

Taxonomy of the monotypic genus *Koehleria* Cherbonnier, 1988 (Echinodermata: Holothuroidea: Cucumariidae)

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Abstract

Voucher material recently collected from the 2-Mile Reef at Sodwana Bay (Republic of South Africa), allows the evaluation of the monotypic genus *Koehleria* Cherbonnier, 1988 and its species *K. unica* Cherbonnier, 1988 collected from Tuléar (Madagascar). Cherbonnier's (1988) conclusion, that *Koehleria* is most related to the also monotypic genus *Pseudocolochirus* Pearson, 1910 is correct, but the differences between *Koehleria* and *Pseudocolochirus* are too small to justify the retention of *Koehleria*. *Koehleria* is relegated herein to the synonymy of *Pseudocolochirus*. Such a step decreases the velocity with which monotypic genera are currently described within the Dendrochirotida.

Key words: Holothuroidea; Cucumariidae; *Koehleria*; *Pseudocolochirus*; *P. unica*. comb. nov.

Introduction

The past quarter century has witnessed a considerable increase in knowledge of the biodiversity of the shallow-water (up to 50 m depth) holothuroids of southern Africa (Thandar 1977, 1984, 1985, 1986, 1987a, b, 1989a, b, c, 1990, 1991, 1994, 1996, 2001; Thandar & Rowe 1989; Rajpal & Thandar 1998, 1999; Thandar & Rajpal 1999; Samyn 2003; Samyn & Thandar 2003a, b; Samyn & Massin 2003; Thandar & Natasen Moodley 2003; Massin *et al.* 2004; Thandar & Samyn in press). However, relating this local biodiversity with neighbouring regions in the south-western Indian Ocean remains problematic (Thandar &

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Samyn in press) as several systematic uncertainties exist *vis-à-vis* the validity of several published records from this large region. This can be exemplified by Cherbonnier's (1988) monograph on the shallow-water holothuroids of Madagascar, a work that is generally accepted as one of the standard references for East Africa. The taxonomic and zoogeographic value of Cherbonnier's (1988) monograph can be grasped easily from its immense temporal and geographical scope (it spans more than a century of sampling and covers a considerable part of larger Madagascar). But, the observation (Samyn & Tallon in press) that more than a third (45 of 122) of the species treated in this work are new to science, in combination with the fact that in 40% of the cases (18 of 45) these descriptions are based on only a single specimen and in roughly 16% of the cases (7 of 45) on just two specimens, raises questions as to the validity of new taxa. Moreover, as it is well-known that ossicles (the main taxonomic character in holothuroids) often change with increasing age (a.o. Thandar 1987a; Massin 1994; Sewell *et al.* 1995; Cutress 1996; Massin *et al.* 2000), many of Cherbonnier's small species may be synonyms of other existing nominal species. Thus, additional information on each of Cherbonnier's (1988) ill-known new species is crucial to arrive at a stable checklist of the south-western Indian Ocean holothuroids. We here provide additional information on just one such species, based on a single specimen collected from shallow-waters of the east coast of South Africa and propose that Cherbonnier's genus *Koehleria* is best treated as a subjective junior synonym of *Pseudocolochirus* Pearson, 1910.

The spectacular increase, in the last half century, in the number of monotypic genera in the large order Dendrochirotida (Pawson 1963; Rowe 1970; Cherbonnier 1972, 1988; Thandar 1986, 1989c, 1990, 1991; Gutt 1990; O'Loughlin & O'Hara 1992; Thandar & Natasen Moodley 2003; among others), seems to indicate that: (i) the diagnoses of many existing genera are fragmentary and hence lack sufficient distinction, (ii) the relationships between the constituent species are poorly understood and, (iii) many of these monotypic genera will prove invalid once more material becomes available for comparative studies.

Here, we provide evidence that Cherbonnier's (1988) genus *Koehleria* is invalid as the diagnostic characters employed by him are better treated as intrageneric variations within *Pseudocolochirus*.

