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A new species of *Sigsbeia* and additional records of ophiuroids from the Great Australian Bight

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Abstract

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A new species of *Sigsbeia* (Hemieuryalidae: Ophiuroidea) is described from south-western Australia. Previously, all species of Hemieuryalidae *sensu stricto* have been found in the tropical western Atlantic and eastern Pacific Oceans. Consequently, all currently recognised families of Ophiuroidea now have been collected from the Australian and New Zealand region. Additional new ophiuroid records from the Great Australian Bight include *Astrotoma manilense*, *Ophiothrix albostriata*, previously known only from the holotype, and *Ophiomusium scalare*. New Zealand records formerly called *Astrotoma drachi* are referred to *A. manilense*. The available name *Ophiomusium aporum* is synonymised with *O. scalare* rather than *O. incertum* or *O. australe* where it has previously been placed.

Keywords

Ophiuroidea, Australia, marine, continental slope, Hemieuryalidae, *Astrotoma*, *Ophiothrix*, *Ophiomusium*

Introduction

As part of a multi-institutional project to survey marine biodiversity on the continental slope of the Great Australian Bight (GAB, for more details see Acknowledgements), one of us (TOH) was commissioned to identify ophiuroids in the South Australian Museum collected from the outer shelf and slope of this region. This report is some taxonomic changes arising from this research, including the description of a new species, one species not seen since the holotype, and alterations to two existing synonymies.

The ophiuroid fauna of the GAB is not well known. Tall cliffs surround much of the coastline preventing ready access to shallow water. Moreover, there have been few targeted expeditions to survey the seafloor biodiversity of either the continental shelf, slope or abyss. The USSR Dmitry Mendeleev Cruise 16 sampled the Bight in February 1976 with the resulting material being deposited in various museums, including Museum Victoria, the Australian Museum, Te Papa in New Zealand, and the Russian Academy of Sciences Institute of Oceanology in Moscow (Baker 1979; Litvinova 2010; O'Hara unpublished). There have been three important expeditions on Australia's research vessel *Franklin* (FR0594, FR0694 and FR0795), the first being a biodiversity study of eastern South-Australia (the second SLOPE survey, lead by Museum Victoria), and the second two examining the formation of bicarbonate sediments (James & Bone 2011). There have been two expeditions on Australia's *RV Southern Surveyor* (SS01/00 and SS03/2008) which sampled a few stations in the GAB in order to characterise the benthos and understand ecosystem function. Most of museum collections from the region have been collected as incidental coastal collections, dredged by the naturalist Sir Joseph Verco between 1890 and 1912 (Verco, 1935) and reported by H.L. Clark (1928), or as bycatch on fishing vessels in the 1980s (O'Hara unpublished data).

Montage photos were taken with a Leica 205C DFC microscope mounted camera and Zerene Stacker software. Abbreviations include: SAM (South Australian Museum, Adelaide), AM (Australian Museum, Sydney), MV (Museum Victoria, Melbourne), MCZ (Museum of Comparative Zoology, Harvard), NIWA (National Institute of Water and Atmospheric Research, Wellington), TMAG (Tasmanian Museum and Art Gallery, Hobart), d.d. (disc diameter).

Systematic Account

Family **Hemieuryalidae**

Sigsbeia oloughlini sp. nov.

Fig. 1 and 2.

Zoobank LSID. http://zoobank.org:act:AE0247F3-DAE5-4F5E-B966-431AD6668EA9

Material examined. -- **Australia**. FR0795: stn 111, SW of Esperance, 34° 23'S, 120° 39'E, 95 m, 1995, holotype: 1 (SAM K4005).

Figure 1. *Sigsbeia oloughlini* sp. nov., holotype SAM K4005, A, dorsal view; B, ventral view.

