scattered, evenly spread, short papillae, each separated by narrow dark brown ring. Trivium lighter brown, covered by small and few, evenly spread, tube feet; no darker ring surrounds ventral tube feet.

**Internal anatomy**—Calcereous ring with stout radial and interradial pieces; interradials slightly wider and longer than interradial ones; radial pieces with deep anterior and posterior notch; interradial pieces with prominent anterior tooth and convex posterior margin. Stone canal single, straight, 30 mm long in holotype, ending in a well developed madreporite, 12 mm long in holotype. Polian vesicle single, club-shaped, 30 mm long in holotype, 35 mm long in paratype. Radial canal positioned nearly 1 cm below calcereous ring. Tentacle ampullae small, 5–8 mm long. Gonad well developed, in single tuft with long tubes that bifurcate only occasionally. Gut filled with fine muddy sediment. Respiratory trees well developed, with left one reaching mid-body while right one goes up to oral end. Longitudinal muscles bifid, flat and wide (10 mm in paratype, 15 mm in holotype) with edges attached to body wall. Inner side body wall brownish, irregularly marked by by purplish-brown spots. Cloaca 35 mm long in paratype, 45 mm long in holotype. Cuvierian tubules present, very thick.

**Ossicles**—Tentacles with curved, occasionally branching, slightly rugose rods, 110–480 µm long (fig. 6C). Ventral and dorsal body wall with nodose buttons and tables (fig. 6D,E). Tables disc 50–70 µm across, perforated by central holes and numerous small peripheral holes, positioned in a ring; rim of disc undulating to spiny, spire with four short smooth to spiny pillars (70–74µm high), united by one or more cross beams and ending in a spiny crown. Buttons moderately to very nodulose, 43–90 µm long, perforated by 3 to 7 pairs of holes, holes larger in the dorsal buttons (fig. 6D,E). Ventral tube feet with perforated rods, 110–300 µm long, and plates, 100–208 µm long, in addition to tables and buttons similar to the ones in the body wall (fig. 6G). Dorsal tube feet with massive plates (up to 265µm long and 90µm wide) in addition to buttons and tables similar to the ones from the dorsal body wall (fig. 6F), rods absent. Longitudinal and cloacal suspensor muscles, gonad and cloaca devoid of ossicles.

**Remarks**. The tables in the body wall of *Holothuria (Metriatyla) cyrielle* sp. nov. have a rugose spire and one to several cross-beams. They resemble those in the original description of *Holothuria (Metriatyla) martensii* Semper, 1868 (See Semper 1868: pl 30, fig 16 a&b). We have examined the holotype of *H. martensii* which we located in the Zoological Museum of Berlin and come to the conclusion that they are different species because *H. martensii* also has tables with smooth tall spires in the body wall, as noted by Théel (1886), Panning (1934) and Liao (1997), and buttons which are less nodulous.

Thandar (pers. comm.) found a specimen of the KwaZulu-Natal Coast in South Africa, at depth of approximately 100 m, that is very close, if not identical, to the species we here recognize.

*H. cyrielle* sp. nov. has a bathymetric range from 257–580 m (100–580 m if Thandar’s (pers. comm.) record proves indeed the same species), which makes it the deepest species in *Metriatyla* ever recorded. It is also interesting to note that *H. cyrielle* confirms that *Holothuria* species with Cuvierian tubules can reach bathyal depths as reported by O’Loughlin et al. (2009) for *H. (Panningothuria) austrinabassa* O’Loughlin, 2007, which is known to occur at 800 m depth.

**Holothuria (Metriatyla) kurti** Ludwig, 1891

(Fig. 7 A–C)

*Holothuria kurti* Ludwig, 1891 [1889–92]: 329; Sluiter, 1901: 27, pl. VI, figs 1a–d Pearson, 1903: 200, pl. 3, figs 42–45; Koechner & Vaney, 1908: 9; Cherbonnier, 1963: 6, 8, fig. 2h.

*Holothuria (Holothuria) kurti*; Panning, 1935: 98, fig. 89a–h.


*Holothuria (Metriatyla) ocellata* (Jaeger,1833); Liao, 1979: 118, fig. 5; Liao, 1997: 135, fig. 78, 305 (description in key) (non *H. ocellata*).

**Material examined.** Non-type material: **IE-2007-768** (1 specimen, collected in front of Nazendry Bay); **IE-2007-790** (4 specimens, collected North of Cape Saint André).
**FIGURE 7.** *Holothuria (Metriatyla) kurti* Ludwig, 1891. A–B: Lateral (A) and dorsal (B) views of specimen IE-2007-768. C: SEM photos of ossicles from the lateral papillae. Scale bars: A,B = 1cm; C = 20µm.

**Remarks.** *H. kurti* is the replacement name that Ludwig (1889–92) proposed for *H. lamperti* Sluiter, 1890, junior homonym of *H. lamperti* Ludwig, 1887.

Liao (1979) suggested that *H. kurti* might be a juvenile form of *H. ocellata* (Jaeger, 1833) (sensu Théel 1886). We do not agree with this point of view because: (i) *H. ocellata* (sensu Théel 1886), as aptly re-described by Teo & Ng (2009), does not present the synallactid-like tables that are characteristic of *H. kurti* (fig. 7C) and (ii) *H. ocellata* (sensu Théel 1886) has few, huge tack-like tables in the papillae (Teo & Ng 2009) whereas *H. kurti* has only tables with a medium high spire ending in a narrow crown, but no true tack-like tables (fig. 7C). Also we can refute the claim that the spatulid tables of *H. kurti* are a juvenile character, because the largest specimen we have under study, 7,3 cm long, possesses gonads and hence is not a juvenile (fig.7 A, B).

