

Status of the Genera *Ophiopeza* and *Ophiopsammus* (Echinodermata: Ophiuroidea) in Australian Waters, with the Description of a new Species

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A study of type and other material has resulted in a reappraisal of the generic limits of the ophiidermatid genera *Ophiopeza* Peters, 1851 and *Ophiopsammus* Lütken, 1869. By using disc scaling as a character of generic significance the species *fallax arabica* A. M. Clark, 1968, *cylindrica* Hutton, 1872a, and *spinosa*, Ljungman, 1867, have been retained in the genus *Ophiopeza*, type-species *fallax fallax* Peters, 1851, while the species *aequalis* Lyman, 1880, *anchista* H. L. Clark, 1911, *assimilis* Bell, 1888, and *maculata* Verrill, 1869 have been transferred to the genus *Ophiopsammus*, type-species *yoldii* Lütken, 1856. In addition, *Ophiopsammus angusta* sp. nov. is described from southeastern Australian waters. The following species have been synonymized: *Ophiopeza arenosa* (Lyman, 1879) and *Ophiopeza gracilis* (Mortensen, 1924) with *Ophiopeza cylindrica*; *Ophiopeza dubiosa* (de Loriol, 1893) with *Ophiopeza spinosa*; and *Ophiopeza dyscrita* (H. L. Clark, 1909) and *Ophiopeza nigra* (H. L. Clark, 1938) with *Ophiopsammus assimilis*. *Ophiopsammus aequalis* is recorded for the first time from Australia. Notes are given for a misidentified type specimen of *anchista*. A key to all the known species of *Ophiopeza* and *Ophiopsammus* is given, except for *exilis* Koehler, 1905.

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INTRODUCTION

The taxonomic status of *Pectinura* Forbes 1843, *Ophiopeza* Peters 1851, and *Ophiopsammus* Lütken 1869 has been most recently discussed by A. M. Clark (1968). Briefly, *Pectinura* was described by Forbes (1843) for *vestita* from a small specimen taken off southern Turkey. *Ophiopeza* was described by Peters (1851) for the species *fallax* which was collected off Mozambique. These two genera were separated on the presence of supplementary oral shields in *Pectinura* and their absence in *Ophiopeza*. *Ophiopsammus* was established by Lütken (1869) for his earlier described species *Ophiopeza yoldii*. This genus was distinguished by the absence of supplementary oral shields and the concealment of radial shields by disc granules. Lyman (1882) subsequently referred *yoldii* back to *Ophiopeza* although he gave no justification. He listed 12 species belonging to the genus *Pectinura* and five species to *Ophiopeza*. In a review, H. L. Clark (1909a) synonymized both *Ophiopeza* and *Ophiopsammus* with *Pectinura* on the grounds that the presence or absence of supplementary oral shields in these genera lacked sufficient taxonomic value. However, he stated that if his interpretation of Forbes' inadequate description of *vestita* was incorrect then *Pectinura* should probably replace *Ophiarachnella* Ljungman, 1871. Furthermore, *Ophiopeza* would become the available generic name for the 10 species he included in the genus *Pectinura*. Later in the same year, he described (H. L. Clark, 1909b) another species of *Pectinura*, *dyscrita*, from off New South Wales. During his visits to Australia in 1913, 1929, and 1932, H. L. Clark collected only one specimen of *Pectinura* which he described as a new species, *nigra* (H. L. Clark, 1938) from Western Australia. In his 1946 review of the Australian echinoderm fauna, H. L. Clark recorded five species of

Pectinura from Australian waters, mentioning that none was known from adequate material.

Mortensen (1940) recorded *Ophiopeza fallax* from the Iranian Gulf. He questioned whether the species should be referred to the genus *Pectinura* but decided that since the type-species of *Pectinura*, *P. vestita*, is insufficiently known he preferred to use the name *Ophiopeza*. A. M. Clark (1968) discussed the problem of these genera and concurred with Mortensen's use of the name *Ophiopeza*, especially since the holotype of *Pectinura* is now lost. She suggested that *P. vestita* could have been a specimen of the Mediterranean species *Ophioconis forbesi* which had lost disc granules from the oral shields. However, A. M. Clark (1968) did not agree with Lyman's inclusion of *Ophiopsammus* in the synonymy of *Ophiopeza* and, on the basis of the shape of its dorsal arm plates, she revived the generic name *Ophiopsammus* for the species *yoldii*.

During the course of researching the echinoderm fauna of New South Wales (F.W.E.R.; ARGS D1805325; MST 84/2092) extensive collections made along the coast during 1981 and 1982 by staff of the Echinoderm Section of the Australian Museum yielded a large number of specimens referred to the genus *Ophiopeza*, as understood by A. M. Clark (1968). This material has been compared with other specimens in the collections of the Australian Museum and with type and other specimens borrowed from the British Museum (Natural History), Museum of Comparative Zoology, Museum of Victoria, National Museum of New Zealand, and the US National Museum (Smithsonian). As a result of our investigations, we have been able to clarify the status of the species of *Ophiopeza* and *Ophiopsammus* occurring in Australia, as well as describing a new species and establishing a new record. Furthermore, we have established the value of disc scaling in separating the genera *Ophiopeza* and *Ophiopsammus*. With the exception of Lyman's (1882) use of this feature in a key to the species of *Pectinura*, disc scaling has been ignored in ophiidermatid taxonomy.

The following abbreviations have been used: ca = approximately; coll. = collection; d.d. = disc diameter; d.r. = disc radius; R = arm length from base of disc to arm tip; AM = Australian Museum, Sydney; BM(NH) = British Museum (Natural History), London; MCZ = Museum of Comparative Zoology, Cambridge, Mass.; NMNZ = National Museum of New Zealand, Wellington; MV = Museum of Victoria, Melbourne; USNM = US National Museum (Smithsonian), Washington; N.S.W. = New South Wales; N.Z. = New Zealand; Qld = Queensland; S.A. = South Australia; Tas. = Tasmania; Vic. = Victoria; W.A. = Western Australia.

All known species in each of the genera (except for *Ophiopeza exilis*) are included in their respective keys, but only species known from Australian waters are discussed in detail.

SYSTEMATIC ACCOUNT

Family OPHIODERMATIDAE

Genus *Ophiopeza* Peters

Ophiopeza Peters, 1851: 465 (type-species *O. fallax* Peters, 1851, by monotypy).

Ophiopezella Ljungman, 1872: 639 (type-species *Ophiarachna spinosa* Ljungman, 1867, by monotypy).

Pectinura: autorum [non *Pectinura* Forbes, 1843].