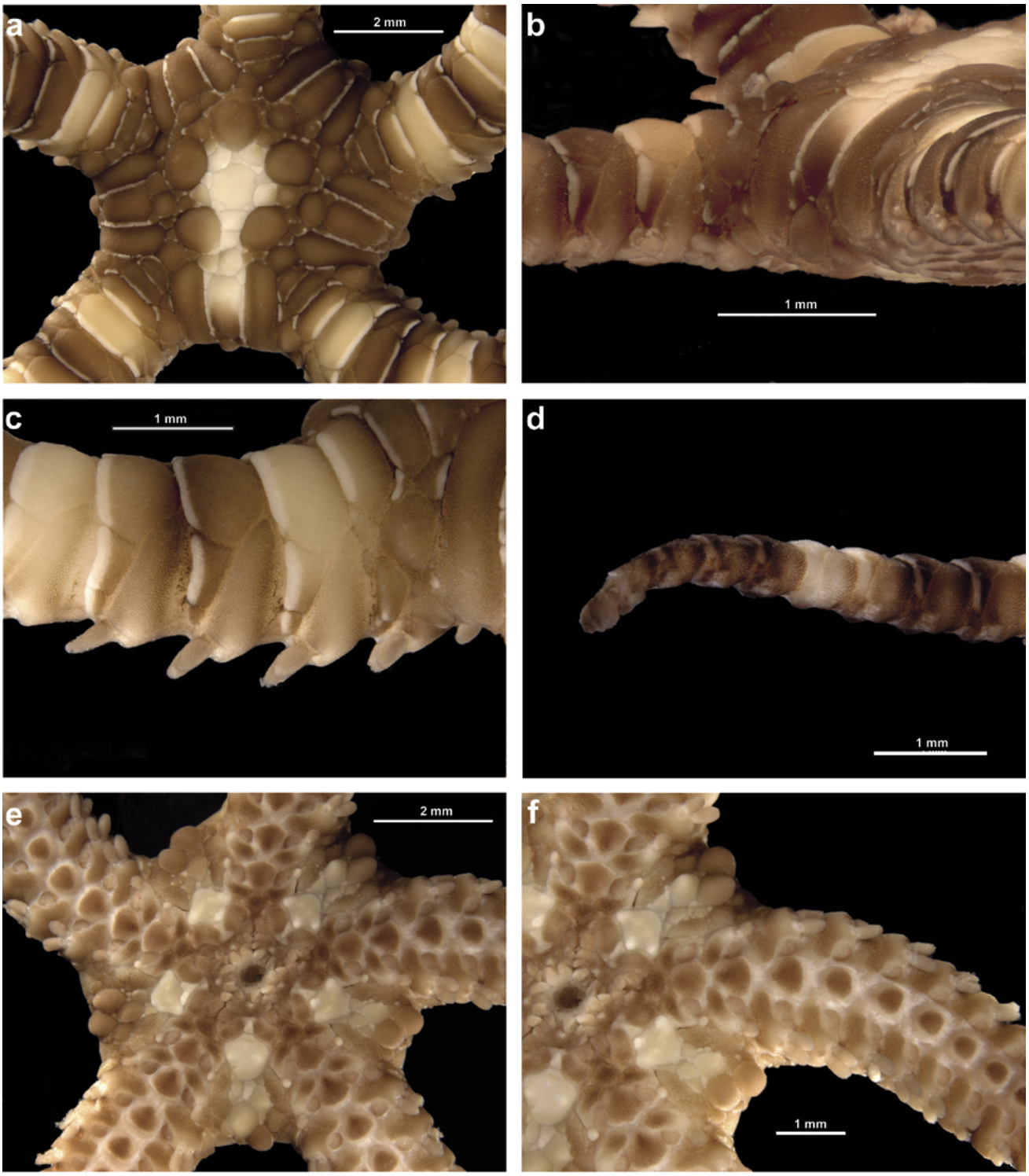

Figure 2. *Sigsbeia oloughlini* sp. nov., holotype SAM K4005, A, dorsal disc details; B, lateral view of disc and arm base; C, lateral view of arm showing supplementary dorsal arm plates; D, arm tip; E, ventral view of disc; F, ventral view of disc and base of arm.

Description. Disc 4.8 mm d.d., arms five, approximately 14 mm long. Disc round to pentagonal, covered in flat polygonal to rounded plates. Primary disc plates are distinct, separated by a series of small interradial plates. A 2nd circle of larger radial and interradial plates occurs near the proximal end of the radial shields, separated by small intercalary platelets. A long narrow plate is present at the interradial margin, 2 times as long as wide, separated from the parallel radial shields by a single series of small platelets. The radial shields are long narrow plates, 3.5-4 times as long as wide, that extend from near the arm base, around the arm, to the latero-ventral edge of the disc. They converge proximally, but do not touch, separated by the secondary radial plate. There are 1-3 tumid quadrangular to triangular plates on the lower side of each arm base, adjacent to the radial shield, which are potentially homologous to the series of plates distal to the radial shields in *Ophiolepis* and *Ophiozonella*.

The ventral interradial disc is completely covered in plates, including short wide plates at the proximal margin, probably rudimentary genital scales. The central area is dominated by 2-3 tumid to protuberant plates, surrounded by 1-2 series of small intercalary platelets. The genital slits are small, and extend from the oral shield for the length of the 1st lateral arm plate.

The jaws are wider than long, with 4 oral papillae on each side that almost completely cover the jaw slit; the inner ones are block-like (almost resembling the infradental papillae on amphiurids), the 2nd and 3rd are smaller, trapezoid, slightly longer than wide, the distal ones are enlarged, 1-5-2 times as wide as long, with an angle proximally and a sloping distal edge. There is also a tiny recurved scale wrapped around the 2nd oral tentacle pore near the apex of the slit. The oral shields are roughly pentagonal, with rounded angles and concave proximo-lateral margins, as wide as long. The madreporite is distinct and enlarged. The adoral shields are sausage-shaped, 2 times as wide as long, separated proximally by a triangular intercalary plate.

The 1st dorsal arm plates are triangular, 2 times as wide as long, and are placed where the arm is inserted into the disc, adjacent to the secondary radial plate and proximal ends of the radial shields. Subsequent plates are oblong to hexagonal, becoming progressively larger and longer from the 2nd to 4th plate, 2-4 times as wide as long with straight proximal and distal margins and a convex to angular lateral margins, fully contiguous until about the 12th plate, after which they become pronounced proximally, as wide as long, and narrowly separate. There are 1-3 accessory dorsal arm plates extending from the distolateral edge of each dorsal arm plate. The largest accessory plate is triangular and contiguous with the main dorsal arm plate. There is often a smaller triangular plate extending from the ventral corner of the larger plate to near the upper arm spine. A tiny intercalary plate is sometimes present at the distal junction of the main dorsal and largest accessory arm plate. The first 2 arm segments have only a single accessory plate angled distally with respect to the dorsal arm plate.