1. We have examined the holotype of *Bohadschia ocellata* Jaeger, 1833 and, after discussion with colleagues (Kerr & Paulay, pers. comm), come to the conclusion that this is a valid *Bohadschia* species. Théel’s (1886) transition to the genus *Holothuria* was clearly unjustified.
Because *H. kurti* lacks tack-like tables and does not have a calcareous ring with radial plates with posterior extensions, we propose to put *H. kurti* in the subgenus *Metriatyla* and not *Theelothuria* Deichmann, 1958 as suggested by Rowe (1969) and Liao (1979, 1997).

The present specimens, sampled between 50 and 54 m, are new records for Madagascar.

Subgenus *Stauropora* Rowe, 1969

*Holothuria (Stauropora) bo* Samyn sp. nov.

(Fig. 8 A–F)

**Material examined.** Type material: IE-2007-791 (holotype, collected between Nosy-Bé and Banc du Leven)

**Type locality.** Madagascar, between Nosy-Bé and Banc du Leven, Station DW3211 (Decimal coordinates: -12.53; 47.87).

**Etymology.** This species is named after Bo Samyn, twin-daughter of Reen Tallon and Yves Samyn, in recognition of her patience, when her dad is writing up some taxonomic work at home. The species epithet has been put in apposition.

**Known geographical distribution.** For now only known from the type locality.

**Taxonomic description (holotype).** External anatomy — 117 mm long and 15–30 mm wide, with maximum circumference of 65 mm at mid-body (fig. 8A). Body tapering towards anterior and posterior ends. Body wall smooth, slightly wrinkled and somewhat gritty to the touch. Bivium convex, low. Trivium flat. Mouth ventral, not surrounded by a collar of papillae. Tentacles, 20. Anus terminal, wide, not surrounded by papillae. Color in alcohol: bivium grey, with white patches and some irregular brownish markings; trivium also grey with irregular white central area (artefact of preservation?). Ventral and dorsal tube feet very scarce, their distribution cannot be determined due to contraction.

**Internal anatomy.** - Calcareous ring with interradial pieces as wide and half as long as radial ones. Radial pieces with anterior and posterior notch. Interradial pieces with straight posterior margin. Stone canal not observed, Polian vesicle single, 25 mm long, very narrow. Tentacle ampullae short: ±5 mm long. Gonad not observed. Gut filled with fine muddy sediment. Right respiratory tree well developed reaching anterior end of body; left respiratory tree poorly developed. Longitudinal muscles, bifid and flat, 7 mm wide, edges attached to body wall. Numerous, well developed whitish Cuvierian tubules present.

**Ossicles.** - Tentacles with spiny rods, occasionally with some perforations, 110–480 µm long (fig. 8B). Ventral and dorsal body wall with similar tables and buttons and pseudobuttons. Tables with rim of disc slightly undulating and slightly nodulous, 30 up to 70 µm across, perforated by a single cruciform hole and up to 12 small peripheral holes, three to five pillars, zero to two cross beam terminating in a small crown of four to eight spines; deformed tables with reduced spire or deformed disc are predominant in the ventral body wall (fig. 8B,C). Buttons very irregular in outline, some reduced to a central bar with lateral extensions, perforated by two to six uneven holes, 40 to 50 µm long (fig. 8B,C). Ventral tube feet with plates (68–100 µm long), rods (180–269 µm long) curved and perforated at the extremities and irregular tables similar to those of the body wall (fig. 8D). Dorsal tube feet with plates slightly larger than the ones occurring in the ventral tube feet and a few deformed tables similar to the one occurring in the body wall (fig. 8F). Longitudinal and cloacal suspensor muscles, gonad and cloaca devoid of ossicles.

**Remarks.** At first we were inclined to classify *Holothuria bo* sp. nov. in the subgenus *Lessonothuria* given the shape of the rods of the tube feet (fig. 8C). However, the tables with their central cruciform hole and one or more smaller holes alternating with each arm of the central cross, an upward turned disc and a spire that often is reduced, in combination with the very variable and/or reduced buttons suggest *Stauropora* (Rowe, 1969). This was confirmed by the COI sequence that clearly positioned *H. bo* in the *Stauropora* clade (Michonneau, pers. comm.).
FIGURE 8. Holothuria (Stauropora) bo sp. nov. A: Ventral and dorsal views of holotype; B–E: Ossicles from dorsal body wall (B), ventral body wall (C), ventral tube feet (D) from tentacles (E), and dorsal tube feet (F). Scale bars: A = 1 cm, B–D = 10 µm, E = 50 µm, F = 20 µm.
**Subgenus Thymiosycia Pearson, 1914**

*Holothuria (Thymiosycia) impatiens* (Forsskål, 1775)
(Fig. 9 A–B)

*Fistularia impatiens* Forsskål, 1775: 121, pl.39B; Lamarck, 1816: 76.
*Treapang impatiens*; Jaeger, 1833: 25.
*Sporadipus impatiens*; Grube, 1840 : 36; Aranda y Millan, 1908 : 250.
*Holothuria (Camerosoma) impatiens*; Brandt, 1835: 53.
*Holothuria (Holothuria) impatiens*; Panning, 1935: 86, fig. 72 (synonymy and records before 1935); Tortonese, 1935: 261;
Domantay, 1936: 358, pl. 7, fig. 83, pl. 6, fig. 65; Zavodnik, 1998: 641.
*Holothuria (Thymiosycia) impatiens*; Rowe & Gates, 1995: 303 (synonymy); Massin, 1999: 57, figs 45 & 111e (records before 1999).

