Zootaxa 4365 (4): 410–420
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4365.4.2
http://zoobank.org/urn:lsid:zoobank.org:pub:27B93F6C-55F8-40BB-A854-EB916E339D04

Two new subfamilies, three new species and a new subspecies of dendrochirotid sea cucumbers (Echinodermata: Holothuroidea)

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Abstract

Some materials in the Natural History Museum, London, originating from various parts of the world, proved on examination, to comprise two new species herein described as *Cladodactyla pesdispersa* n. sp. and *Thyonina rasidae* n. sp., and a new subspecies, *Havelockia ferali andamanensis* n. subsp. In addition, some specimens examined from the museum collections of the Department of Aquatic Biology and Fisheries, University of Kerala in India contained, besides the well-known dendrochirotids, *Aslia forbesi* (Bell) and *Stolus buccalis* (Stimpson), two specimens which proved to also represent a new species of *Thyonina*, herein described as *Thyonina bijui* n. sp., as it differs significantly from *T. rasidae* n. sp. from Pakistan and the South African *T. articulata* Vaney. For the genus *Thyonina,* currently attributed to the subfamily Thyoninae, a new subfamily Thyonininae is here diagnosed. In addition a new subfamily Hemithyoninae is proposed for *Hemithyone semperi* (Bell), also placed in the Thyoninae till now.

Key words: new subfamilies, new species, new subspecies, Dendrochirotida, Thyonidae, Cucumariidae, Sclerodactylidae

Introduction

While searching for sea cucumbers from Ghana, in the collections of the Natural History Museum, London, a mixed batch of holothuroids, tentatively labelled "?*Havelockia* or ?*Thyone* sp.", were uncovered. This material, originating from various parts of the world, proved to be rather rich in the number of species than specimens. Besides several already known species and several unidentifiable forms, it contains two new species here described as *Cladodactyla pesdispersa* n. sp. from Angola and *Thyonina rasidae* n. sp. from Pakistan, and a new subspecies, *Havelockia ferali andamanensis* n. subsp. from Palaw Bay, Mergui Archipelago. In addition to these, some specimens were examined in the museum collections of the Department of Aquatic Biology and Fisheries, University of Kerala, India. These contained, besides the well-known dendrochirotids, *Aslia forbesi* (Bell) and *Stolus buccalis* (Stimpson), yet another new species herein described as *Thyonina bijui* n. sp.

Panning (1949) erected the subfamily Thyoninae for a group of 10-tentacled (8 + 2) dendrochirotid holothuroids with a complex calcareous ring constructed in a mosaic-like fashion, with subdivided radial processes, and body wall ossicles either as tables only, tables and plates, plates only, or cups and plates. Smirnov (2012) elevated this subfamily to full family status, including in it the nominal subfamily Thyoninae Panning, 1949 and the polytentaculate subfamily Semperiellinae Heding & Panning, 1954, characterised by tables and/or plates and also a subdivided calcareous ring but with often fused radial and sometimes interradial processes. The writer is of the opinion that the subfamily Thyoninae should be restricted with reference to its type genus *Thyone* Oken to include only forms with 10 tentacles, scattered tube feet and body wall ossicles comprising tables only or table-like plates or plates only. Hence the genus *Thyonina* Thandar, 1990*,* long classified in Thyoninae, but with only rods in the body wall and lacking tables or table-like plates does not strictly belong in this taxon. Hence the subfamily **Thyonininae** is here diagnosed to accommodate it. While the genera *Allothyone* Deichmann and *Pentamera* Ayres do strictly belong in the Thyoninae, the genus *Stolus* Selenka, characterised by table-like plates or plates/buttons only, is left to stand in Thyoninae until a revision of this genus is forthcoming. *Hemithyone semperi* (Pawson, 1967) , currently classified in the Thyoninae, is here reassigned also to a new subfamily as its ossicles comprising

 Accepted by A. Kroh: 29 Nov. 2017; published: 20 Dec. 2017

"cup-like bodies" (sensu Smirnov 2012) or fenestrated ellipsoids (sensu Massin 1999), neither conform to tables or plates of the Thyoninae, nor rods of Thyonininae, despite the fact that its calcareous ring is definitely of the thyonid type, well-illustrated by Cherbonnier (1988) and Massin (1999). It is here noted that Smirnov's (2012) observation that the calcareous ring of this species is not mosaic-like is based on Pawson's (1967) illustration, although both Cherbonnier (1988) and Massin (1999) illustrate a mosaic-like calcareous ring for this species. Because of its peculiar body wall ossicles the subfamily **Hemithyoninae** is here diagnosed with *Hemithyone* Pawson as type genus. It is regrettable that this subfamily is monotypic but its position within the Thyoninae was questioned on several occasions, more recently by Smirnov (2012). This subfamily can be diagnosed as follows:

Hemithyoninae n. subfam.

Diagnosis. *A subfamily of thyonid dendrochirotid holothuroids with tube feet mostly restricted to the radii, a complex completely fragmented calcareous ring, and body wall ossicles appearing as fenestrated ellipsoids ("cups") and fusiform plates. Tables and rods absent.*

Type genus. *Hemithyone* Pawson, 1967.

Hence the family Thyonidae (*sensu* Smirnov 2012) now comprises the following subfamilies:

Thyoninae Panning, 1949 with the genera *Thyone*, *Allothyone*, *Stolus*, and *Pentamera.*

Thyonininae n. subfam. with the genus *Thyonina.*

Hemithyoninae n. subfam. with the monotypic genus *Hemithyone.*

Semperiellinae Heding & Panning, 1954 with the genera *Semperiella*, *Phyrella*, *Neopentadactyla*, *Pentadactyla*, *Neothyonidium*, *Massinium*, and *Cladolella*.

TABLE 1. Diagnostic features of all four subfamilies now included in the family Thyonidae Panning, 1949 (*sensu* Smirnov 2012).