The lateral arm plate extends around the arm from the dorsal to ventral arm plate, having a swollen ventro-distal flange which usually bears 2 small cylindrical arm spines, the upper is 2 times as tall as wide with a blunt rounded apex, the lower is slightly longer or subequal, to 2/3rds the length of the arm segment. There is one, almost granule-like, spine on the first segment and up to 3 cylindrical spines on some segments near the arm tip.

The 1st ventral arm plate is rounded-triangular, the proximal angle forms the apex of the jaw slit, the proximolateral sides are contiguous with the adoral plates and the lateral end of the distal margin with the first lateral arm plates, the centre of the distal margin is contiguous with the 2nd ventral arm plate. The 2nd plate is bell-shaped to pentagonal, with a curved to angular proximal margin, sides recurved around the tentacle pore, and a convex distal margin. From the 3rd plate, the plates are sunken around the margin and covered in thick epithelium or connective tissue, the raised central portion of the plate is pentagonal to ovoid, the 3rd and 4th slightly wider than long, and thereafter as wide as long. The tentacle pores are oval, the base as long as the raised section of the ventral arm plate, but becoming progressively shorter. A thin sunken oval tentacle scale almost completely covers the pore.

The colour (in ethanol) is brown and white. The dorsal disc is mostly brown, except for a splash of white from the centre to one interradial margin and series of small white intercalary plates around the radial shields. Arms are banded, with 1-2 pale and 2-3 darker segments; in addition, there is a strong narrow transverse white band along the distal edge of each dorsal arm plate and adjacent accessory plates. The oral shields (often with whiter proximal apices), ventral disc plates adjacent to the oral shields and the intercalary plate separating the adoral shields are also pale. The distal ventral disc plates, raised section of the ventral arm plates, lateral arm plates, tentacle scales, adoral shields and oral plates are brown.

Distribution. Southwestern Western Australia, 95 m

Remarks. Despite being known from only one specimen, which precludes dissection, this species has characteristic features that warrant its description. We place it in the genus *Sigsbeia* in the family Hemieuryalidae on the basis of the coiled arms, adapted for an epizoic habit, the integration of the arms into the disc, the narrow radial shields that extend around the lateral disc margin almost to the ventral surface, the presence of accessory plates at the distal lateral corners of the dorsal arm plates, the single tentacle scale and the second oral tentacle pore hidden within the jaw slit.

Matsumoto (1915) recognised two subfamilies within the Hemieuryalidae, the Hemieuryalinae with supplementary or subdivided dorsal arm plates and the Ophiochondrinae with entire plates. Martynov (2010) reviewed several genera within the Ophiochondrinae and on the basis of their arm spine articulation morphology regarded them as belonging to the Ophiacanthidae. He thus restricted the Hemieuryalidae to those genera formerly in the Hemieuryalinae, explicitly *Hemieuryale* von Martens, 1867 and *Sigsbeia* Lyman, 1878b. To these we can add the similar genera *Quironia* A.H. Clark, 1934, *Ophioplus* Verrill, 1899, and *Ophioholcus* H.L. Clark, 1915. Two additional genera remain problematic and require further study. *Ophioleila* A.H. Clark, 1949 is superficially similar to *Ophioplinthaca*, an ophiacanthid, and *Amphigyptis* Nielsen, 1932 was provisionally referred to the synonymy of the amphiurid *Axiognathus* (=*Amphipholis*) by Thomas (1966).

The other genera of hemieuryalids are separated from *Sigsbeia* as follows (Fell 1960). *Hemieuryale* has fragmented

dorsal arm plates, *Ophioholcus* has 6 arms and contiguous radial shields, *Quironia* also has 6 arms and a single genital slit in each interradius that continues around the distal edge of the oral shield, and *Ophioplus* has a few accessory plates spaced along the distal edge of the dorsal arm plates. All four of these genera are monospecific, with their species restricted to the Caribbean/Western Atlantic continental shelf and upper slope.

The four previously known species of *Sigsbeia* differ from *S. oloughlini* most notably in the morphology of the disc plates, dorsal arm plates, arm spines and colour pattern. The type species, *S. murrhina* Lyman, 1878b (holotype: 12 mm d.d.) and *S. conifera* Koehler, 1914 (5 mm d.d.), both from the Caribbean, have granulated disc plates, a single rectangular to ovoid accessory dorsal arm plate, and two rounded, slightly flattened, arm spines. Furthermore, on *S. conifera* some of the larger dorsal disc plates are tumid and the dorsal plates non-contiguous after the basal few. *Sigsbeia lineata* Lütken & Mortensen, 1899 from the Galapagos and Cocos Islands has smooth disc plates without granules and the inner end of the ventral arm plates sunken like on *S. oloughlini*; but has flat widened arm spines, a trapezoid accessory arm plate, and two thin longitudinal stripes running from the disc down each side of the dorsal arm surface. Finally, *Sigsbeia laevis* Ziesenhene, 1940 from the Pacific coast of Panama has tumid but ungranulated disc plates, small dorsal arm plates, as long as wide, barely contiguous, and flattened plate-like ovoid arm spines, and a squarish to rounded accessory arm plate. None of these species have the tumid ventral disc plates characteristic of *S. oloughlini*.