**Material examined.** Non-type material: IE-2007-812 (1 specimen, sampled West of Nosy-Bé)

**Remarks.** This single specimen accords with H. L. Clark’s (1921: 179, pl. 19, fig. 5) ‘typical’ colour morph of *Holothuria (Thymiosycia) impatiens*. *H. impatiens* is known to be a complicated species complex (Clark, 1921; Michonneau, 2015), but until formal species are established or synonymised names are re-validated we follow the ‘sweeping’ synonymy of Panning (1935) and Rowe & Gates (1995). However, we agree with Cherbonnier (1974) to treat *Holothuria truncata* Lampert, 1885 as a valid species, and not as a junior subjective synonym of *H. impatiens* as suggested by Rowe (in Rowe & Gates, 1995).

According to Lane *et al.* (2000), *H. impatiens* is found between 0 and 30 m depth. The present record was sampled at 158 m and thus the bathymetric range of the *H. impatiens* complex is much larger than previously thought.

**FIGURE 9.** *Holothuria (Thymiosycia) impatiens* (Forsskål, 1775). **A:** dorsal view of specimen IE-2007-812; **B:** Sem views of ossicles from the dorsal body wall. Scale bars: **A** = 1cm; **B** = 20µm.
Family Stichopodidae Haeckel, 1896

Genus Stichopus Brandt, 1835

Stichopus herrmanni Semper, 1868
(Fig. 10 A–C)

Stichopus variegatus Hermanni Semper, 1868: 73, pls 17, 30, fig. 2.
Stichopus herrmanni; Massin, 1999: 63, 64 fig. 52 (synonymy).

Material examined. Non-type material: IE-2007-755 (1 specimen (skin fragment only), sampled North of Cape Saint-André).

Remarks. Stichopus herrmanni Semper, 1868 is a littoral species with a bathymetric distribution 0–20 m (Lane et al., 2000). The present sample was taken from an individual sampled in the intertidal.

FIGURE 10. Stichopus herrmanni Semper, 1868. A–C: SEM photos of ossicles from the body wall (A,B) and tube feet (C). Scale bars: A, B = 10µm; C = 50µm.

Family Mesothuriidae Smirnov, 2012

Genus Mesothuria Ludwig, 1894

Mesothuria oktaknemus Sluiter, 1901
(Fig. 11 A–D)

Mesothuria oktaknemus Sluiter, 1901; Féral & Cherbonnier, 1981: 373, fig. 10A–J.
Mesothuria (Allantis) oktaknemus; Heding, 1940: 333.

Material examined. Non-type material: IE-2007-754(2) (1 specimen, sampled around Majumga); IE-2007-760 (1 specimen, collected between Majunga & Cape Saint-André); IE-2007-777 (1 specimen, around Majumga); IE-2007-778(4) (3 specimens, collected around Majumga); IE-2007-804 (3 specimens, sampled between Majunga & Cape Saint-André).

Remarks. The present record extends the distribution of this species from the Indo-West Pacific Ocean to the East Indian Ocean.

Mesothuria regularia Heding, 1940
(Fig. 12 A–B)

Mesothuria (Allantis) regularia Heding, 1940: 335–336, textfig. 4.
Mesothuria regularia; Cherbonnier & Féral, 1981: 371, fig. 8 A–I; Liao, 1997: 77–78, fig. 42.

Material examined. Non-type material: IE-2007-754(1) (1 specimen, collected sampled around Majumga); IE-
Remarks. This species was already known from the Pemba Channel (Heding, 1940) and has also been recorded in the Atlantic (Heding, 1940) and the Pacific (Cherbonnier & Féral 1981; Liao 1997). It is however a new record for Madagascar.

**FIGURE 11.** Mesothuria oktaknemus Sluiter, 1901. **A:** External views of specimens IE-2007-804. **B–D:** SEM photos of ossicles from dorsal body wall (B), ventral body wall (C) and ventral tube feet (D). Scale bars: A = 1cm; B = 20µm; C,D = 10µm.
FIGURE 12. *Mesothuria regularia* Heding, 1940. **A**: Dorsal view of specimen IE-2007-794; **B**: SEM photos of ossicles from the body wall. Scale bars: **A** = 1 cm; **B** = 20 µm.

*Mesothuria parva* (Théel, 1886)

(Fig. 13 A–B)

*Holothuria murrayi* var. *parva* Théel, 1886: 186, pl. 9, fig. 2, pl 16, figs 4 & 5  
*Mesothuria parva*, Cherbonnier & Féral, 1981 (records); Thandar 1992: 161, figs 1 & 6A  
*Mesothuria deani* Mitsikuri, 1912: 40–42, textfig. 9

**Material examined.** Non-type material: **IE-2007-813** (3 specimens, sampled in front of Nazendry Bay); **IE-2007-775** (3 specimens, collected in front of Nazendry Bay)

**Remarks.** This well-known species is a new record for Madagascar. The closest previous record is from Sodwana Bay in South Africa (Thandar, 1992).
Genus *Zygothuria* Perrier, 1898

*Zygothuria marginata* (Sluiter, 1901)
(Fig. 14 A–C)

*Mesothuria marginata* Sluiter, 1901: 26, pl 8, fig. 4; Liao, 1997: 75, fig. 40.
Mesothuria (Monothuria) marginata; Heding, 1940: 341, textfig. 8.
Zygothuria marginata; Perrier 1902: 331; Gebruk et al. 2012: 326, fig. 18.