Diagnosis: A genus of ophiidermatid with radial shields usually obscured by granules; marginal disc scales enlarged, usually covered by granules, rarely bare; disc scales coarse, overlapping, 1-3 large scales separating the two plates of each pair of radial shields; oral plates covered by granules; oral shields naked, supplementary oral shields

frequently present and at least partially naked; dorsal arm plates fan shaped to transversely rectangular (up to ca 2 x wider than long), flat; arm spines never exceeding one arm segment in length, often appressed.

Other species included: *O. fallax arabica* A. M. Clark, 1968; *O. cylindrica* (Hutton, 1872a); *O. spinosa* (Ljungman, 1867).

Remarks: We concur with Mortensen (1940) and A. M. Clark (1968) in their recognition of the genus *Ophiopeza*. Also, we are able to support A. M. Clark's reasoning and decision in her resurrection of the genus *Ophiopsammus* from synonymy with *Ophiopeza*. However, in addition, we draw attention to differences in the type of disc scaling between *Ophiopeza* and *Ophiopsammus* (see p. 268). Using these characters, we propose to restrict *Ophiopeza* for *fallax fallax*, *fallax arabica*, *cylindrica*, and *spinosa*. Of the other species previously referred to *Ophiopeza* by A. M. Clark (1968), we propose that *anchista* H. L. Clark, 1911, *assimilis* Bell, 1888, *aequalis* Lyman, 1880, and *maculata* Verrill, 1869, be referred to *Ophiopsammus*, as we consider them to be congeneric with *yoldii* Lütken, the type species of *Ophiopsammus*. We are uncertain of the affinity of *exilis* (Koehler, 1905) which A. M. Clark (1968) transferred back from *Pectinura* to *Ophiopeza* as its disc scaling is not evident on the figure given for it by Koehler (1905: pl. 2, fig. 5) and because we have not examined material referable to this species.

Ophiopeza cylindrica (Hutton, 1872a)

Figs 1A-C, 2A-B

Ophiura cylindrica Hutton, 1872a: 3; 1872b: 811.

Pectinura arenosa Lyman, 1879: 48, pl. 14, figs 392-394; 1882: 15, pl. 23, figs 10-12. H. L. Clark, 1909: 117; 1921: 141; 1946: 257. A. M. Clark, 1966: 327. Dartnall, 1980: 42, 71.

Ophiopora cylindrica. Farquhar, 1895: 198, 1898b: 306 [? non *Ophiopeza cylindrica*. Farquhar, 1898a: 190, pl. 14, figs 4, 5 = *assimilis*.]

Pectinura cylindrica. H. L. Clark, 1909: 117; 1915: 303 [? non *Pectinura cylindrica*. Mortensen, 1924: 172, non fig. 35(1-2) = *assimilis*.]

Pectinura gracilis Mortensen, 1924: 173, figs 35(3-5), 36.

Ophiopeza arenosa. A. M. Clark, 1968: 313. Rowe and Vail, 1982: 222. [? non *Ophiopeza arenosa*. Baker, 1982: 431, fig. 10.18c. = *assimilis*.]

Material examined: Lectotype of *O. cylindrica* NMNZ Ech 6, no coll. data; lectotype of *O. gracilis* NMNZ Ech 375, Paterson Inlet, Stewart Id, N.Z., 9-28m, 17. xi. 14; holotype of *O. arenosa* BM(NH) 82.12.23.247, off East Mancoeur Id, Bass Strait, Tas., 70-74m, 2.iv.1874; 1 paratype of *O. arenosa* BM(NH) 82.12.23.247 (pt) off East Mancoeur Id, Bass Strait, Tas., 70-74m, 2.iv.1874; 1 spec., AM G7831, Watson's Bay, Port Jackson, N.S.W., no coll. depth or date; 1 spec., AM G11413, Broughton Id, nr Port Stephens, N.S.W., 66m, no coll. date; 2 spec., AM J15049, NW Solitary Id, nr Coffs Hbr, N.S.W., 22m, 10.ii.82; 1 spec., AM G11032, Port Jackson, N.S.W., no coll. depth; 1 spec., AM J1974, Port Phillip, Vic., no coll. depth; 3 spec., MNMZ (Ech 3412), Paterson Inlet, N.Z., 23m, 26.i.60; 2 spec., NMNZ (ECH 3413), North Arm, Port Pegasus, Stewart Id, N.Z. 37-44m, 22.ii.72.

Diagnosis: Disc diameter to 11mm, densely covered with round granules, 13-16 per mm; coarse, slightly overlapping scales underlying the granules. Each interradius with 7-9 marginal disc plates, middle ones largest, each plate obscured by granule cover. Radial