Systematic account

Order Dendrochirotida Grube

Family Cucumariidae Ludwig

Genus *Pseudocolochirus* Pearson

Koehleria Cherbonnier, 1988: 178 (syn. nov.).

Diagnosis (after Pearson 1910: 172, amended herein) [Type-species: *Colochirus violaceus* Théel, 1886, by monotypy]

Small to medium-sized species; tentacles ten, of more or less equal size; larger podia restricted to ambulacra of trivium; smaller podia papilliform, scattered in the interambulacra of especially the bivium; anus dorsal, surrounded by anal teeth, very conspicuous in the type species. Ossicles of body wall scarce or numerous, comprising large or small perforated plates / rods of variable thickness, with holes often occluded; few large reticulate rosace-like plates also present.

Key to the species of *Pseudocolochirus*

1. Conspicuously coloured species with podia in yellow, orange or red bands against a bright blue to purple background; anal teeth conspicuous; body wall ossicles scarce, especially dorsally, comprising small irregular smooth to slightly knobbed plates, usually perforated by one to few holes, in addition to large, thick, multilocular plates with smooth rim *Pseudocolochirus violaceus* (Théel, 1886)
2. Yellowish to beige-brown species, mottled with dark spots and irregular dark blotches; anal teeth present but inconspicuous; body wall ossicles abundant, comprising numerous, thick, multilocular plates with spiny rim
..... *Pseudocolochirus unica* (Cherbonnier, 1988)

Pseudocolochirus unica (Cherbonnier, 1988) (comb. nov.) (figs 1, 2)

Koehleria unica Cherbonnier, 1988: 178, figs 75A–L.

Material examined. Republic of South Africa (Sodwana Bay, 2-Mile Reef), 10.ii.2001, 12 m depth, coll. Y. Samyn, RMCA1731 / RSAKZN/0157 (1 specimen).

Description. Specimen well preserved; mouth anterior, tentacles extended; anus posterior, dorsally directed. Length (excluding tentacles) 32 mm; width of mid-body 10 mm; height 12 mm. Colour of dorsal surface, in alcohol, beige-brown with dark speckles and other dark blotches arranged in two irregular series of 3–4 pairs; ventral surface off-white to yellowish. Body wall moderately thick (<1 mm), only slightly rough to the touch. Podia in two rows in ambulacra, also scattered in interambulacra of especially mid-ventral surface where they appear in more than two rows; dorsal interambulacra also with numerous, scattered, papilliform podia. Anteriorly, podia well-developed in five groups around mouth, each group with 4–8 podia. Tentacles 10, only four partially extended, well-branched, all of more or less equal size (ventral two slightly smaller), dark brown in colouration. Anus terminal, star-shaped, surrounded by minute, conical anal teeth.

Calcareous ring (fig. 1H) well developed, low, simple, without posterior prolongations; radial and interradial plates of more or less equal size, anterior projections of radial

plates with a deep groove for attachment of retractor muscles; posterior margins of all plates notched, those of interradians deeper and more pronounced. Polian vesicle single, elongated, about 8 mm long, with dark brown streaks. Stone canal single, short, twisted in dorsal mesentery; madreporite four-lobed (fig. 1J). Introvert retractor muscles well developed, originating as single strands from the longitudinal muscles in anterior third of body, more posteriorly in the ventral ambulacra. Gonad well developed, tubules straight, unbranched, full of sperm, filling most of posterior half of body cavity. Respiratory trees richly branched, reaching anterior end of body, both trees arise independently from narrow, slightly elongated cloaca.

Ossicles of dorsal and ventral body wall (figs 1A, B, C; 2A, B, D) similar in size and shape, increasing in length antero-posteriorly (tables 1, 2), comprising simple, thick, perforated rods or plates with spiny or serrated margins, holes variable in number and usually small in diameter, frequently occluded.

TABLE 1. Dorsal deposits of *Pseudocolochirus unica* (Cherbonnier, 1988); s.d. = standard deviation, n = number of ossicles measured.