**FIGURE 14.** *Zygothuria marginata* (Sluiter, 1901). A: External views of specimens IE-2007-778(2); B–C: SEM photos of ossicles from tentacles (B) and body wall (C). Scale bars: A = 1cm; B = 100µm; C = 20µm.

Remarks. This record is the first for the Indian Ocean.

Family *Synallactidae* Ludwig, 1894

Genus *Amphigymnas* Walsh, 1891

*Amphigymnas woodmasoni* (Walsh, 1891) (Fig. 15 A–B)


*Amphigymnas multipes* Walsh, 1891: 199.

*Synallactes reticulatus* Sluiter, 1901: 46–48, pl.3, figs 1–2, pl. 8, fig 9.


Remarks. This record is the first for the Indian Ocean.

Genus *Bathyplotes* Östergren, 1896

*Bathyplotes natans* (Sars, 1868) (Fig. 16 A–D)

*Holothuria natans* Sars, 1868: 20.

*Bathyplotes natans*; Rowe & Gates, 1995: 328 (synonymy); Pawson et al., 2009: 1202.

Material examined. *Non-type material: IE-2007-772* (1 specimen, collected between Majunga and Cape Saint André)

Remarks. C-shaped rods have been reported from the body wall of several *Bathyplotes* species. As already noted by Östergren (1896), C-shaped ossicles are absent in the body wall of *B. natans*; they are however present in the cloacal wall and in the longitudinal muscles, the latter being a new observation (fig. 12D).

This record is however the first for the Indian Ocean.

*Bathyplotes aymeric* VandenSpiegel sp. nov. (Fig. 17 A–E)


Type locality. Madagascar, between Majunga and Cape Saint-André, Station CP3273 (Decimal coordinates: -15.5; 46.06); in front of Mahajamba Bay, Station CP3281 (Decimal coordinates: -14.97; 46.95)

Etymology. This species with elegant ossicles is named after Aymeric VandenSpiegel, son of Joelle Dellis and Didier VandenSpiegel, in recognition of his patience when his dad is ‘cleaning sea cucumber skeletons at home.

Known geographic description. For now only known from the type locality.

Taxonomic description (holotype and paratype). *External anatomy*—Holotype 12 mm long and 6 mm wide (fig. 17A). Paratype 19 mm long and 9 mm wide. Body with rounded extremities. Bivium somewhat rounded and trivium flattened in holotype, undeterminable in paratype. Body wall gritty to the touch. Bivium with some scattered papillae and laterally with a row of papillae. Trivium seemingly devoid of appendages. Anus terminal. Mouth ventral, tentacles could not be observed. Color in alcohol uniform brown.
FIGURE 15. *Amphigymnas woodmasoni* (Walsh, 1891). **A**: dorsal view of specimen IE-2007-798, **B**: SEM view of ossicles from the body wall. Scale bars: **A** = 1cm; **B** = 50µm.
**FIGURE 16.** *Bathyplotes natans* (Sars, 1868). **A–B:** Dorsal (A) and ventral (B) views of specimen IE-2007-772. **C–D:** SEM photos of ossicles from the body wall (C), the longitudinal muscles and cloaca (D). Scale bars: A,B = 1 cm; C = 20 µm; D = 10 µm.

*Internal anatomy*—calcareous ring with radial plate twice as long as wide, with anterior and posterior invagination; interradial pieces wider than radial ones, with anteriorly a long and fine tooth and with a straight posterior margin. Stone canal, Polian vesicle and gonad not observed. Respiratory trees very fine, nearly transparent, reaching nearly the anterior end. Longitudinal muscles very narrow, flat, undivided and marginally attached.

*Ossicles*—Dorsal and ventral body wall with similar numerous tables with a cross-shaped disc surmounted by a long spire (50 to 90 µm long) and a few tables with a more or less circular disc and a reduced spire (fig. 17B). Cross-shaped disc 180–204 µm across, 2 to 5 racket-shaped arms perforated at their extremities; four, rarely 5 pillars united by up to 6 cross beam ending in a moderately spiny crown (fig. 17B,C). Dorsal papillae with perforated plates (120 to 180 µm long), and tables similar to those of body wall. Lateral papillae with curved rods, plates and tables (fig. 17D); tables generally similar to the ones observed in the body wall but some with a higher spire (140 µm high) and seven cross beam. Longitudinal muscles with spiny rods up to 237 µm long (fig. 17E).

**Remarks.** The undivided longitudinal muscles and the predominantly four-pillared tables leave no doubt that this species belongs to the *Bathyplotes*. The long spires with numerous crossbeams resemble those in *B. cinctus* Koehler & Vaney, 1910. However, the latter species always has tables with four arms whereas in *H. aymeric* there can be up to 5 arms. Moreover, *B. cinctus* presents C-shaped ossicles whereas *H. aymeric* does not. Lot IE 2007-769 contained two specimens; one is however not a holothuroid.
Genus *Kareniella* Heding, 1940

*Kareniella gracilis* Heding, 1940
(Fig. 18 A–C)

*Kareniella gracilis* Heding, 1940: 349, textfig. 14; Cherbonnier & Féral, 1981: 381, fig.15 A–J.
FIGURE 18. Kareniella gracilis Heding, 1940. A–B: Dorsal (A) and ventral (B) views of specimen IE-2007-803; C: SEM photos of ossicles from the body wall. Scale bars: A, B = 1cm; C = 50μm.