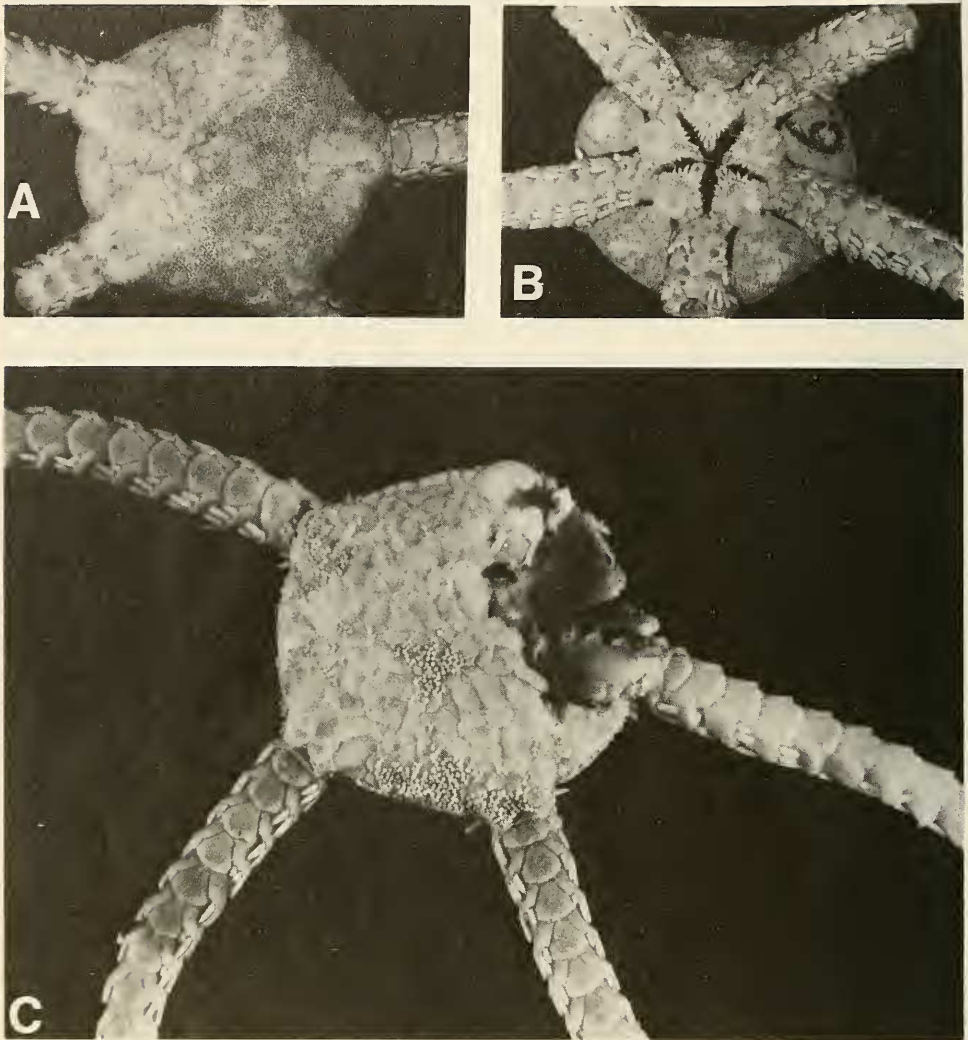


Fig. 1. A, B, *Ophiopeza cylindrica*, lectotype (NMNZ Ech 6), dorsal and ventral view respectively, dd = 8mm. C, *Ophiopeza gracilis*, lectotype (NMNZ Ech 375), dorsal view, dd = 5mm. Some disc granules were removed in A and C to show disc scaling.

shields 0.1 x d.r., obscured by granules. Three conspicuous plates in triangular arrangement separating the two plates of each pair of radial shields. Arms to 42mm, 2.6-3.9 x d.d., dorsal plates fan shaped in specimens with d.d. \approx 7mm becoming transversely rectangular in shape (up to 2.0 times wider than long) in larger specimens; ventral plates as long as or slightly longer than wide. Eight to ten short, stout arm spines per segment; lowermost sometimes longer and wider than the others, which were about half an arm segment long. Two tentacle scales per pore, inner one longest, the outer one covering the base of lowest arm spine. Oral shields usually with a distal supplementary plate which is up to $\frac{1}{2}$ as long as the oral plate; adoral plates roughly triangular in shape. Oral plates covered with granules. Seven to eight short, flat, oral papillae; tooth papillae flattish, rounded distally.

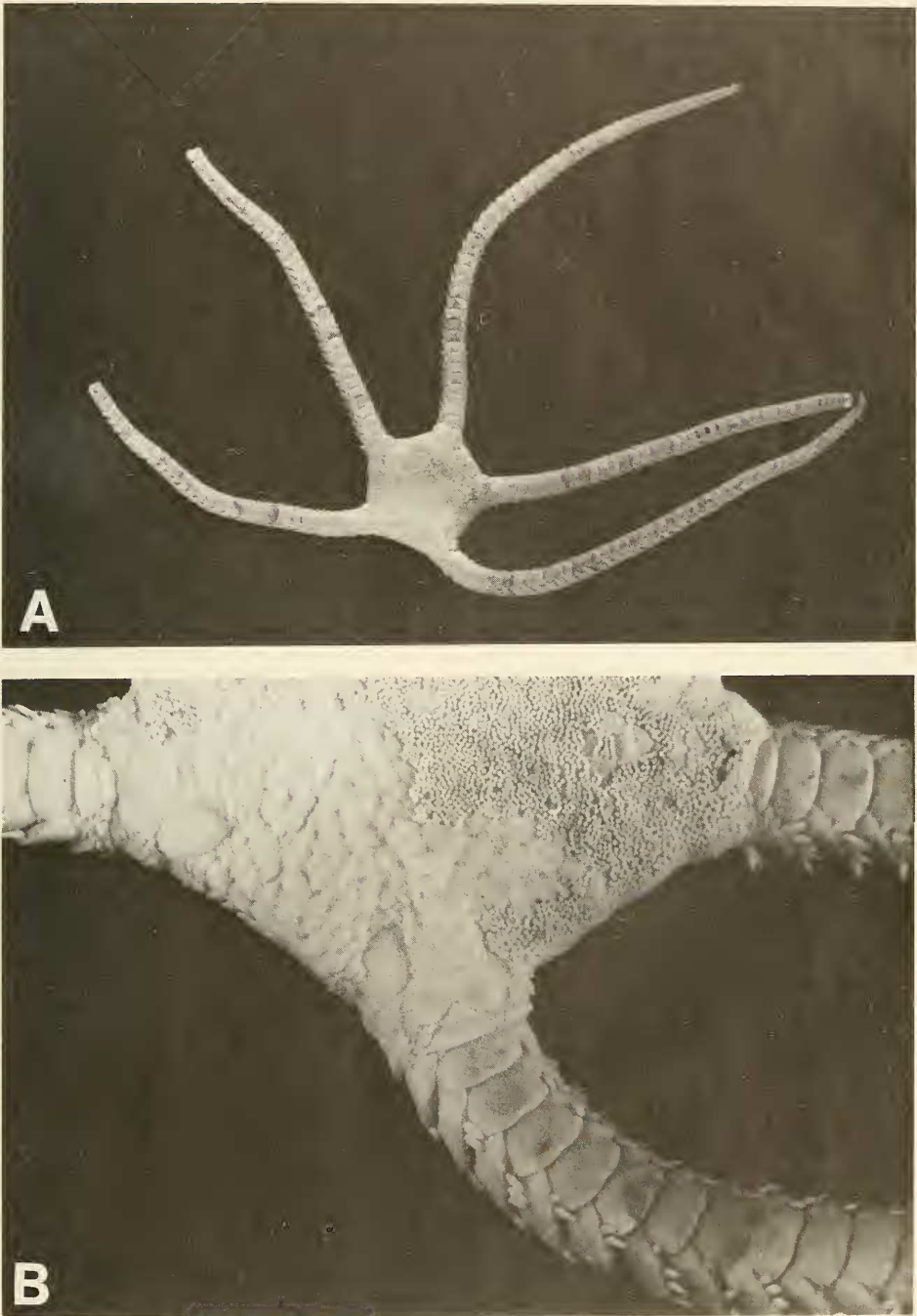


Fig. 2. A, B, *Ophiopeza arenosa*, paratype (BM(NH) 82.12.23.247 (pt)), dorsal view, dd = 9mm. Synonymized with *Ophiopeza cylindrica* hercin. Some disc granules were removed to show disc scaling.