Different authors have disagreed about the nature of the accessory dorsal arm plates. While Lyman (1878b), Koehler (1914) and Fell (1960) have treated them as accessory arm plates, Lütken & Mortensen (1899) and Ziesenhenne (1940) considered them as highly modified upper arm spines that overlie the lateral arm plate. While the ontology of these plates cannot be fully addressed from our single specimen, here they do appear to be true plates, lying in a series confluent with the dorsal arm plate and abutting the edge of the previous lateral arm plate. They do not align with the two arm spines which emerge from a distal flange of the lateral arm plate. Moreover, where these accessory plates are missing, the underlying areas appear to be at least partially decalcified, suggesting that they are dorsal arm plates. Under this interpretation, these plates and the arm spines have converged in morphology in *S. laevis* and *S. lineata*, possibly functioning as a frictional aide to climbing.

The position of the accessory dorsal arm plates in *S. oloughlini* recalls *Ophiolepis species* such as *O. elegans* Lütken, 1859 or *O. superba* H.L. Clark, 1915b. In fact, the overall morphology is quite similar to *Ophiolepis*, including the integration of the arms into the disc, the form of the oral frame, and the disc plating. In particular, the row of disc plates that are placed distal to the radial shields in *Ophiolepis* and related genera are also apparent in *Sigsbeia* - the middle plate placed between the proximal ends of the radial shields and the lateral ones positioned at the base of the arm between the radial shields and third dorsal arm plate. *Ophiolepis* can be distinguished by its smaller radial shields, which are largely restricted to the dorsal surface and the long genital slits bordered by elongated genital scales.

This is the first record of a hemieuryalid species outside the equatorial western Atlantic and eastern Pacific. Now all recognised families of ophiuroids have been recorded from the Australian/New Zealand region. The new record from the outer continental shelf off SW Australia may indicate a lack of sampling at these depths from this region. Three of the other four *Sigsbeia* have been recorded living on stylasterids. The catch description for this sample did not record stylasterids explicitly but did record abundant octocorals, ascidians, sponges, and bryozoans.

Etymology. Named after Mark O'Loughlin, teacher, mentor and friend (of TOH) for over 35 years.

Family **Gorgonocephalidae**

Astrotoma manilense Döderlein, 1927

Astrotoma manilense Döderlein, 1927: 19-21, pl. 1(1-1b).

Astrotoma drachi.--McKnight, 2000: 68, fig. 33, pl. 32.--Okanishi & Fujita, 2013: 569 [Non *Astrotoma drachi* Guille A, 1979].

Material examined. **Great Australian Bight**. 110 nm due W of Whidbey Point, 34° 65'S, 132° 51'E, 880-940 m, 1989: 2 (SAM K2734). -- 165 nm SW of Eucla, 33° 23'S, 126° 26.3'E, 391-398 m, 1988: 1 (SAM K3105). -- 75 nm ESE of Cape Arid, 34° 15'S, 124° 42'E, 920-1120 m, 1989: 1 (SAM K2732). -- 105 nm SSE of Eucla, 33° 35'S, 129° 4'E, 860-931 m, 1989: 4 (SAM K2731). -- Adelaide Pearl: stn 15, 125 nm E of Cape Arid, 34° 3'S, 125° 31'E, 1011-1020 m, 1988: 1 (SAM K2763). -- Adelaide Pearl: stn 28, 125 nm S of Eucla, 33° 45'S, 129° 17'E, 999-1110 m, 1988: 3 (SAM K2762); 1 (SAM K2726).-- 80 nm SW of Pearson Is, 35° 4'S, 133° 35'E, 900-960 m, 1989: 1 (SAM K3106). -- Margaret Phillipa 6: stn 4, South of Ceduna, 33° 48'S, 130° 33'E to 33° 42'S, 130° 31'E, 1040 m, 1984: 3 (TMAG H1985).

New South Wales. NZOI: stn U223, east of Newcastle, New South Wales, Australia, 32° 58.8'S, 152° 41.598'E, 1150 m, 1982: 1 (NIWA 49781). -- K88-22: stn 01, east of Ulladulla, 35° 27'S, 150° 54'E, 1060-1123 m, 1988: 1 (AM J22108).

New Zealand. TAN0604: stn 133, Shipley Seamount, 41° 48.072'S, 179° 29.61'W to 41° 48.03'S, 179° 30.198'W, 1240-1275 m, 2006: 1 (NIWA 42265). -- TAN0705: stn 211, 9D19, 42° 39.28'S, 177° 12.792'W to 42° 38.88'S, 177° 12.462'W, 1377-1402 m, 2007, identified by Okanishi & Fujita (2013) as *Astrotoma drachi*: 1 (NIWA 30980). -- NZOI: stn I666, 47° 47.502'S, 178° 59.502'W, 1165 m, 1979, identified by McKnight (2000) as *Astrotoma drachi*: 1 (NIWA 48404); 1 (NIWA 48405). -- TRIP1650: stn 23, 46° 45'S, 170° 3'E, 1036-1312 m, 2002: 1 (NIWA 49785).-- TRIP2124: stn 21, 49° 17'S, 176° 18'E, 1192-1300 m, 2006: 1 (NIWA 75841).