Material examined. Non-type material: IE-2007-803 (1 specimen, collected between Nosy Bé and Band du Leven)

Remarks. Heding (1940) erected Kareniella for synallactids that are distinctly flattened, have four-pillared tables and have non-retractile tube feet in the median ventral radial area (fig. 14A–C). Rowe (1989: 282) considered K. gracilis to be the junior synonym of Bathyherpystikes punctatus Sluiter, 1901. We do not agree with this decision as the presence of well-developed medio-ventral tube feet clearly makes K. gracilis a distinctive species to be classified in its own genus. Such was also the conclusion of Cherbonnier & Féral (1981) who had examined some of the type material of K. gracilis.

We however do agree with Rowe (1989) in classifying Bathyherpystikes punctatus in the genus Bathyploites. The present record is the first for the Indian Ocean.

Genus Pseudostichopus Théel, 1886

Pseudostichopus hyalegerus Sluiter, 1901
(Fig. 19)

Meseres hyalegerus Sluiter, 1901: 12.

Material examined. Non-type material: IE-2007-793 (4 specimens, dredged between Nosy-Bé and Banc du Leven); IE-2007-796 (2 specimens, dredged between Nosy-Bé and Banc du Leven); IE-2007-799 (3 specimens, dredged between Nosy-Bé and Banc du Leven); IE-2007-800 (1 specimen, dredged between Nosy-Bé and Banc du Leven); IE-2007-802 (18² specimens, dredged between Nosy-Bé and Banc du Leven); IE-2007-805 (1 specimen, dredged in front of Nazendry Bay); IE-2007-807 (4 specimens, dredged between Nosy-Bé and Banc du Leven).

Remarks. This species is characterized by having the body wall lacking ossicles, but covered by molluscs, sponge ossicles and foraminifers (fig. 18).

2. One of the specimens was destructed for SEM imaging.
To date, *Pseudostichopus hyalegerus* was known only from Japan, Eastern Australia and Indonesia (O’Loughlin, 2002; O’Loughlin & Ahearn, 2005), this record extends its range into the Indian Ocean.

**FIGURE 19.** *Pseudostichopus hyalegerus* Sluiter, 1901. Scale bar = 1cm.

**Pseudostichopus mollis** Théel, 1886
(Fig. 20A–B)

*Pseudostichopus mollis* Théel, 1886: 169–170, pl. 10 figs 5, 6; O’Loughlin & Ahearn, 2005: 171, figs 1b, c, 9a, e, 10b, c, 11e, f (synonymy and records before 2005).

**Material examined.** *Non-type material: IE-2007-778 (3)* (6 specimens, sampled in front of Majumga).

**FIGURE 20.** *Pseudostichopus mollis* Théel, 1886. A: different view of specimens, B: ossicles from tentacles Scale bar: A = 1cm, B = 20µm.
Remarks. The species in the genus *Pseudostichopus* are notoriously difficult to identify because they are characterized by lacking ossicles in the body wall. From the region, three species have been documented: *P. echinatus* Thandar, 1992 characterized by having very irregular knobbed rod ossicles in the tentacles; *P. hyalaegeus* (Sluiter, 1901) (see above) and *P. langeae* Thandar, 2006, characterized by having branched rods in the gonad. *P. mollis* had already been reported from the Southern Indian Ocean, off Marion Island (O’loughlin & Ahearn 2005). The six specimens of *P. mollis* observed were eviscerated but pieces of gonads were found in two specimens; no ossicles was observed in the gonads but spiny rods (60–240µm long), occasionally branched and with some perforations, were found in the tentacles (Fig. 20B).

Order Dactylochirotida Pawson & Fell, 1865

Family Ypsilothuriidae Heding, 1942

Genus *Ypsilothuria* E. Perrier, 1886

*Ypsilothuria* cf. *bitentaculata* (Ludwig, 1893)
(Fig. 21 A–C)

*Sphaeroturia bitentaculata* Ludwig, 1893: 184; 1894: 141, pl. 12, figs 16–17, pl. 14, figs 5–14.
*Ypsilothuria bitentaculata*: Massin & Hendrix, 2011: 422, fig. 7 (synonymy and records before 2011)

Material examined. Non-type material: IE-2007-757 (1 specimen, sampled between Majunga and Cape Saint André); IE-2007-758 (1 specimen, sampled between Majunga and Cape Saint André); IE-2007-762 (1 specimen, sampled in front of Nazendry Bay); IE-2007-765 (2 specimens, sampled in front of Majunga); IE-2007-784 (1 specimen, sampled between Majunga and Cape Saint André); IE-2007-786 (1 specimen, sampled in front of Nazendry Bay); IE-2007-789 (1 specimen, sampled in front of Majunga); IE-2007-780 (5 specimens, sampled in front of Nazendry Bay); IE-2007-792 (2 specimens, sampled between Majunga and Cape Saint André); IE-2007-795 (1 specimen, sampled between Majunga and Cape Saint André); IE-2007-797 (2 specimens, sampled between Majunga and Cape Saint André); IE-2007-811 (3 specimens, sampled in front of Mahajamba Bay); IE-2007-815 (1 specimen, sampled between Majunga and Cape Saint André); IE-2007-821 (2 specimens, sampled in front of Nazendry Bay).