Colour (dried): Light brown to charcoal grey; some arms with dark, cream, or reddish bands.

Distribution: Northeastern Tas. and Port Phillip Bay, Vic. to off Coffs Harbour, N.S.W., Stewart Id, N.Z.; to 74m.

Remarks: The description of *Ophiura cylindrica* by Hutton (1872a) was based on two specimens (Hutton, 1872b); neither of which had locality data according to the original authority. Lyman (1882) synonymized this species with *Pectinura rigida* Lyman, 1874, although he gave no reasons for the synonymy. Farquhar (1895) compared Lyman's description of *P. rigida* with the syntype series of *O. cylindrica* and concluded that they represented two distinct species. H. L. Clark (1915) subsequently synonymized *rigida* with *Ophiarachnella septemspinosa* (Müller and Troschel, 1842). Farquhar (1898a) described and figured material as *cylindrica*, which we believe refers to *Ophiopsammus assimilis* on the grounds of dorsal arm plate shape (see below). One of two syntypes of *O. cylindrica* was already lost when Mortensen (1924) compared this species with his newly-established species, *Ophiopeza gracilis*. We have examined the remaining syntype specimen of *O. cylindrica* (NMNZ Ech 6) examined by Mortensen, and agree with his comments (Mortensen, 1924). We are therefore convinced that this is one of Hutton's syntype series and we designate it as the **lectotype** of *O. cylindrica*.

O. gracilis (Mortensen, 1924) was established on a number of specimens from New Zealand. These included an unspecified number from Stewart Id, two from Queen Charlotte Sound, and one from Three Kings Island. We designate one specimen from Stewart Id (NMNZ Ech 375) as a **lectotype** of *O. gracilis* (Mortensen) since we consider it to be part of his syntype series.

When Mortensen described *O. gracilis*, he compared it with the closely related species *cylindrica* and also figured each of the species (Mortensen, 1924: 174, fig. 35 (1-2)). We have material of a size similar to the specimens of *cylindrica* figured by both Mortensen (1924) and Farquhar (1898a: 190, pl. 14, figs 4, 5). Our material agrees with the specimens figured by both of them although we identify our specimens as *Ophiopsammus assimilis* on the basis of disc scaling and shape of the dorsal arm plates. Consequently, we contend that Mortensen and Farquhar mistakenly referred specimens of *assimilis* to *cylindrica*. However, we agree with the differences discussed by Mortensen (1924) between the species '*cylindrica*' and '*gracilis*' but only in that they refer to differences between *Ophiopsammus assimilis* (i.e. Mortensen's and Farquhar's *cylindrica*) and *cylindrica* s.s. (i.e. Mortensen's *gracilis*).

Mortensen (1924) used dorsal arm plate and arm spine shape, relative size of oral shields, and the extent of granulation on oral plates to differentiate '*cylindrica*' and '*gracilis*'. He concluded that the dorsal arm plates were basically fan shaped in '*gracilis*' but that they were more transversely rectangular in '*cylindrica*'. Table 1 summarizes measurements from 15 specimens we have identified as *cylindrica* s.s., based primarily on dorsal disc scaling. Dorsal arm plates change from fan shaped in small individuals (d.d. \approx 7mm) to more transversely rectangular shaped in larger individuals, as shown in the dorsal arm plate ratio column of Table 1. This evidence suggests that the differences referred to by Mortensen can be explained by ontogenic development.

Ophiopeza arenosa was established on 6 type specimens by Lyman (1879). We have examined the holotype and a paratype (BM(NH) 82.12.23.247). Type material of *arenosa* was compared with the lectotype of *Ophiopeza cylindrica*. In these specimens, only slight differences attributable to size could be detected and these are within the range of variation found in *cylindrica* (Table 1).

TABLE 1
Measurements of specimens of Ophiopeza cylindrica

Registration no.	d.d.	d.a.p.r.	o.s.r.	n.s.p.	\bar{x}	o.p.g.- sd	n
NMNZ Ech 375	5	4.0	0.1	1	33	5.8	5
NMNZ Ech 3412	5	3.0	0.1	4	38*	—	1
NMNZ Ech 3412a	5	2.2	0.2	4	34	6.8	5
NMNZ Ech 3412b	7	2.0	0.1	2	41	2.7	5
AM J1974	7	1.8	0.1	5	34	3.5	5
AM G7831	7	1.8	0.1	5	48	4.2	4
NMNZ Ech 6	8	1.8	0.1	4	31	4.4	5
BM (NH) 82.12.23.247 (pt)	9	1.3	0.1	5	57*	—	1
AM G11413	9	1.8	0.1	5	?		
AM G11032	9	1.5	0.1	5	57*	—	1
NMNZ Ech 3413	10	1.7	0.1	5	72	10.1	5
BM (NH) 82.12.23.247	10	1.6	0.09	5	?		
AM J15049	10	1.6	0.09	5	56	3.6	5
NMNZ Ech 3413a	11	1.5	0.1	5	72	10.2	5
AM J15049	11	1.5	0.08	5	56	3.6	5

Abbreviations: d.d., disc diameter; d.a.p.r., dorsal arm plate ratio; o.s.r., oral shield ratio; n.s.p., number supplementary oral plates (maximum available is 5); o.p.g., oral plate granules with mean (\bar{x}), standard deviation (sd) and number (n) indicated; *, number of granules was estimated due to some missing granules; ?, all oral plate granules were missing (presumably either worn away or dislodged after preservation). Dorsal arm plate ratio was calculated for the fifth dorsal arm plate along the arm. This ratio is an approximate measure of the relative width of that plate's distalmost margin to its proximalmost one. Oral shield ratio is the approximate length of an individual's oral shield plate relative to its disc diameter. Bold registration numbers indicate type specimens.

After comparing the lectotype of *Ophiopeza cylindrica*, the lectotype of *Ophiopeza gracilis*, the holotype and paratype of *Ophiopeza arenosa* and 11 other specimens from New Zealand and Australia, we conclude that they are conspecific and that their variation in morphology is primarily due to ontogeny. *Ophiopeza arenosa* and *gracilis* are consequently synonymized with *Ophiopeza cylindrica*.

O. cylindrica has only been recorded from temperate seas whereas *O. spinosa*, *O. fallax fallax*, and *O. fallax arabica* are only known from tropical seas. In addition to their apparent geographic separation, *cylindrica* and *spinosa* differ most obviously by the fine, flat-topped granules of *spinosa* (see p. 275). *O. cylindrica* differs from *fallax fallax* and *fallax arabica* not only by the finer granulation of *cylindrica* but both *fallax* and *arabica* possess shorter arm spines, some bare marginal plates and, in *arabica*, bare radial shields.