	Number of tentacles	Tube feet distrib.	Calcareous ring	Body wall ossicles
Thyoninae Panning, 1949	10 (8 + 2 arrangement)	scattered or restricted to radii	long, tubular, broken into mosaic of pieces, fragmentation not always obvious; processes of the radial plates usually long	usually 2–4 pillared tables or knobbed plates resembling tables with a half-ring or arch on one side; rarely plates smooth, without a spire; ossicles sometimes reduced with age or altogether absent
Thyonininae n. subfam.	10 (8 + 2 arrangement)	scattered	short, tubular, divided into a mosaic, processes of medium size	slender rods with digitated or perforated ends; tables, plates or buttons always absent
Hemithyoninae n. subfam	10 (8 + 2 arrangement)	mostly restricted to radii	long, tubular, broken into mosaic of pieces; processes usually long	fenestrated ellipsoids and perforated fusiform plates
Semperiellinae Heding & Panning, 1954	15–20 (in 1 or 2 rings)	scattered or restricted to radii	complex, mosaic-like, with radial and sometimes interradial plates with elongated processes, sometimes united at base	tables only, 2–4 pillared; in one species spinous rods, similar to those of some *Ohshimella* species occur

While the current classification system in use by most holothuroid taxonomists is the traditional one formulated by Pawson & Fell (1965) and modified by Smirnov (2012), more recent molecular phylogenetic work by Miller *et al.* (2017), using both mitochondrial and nuclear DNA and several well-established methodologies, on extant Holothuroidea representing 23 out of 28 families, does not support either of the two systems. Although they recovered the order Dendrochirotida (including Dactylochirotida) as a well-supported clade, they found poor topological support for the internal clades within this and other groups. As suggested by Michonneau & Paulay (2014) they also proposed that the morphological characters currently used in traditional taxonomy to diagnose families and genera within the Holothuroidea need a revision. This was also suggested by Kerr & Kim (2001) in their cladistic analysis using morphological data only. In fact, Miller *et al.* (2017), although diagnosing three additional families, reached an interesting conclusion with well-supported groups for the entire system of the

Holothuroidea. They proposed several new groupings but, perhaps not to disrupt the current system, fell short of proposing any Linnaean hierarchical categories for their groupings. While their system appears to be well-founded it requires some debate regarding hierarchical categories before it can be universally adopted. Hence the system of Smirnov (2012) is here used as only species from three dendrochirotid families are dealt with.

Collection acronyms

DABFUK: Department of Aquatic Biology and Fisheries, University of Kerala, India.
NHMUK: Natural History Museum, London, UK.
MNHN: Muséum National d'Histoire Naturelle, Paris, France.

Systematic Part

Family Sclerodactylidae Panning, 1949

Genus *Havelockia* Pearson, 1903

Havelockia ferali ferali **Cherbonnier, 1988**
Havelockia ferali Cherbonnier, 1988: 183, text-fig. 78 A–M.

Diagnosis (after Cherbonnier 1988). A small, sclerodactylid holothuroid, yellowish in colour, sometimes with some brownish spots. Body in-curved, length 13–17 mm. Tube feet long, scattered, with some apparent serial arrangement. Tentacles 10, mid-ventral two greatly reduced. Calcareous ring unfragmented but processes clearly subdivided. Polian vesicle and stone canal single, madreporite not calcified. Body wall ossicles as tables with fusiform or triangular disc pierced by four central holes accompanied by two or more supplementary holes; spire of two arched-pillars terminating in a non-perforate, spinous crown; smooth multilocular plates also present. Anal tables with smaller disc but usually with perforated crown to spire. Tube feet ossicles as tables with a curved disc and a toothed, terminally pierced spire. Introvert supported by tables with large multilocular disc. Tentacles with rosettes or rosette-like plates.

Holotype. MNHN EcHh 3544, Tuléar, Madagascar.

Paratypes. MNHN EcHh 7077, 7076, 7077 and 3591 (all from Nosy Bay, Madagascar).

Remarks. This is the nominal subspecies of *Thyone ferali* and is not represented in the material at hand. It was described from the holotype and several paratypes but Cherbonnier (1988) mentioned that his description related only to the holotype. The author has had the opportunity to study all the type material at the MNHN and his observations are here contained in the remarks section under the new subspecies described below.

Havelockia ferali andamanensis n. subsp.
Figure 1

Etymology. This subspecies takes its name from its type locality in Mergui Archipelago, Andaman Sea.

Diagnosis. A cylindrical, slightly ‘U’-shaped subspecies of *H. ferali*, up to 22 mm in length; colour in alcohol yellowish to off-white. Tube feet small, non-retractile. Anal teeth absent, anal papillae sometimes evident. Tentacles 10, in 8 + 2 arrangement. Radial and interradial plates of calcareous ring unfragmented, broadly joined; posterior processes of radial plates fragmented, of approximately same length as radial plates; most radial plates slightly prolonged before bifurcation. Polian vesicle single; stone canal short, suspended in dorsal mesentery; madreporite ‘bean’-shaped. Ossicles of body wall comprise only tables, with irregular, elongated or quadrangular or circular disc, 57–97 µm, perforated by numerous holes. Spire of two pillars, sometimes arched, sometimes terminally bifurcate, with few teeth, sometimes reduced to knobs on surface of disc, crowns non-perforate. Supporting tables of tube feet with curved disc and spire ending in couple of teeth; end-plates present. Introvert with tables with disc smaller than that of body wall tables, 47–73 µm; spire ending in few to many teeth. Tentacle deposits as open rosettes, 15–43 µm.