Distribution. Philippines (721 m), Japan (660-710 m), Great Australian Bight (391-1120 m), Eastern Australia (1060-1150 m), SE New Zealand (1036-1402 m).

Remarks. There is a large *Astrotoma* species present on the continental slope of southern Australia and New Zealand in 400-1400 m. Specimens collected to date form three populations, in the Great Australian Bight, off New South Wales and off south-east New Zealand, including the Campbell Plateau and the Chatham Rise. The latter population was first reported by McKnight (2000) who referred one lot (NZOI I666) to the species *A. drachi* Guille, 1979 without comment. This is one of three similar species of *Astrotoma* reported from a few specimens from the Philippines and Japan. The differences

between these species are minor, slight modifications to the shape and density of the disc tubercles on the disc and the number of arm spines, and may be related to size, with the holotype of *A. manilense* measuring 31 mm d.d., *A. drachi* is 15 mm d.d., and *A. deficiens* Koehler, 1922 is 21 mm d.d..

Examination of a series of specimens from the Great Australian Bight indicates that there is some variation with growth. Smaller specimens (e.g. 2 specimens in SAM K2762; 10-12 mm d.d.) appear like *A. drachi* with 2 (rarely 3) arm spines, sparse disc tubercles, and granular suboral papillae. Larger specimens are like *A. manilense* (e.g., SAM K3106, K3105; 25 & 34 mm d.d.) with a variable (medium to dense) coating of stout hemispherical to cylindrical disc tubercles on the radial shields and interradial margin, 3 (rarely 4) arm spines and spiniform suboral papillae. *Astrotoma deficiens* may differ in predominantly having conical pointed disc tubercles.

Without examining a range of specimens from the Philippines, we are hesitant to formally synonymise any of these species. However, there is no evidence of multiple species in the Australian and New Zealand region and we refer all specimens to the species *A. manilense*, as this name has date priority and represents the adult form. We note that no specimens of *Astrotoma* have been found in the tropical southern hemisphere, including the densely sampled New Caledonian region. Thus, as defined here, *A. manilense* has a disjunct distribution, with at least four isolated populations. Molecular data is required to further investigate species boundaries in this genus. The species is adequately figured my McKnight (2000).

The only other species of *Astrotoma* is the type *A. agassizii* Lyman, 1875 from circum-Antarctica and southern South America. It differs from the other species in having a covering of fine granules on the disc. *Astrotoma agassizii* has been found to both brood young and have a pelagic larva (Heimeier et al. 2010) and Hunter & Halanych (2008) also found several separate genetic lineages that may indicate cryptic speciation.

Family **Ophiotrichidae**

Ophiothrix* (*Placophiothrix*) *albostriata H.L. Clark, 1928

Fig. 3

Ophiothrix albostriata Clark, H.L., 1928: 429-430, fig. 127.
Placophiothrix albostriata.--Clark, H.L., 1946: 227.
Ophiothrix (Placophiothrix) albostriata.--Clark, A.M., 1967: 648.--Baker & Devaney, 1981: 167, fig. 49-54.--Rowe & Gates, 1995: 427.

Material examined. -- Great Australian Bight, holotype: 1 (SAM K215). -- Great Australian Bight, 75 nm SSW of Pearson Is, 35° 8'S, 133° 47'E, 920-1040 m, 1989: 2 (SAM K2748).