Ophiopeza spinosa (Ljungman, 1867)

Fig. 3A,B

Ophiarachna spinosum Lungman, 1867: 305.

Ophiopeza fallax. Lütken, 1869: 35. [non *fallax* Peters, 1851.]

Pectinura spinosa. Lyman, 1874: 221.

Ophiopezella spinosa. Ljungman, 1872: 639. Lyman, 1882: 17. H. L. Clark, 1909a: 120; 1915: 304; 1921: 141, 1946: 258. Koehler, 1922: 338. Marsh and Marshall, 1983: 678.

Ophiopezella lütkeni de Loriol, 1893a: 392, pl. 13, fig. 1-1e.

Ophiopezella dubiosa de Loriol, 1893b: 7, pl. 23, fig. 2-2f. H. L. Clark, 1909a: 120. Koehler, 1922: 120.

Ophiopeza dubiosa. A. M. Clark, 1968: 313. Clark and Rowe, 1971: 127.

Ophiopeza spinosa. A. M. Clark, 1968: 313. Clark and Rowe, 1971: 90, 127, fig. 44e. Gibbs *et al.*, 1976: 130. Kingston, 1980: 145.

Material examined: (All specimens examined are held in the AM) 3 spec., J5352, Norwest Id, Capricorn Group, Qld, no coll. depth, vii.29; 3 spec., J5967, Norwest Id, Capricorn Group, Qld, no coll. depth or date; 2 spec., J8881, NW of Gillett Cay, Swain Reefs, Qld, no coll. depth, 17.x.62; 2 spec., J8882, off Gillett Cay Swain Reefs, Qld, 65-74m, 18.x.62; 2 spec., J9303, Heron Id, Qld, no coll. depth, xii.59; 1 spec., J10939, Marion Reef, Qld, 4m, 1.ix.77; 1 spec., J10940, Marion Reef, Qld, 8m, 27.viii.77; 1 spec., J15134, South Solitary Id, N.S.W., 27m, 31.i.82; 1 spec., J16602, Malabar, Lord Howe Id, 10m, 10.xii.79; 1 spec., J16856, Three Isles, Qld, 3-12m, 6.x.82; 3 spec., J19461, Heron Id, Qld, no coll. depth, 29.viii.85; 1 spec., J19577, Heron Id, Qld, no coll. depth, 23.viii.85; 1 spec., J19578, Heron Id, Qld, no coll. depth, 25.viii.85; 1 spec., J19579, Heron Id, Qld, no coll. depth, 28.viii.85.

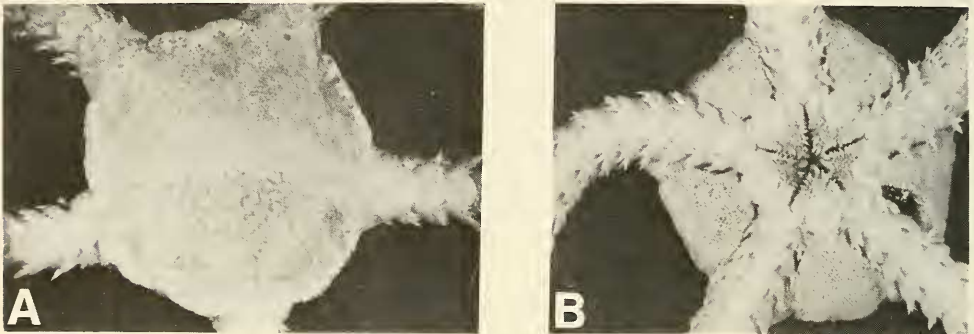


Fig. 3. A, B. *Ophiopeza spinosa*, (AM J19461), dorsal and ventral view respectively, dd = 6mm. Some disc granules were removed in A to show disc scaling.

Diagnosis: Disc diameter to 9mm, densely covered with small granules which are triangular in cross-section and flat-topped with a slightly depressed central area, ca 50 per mm; coarse overlapping scales underlying the granules. Each interradius with about nine marginal disc plates which are convex, prominent, and covered with larger granules than are present on the rest of the disc. Radial shields small (0.1 x d.r.), obscured by granules; only 1-2 scales separating the two plates of each pair of radial shields. Arms to 30mm, ca 5 x d.d., dorsal plates fan shaped, ca as wide as long. Nine to twelve, pointed, arm spines, less than half an arm segment long. Two tentacle scales per pore, inner one longest, outer one covering base of lowest arm spine. Oral shields longer than wide with a blunt proximal margin, supplementary plates usually present; adoral plates triangular, ca half as long as the oral shields, not contiguous. Oral plates covered with flat-topped granules. Eight to ten oral papillae; tooth papillae generally pointed.

Colour (dried): Dorsal surface cream to light grey, arms generally with dark banding; ventral surface cream, little sign of banding.

Colour (live): Kingston (1980: 145) described one live specimen as 'cream with faint brown cross-bands on the dorsal arm surface'.

Distribution: In Australia, from off Coffs Harbour, N.S.W., along the Great Barrier Reef, Qld, and in off-shore reefs of northwestern Australia. Overseas, western Indian

Ocean and the Red Sea to Indonesia, the Philippines and the western Pacific Ocean. A cryptic species often found under rocks or rubble, 3-74m.

Remarks: Both H. L. Clark (1909a) and Clark and Rowe (1971) were hesitant in recognizing *spinosa* and *dubiosa* as distinct species. De Loriol (1893b) considered *dubiosa* separate from *spinosa* because it had fewer arm spines (9 compared with 12-14) and because of its yellowish-green colour, instead of brown as in *spinosa*. We have examined 20 specimens of *spinosa* held in collections of the Australian Museum. Their disc diameters ranged from 4-9mm and their arm spine number from 9-12, overlapping the numbers supposedly characteristic of these two species. Although specimens examined by us were coloured a shade of brown, we do not consider the slight variation in colour recorded by de Loriol to be significant. In addition, our material also agrees with de Loriol's figures of *dubiosa*. Thus, we herein consider *dubiosa* to be synonymous with *spinosa*.

O. spinosa shares with *cylindrica*, *fallax*, and *arabica* the character of only a few large scales separating the two plates of each pair of radial shields. *O. spinosa* can be separated from these taxa in possessing only 1-2 scales in that position, but more readily by the distinctive shape of its disc granules.