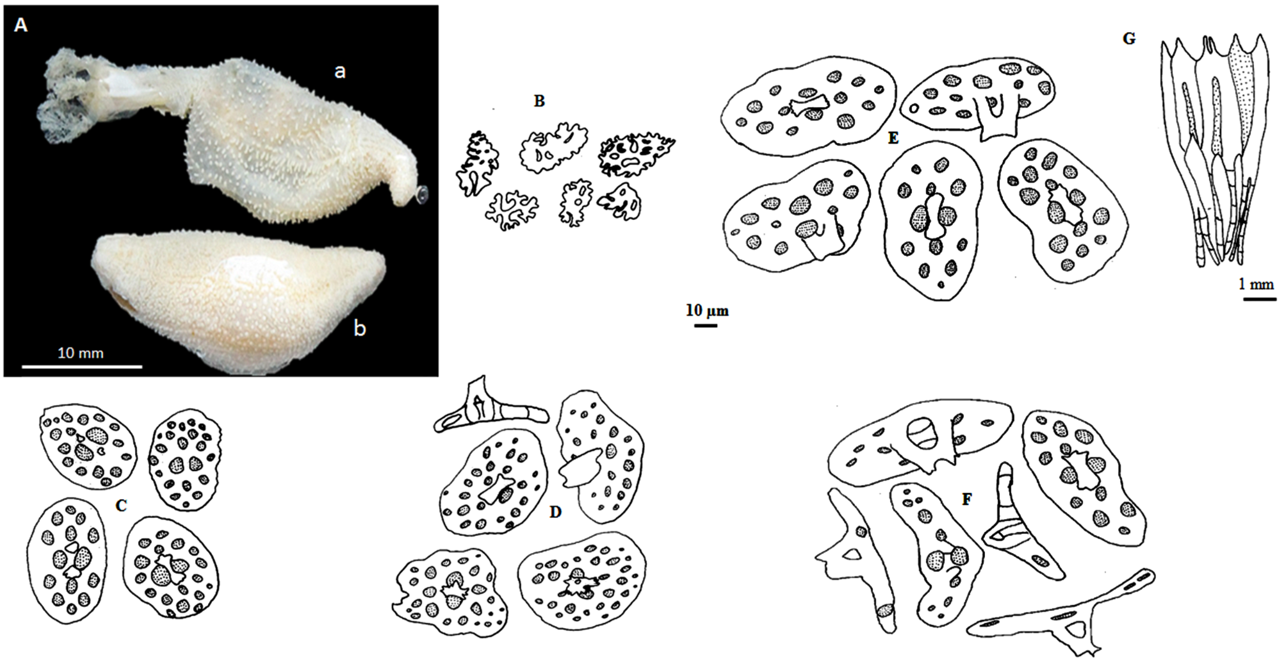

FIGURE 1. *Havelockia ferali andamanensis* n. subsp. A. Specimens entire (a: holotype, NHMUK 1886.2.2.21; b: paratype, NHMUK 1986.2.2.22-24); B. Tentacle ossicles; C. Anal ossicles; D. Introvert ossicles; E. Body wall tables; F. Tube feet tables; G. Part of calcareous ring (dorsal). (B–F drawn to same scale).

Holotype. NHMUK 1886.2.2.21, "Palour Bay, Margui" (locality not clearly legible on label but according to the accession record supplied by the curator at NHMUK, it should read Palaw Bay, Mergui, Myanmar, on the Andaman Sea); received by NHMUK from the Indian Museum.

Paratypes. NHMUK 1886.2.2.22-24, other data as for holotype, 6 specimens.

Description. All specimens cylindrical, slightly 'U'-shaped, colour in alcohol yellowish to off-white. Largest specimen (holotype) 22 mm in length, 5 mm in breadth in mid-body (Figure 1Aa). Smallest specimen contracted, 10 mm in length and 7 mm in breadth. Calcareous ring and tentacles lost except in holotype and in all but one 20 mm paratype (NHMUK 1886.2.2.22), where it is extruded but still attached to body.

Holotype (Figure 1Aa)

Length 22 mm. Tube feet small, non-retractile, scattered, some serial arrangement visible, more numerous ventrally. Suckers more or less of equal diameter as tube feet. Anal teeth absent, anal papillae sometimes evident. Tentacles 10, well branched, whitish, in 8 + 2 arrangement, longest 5 mm, mid-ventral two approximately one third length of others.

Calcareous ring complex (Figure 1G), radial and interradial plates not fused but broadly joined by a membrane; radial plates anteriorly bifurcate, some slightly prolonged posteriorly before bifurcation into paired processes of approximately same length as radial plates; interradial plates anteriorly pointed, posteriorly slightly concave. All plates intact, non-fragmented but radial processes broken up into a series of fragments. Polian vesicle single, slightly elongated; stone canal short, mid-dorsal, attached in dorsal mesentery; madreporic body 'bean'-shaped. Respiratory trees short, well branched, very transparent, left slightly longer than right, but not reaching end of calcareous ring. Gonad in two tufts of short 'banana'-shaped tubules, apparently immature or spent in holotype (and all dissected specimens). Longitudinal muscles thin, thread-like. Retractor muscles thicker, more so anteriorly where they insert on the anterior tips of the radial plates, ventral retractors originating more posteriorly at approximately one third body length from posterior end.

Ossicles of body wall comprise tables only (Figure 1E), with variously-shaped disc, either elongated, quadrangular or circular, perforated by numerous holes, rarely any difference between the four central holes and others. Margin of disc smooth; spire of two pillars of moderate height, sometimes arched, sometimes terminally bifurcate, with few teeth, often reduced to knobs on surface of disc; disc size 57–97 µm (mean 77 µm). Supporting tables of tube feet (Figure 1F) with curved disc and two-pillared spire ending in couple of teeth, spire often triangular; disc perforated by a few central holes and one or two terminal holes; end-plates present, with no regular arrangement of holes except in some plates in which medial holes are smaller. Disc of anal tables 53–87 µm (mean 65 µm) (Figure 1C). Introvert deposits comprise only tables (Figure 1D) with disc smaller than that of body wall tables, 47–73 µm (mean 64 µm), spire two-pillared, ending in few to numerous teeth, top of spire sometimes perforated. Tentacle deposits comprise only open rosettes of a variety of form (Figure 1B), 15–43 µm in length (mean 29 µm), mostly concentrated in the stalk, few and scattered elsewhere.