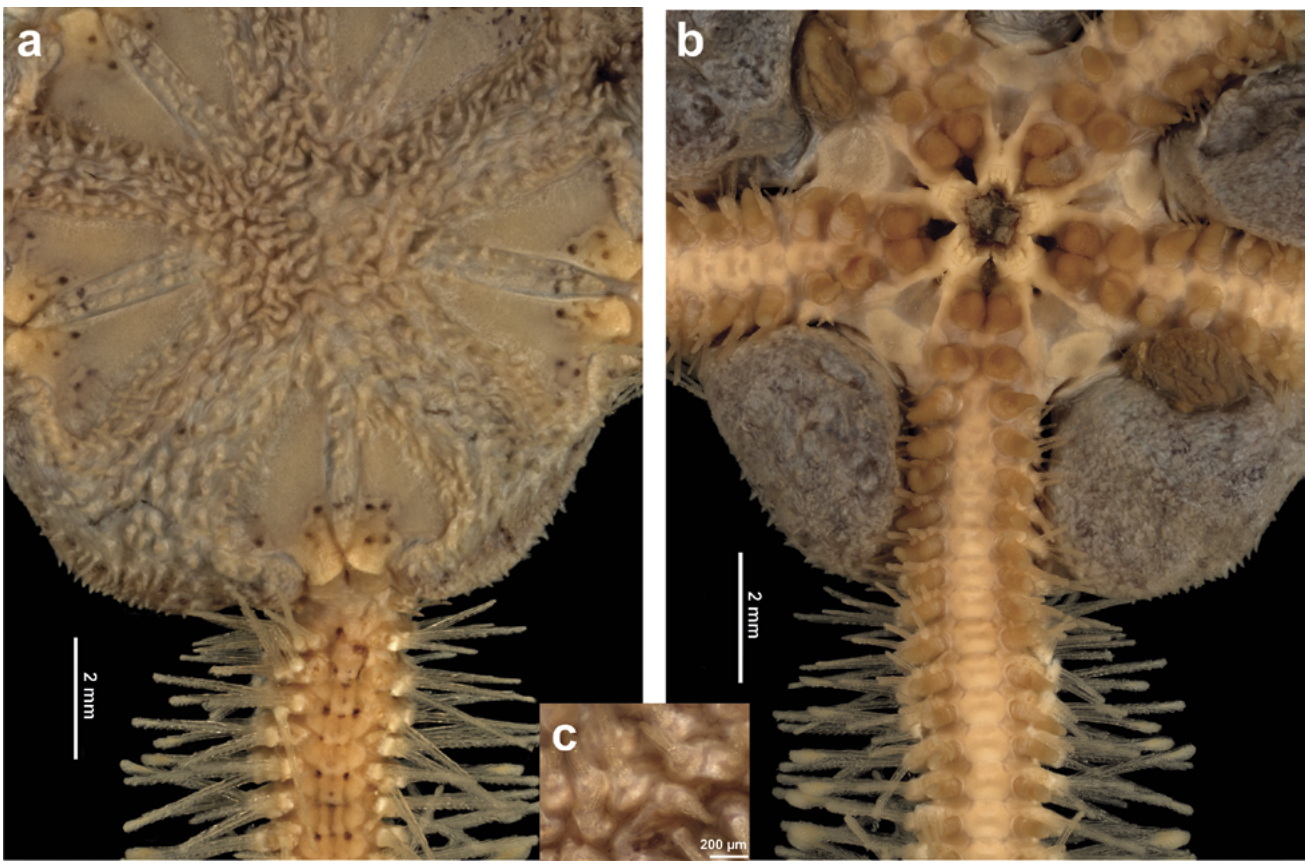

Figure 3. *Ophiothrix albostriata* H.L. Clark, 1928, SAM K2748, A, dorsal view of disc and arm base, B, ventral view of disc and arm base; C, details of disc spinelets visible through epithelium.

Distribution. Great Australian Bight, ?200-1040 m.

Remarks. This is the first record of this species since the 10 mm d.d. holotype was described by H.L. Clark in 1928. Baker & Devaney (1981) figured the dorsal disc and arms of the holotype. Key diagnostic characters include the large (2/5 d.d.) naked radial shields; the tall (3-4x longer than wide) cylindrical disc stumps with a crown of small thorns; the wide (2x as wide as long) dorsal arm plates, with a centrally produced distal margin, and two longitudinal lines (after the 20th segment); up to 9 arm spines, the longest (2-3rd from the top) measuring 2x the width of the dorsal arm plate, slightly expanded at the tip, with thorns largely restricted to the apical half of the spine; oral shield diamond-shaped, twice as wide as long; ventral arm plates rectangular, 1.5x as wide as long, with a straight distal edge, and a minute tentacle scale that becomes hook-shaped distally with 2-3 accessory points.

The two new specimens are considerably larger than the type, 16 and 17 mm d.d., but share many of the features. Differences include the elongated thorns on the disc spines, which can measure ½ the height of the spine, the presence of a row of minute spines along the abradial edge of the radial shield, and the distal edge of the dorsal arm plates with is convex rather than medially produced. The largest specimen (Fig. 3a) has three longitudinal broken lines along the arm, occasionally darkened into discrete spots, which can also occur at the distal end of the radial shields.

These specimens were collected from 920-1040 m, which is exceptionally deep for an ophiotrichid. The collection details on the type specimen only list the locality (Great Australian Bight) and not the depth, latitude/longitude or date. Like many other specimens described by H.L. Clark in 1928, they were presumably collected by the malacologist Joseph Verco, who is known to have participated in an expedition by the Australian fishery research vessel 'Endeavour' to the Great Australian Bight in March 1909 (Verco 1935). They trawled predominately along the "one hundred fathom line" in approximately 125-220 m of water in an area 30-120 nautical miles (55-222 km) west of Eucla. Possibly this species is restricted to the upper continental slope (200-1040 m).