Key to the species of *Ophiopeza*
(excluding *O. exilis*)

- 1 Disc completely covered with granules 2
- 1' Some marginal disc plates, both radial and interradial, without granules 3
- 2 Marginal interradial disc plates convex, conspicuous despite cover of granulation; disc granules flat-topped *O. spinosa*
- 2' Marginal interradial disc plates not conspicuously convex, not visible through granulation; disc granules rounded *O. cylindrica*
- 3 Only the middle marginal interradial disc plates are bare; radial shields covered with granules *O. fallax fallax* (Fig. 4A, B)
- 3' Some marginal disc plates, both radial and interradial, are bare; radial shields sometimes partially bare *O. fallax arabica*

Genus *Ophiopsammus* Lütken

Ophiopsammus Lütken, 1869: 37 (type-species *Ophiopeza yoldii*, Lütken, 1856, by monotypy).

Diagnosis: A genus of ophiidermatid with radial shields obscured by granules; marginal interradial disc scales enlarged, covered by granules, never bare; disc scales very fine, overlapping, numerous disc scales separating the two plates of each pair of radial shields; oral plates covered by granules; oral shields naked, supplementary plates absent or present; dorsal arm plates transversely rectangular (up to ca 5 x wider than long), convex to conspicuously carinate; arm spines seldom exceeding one arm segment in length, often appressed.

Other species included: *O. aequalis* (Lyman, 1880), *O. anchista* (H. L. Clark, 1911), *O. angusta* sp. nov., *O. assimilis* (Bell, 1888), *O. maculata* (Verrill, 1869).

Remarks: We support A. M. Clark's (1968) resurrection of *Ophiopsammus*, but not solely on the basis of its carinate dorsal arm plate shape. In addition, our studies have shown the importance of disc scaling in recognizing *Ophiopsammus*. This genus differs from

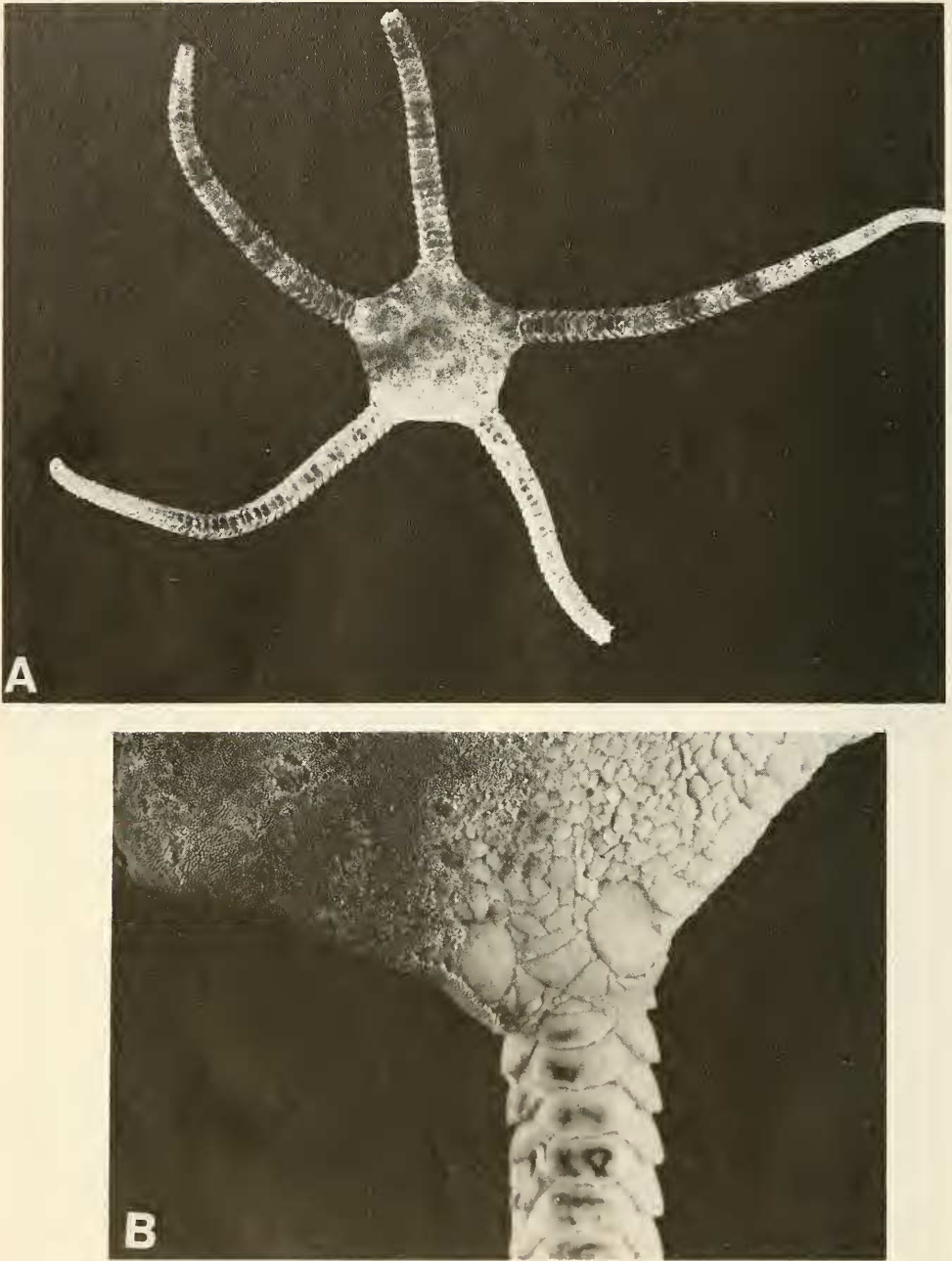


Fig. 4. A, B, *Ophiopeza fallax fallax*, (BM (NH) 1965.6.1.507), dorsal view, dd = 14mm. Some disc granules were removed to show disc scaling.

Ophiopeza in having relatively finer disc scaling, and numerous small scales separating the two plates of each pair of radial shields. In addition, the dorsal arm plates are wide and transversely rectangular shaped. The species we include in *Ophiopsammus* also attain

a greater size (d.d. to ca 41mm, arm length to ca 180mm) than those of *Ophiopeza* (d.d to ca 11mm, arm length to ca 40mm).

Ophiopsammus yoldii Lütken, 1856

Fig. 5A,B

Ophiopeza yoldii Lütken, 1856: 9. Lyman, 1874: 221.

Ophiopsammus yoldii. Lütken, 1869: 37. A. M. Clark, 1968: 317, fig. 9a, b. Clark and Rowe, 1971: 90, 127, pl. 21, figs 7, 8. Gibbs *et al.*, 1976: 130. Kingston, 1980: 145.