Remarks. In colour, size and form of the ossicles, the current specimens come very close to *H. ferali* Cherbonnier, 1988 described from Madagascar but I am inclined to consider the Palaw Bay material as representing a new subspecies. Cherbonnier's holotype of *H. ferali* came from Tuléar, and his paratypes from Nosy Bay. Cherbonnier states that his description is valid for the holotype only. There are slight variations between the Madagascar and the current Palaw Bay material. These variations are here described as it is suspected that they may reflect geographic rather than specific differences. Cherbonnier describes the tube feet as being long with some radial seriation. In the Palaw Bay material the tube feet are short and appear to be mostly scattered. The calcareous ring described by Cherbonnier, while definitely of the sclerodactylid type, shows the radial plates as being enlarged before bifurcation and the posterior processes arise at the level of the posterior end of the interradial plates. In the two Palaw Bay specimens in which the calcareous ring is present, one (paratype NHMUK 1886.2.2.22) does show some fragmentation of the plates but both in this specimen and the holotype, there is no enlargement of the radial plates before bifurcation. The writer examined some extant type material of *H. ferali* (EcHh 7077, 7076 and 3591) at the MNHN and found that in paratype 7077, the calcareous ring is slightly fragmented, the interradial plates are in a single series and the radial plates into two series, but there was no convincing evidence that this was due to preservation. In specimen numbered 7076, the originally dissected one, also shows a similar calcareous ring and in specimen 3591, the interradials have incipient subdivisions and the radials are deeply cleft with a double series of plates. The body wall and introvert ossicles of the extant type material are identical to those illustrated by Cherbonnier (1988). Although fragmentation is present in the type material as well as in one of the current specimens, the ring of both subspecies (*H. ferali ferali* and *H. ferali andamensis*) appears clearly of the sclerodactylid type. The ossicles of the current material are similar to those of the type illustrated by Cherbonnier except that the spire tops are not as dentate and those of the anal region are not perforated. Hence a comparative study of both the Madagascar and the Palaw Bay material indicates that there are some differences which are here regarded as geographic variations in distantly separated populations. It is for this reason that the Palaw Bay material is here described as a new subspecies of *H. ferali*.

Family Thyonidae Panning, 1949

Subfamily Thyonininae n. subfam.

Diagnosis. A subfamily of the family Thyonidae with body wall ossicles comprising mostly slender curved rods perforated by usually a single or few holes at each end.

Type genus. *Thyonina* Thandar, 1990 (here designated).

Type species. *Thyone articulata* Vaney, 1908 (designated by Thandar 1990).

Remarks. This genus was erected by Thandar (1990) for the southern African *Thyone articulata* Vaney, 1908, which remained monotypic since then and was thought to be strictly a southern African genus. The two new species described below are now referred to this genus which after all is not monotypic anymore.

Genus *Thyonina* Thandar, 1990

Thyonina bijui n. sp.
Figure 2

Diagnosis. A small, barrel-shaped species, about 20 mm in length. Colour in alcohol greyish-black to greyish-white, live colouration reddish-brown. Anal teeth absent, anal papillae present. Tube feet scattered, dorsally papilliform. Tentacles nine (?10), in 7 + 2 arrangement, blackish. Calcareous ring with fused radial and interradial plates, posterior processes of radial plates longer than height of ring, all arising from more or less same level, both ring and processes subdivided. Polian vesicle and stone canal single; madreporite dicotyledonous. Ossicles of body wall as slender, curved, smooth rods expanded and digitated at ends with one or more holes. Ossicles of tube feet similar; end-plates typical of type species. Tentacle ossicles comprise slender rods, rosette-like rods and minute mulberry-like rosettes. Introvert with rosettes similar to those of tentacles and tables.

Etymology. This species is named after one of its collectors, Dr Biju Kumar, of the Department of Aquatic Biology & Fisheries, University of Kerala (DABFUK), India, for allowing me to examine the materials in his museum collections.

Holotype. DABFUK ECH HO 17. Vizhinjam, Kerala State, India (Arabian Sea), SCUBA gear, 2 m., 02 March 2013, collected by Biju Kumar and Deepa Pillai.

Paratype. DABFUK ECH HO 18. Same data as holotype.