	Dorsal deposits								
	<i>Anterior</i>			<i>Mid</i>			<i>Posterior</i>		
	length (μm)	width (μm)	holes	length (μm)	width (μm)	holes	length (μm)	width (μm)	holes
mean	215.7	128.1	6	279.1	149.3	8.1	329.8	153.1	9.8
s.d.	26.4	25.9	1.6	46.6	23.2	2.4	61.3	24.8	3.1
n	30	30	30	30	30	30	30	30	30

TABLE 2. Ventral deposits of *Pseudocolochirus unica* (Cherbonnier, 1988); s.d. = standard deviation, n = number of ossicles measured.

	Ventral deposits								
	<i>Anterior</i>			<i>Mid</i>			<i>Posterior</i>		
	length (μm)	width (μm)	holes	length (μm)	width (μm)	holes	length (μm)	width (μm)	holes
mean	263.7	143.2	8.5	291.6	141.3	7.9	298.5	130.1	7.4
s.d.	43.2	30.4	2.4	47.2	25.9	2.8	43.9	25.8	2.3
n	30	30	30	30	30	30	30	30	30

Dorsal deposits 165–475 μm long, 85–190 μm wide, with 3–21 holes (figs 1A; 2A). Ventral deposits 175–390 μm long, 85–220 μm wide, with 4–15 holes (figs 1B; 2D). Ven-

tral body wall also with few other reticulated rosace-like plates, up to 420 μm in size, with irregular margins and numerous holes (figs 1C; 2B). Podia with simple, slightly spiny rods (figs 1F; 2E) with one or more perforations at each end, suckers strengthened by well-formed end-plates (figs 1G; 2C). Tentacle deposits include rods and rosettes (Figs 1D, E; 2F, G); rods 150–250 μm long, straight or slightly curved with one or more perforations at each end; rosettes 20–40 μm long, in the form of branched rods or crinkly corpuscles (tab. 3). Introvert without ossicles.

TABLE 3. Length of tentacle deposits of *Pseudocolochirus unica* (Cherbonnier, 1988); s.d. = standard deviation, n = number of ossicles measured.

	Rods (μm)	Rosettes (μm)
mean	195	30.5
s.d.	29.7	5.8
n	14	30

Ecology. The specimen was found under a large coral block, at 12 m depth, in association with *Holothuria* (*Mertensiothuria*) *hilla* Lesson. Cherbonnier (1988) reported that the holotype was recovered from the cryptofaunal crevices of the reef flat of Tuléar, during ebb tide. It thus seems that this species is fugitive rather than fossorial.

The cryptic behaviour and the small size of the species make it difficult to find; as such commenting on its rarity is currently impossible.

Remarks. This is only the second specimen of *P. unica* (Cherbonnier). In general its internal and external morphology and its ossicle assemblage correspond well with the original description. The observed differences are the following: (i) the holotype has a uniform yellowish colouration while our specimen is mottled with dark spots and irregularly arranged blotches; (ii) the holotype possesses two Polian vesicles while we observed only a single one; (iii) the holotype's madreporite is described as spherical, while in our specimen it is distinctly four-lobed (Fig. 1J); (iv) the introvert retractor muscles of the holotype are described as being special, each consisting of two discrete, thick strands; in the present specimen the retractor muscles are simple and not divided; (v) the holotype is reported without anal teeth, whereas in the present specimen minute anal teeth were observed. However, the overall ossicle assemblage of the holotype corresponds remarkably well with what is reported here, both in structure and in dimensions, although it must be noted that in Cherbonnier's (1988) description, the ossicles from the podia have, in the text, been confused with those from the tentacles (see Cherbonnier 1988: 179, fig. 75 L for tentacle and not podia deposits and compare with figs 1E, 2F in our description).