Ophiopeza conjungens. Bell, 1884: 137. Döderlein, 1896: 281, pl. 15, fig. 1.

Pectinura yoldii. H. L. Clark, 1909a: 119; 1921: 141; 1938: 344. Koehler, 1922: 338, 1930: 270.

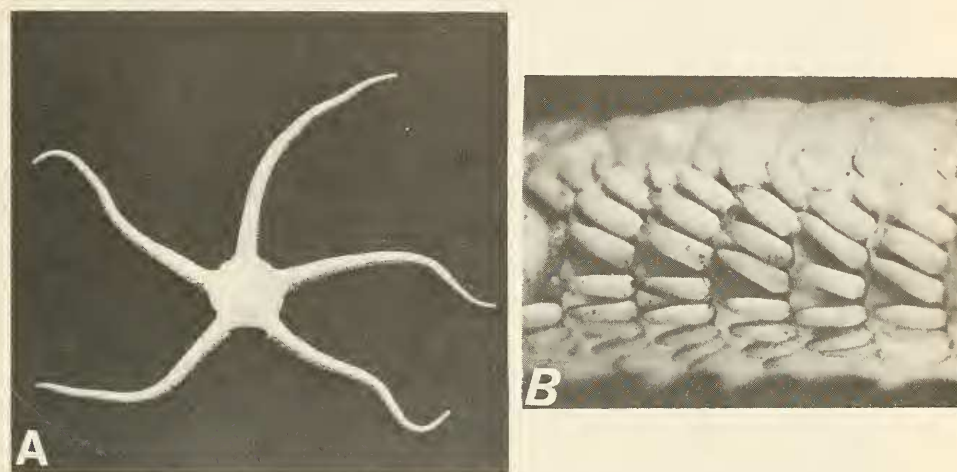


Fig. 5. *Ophiopsammus yoldii*, (AM J5374), dd = 22mm. A, dorsal view, some disc granules were removed; B, arm spines (proximal) and a portion of dorsal arm plate (top of photo).

Material Examined: (All specimens examined are held in the AM) 3 spec., G4208, Mapoon, Gulf of Carpentaria, Qld, no coll. depth or date; 1 spec., G4983, Port Curtis, Qld, no coll. depth or date; 1 spec., G1420, Port Denison, Qld, no coll. depth or date; 4 spec., J2413-16, Port Curtis, Qld, no coll. depth or date; 2 spec., J5307, Albany Passage, Qld, 17-22m, ix.28; 2 spec., J5374, off Gatcombe Head, Port Curtis, Qld, 17-22m, vii.29; 3 spec., J5375, off Gatcombe Head, Port Curtis, Qld, 17-22m, vii.29; 1 spec., J5487, Port Curtis, Qld, no coll. depth or date; 1 spec., J5924, Kennedy Sound, nr Whitsunday Passage, Qld, 15m, no coll. date; 1 spec., J8889, off Gillett Cay, Swain Reefs, Qld, 65-74m, 19.x.62; 1 spec., J8890, off Gillett Cay, Swain Reefs, Qld, 65-74m, 18.x.62; 1 spec., J9306, Gulf of Carpentaria, Qld, <26m, ix.64; 1 spec., J11227, SE corner of Gulf of Carpentaria, Qld, no coll. depth or date; 1 spec., J12208, nr Turtle Head Id, Cape York, Qld, no coll. depth, 15.ii.79; 12 spec., J12228, Cape York, Qld, no coll. depth, 15.ii.79; 1 spec., J18001, Abbot Pt, Bowen Qld, 15-17m, 11.vi.83; 5 spec., J18002, Abbot Pt, Bowen, Qld, 6-11m, 11.vi.83; 4 spec., J18009, Abbot Pt, Bowen, Qld, 11-12m, 11.vi.83; 2 spec., J18010, Abbot Pt, Bowen, Qld, 15-17m, 11.vi.83; 1 spec., J18013, Abbot Pt, Bowen, Qld, 16m, 12.vi.83; 2 spec., J18016, Abbot Pt, Bowen, Qld, 10-16m, 12.vi.83; 2 spec., J18017, Abbot Pt, Bowen, Qld, 5-19m, 10.vi.83; 1 spec., J18018, Abbot Pt, Bowen, Qld, 5-19m, 10.vi.83; 2 spec., J18048, Abbot Pt, Bowen, Qld, 5-6m, 19.vi.82; 2 spec., J18049, Abbot Pt, Bowen, Qld, 14-15m, 11.vi.83; 1 spec., J18345, 74 n.m. NNE

Pt Hedland, W.A., 80m, 30.x.83; 1 spec., J18370, 50 n.m. NNE Pt Hedland, W.A., 38-40m, 25.x.83; 1 spec., J18400, 52 n.m. NNE Pt Hedland, W.A., 36-37m, 24.x.83; 1 spec., J18409, 52 n.m. NNE Pt Hedland, W.A., 36-37m, 24.x.83; 1 spec., J18478, 80 n.m. NNE Pt Hedland, W.A., 82m, 23.x.83; 1 spec., J18497, 80 n.m. NNE Pt Hedland, W.A., 83m, 23.x.83.

Diagnosis: Disc diameter to 22mm, densely covered with rounded granules, 14-23 per mm; fine, overlapping scales underlying the granules. Each interradius with about 9 marginal disc plates, obscured by granule cover, middle plate the largest. Radial shields 0.3 x d.r., obscured by granules, the two plates of each pair of radial shields separated by numerous scales. Arms to 75mm, 1.8-3.1. x d.d.; dorsal arm plates mainly transversely rectangular in shape (2-5 x wider than long) but becoming fan shaped near the arm tip, carinate, even in small specimens, usually entire but occasionally fragmented; ventral arm plates ca as long as wide in small specimens (d.d. \approx 10mm), becoming wider than long (up to 2 times) in larger specimens, distalmost margin slightly irregular. Five to ten stout arm spines, middle ones longest (sometimes slightly exceeding an arm segment in length) and in large specimens (d.d. \approx 20mm) also wider than the remaining spines. Two tentacle scales per pore, inner one larger, ca half the length of lowest arm spine and distinctly curved, outer one covering base of lowest arm spine. Supplementary oral shields generally absent, rudimentary when present. Oral shields pentagonal in small specimens, becoming heart-shaped with growth, flat, ca as wide as long; adoral plates small, triangular, not contiguous. Oral plates covered with granules. Ten to twelve oral papillae; tooth papillae pointed.