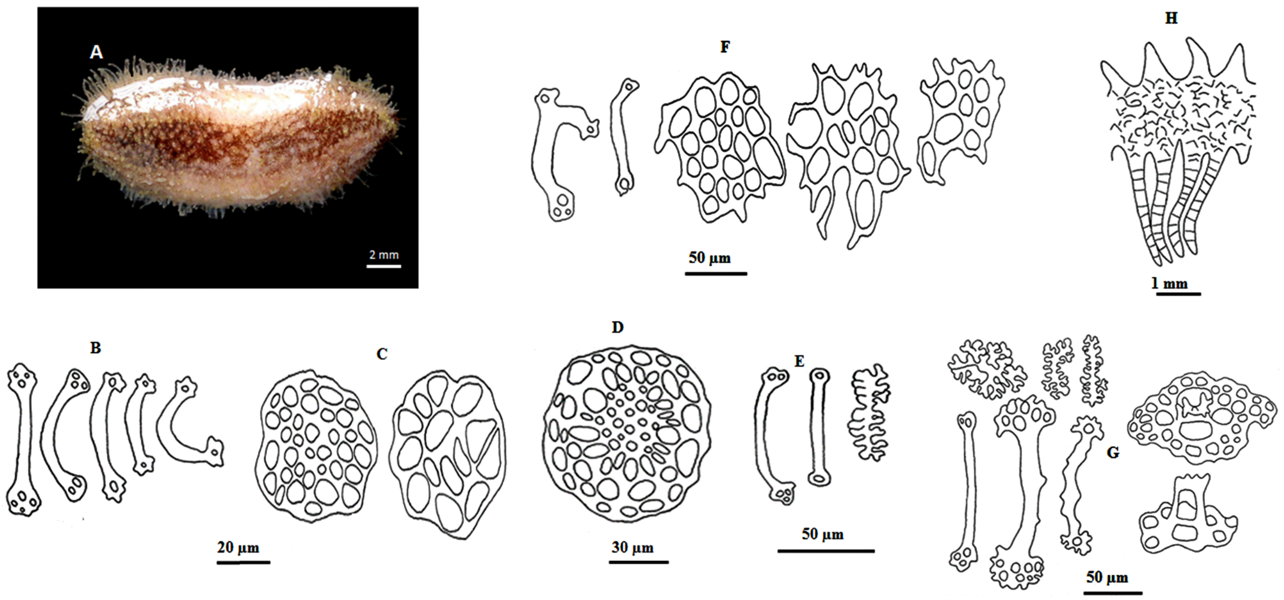

FIGURE 2. *Thyonina bijui* n. sp. A. Specimen entire (holotype, DABFUK ECH HO 17); B. Body wall ossicles; C. Ventral podia plates; D. Dorsal podia plate; E. rods and rosettes from tentacles; F. Anal region ossicles; G. Introvert ossices; H. Part of calcareous ring (dorsal). (A–D, F, G by courtesy of Biju Kumar).

Description

Holotype

Specimen (Figure 2A) small, barrel-shaped, length about 20 mm, breadth in mid-body about 9 mm, live colouration reddish-brown, in alcohol greyish-black dorsally, greyish-white ventrally. Body wall thin, slightly rough to the touch. Mouth and anus terminal, the latter slightly sub-dorsal, anal teeth absent, anal papillae present. Tube feet scattered, elongated in living specimens, with suckers of more or less the same diameter as tube feet, the latter more abundant in the ventral ambulacra with some indication of their arrangement in rows. Dorsal tube feet small, papilliform. Tentacles retracted, nine (?10), in 7 + 2 arrangement, blackish, well-branched, typically dendrochirotid.

Calcareous ring complex (Figure 2H), well-calcified, mosaic, definitely of the thyonid type, tube well developed, radial and interradial plates fused, hardly leaving any mark of their original limits. Anterior tips of both radial and inter-radial plates triangular, non-bifid. Paired posterior processes of the radial plates longer than height of ring, all arising from more or less the same level at posterior border of interradial plates; both ring and processes subdivided into a mosaic of small pieces of calcite. Polian vesicle single, elongated, 10 mm long, with saccular distal end. Stone canal simple, very short, straight; madreporite small, dicotyledonous. Respiratory trees well branched. Gonadal tubules amorphous, full of mature gametes. Longitudinal muscles unpaired, well developed. Retractor muscles short, thick, perhaps due to retracted tentacles, arising from longitudinal bands anteriorly.

Ossicles of body wall comprise slender, curved, smooth rods, expanded and digitated at ends, each end perforated by one to few tiny holes (Figure 2B). No special ossicles in anal region except for some rods and degenerating end-plates of the anal papillae (Figure 2F). Ossicles of tube feet similar to those of body wall and end-plates (Figure 2C–D) to those of the type species, with small holes medially and large holes along the margin. Tentacle ossicles comprise slender rods, rosette-like rods and minute, mulberry-like, closed rosettes (Figure 2E). Introvert ossicles comprise rosettes similar to those of tentacles as well as tables with smooth, multilocular disc and short spire (Figure 2G).

Distribution. Known only from type locality Kerala on the Arabian Sea.

Remarks. In its body wall ossicles, the new species comes quite close to those of the genus *Roweia* Thandar, 1985, the type species of *Thyonina*, and another new species *Thyonina rasidae* n. sp., described below, differing from both *Thyonina* species in its conspicuous barrel-shaped form and a different type of calcareous ring. Its ventral tube feet end-plates are typical of the type species of *Thyonina* but it has no rods or plates in the tentacles, but its tentacle and introvert deposits (rods and rosettes) resemble those of *T. rasidae.*

According to Gustav Paulay (pers. comm.), the new *Thyonina* species from India (i. e., *T. bijui*) is sister to a yet an undescribed *Thyone* sp. from Oman, based on a preliminary genetic analyses (based on the COI sequences). The neighbour-joining tree suggests that the two lineages are closely related with about 4% divergence. Both lineages might prove to represent a single species or two distinct species and are sister to *Cucuvitrum* O'Loughlin & O'Hara, 1992 from Western Australia, including Tasmania. However, a close morphological examination is required of the Oman specimen to confirm its taxonomic status. Additionally, the type species *T. articulata* from South Africa and *T. rasidae,* described below, need to be included in the molecular analyses to determine their relationships with the lineages mentioned above.

Note. Judging from some some pictures received of the body form, colouration and ossicles of a specimen recently collected from Karachi (Pakistan), transmitted by Dr Quratulan Ahmed of the Marine Reference Collection and Resource Centre, University of Karachi, the specimen in question resembles *T. bijui* in its barrel-shape, colouration and tube feet end-plates rather than the new Karachi sp. described below. However, a detailed study of its calcareous ring, tentacle and introvert ossicles may prove otherwise. The museum lable reads as follows:

Catalogue No. :	Holo-22
Accession No. :	2035
Name:	*Thyonina* sp.
Site:	Buleji (Lat: 24°50'20.41" N Long: 66°49'24.15" E)
Depositors:	Quratulan Ahmed & Qadeer Mohammad Ali
Identifier:	Ahmed Thandar (South Africa)
No. of specimens:	one
Colour:	dark orangish with brownish tinge
Habitat:	attached to rock
Size:	length 30 mm; weight 5.95g
Received:	11-08-2017