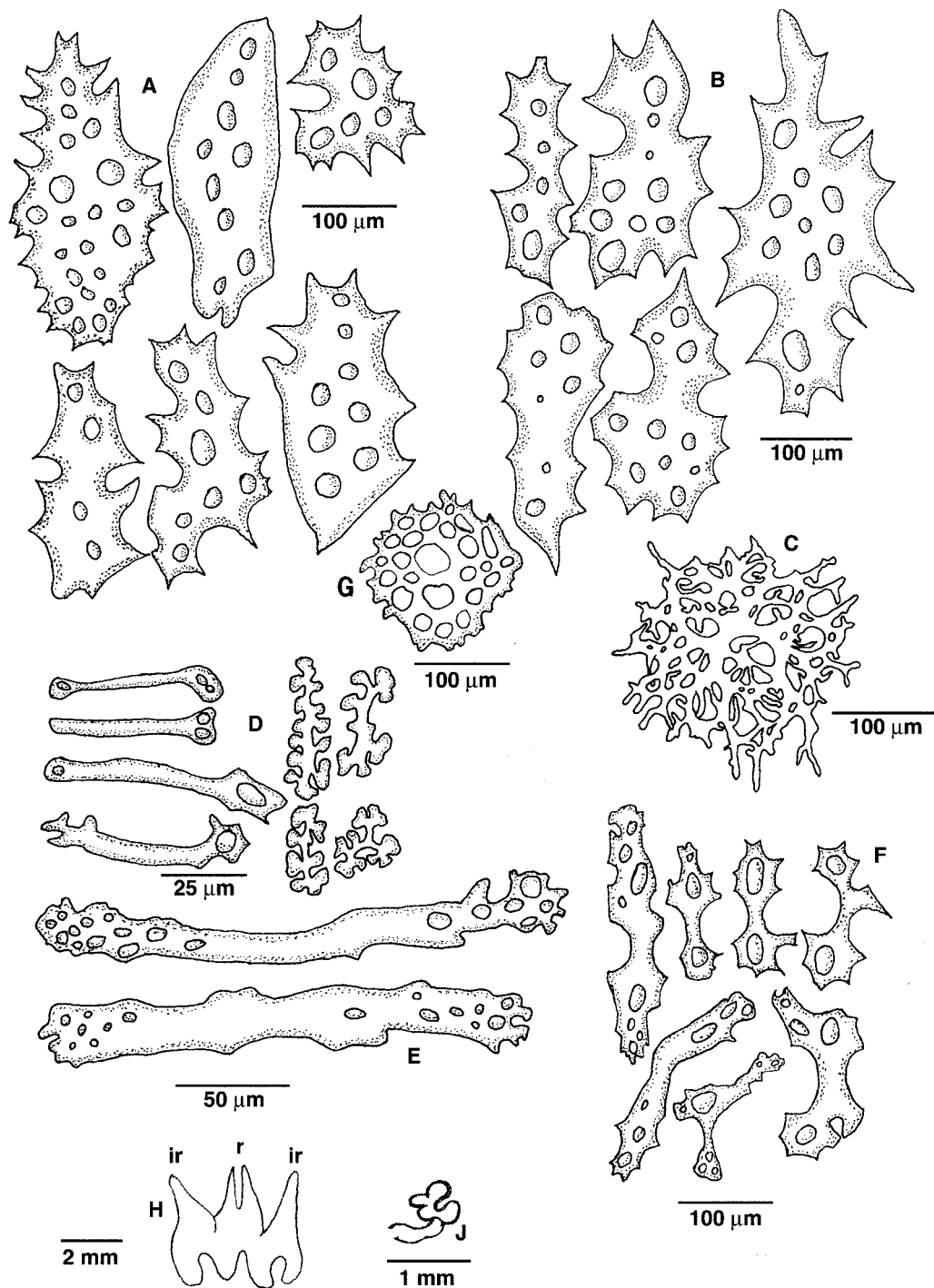


FIGURE 1. *Pseudocolochirus unica* (Cherbonnier, 1988) from South Africa. Ossicles. A. from dorsal body wall; B. from ventral body wall; C. rosace-like reticulated plate from ventral body wall; D. minute rods and rosettes from tentacle; E. large rods from tentacle; F. ventral podia deposits; G. podia end-plate; H. calcareous ring (r=radial plate; ir=interradial plate); J. stone canal and madreporite.