Remarks. *Ypsilothuria* is thought to contain only two species: *Y. talismani* Heding, 1942, which is soft bodied, and *Y. bitentaculata* (Ludwig, 1893) which is ‘hard as a little echinoid’ according to Heding (1942). The specimens here under study clearly also have the ‘hard’ aspect of *Y. bitentaculata* (fig. 21A–B). Heding (1942) recognized two subspecies in the latter species: the cosmopolitan *Y. bitentaculata attenuata* R. Perrier, 1886 and the North Atlantic *Y. bitentaculata virginiensis* Heding, 1942. For *Y. bitentaculata attenuata*, Heding (1942) states that it is closely related to the *bitentaculata* from the Indo-Pacific which he described earlier (Ludwig & Heding, 1935; see also Heding, 1942: textfig 27, 2) based on material collected in the Zanzibar Channel. Our specimens fit well with those descriptions because their body wall thecal plates vary in length between 1500–3000 mm (fig. 21C). This is also more or less in agreement with the measurements (scales can exceed 2 mm in length) that Cherbonnier & Féral (1981) provide. On the other hand our specimens differ from other descriptions of *Y. bitentaculata* from the Indo-Pacific in that their thecal plates are more than twice as long (e.g. Pawson, 1965 reports on an average length of 1200 mm; Thandar (1999) gives a range between 900 and 1270 mm) or from the Mediterranean (Massin, 1996; mean length of plates 1000 mm), in that they often carry two spires, and in that these spires are, with a length up to 1100 mm, considerably higher then those reported by Ludwig (1894) (500–580 mm high), Pawson (1965) (500 mm high), Thandar (1999) (500 mm high), Cherbonnier and Féral (1981) (100 mm high) and Massin (1996) (400–500 mm high).

Given these differences we were tempted to erect a new species for our material. We however refrained from doing so until the material collected earlier in the Zanzibar Channel could also be studied.
Order Dendrochirotida Grube, 1840

Family Cucumariidae Ludwig, 1894

Genus *Panningia* Cherbonnier, 1958

*Panningia trispicula* Thandar 2008
(Fig. 22 A–C)

*Panningia trispicula* Thandar, 2008: 29, fig. 11.

**Material examined.** Non-type material: **IE-2007-773** (1 specimen, sampled between Majunga and Cape Saint André); **IE-2007-761** (1 specimen sampled in front of Majunga); **IE-2007-819** (1 specimen, sampled in front of Nazendry Bay).

![Figure 22](image)

**FIGURE 22.** *Panningia trispicula* Thandar 2008. **A:** lateral view of specimen IE-2007-761, **B–C:** SEM view of ossicles from tentacles (B) and body wall (C). Scale bars: **A = 1cm, B = 20µm; C = 100µm.**

**Remarks.** The three specimens before us, 100 mm long and 12.5 mm wide with maximum circumference of 53 mm, 52 mm long and 7.5 mm wide with maximum circumference of 36 mm and 12 mm long and 2 mm wide with maximum circumference of 3 mm most possibly are *Panningia trispicula* Thandar, 2008 which was hitherto known only from the holotype and the paratype that were sampled off Mossel Bay (34°10' S, 23° 32' E), at
97 m depth. Some differences between our largest specimens and the types are apparent: the largest plates of our largest specimens range from 0.7 to 1.1 mm in length and 0.5 to 0.7 mm in width, whereas those of the types are 0.28 to 0.445 mm long. Also the deposits in the tentacles of the types are less complex than those in our largest specimens.

**Genus Pentacta** Goldfuss, 1820

**Pentacta doliolum** (Pallas, 1766)

(Fig. 23 A–C)

*Actinia doliolum* Pallas, 1766: 152, pl. ii, figs 10–12.

*Pentacta doliolum*; Cherbonnier, 1952: 490, pl. 43, figs 1–15 (synonymy); Thandar, 1991: 122, figs. 1b, 7, 14c (synonymy and records before 1991)

*Pentacta tesselara*; Samyn et al. 2006: 116 fig. 83 A–H (non *P. tesselara* Cherbonnier, 1970)

**Material examined.** Non-type material: IE-2007-809 (1 specimen, sampled in front of Nazendry Bay)

![FIGURE 23 Pentacta doliolum (Pallas, 1766). A: Lateral view of specimen IE-2007-809; B: SEM photos of ossicles from the body wall. Scale bars: A = 1cm; B = 100µm; C = 10µm.](image-url)
Remarks. Thandar (1991; 2006) questioned whether this species is present in East Africa. The present record confirms it is present in the Indian Ocean. Moreover, the specimen studied matches well with material from the nearby Comoros Islands of the same species which, we had previously erroneously identified as *P. tesselara* Cherbonnier, 1970 (Samyn et al., 2006)

**Pentacta tesselara** Cherbonnier, 1970  
(Fig. 24 A–D)

*Colochirus minutus*; Macnae & Kalk, 1958: 130 (non Ludwig, 1875)  
*Plesiocolochirus tesselara*; Thandar, 2006: 30, fig. 10

**Material examined.** *Non-type material: IE-2007-814* (3 specimens, sampled in Mahajamba Bay)

![Figure 24. Pentacta tesselara Cherbonnier, 1970. A: External view of specimen IE-2007-814; B–D: SEM photos of ossicles from the tentacles (B) and dorsal body wall (C, D). Scale bars: A = 1cm; B = 50µm; C = 100µm; D = 20µm.](image-url)
Remarks. Hitherto this species was known from only from the shallow-waters of southern Mozambique (Macnae & Kalk, 1958) and the East coast of South Africa (Cherbonnier, 1970, Thandar, 1991, 2006). The present records, sampled at 257 m depth in the Northern Mozambique Channel are thus considerable latitudinal and bathymetric range extensions.