Thyonina rasidae n.sp.
Figure 3

Diagnosis. A strongly U-shaped species, up to 50 mm in length along ventral surface; mouth surrounded by fringe of papillae. Colour off white in alcohol. Tentacles 10, ventral two reduced, others of unequal length. Tube feet short, scattered. Anal teeth absent, anal papillae present. Calcareous ring complex, radial and interradial plates short, faintly fused and weakly subdivided into few pieces of calcite; posterior processes of radial plates long, about thrice the length of ring, conspicuously subdivided. Polian vesicles four, one long, others diminutive; stone canal short, madreporite spherical. Body wall ossicles as smooth curved rods, 20–47 µm long, with dichotomously branched and/or perforated ends. Tube feet with similar rods, end-plates reduced. Introvert with closed mulberry-like rosettes. Tentacles with mulberry-like bodies and rods, of which some rosette-like.

Etymology. This species is named after my dear wife Rasida for her patience and tolerance in allowing me to continue with my passion long after retirement.

Holotype. NHMUK 1883.4.19.7, Kurrachee (colonial spelling of Karachi), ex Karachi Museum, Pakistan.

Paratypes. NHMUK 1883.4.19.8-9. Same data as the holotype, 2 specimens.

Description. All three specimens U-shaped, mouth and anus terminal, level of mouth higher than that of anus, anal end attenuated. Length 28–51 mm, mid-body width 5–10 mm. Skin thin, colour off white in alcohol.

Holotype

Length 51 mm (Figure 3A). Tentacles 10, white, bushy, in 8 + 2 arrangement, ventral two reduced, others of unequal length, longer ones occurring dorsally, decreasing in size ventrally. Tube feet short, well developed, scattered, longer and more numerous in ventral ambulacra, decreasing in size dorsally, suckers conspicuous. Mouth circular, surrounded by a fringe of papillae. Anal teeth absent but anal papillae present in pairs in the five radii surrounding anus.

Calcareous ring complex (Figure 3G), radial and interradial plates short, faintly fused, plates weakly subdivided but subdivisions not obvious. Radial plates anteriorly bifid, but bifurcations not conspicuous; some radial plates somewhat incised posteriorly; posterior processes of radial plates arise at posterior border of the interradial plates; posterior processes long, about thrice the size of the ring itself, all conspicuously subdivided. Polian vesicles four, of variable length, longest one straight, tubular, 10 mm in length, remaining three diminutive, dorsal in position, apparently arising at the same point as the stone canal. Stone canal short, thin, straight, embedded in dorsal mesentery; madreporite spherical. Longitudinal muscles unpaired; retractors arise from longitudinal muscles at about mid-body, dorsal ones more anteriorly.

Body wall ossicles comprise smooth, curved rods (Figure 3C) of two types: delicate ones 20–47 µm long (mean 36 µm) with dichotomously branched and/or perforated ends; stouter rods with corrugated surface and also with perforated and/or branched ends, both types somewhat corroded, hence corrugation of the larger rods perhaps a result of corrosion. Anal region supported by fragmented, perforated plates on way to corrosion (Figure 3B). Other perforated plates in body wall are perhaps remains of tube feet end-plates but without any regular arrangement of holes. Tube feet supported by similar rods and reduced end-plates (Figure 3D), also without regular arrangement of holes and showing signs of corrosion. Introvert supported by closed, mulberry-like rosettes, 12–22 µm (mean 16 µm) and branched rods (Figure 3F) and tentacles by rods with few "branches", thus appearing as open rosettes, as well as closed mulberry like rosettes, 11–29 µm (mean 17 µm) (Figure 3E).