Family **Ophiolepididae**

Ophiomusium scalare Lyman, 1878

Fig. 4

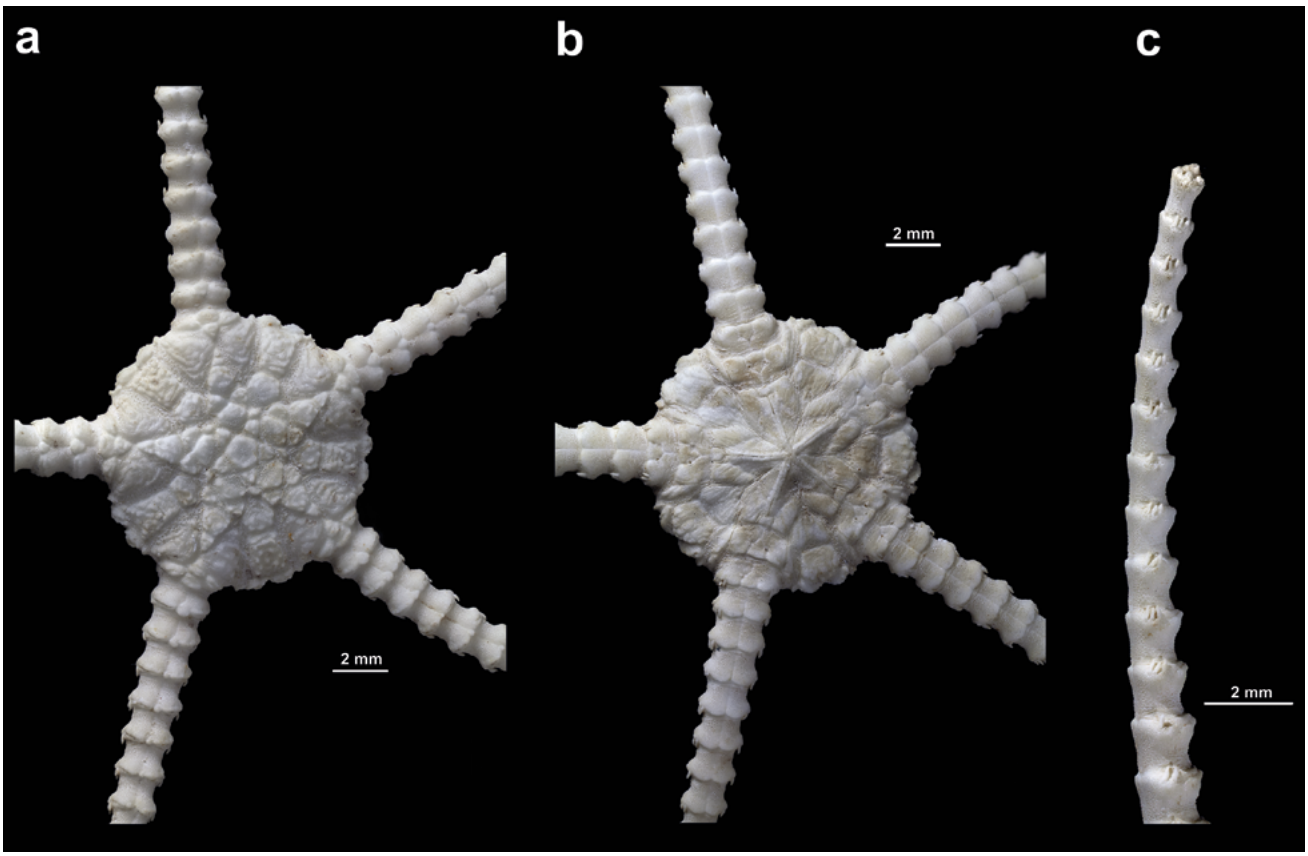

Figure 4. *Ophiomusium scalare* Lyman, 1878, MV F214065, A, dorsal view of disc and arm base, B, ventral view of disc and arm base; C, lateral view of arm segments from mid arm showing the three short arm spines clustered together (broken off from some segments), the middle arm spine is microscopically hooked distally.

Ophiomusium scalare Lyman, 1878a: 117-118, pl. 1(1-3).--Lyman, 1882: 95-96, pl. 1(4-6).--Koehler, 1897: 308-312, pl. 6(24-25).--Koehler, 1899: 26-28, pl. 2(12-13), 3(21).--Koehler, 1904: 65.--Clark, H.L., 1915a: 334.--Matsumoto, 1917: 285-268, fig. 77.--Koehler, 1922: 417, pl. 89(7), 90(1-2).--Koehler, 1930: 242-243.--McKnight, 1975: 64-65.--Irimura, 1981: 40-41.--Guille, 1981: 454, pl. 9(56-57).--Vadon & Guille, 1984: 584.--Rowe, 1989: 287.--Imaoka et al., 1990: 93, fig. 51.--McKnight, 1993: 176, 189.--Liao & Clark, A.M. 1995: 296-297, fig. 167.--Rowe & Gates, 1995: 435.--Stöhr, 2011: 45-46, fig. 21g-I.

Ophiomusium aporum Clark, H.L., 1928: 447-449, fig. 134.--Clark, H.L., 1946: 275 [new synonymy].

Non *Ophiomusium aporum*.--Madsen, 1967: 143, fig. 8 [= *Ophiomusium incertum* Koehler R, 1930; according to Baker, 1979].