Family Phyllophoridae Östergren, 1907

Genus Ekmanothyone Massin, 1993

Ekmanothyone incurva (Cherbonnier, 1988)
(Fig. 25 A–D)

Parathyone incurva Cherbonnier, 1988: 206, fig 89
Parathyone incurvata; Massin, 1993: 257 (lapsus calami)
Ekmathyone incurvata; Massin, 1993: 257 (lapsus calami)

FIGURE 25. Ekmanothyone incurva (Cherbonnier, 1988). A: Lateral view of specimens IE-2007-787; B–C: SEM photos of ossicles from tentacles (B), dorsal body wall (C) and tube feet (D). Scale bars: A = 1cm; B = 20µm; C, D = 10µm.
Material examined. Non-type material: **IE-2007-774** (3 specimens, sampled North of Cape Saint André); **IE-2007-776** (10 specimens, sampled in South of Cape Saint Sébastien); **IE-2007-787** (7 specimens, sampled in front of Nazendry Bay); **IE-2007-788** (1 specimen, sampled between Majunga and Cape Saint André).

Remarks. Massin (1993) noted that *Parathyone* Cherbonnier, 1988, is preoccupied and proposed *Ekmanothyone* Massin, 1993 as replacement name.

The specimens before us match perfectly with Cherbonnier’s (1988) description of *P. incurva*, and come from roughly the same area (Banc de Prace) and depths (65m).

**Family Sclerodactylidae Panning, 1949**

**Genus Sclerodactyla Ayers, 1851**

*Sclerodactyla multipes* (Théel, 1886)

*(Fig. 26 A–C)*

*Cucumaria multipes* Théel, 1886: 72, pl. 4, fig. 4.
*Sclerodactyla multipes*; Panning 1949: 459; Liao, 1997: 177 (records before 1997)

**FIGURE 26. Sclerodactyla multipes** (Théel, 1868). A: Lateral view of specimen IE-2007-767; B–C: SEM photos of ossicles from introvert (B) and dorsal body wall (C). Scale bars: A = 1cm; B = 20µm; C = 50µm.
Material examined. Non-type material: IE-2007-763 (1 specimen sampled between Majunga and Cape Saint André); IE-2007-767 (1 specimen sampled between Majunga and Cape Saint André);

Remarks. According to Panning (1949) *Sclerodactyla* holds three species: *S. briareus* (Lesueur, 1824), *S. multipes* (Théel, 1886) and *S. longipeda* (Semper, 1868). It is puzzling that Heding & Panning (1954) transferred *S. longipeda* (Semper, 1868), with its 10 tentacles according to the original description, to *Phyllophourus (Phyllophorella)* Heding & Panning, 1954, which has 20 (15+5) tentacles.

Family Psolidae R. Perrier, 1902

Genus *Psolidium* Ludwig, 1887

*Psolidium acorbulum* Thandar, 2006  
(Fig 27 A–D)

*Psolidium acorbulum* Thandar, 2006: 38, fig. 13.

Material examined. Non-type material: IE-2007-808 (1 broken specimen; sampled in front of Nazendry Bay)

Remarks. This species was previously known only from the type material that was collected on the South East coast of South Africa between 710–775m. The depth of collection of the studied specimen is unknown (marked as ‘croché’ or meaning attached in the cruise report and as 0 m on the label). However the coordinates of station DW3239 correspond exactly to those of stationCP3293: 268–408 m. This record thus extends the bathymetric distribution of *P. acorbulum*.

![FIGURE 27. *Psolidium acorbulum* Thandar, 2006. A–D: SEM photos of ossicles from dorsal body wall (A–C) and ventral body wall (D). Scale bars: A, B = 100µm; C = 10µm; D = 20µm.](image-url)
Genus *Psolus* Oken, 1815

*Psolus agulhasicus* Ludwig & Heding, 1935

(Fig. 28 A–C)


**Material examined.** Non-type material: **IE-2007-771** (22 specimens, sampled West of Ambre Cape); **IE-2007-770** (1 specimen, sampled West of Cape Ambre).

**Remarks.** Previously known only from off Aghulhas and off Cape Good Hope, South Africa. The present records extends the distribution of *P. agulhasicus* considerably to the north. Previous records were taken at depths varying from ±140 m to ±1365 m; our samples were taken at depths of 653 m and 930 m.


**Order Elasipodida Théel, 1882**

**Family Deimatidae Ekman, 1926**

3. Two were used for SEM.
Genus *Orphnurgus* Théel, 1879

*Orphnurgus natalasper* Thandar 1992
(Fig. 29 A–E)

*Orphnurgus natalasper* Thandar, 1992: 176, figs 5, 7B.

**Material examined.** IE-2007-801 (1 specimen, sampled between Nosy Bé and Banc du Leven); IE-2007-820 (1 specimen, sampled between Nosy Bé and Banc du Leven).

**Remarks.** Even though our specimens have only 30 ventrolateral tube feet whereas the original description of *O. natalasper* Thandar, 1992, mentions 40, we feel no hesitation in assigning them to Thandar’s (1992) species because the short undivided spinous rods of the body wall are a near perfect match.

These records extends the range of *O. natalasper* northwards roughly 15 degrees. Depth (704 m) is close to the 860 m reported by Thandar (1992).