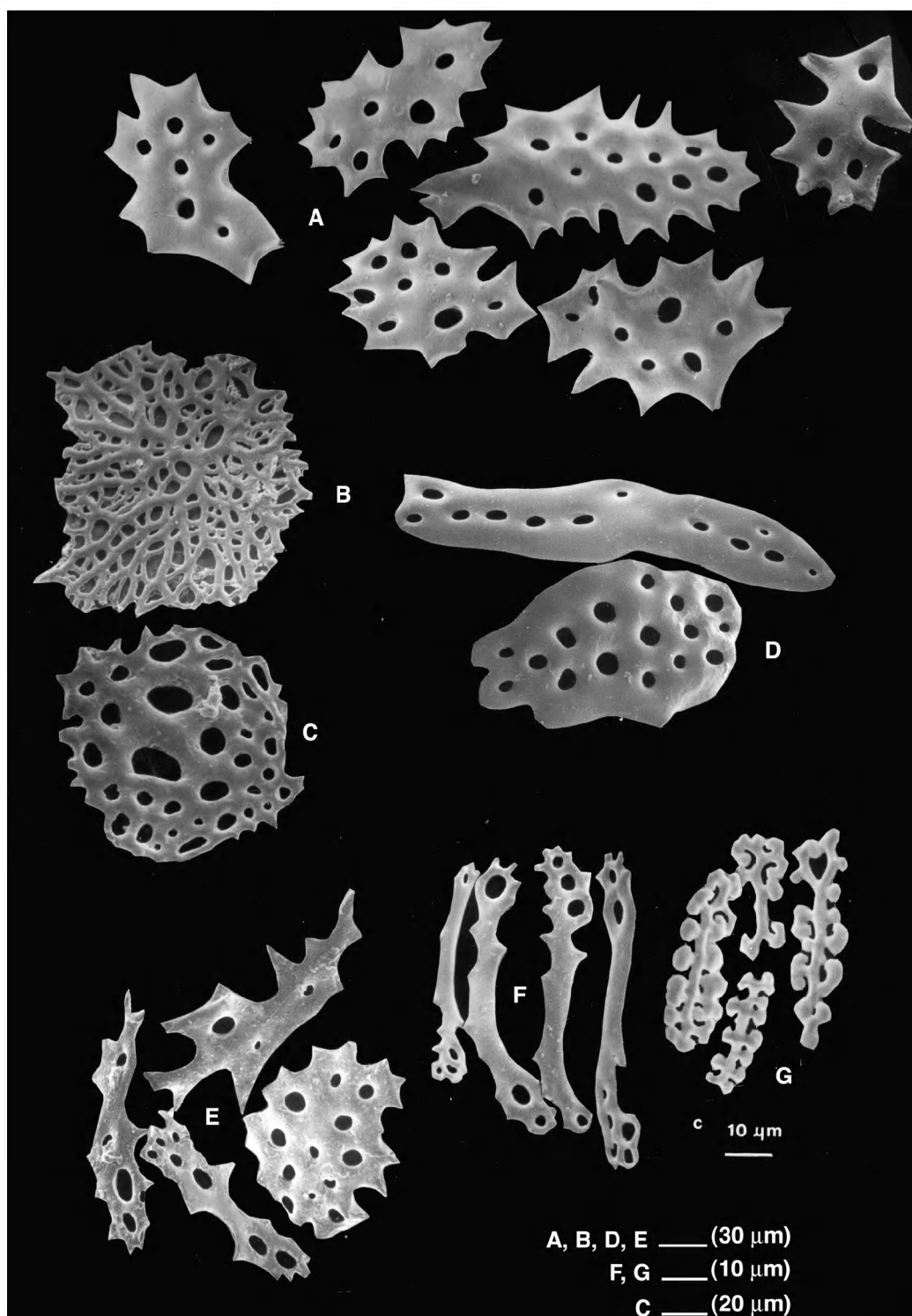


FIGURE 2. *Pseudocolochirus unica* (Cherbonnier, 1988) from South Africa. Ossicles. A. from dorsal body wall; B. rosace-like reticulated plate from ventral body wall; C. podia end-plate; D. ventral body wall; E. podia deposits; F. tentacle rods; G. tentacle rosettes.