Material examined. -- 'Spencer and St Vincent Gulfs', holotype of *O. aporum*: 1 (SAM K255). -- 100 nm SSE of Cape du Couedic, 900-1000 m, 1988: 1 (SAM K3990). -- SS03/2008: stn 47, Great Australian Bight, 35° 12.564'S, 134° 27.012'E, 456 m, 2008 to 2008: 1 (MV F159801). -- SS03/2008: stn 69, 35° 8.436'S, 134° 16.482'E, 450 m, 2008 to 2008: 15 (MV F159741). -- SS03/2008: stn 126, 35° 13.77'S, 134° 30.798'E to 35° 14.268'S, 134° 30.78'E, 300-400 m, 2008 to 2008: 4 (MV F159752). -- SLOPE: stn 203, Off Murray River mouth Encounter Bay, 37° 1.42'S, 137° 44.19'E to 37° 1.13'S, 137° 44.18'E, 403 m, 1994 to 1994: 18 (MV F89438). -- FR0694: stn 22, 58 nm SW Coffin Bay, 35° 27'S, 134° 48.6'E, 300-400 m, 1994: 10 (SAM K2770). -- SS10/2005: stn 80, Jurien Bay, 29° 50.514'S, 114° 21.72'E to 29° 51.012'S, 114° 22.02'E, 408-427 m, 2005 to 2005: 7 (MV F112020). -- SS10/2005: stn 34, Bald Island, 35° 12.81'S, 118° 39.06'E to 35° 12.24'S, 118° 40.14'E, 431-408 m, 2005 to 2005: 300 (MV F111164).

Distribution. India, Indonesia, western and south-western Australia, Philippines, Japan, SW Pacific from Papua New Guinea to the northern Louisville Ridge. Depth range 124-1100 m

Remarks. H.L. Clark (1928) described two specimens of *Ophiomusium* from South Australia as a new species *O. aporum*. However, in 1946 he subsequently synonymised his species with *O. incertum* Koehler, 1930, the existence of which he had been unaware in 1928. Baker (1979) re-examined both specimens and referred the holotype (SAM K481) to *O. australis* H.L. Clark, 1928, on the basis that tentacle pores are present on the first two arm segments, but leaving the smaller 3.3 mm d.d. paratype (MCZ 4712) as *O. incertum*.

However, after examination of hundreds of *Ophiomusium* specimens from southern Australia, we consider that there are three species characterised by having two-tumid plates along each disc margin. These are 1) *O. australe* with smooth disc plates, two arm spines (see O'Hara 1990), two ventral arm plates and pore pairs (see Baker & Devaney 1981 fig. 25-28), 2) *O. incertum* with granulated disc plates, 3-5 arm spines, no obvious pore pairs (except in small juveniles, see O'Hara 1990), and no ventral arm plates (see Madsen 1967 fig. 8), and 3) *O. scalare* with disc covered in wrinkled skin, 3 arm spines, and two ventral arm plates and pore pairs.

We judge that the holotype of *Ophiomusium aporum* is closer to *O. scalare* than *O. incertum*, as it has wrinkled skin on the disc, two (although frequently indistinct) pore pairs, and 3 arm spines. However, *O. scalare* is morphologically variable (particularly the appearance of the dorsal disc) across its large range and the form found off SW Australia could easily be a separate cryptic species for which the name *O. aporum* would be available. *Ophiomusium scalare* is known from the Andaman Islands to Tonga, and Japan to the Taupo Seamount in the Tasman Sea. It usually occurs in 100-1500 m. A very similar species, *O. ultima* Hertz, 1927 has been recorded off eastern Africa. We have not had the opportunity to examine the smaller paratype of *O. aporum* in the MCZ which has been described as having no tentacle pores and a granulated disc. Our other records of *O. incertum* are restricted to Tasmania and eastern Bass Strait.

Discussion

The last major study on the ophiuroids of the GAB was by H.L. Clark (1928), where he described or reported species from the South Australian Museum collections, many dredged by the naturalist Joseph Verco. Unfortunately, the location data on many of these specimens were imprecise and assumed to be St Vincent and Spencer Gulfs where Verco did much of his dredging. Verco also dredged along the upper continental slope off Beachport (to 550 m) and Kangaroo Island (to 210 m) (Verco 1935). This is significant as the seafloor depth in the Gulfs is limited to less than 40 m but many of the species reported by Clark have only been subsequently found on the outer continental shelf or more usually the upper continental slope (> 100 m) (O'Hara, unpublished information). These species include *Ophioscolex* cf *glacialis*, *Ophiacantha brachygnatha*, *Amphiophiura collecta* (=*A. urbana*), *Ophiura ooplax*, *Ophiomusium anisacanthum*, *O. simplex* var *australe* (=*O. australe*), and *O. aporum* (=*O. scalare*, see above), and *Ophiozonella elevata* (=*O. bispinosa*). Thus it is likely that the reported localities for all these species (and the type localities of *O. brachygnatha* and the *Ophiomusium* spp) are the upper continental slope of eastern to central South Australia.

The discovery of new ophiuroid species on the continental shelf and upper slope of South Australia indicates that the fauna is still inadequately sampled to be complete. The report of a hemieuryalid species on the Southern Australian coast is remarkable as this family (as now restricted) has previously only been found in the tropical western Atlantic and eastern Pacific. However, this trans-Pacific distribution also occurs in some other relict genera. For example *Ophiopteris* species are only known from New Zealand and California (Devaney 1970). Extant *Ophiocrossota* is only known from southern Australia (*O. multispina*); however, fossils of this easily recognised genus have also been found from the Miocene and Eocene of the western United States (Blake, 1975; Blake & Allison 1970) and the Miocene of Patagonia (Caviglia et al. 2007).

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