![FIGURE 29. *Orphnurgus natalasper* Thandar, 1992. A–B: Dorsal view (A) and ventral view (B) of specimen IE-2007-801. C–E: SEM photos of ossicles from the anterior part of dorsal body wall (C) anterior (D) and posterior (E) part of ventral body wall. Scale bars: A,B = 1cm; C,D,E = 100µm.](image-url)
Order Molpadida Haeckel, 1896

Family Molpadiidae Müller, 1850

*Molpadia africana* (Ludwig & Heding, 1935)
(Fig. 30 A–C)


**Material examined.** IE-2007-756 (2 specimens sampled in Mahajamba Bay); IE-2007-781 (1 specimen, sampled in front of Mahajamba Bay)

**Remarks.** This specimen fits remarkably well with the only known previous record of this species approximately 10° to the north in the Zanzibar Channel.

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*Molpadia andamanensis* (Walsh, 1891)
(Fig. 31 A–C)

*Trochostoma andamanense* Walsh, 1891: 203
*Molpadia andamanensis*; Clark, 1908: 162 (synonymy)

**Material examined.** IE 2007-782 (3 specimens sampled between Majunga and Cape Saint-Andre); IE-2007-817 (2 specimens sampled between Majunga and Cape Saint-Andre)

(Fig. 32 A–B)

*Trochostoma lenticulum* Cherbonnier & Féral, 1981: 405, fig.29

**Material examined.** IE-2007-778(1) (1 specimen sampled in front of Majumga)

**Remarks.** Pawson (1965, 1967, 1977) lumped *Trochostoma* (and eight other genera) with *Molpadia*. As long as no complete revision of the group is carried out, we follow this decision. The holotype and paratype of this species were sampled at 750 m depth in the Philippines. The present record is thus a significant horizontal and vertical (950 m depth) range extension.

*Molpadia thandari* Samyn & VandenSpiegel sp. nov.

(Fig. 33 A–C)

*Molpadia* sp. indet.; Thandar, 2007: 52, fig. 24

**Material examined.** Type material: IE-2007-759 (holotype, sampled in front of Nazendry Bay); IE-2007-806 (1 paratype, sampled in front of Nazendry Bay)

**Type locality.** Madagascar, Nazendry Bay, Station CP3289 (Decimal coordinates: -14,4833; 47,4333)

**Etymology.** This species is named after Prof. Em. Ahmed S. Thandar of the University of KwaZulu-Natal in South Africa, who, in 2007, was the first to recognize this species as a separate taxon.

**Known geographic description.** Known from off Tongaat Bluff just North of Durban (Decimal coordinates: -29.73; 31.42) to Nazendry Bay near Nozi Lava (Decimal coordinates: -14,4833; 47,4333)

**Taxonomic description (holotype and paratype).** *Anatomy*—Holotype 70 mm long and 35 mm wide with tail 5 mm long. Paratype 25 mm long and 12 mm wide, with tail 2 mm long (fig. 33A). Body uniform light chocolate brown, with tail somewhat lighter in color. Muscle bands can be seen through the body wall. Tentacles 15, retracted, morphology could not be determined. Anus surrounded by five minute and slender teeth. Calcareous ring with, plates fused, radials with a terminal bifid posterior projection (broken in holotype); interradial with triangular anterior projection of same length of that of radial plate. 15 short tentacle ampullae; Polian vesicule single, elongated; stone canal not detected. Left respiratory tree reaching mid body, right longer. (see also Thandar (2007) for *Molpadia* sp. indet.) Gonad well-developed, branching. Longitudinal muscles divided into two lateral bands that unite before reaching the calcareous ring.
**Ossicles**—Ossicle assemblage of tentacles could not be determined. Body wall with tables of two different morphologies. The first type has their disc, 123–176 µm wide, perforated with 4 to 6 holes and with four to six arms 132–208 µm long. Disc spire is made of 3 pillars fused over their complete length, 253–300 high (no trace of cross-beams can be seen). The second type of table does not have long disc arms and has their discs perforated by 3–5 large holes, 42–74µm- wide; spire again consisting of three fused pillars, 113–129µm high. Tables from the tail are the typical fusiform *Molpadia* type, 360–412 µm long, with disc slightly swollen centrally and perforated by 2–4 small holes; spire low, 37–51 mm high, ending in four teeth.

**Remarks.** We agree with Thandar (2007) that the large body wall tables with multi-armed discs and 4–6 holes make this species stand aside from other *Molpadia* species. We feel it justified to regard this character state important enough to warrant it diagnostic for a species new to science.

We decided to picture only the paratype, because the dissected holotype might give a wrong impression of the species.

![Image](image-url)
**FIGURE 33. Molpadia thandari sp. nov.** A: Dorsal view of the paratype; B–C: SEM photos of ossicles from dorsal body wall (B) and tail (C). Scale bars: A = 1cm; B,C = 50µm.

**Discussion**

As argued by Hanssen (1975) the bathyal zone, from 200/400 to 1800/2600 m depth, has the most varied ecological conditions and hence it is not surprising that in this zone the largest taxonomic richness can be found. Our results indicate that this is indeed the case as we found representatives of five out of the six extant orders. Although, no Apodida were found in this small collection, they probably do occur at the here sampled locations and depths too as all families in this order have deep-see representatives, with the Myyriotrochidae being the most common (Billett, 1991). Their absence in this sample most possibly lays in the fact that sampling was done with a beam trawl and a dredge and not with box-coring or other sampling technique that recovers infaunal organisms such as many deep sea apodids.

The fact that six out of the 31 species present in this small collection are new to science clearly shows that areas and habitats that have received little exploration continue to reveal new taxa. International and collaborative programs like “La Planète Revisitée” that revealed this fauna are to be encouraged.

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