The above differences are intraspecific variations within *P. unica*, since it has been evidenced that in many taxa the colouration and number of Polian vesicles are variable characters. Regrettably, since little or no data exist as to the taxonomic significance of the form of the madreporite (see also Deichmann 1948) and the branching-off points of the retractor muscles, we cannot comment on these differences, as they may be specimen-rather than species-specific.

In order to judge the status of the genus *Koehleria*, we first need to position it within the higher-level taxonomy of the Cucumariidae, the family in which Cherbonnier (1988) quite correctly placed *Koehleria*. In this family, Pawson & Fell 1965 recognise three subfamilies: Cucumariinae Ludwig, Colochirinae Panning and Thyonidiinae Heding & Panning. Of these only the first two include ten-tentacled species. The Colochirinae, in addition, are characterised by species which possess complete or incomplete baskets in the body wall, while the Cucumariinae lack baskets in their body wall, at least in their adult stage (Thandar 1991). Cherbonnier (1988), who refrained from assigning subfamilies, implied that *Koehleria* is classified within the Cucumariinae by stating that it comes closest to *Pseudocolochirus*. The latter is classified in the Cucumariinae (see Thandar 1991). However, we believe that the characters used by Cherbonnier (1988) to erect his new genus are inadequate. Cherbonnier only commented that *Koehleria* differs from *Pseudocolochirus* in the “forme si particulière des spicules” and the absence of anal teeth. In this study, we have shown that *unica* does have anal teeth and that the ossicle assemblage it presents is similar to that of *P. violaceus*. As such, we believe that the genus *Koehleria* is invalid and must best be regarded as a junior subjective synonym of *Pseudocolochirus*.

TABLE 4. Ossicle assemblage of *P. unica* (Cherbonnier, 1988) and *P. violaceus* (Théel, 1886). The differences are mainly in size and in abundance of dorsal ossicles in *P. violaceus* and the smoothness of its plates.

Ossicle assemblage	<i>P. unica</i> (Cherbonnier, 1988)	<i>P. violaceus</i> (Théel, 1886)
dorsal body wall	thick perforated rods or plates with serrated to spiny rim; mean length 274 mm; mean width 143 mm; holes per ossicle 3–21, frequently occluded	ossicles scarce or absent
ventral body wall	similar in size (mean length 284 mm; mean width 138 mm; holes 4–15) and shape as those of dorsal body wall, but few reticulated rosace-like plates (diameter up to 420 mm) with irregular margins and numerous holes also present.	scarce, thick, subcircular to elongated perforated rods or plates with slightly knobbed or smooth margin; mean length \pm 114 mm; mean width \pm 70 mm; average number of holes per ossicle 9; anal end with reticulated rosette-like plates (diameter roughly 220 mm) with irregular margins and numerous holes
ventral podia	simple, slightly spined rods with one or more perforations at each end or small multilocular plates with spiny margins	perforated rods to irregular multilocular plates with corrugated/crinkly margin
tentacles	rods and rosettes	rods and rosette-derived plates
introvert	no ossicles	no ossicles

Table 4 summarizes the ossicle assemblage of the two species now recognized in *Pseudocolochirus*.