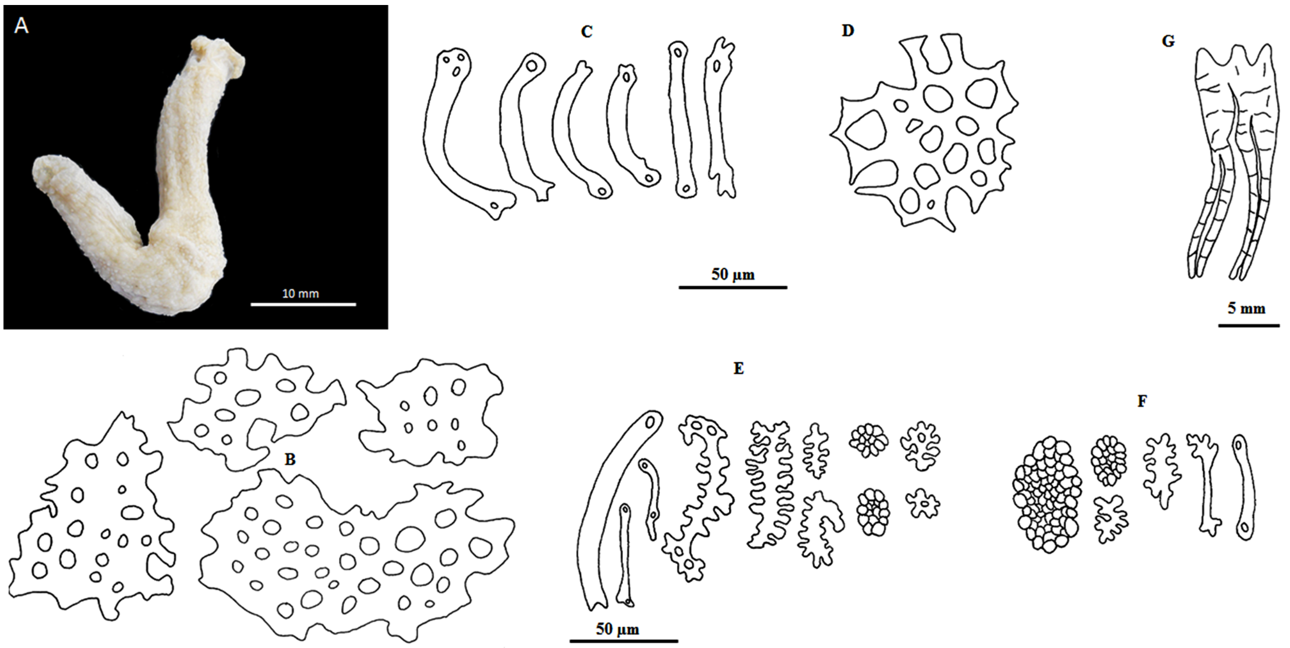

FIGURE 3. *Thyonina rasidae* n. sp. A. Specimen entire (holotype,NHMUK 1883.4.19.7); B. Anal body wall plates; C. Body wall ossicles; D. Tube feet end-plate; E. Rods and rosettes from tentacles; F. Rods and rosettes from introvert; G. Part of calcareous ring (dorsal). (B–F drawn to same scale).

Distribution. Known only from Karachi, Pakistan (Arabian Sea).

Remarks. *Thyonina articulata* from South Africa was the only species in this genus, hence the genus was long thought to be monotypic and endemic to South Africa. The presence now of a similar but not identical form from Karachi, Pakistan (*T. rasidae* n. sp.), and another form (*T. bijui* n. sp.) with similar ossicles from Kerala, India, also in the Arabian Sea, described above, confirms that the genus is not monotypic after all. The Pakistan species differs from the South African *T. articulata* not only in the form of the body and the size and form of the body wall rods, but also in the tentacle and introvert deposits and tube feet end-plates. The tentacle deposits in the South African species comprise plates only, compared to rods and rosettes in the Pakistan and Kerala forms. The end-plates of the South African form and *T. bijui* are very characteristic with minute medial holes surrounded by a ring of larger holes outside these. However, these deposits in *T. rasidae*, although somewhat corroded show no signs of clearly differentiated holes with regular arrangement. The calcareous ring is also quite different with the new species not showing as much fragmentation of plates as the type species and *T. bijui*, and the processes are much longer.

Family Cucumariidae Ludwig, 1894

Subfamily Cucumariinae Ludwig, 1894

Genus *Cladodactyla* Brandt, 1835

Cladodactyla pesdispersa n. sp.
Figure 4

Diagnosis
A cylindrical, cucumber-like species of *Cladodactyla*, up to about 56 mm long. Colour in alcohol an admixture of dark and light brown. Tentacles 10, ventral two considerably reduced. Tube feet thick, scattered. Anal teeth present. Calcareous ring typically cucumariid, dorsal radial and interradial plates fused. Polian vesicle elongated; stone canal short, madreporite oval to spherical. Each respiratory with two main branches. Body wall ossicles few, comprising smooth multilocular plates with up to 12 holes; plates of anal region with two or more arms and minute perforations, some rod-like, with usually two apophyses, both rod and apophyses terminally perforated. Tube feet with usually curved rods, minutely perforated at ends and often with medial projection/spine; end-plates reduced. Ossicles of tentacles as simple rods, some rosette-like, and rosettes. Introvert with elongated rods, some stellate, and minute plates and rosettes.

Etymology. The specific name is with reference to the scattered tube feet as opposed to their ambulacral restriction in its congenerics: *pes* (Latin) – feet, *dispersisti* (Latin) – scattered.

Holotype. NHMUK 1873.7.29.2a, Angola (detailed locality and depth unknown).

Paratype. NHMUK 1873.7.29.2b, locality as above.

Description

Holotype (Figure 4A).
Previously dissected. Calcareous ring and alimentary canal slightly damaged. Form cylindrical, cucumber-like. Colour in alcohol an admixture of dark and light brown; skin wrinkled and soft. Length 56 mm, breadth in mid-body 19 mm. Tentacles 10, dendritic, extremely well-branched, ventral two very evidently reduced, all tentacles dark brown to blackish in colour. Tube feet well developed, thick, scattered, more numerous ventrally but with no indication of their arrangement in rows or their restriction to ambulacra, dorsally reduced, more retractile; suckers more or less of same diameter as tube feet. Mouth and anus terminal, anal teeth short, blunt.

Calcareous ring (Figure 4I) typically cucumariid without any evidence of posterior prolongations of any sort. Dorsal radial and interradial plates fused, mid-ventral radial and adjacent interradial plates not fused; radial plates slightly longer and bifid anteriorly, deeply notched posteriorly; interradial plates triangular with undulating posterior margin. Polian vesicle single, extremely long, extending to level of cloaca; stone canal also single, extremely short, thin, sinuous and embedded in dorsal mesentery; madreporite oval to spherical, brain-coral-like. Respiratory trees well branched, each with two main branches of which one is much shorter than the other. Longitudinal muscles paired; retractor muscles exceptionally well developed, arising from longitudinal muscles, more anteriorly in the ventral ambulacra. Gonad comprising few, elongated, unbranched tubules; gametes not discernible. Cloaca elongate, suspensor muscles exceptionally well formed.

Body wall ossicles few, scattered, comprising simple multilocular plates (Figure 4C–D) with a varying number of holes (up to 12), margins and surface of plates smooth; holes variable in size. Dorsal plates (Figure 4C) 195–390 µm (mean 283 µm), usually larger than those of the ventral surface (Figure 4D), 215–320 µm (mean 258 µm), with larger holes; plates of anal region 215–525 µm (mean 360 µm), of various form (Figure 4B), usually large, with two or more arms and minute perforations, either localized on the entire plate or on the arms alone, or both, some plates rod-like, curved, with usually two apophyses, both rod and apophyses terminally perforated by usually a single hole. Tube feet ossicles comprise simple rods (Figure 4F), 200–440 µm long (mean 326 µm), usually curved, minutely perforated at ends and often with a medial branch, projection or spine, sometimes with a pronounced apophysis; end-plates ca. 131 µm, reduced, especially those of the dorsal tube feet, margins irregular, holes large and irregularly scattered (Figure 4H). Ossicles of tentacles (Figure 4E) comprise simple rods, rosette-like rods, 135–265 µm long (mean 208 µm), and rosettes of various form and size, 15–67 µm (mean 43 µm). Introvert deposits (Figure 4G) comprise elongated rods, 464–971 µm (mean 710 µm) with minute perforations throughout their length, with irregular terminations, some rods star-shaped or as minute plates and rosettes.

Distribution. Known only from Angola.

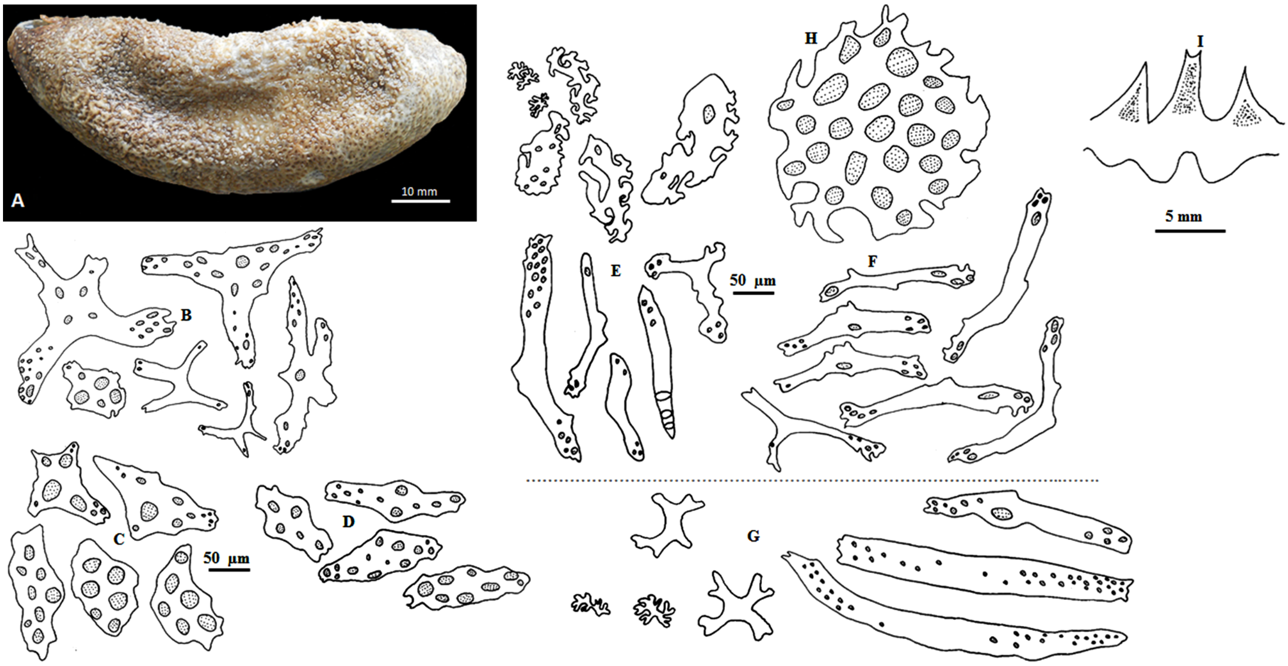

FIGURE 4. *Cladodactyla pesdispersa* n. sp. A. Specimen entire (paratype, NHMUK 1873.7.29.2b); B. Anal ossicles; C. Ventral body wall ossicles; D. Dorsal body wall ossicles; E. Tentacle rods; F. Tube feet rods; G. Introvert ossicles; H. End plate; I. Part of calcareous ring (dorsal). (B–H drawn to same scale).

Remarks. It is regrettable that this new species, represented by two well-preserved specimens, has only Angola, West Africa, as its recorded locality, without any reference to its exact site of collection, coordinates, or depth at which it was taken. Judging from the form of its body and ossicles this species obviously belongs in the genus *Cladodactyla* and I was at first inclined to identify it as representing *C. senegalensis* since its body wall and tentacle ossicles come quite close to those recorded for the species by Panning (1940), Cherbonnier (1950a), and Massin (1993). Regrettably none of these workers examined or illustrated the introvert ossicles which appear to be quite characteristic. All of them describe the arrangement of tube feet in their materials of *C. senegalensis* in rows in the ambulacra of both the dorsal and ventral surfaces. In the specimens at hand, the tube feet are clearly scattered and hence the current material cannot be referred to *C. senegalensis.* The new species also differs from the type species of *Cladodactyla*, *C. crocea* Lesson, 1830, or the South African *C. brunspicula* Thandar, 2008, which have 10 equal tentacles and restricted tube feet. *C. monodi* Cherbonnier, 1950b has knobbed plates and was recently referred to the genus *Stereoderma* by Thandar & Mjobo (2014). The calcareous ring of the new species also differs from that of *C. monodi* illustrated notably by Cherbonnier (1950b) and Massin (1993). *C. senagalensis* has not yet been recorded from south of the equator. The poorly preserved indeterminate *Cladodactyla* sp. recorded from Angola by Thandar *et al.* (2010) may be regarded as conspecific with *C. pesdispersa* n. sp. if it were not for its imbricating plates.

Acknowledgements

I thank the National Research Foundation (NRF South Africa) and the University of KwaZulu-Natal for financial support during the cause of this work. Special thanks are due to NHMUK (especially to Andrew Cabrinovic) for the loan of its invaluable collection which rendered two new species and one new subspecies and to Drs. Biju Kumar and Deepa Pillai of DABFUK for allowing me to examine their materials which resulted in the description of another new species. Gratitude is also due to Dr. Gustav Paulay of the Florida Museum of Natural History for his preliminary molecular work on *Thyonina bijui* and a related but as yet undescribed form from Oman.

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