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References

- Cherbonnier, G. (1988) Echinodermes: Holothurides. *Faune de Madagascar*, 70, 1–292.
- Cherbonnier, G. (1972) *Neocnus incubans*, nouveau genre et nouvelle espèce d'Holothurie dendrochirote incubatrice de Méditerranée, *Comptes Rendus des séances de l'Académie de Science de Paris*, 275, 225–227.
- Cutress, B.M. (1996) Changes in dermal ossicles during somatic growth in Caribbean littoral sea cucumbers (Echinoidea [sic]: Holothuroidea: Aspidochirotida), *Bulletin of Marine Science*, 58, 44–116.
- Deichmann, E. (1948) The Holothurian Fauna of South Africa, *Annals of the Natal Museum*, 11, 325–376.
- Gutt, J. (1990) New Antarctic holothurians (Echinodermata) – I. Five new species with four new genera of the order Dendrochirotida, *Zoologica Scripta*, 19, 101–117.
- Massin, C. (1994) Ossicle variation in Antarctic dendrochirote holothurians (Echinodermata), *Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, 64, 129–146.
- Massin, C., Mercier A. & Hamel, J.-F. (2000) Ossicle change in *Holothuria scabra* with a discussion of ossicle evolution within the Holothuriidae (Echinodermata), *Acta Zoologica*, 81, 77–91.
- Massin, C., Samyn, Y. & Thandar, A.S. (2004) The genus *Labidodemas* (Echinodermata: Aspidochirotida) revisited with description of three new species and with re-positioning of *Holothuria (Irenothuria) maccullochi* (Deichmann, 1958), *Journal of Natural History*, 38, 1811–1874.
- O'Loughlin, P.M. & O'Hara T.D. (1992) New cucumariid holothurians (Echinodermata) from southern Australia, including two brooding and one fissiparous species, *Memoirs of the Museum of Victoria*, 53, 227–266.
- Pawson, D.L. (1963) The Holothurian Fauna of Cook Strait, New Zealand, *Zoology Publications from Victoria University of Wellington*, 36, 1–38.
- Pawson, D.L. & Fell, H. B. (1965) A revised classification of the dendrochirote holothurians, *Breviora*, 214, 1–7.
- Pearson, J. (1910) On marine fauna from Kerimba Archipelago. 2. Littoral Marine Fauna: Kerimba Archipelago, Portuguese East Africa, Holothuroidea, *Proceedings of the Zoological Society, London*, 1910, 167–182.
- Rajpal, V. & Thandar, A.S. (1998) *Neocucumis kilburni* sp. nov. (Echinodermata: Holothuroidea:

- Cucumariidae) from the east coast of South Africa, with a key to the genus *Neocucumis*, *South African Journal of Zoology* 33, 195–199.
- Rajpal, V. & Thandar, A.S. (1999) *Stolus kilberti*, a new species from the east coast of South Africa (Echinodermata: Holothuroidea: Dendrochirotida) with a key to the genus *Stolus* Selenka, *South African Journal of Zoology*, 34, 130–133.
- Rowe, F.W.E. (1970) A note on the British species of cucumarians, involving the erection of two new nominal genera, *Journal of the marine biological Association of the United Kingdom*, 50, 683–687.
- Samyn, Y. (2003) Shallow-water Holothuroidea (Echinodermata) from Kenya and Pemba Island, Tanzania, *Studies in Afrotropical Zoology*, 292, 158 pp.
- Samyn, Y. & Massin, C. (2003) The holothurian subgenus *Mertensiothuria* (Aspidochirotida: Holothuriidae) revisited, *Journal of Natural History*, 37, 2487–2519.
- Samyn, Y. & Thandar, A.S. (2003a) Towards an understanding of the shallow-water echinoderm biodiversity of KwaZulu-Natal, Republic of South Africa. In: Féral, J.-P. & David, B. (Eds). *Echinoderm Research 2001*, Swets & Zeitlinger, Lisse, The Netherlands, pp. 41–47.
- Samyn, Y. & Thandar, A.S. (2003b) *Massinium*, a new genus in the holothuroid family Phyllophoridae (Holothuroidea: Dendrochirotida) with description of a new south-west Indian Ocean species *M. maculosum*, *Belgian Journal of Zoology*, 133, 135–142.
- Samyn, Y. & Tallon, I. (in press) Zoogeography of the shallow-water holothuroids of the western Indian Ocean, *Journal of Biogeography*.
- Sewell, M.A., Thandar, A.S. & Chia F.-S. (1995) A redescription of *Leptosynapta clarki* Heding (Echinodermata: Holothuroidea) from the northeast Pacific, with notes on changes in spicule form and size with age, *Canadian Journal of Zoology*, 73, 469–485.
- Thandar, A.S. (1977) Descriptions of two new species of Holothuroidea from the East Coast of South Africa, *Annals of the Natal Museum*, 23, 57–66.
- Thandar, A.S. (1984) *The holothurian fauna of southern Africa*, PhD thesis, University of Durban-Westville, South Africa, 566 pp.
- Thandar, A.S. (1985) A new southern African genus in the holothurian family Cucumariidae (Echinodermata: Holothuroidea) with the recognition of two subspecies in *Cucumaria frauenfeldi* Ludwig, *South African Journal of Zoology*, 20, 109–114.
- Thandar, A.S. (1986) A new genus and species of a dendrochirotid holothurian from southern Africa, *Journal of Zoology, London*, 210, 483–488.
- Thandar, A.S. (1987a) The southern African stichopodid holothurians, with notes on the changes in spicule composition with age in the endemic *Neostichopus grammatus* (H.L. Clark), *South African Journal of Zoology*, 22, 278–286.
- Thandar, A.S. (1987b) The status of some southern African nominal species of *Cucumaria* (s.e.) referable to a new genus and their ecological isolation, *South African Journal of Zoology*, 22, 287–296.
- Thandar, A.S. (1989a) A new species of a phylloporid holothurian from southern Africa, *Journal of Zoology, London*, 219, 637–644.
- Thandar, A.S. (1989b) A study of two apodous holothurians from Southern Africa, *South African Journal of Science*, 85, 451–454.
- Thandar, A.S. (1989c) The sclerodactylid holothurians of southern Africa with the erection of one new subfamily and two new genera, *South African Journal of Zoology*, 24, 290–304.
- Thandar, A.S. (1990) The phylloporid holothurians of southern Africa and the erection of a new genus, *South African Journal of Zoology*, 25, 207–223.
- Thandar, A.S. (1991) The cucumariid holothurians of South Africa with the erection of a new genus, *South African Journal of Zoology* 26, 115–139.
- Thandar, A.S. (1994) A new species of the holothurian genus *Phyllophorus* from South Africa with a key to subgenus *Phyllophorella*, *Journal of Zoology, London*, 234, 341–351.

- Thandar, A.S. (1996). *Chiridota durbanensis* new species and a new record of *Neothyonidium arthroprocessum* from the east coast of South Africa (Echinodermata: Holothuroidea), *South African Journal of Zoology*, 31, 208–213.
- Thandar, A.S. (2001). The holothuroid family Rhopalodinidae – its composition, distribution, phylogeny and taxonomic status, *African Zoology*, 36, 229–243.
- Thandar, A.S. & Natasen Moodley, M. (2003) Two new genera and a new species in the holothurian family Cucumariidae (Echinodermata: Holothuroidea), *African Zoology*, 38, 279–284.
- Thandar, A.S. & Rajpal, V. (1999). *Thyone herberti*, a new dendrochirotid species from the east coast of South Africa (Echinodermata: Holothuroidea). *Journal of Zoology, London* 248, 189–193.
- Thandar, A.S. & Rowe, F.W.E. (1989) New species and new records of apodous holothurians (Echinodermata, Holothuroidea) from southern Africa, *Zoologica Scripta*, 18, 145–155.
- Thandar, A.S. & Samyn, Y. (In press). Shallow-water holothuroid (Echinodermata: Holothuroidea) biodiversity and biogeography of the subtropical east coast of South Africa. *In*: Heinzeller, T., Nebelsick J. H. (Eds) *Echinoderm: Munich*. Swets & Zeitlinger, Lisse, The Netherlands
- Théel, H. (1886) Report on the Holothurioidea dredged by H.M.S. Challenger during the Years 1873–76. Part 2. *Report on the Scientific results of the Voyage of the "Challenger" (Zoology)*, XIV (part XXXIX), 1–290, 16 pls.