Colour (dried): Dorsal surface light grey or brown to a darker reddish brown, ventral surface generally a lighter shade of the dorsal surface colour. Some specimens have mottled cream and grey discs with grey banding on cream coloured arms, while others have a large, light stellate pattern in the disc centre contrasting with a darker background.

Distribution: In Australia, along the Great Barrier Reef and in the Gulf of Carpentaria, Qld, and off Pt Hedland, W.A.; 5-83m. Overseas, the species has been recorded from the Bay of Bengal to the Philippines Ids, to 215m.

Remarks: Housed in the Australian Museum is a collection of approximately 60 specimens of *Ophiopsammus yoldii* and 40 specimens of *Ophiopsammus assimilis*. Examination of dorsal disc scaling in these specimens has shown the two species to be very similar. In fact, the very distinctive arm spine arrangement of *yoldii* is the only character we can find to separate it from *assimilis*. In *yoldii*, the middle arm spines are longest (ca one arm segment long), whereas in *assimilis* all arm spines are of approximately equal length (ca $\frac{1}{2}$ - $\frac{2}{3}$ of an arm segment long). Characters separating *yoldii* from its congeners are given in the key.

Ophiopsammus aequalis (Lyman, 1880)

Fig. 6A-C

Ophiopoeza aequalis Lyman, 1880: 9, pl. 2, figs 23-25; 1882: 12, pl. 27, figs 7-9. Koehler, 1904: 10; 1922: 337, pl. 77, figs 16, 17. A. M. Clark, 1968: 313.

Pectinura aequalis. H. L. Clark, 1909a: 118; 1915: 303.

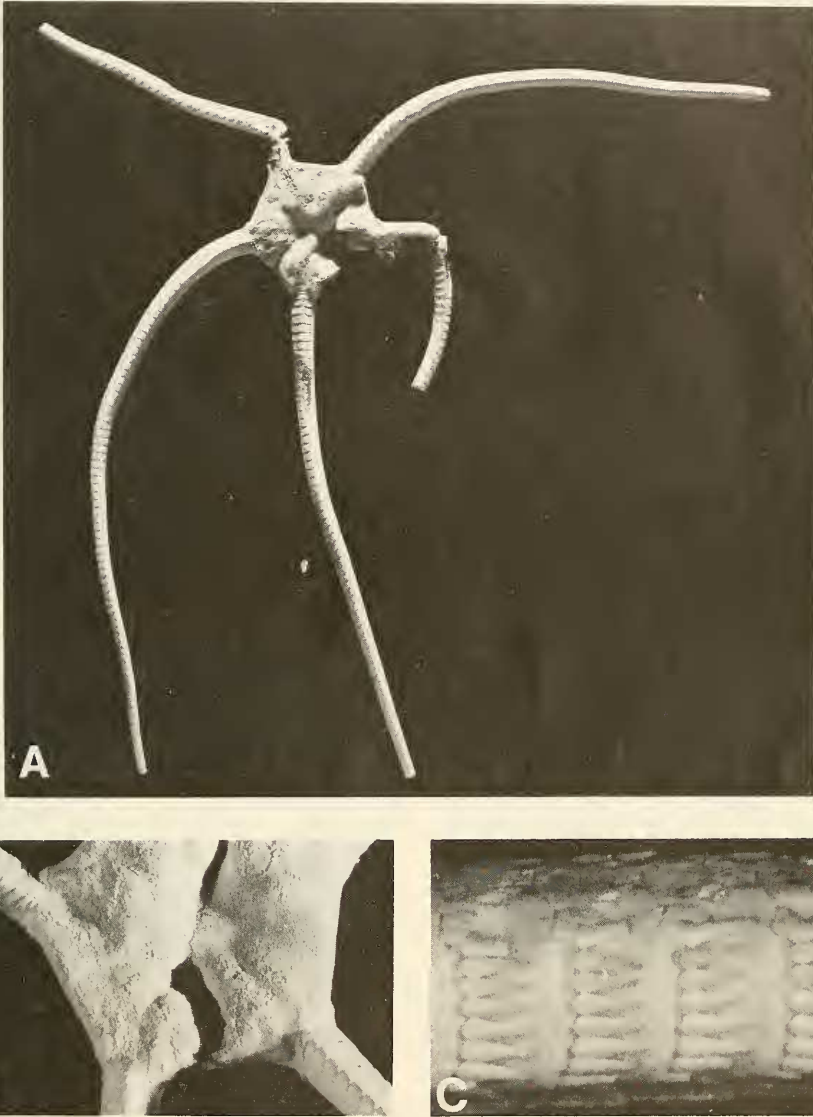


Fig. 6. *Ophiopsammus aequalis*, (AM J13960; 2 specimens, i and ii). A, dorsal view, specimen i, dd = 23mm; B, dorsal view, specimen ii, dd = 26mm; C, arm spines (proximal) and ventral arm plates (bottom of photo), specimen i. Some disc granules were removed in A and B.

Material examined: 3 spec., AM J13960, Timor Sea, northern Australia ($09^{\circ} 48' S$, $129^{\circ} 23' E$), 270-272m, 25.vi.79.

Diagnosis: Disc diameter to 23mm, densely covered with small, round granules, ca 15 per mm; exceedingly fine overlapping scales underlying the granules. Each interradius with eleven marginal interradial disc plates, slightly convex, middle one largest, all

covered by granules. Radial shields 0.15-0.2 x d.r., obscured by granules; numerous scales separating the two plates of each pair of radial shields. Arms to ca 140mm (tips broken), ca 5-6 x d.d.; dorsal arm plates transversely rectangular (2-3 x wider than long) and strongly carinate. Nine to ten pointed arm spines, $\frac{1}{2}$ - $\frac{2}{3}$ of an arm segment long, lowest spine marginally longer and wider than the remaining spines. Two tentacle scales per pore, inner one longer, outer one covering base of lowest arm spine. Oral shields slightly wider than long, proximal margin blunt, distal margin broadly convex, some oral shields with a rudimentary supplementary plate; adoral plates small, ca 0.2-0.3 x oral shields long, not contiguous. Oral plates covered by numerous granules. Eight to nine oral papillae, penultimate very long (up to 3 x longer than the other papillae); tooth papillae blunt.

Colour (dried): Cream to light grey both dorsally and ventrally. Koehler (1922: 337) records one preserved specimen with a pink dorsal disc surface and arms with light pink and dark red annulations.

Distribution: Lyman's types came from northeast of New Guinea and the Kei Islands. Additional specimens were collected by the 'Siboga' northeast of northern Borneo. The three specimens examined by us from the Timor Sea are the first records of this species from Australia. This is a deep-water ophiidermatid species previously collected from 209-274m.

Remarks: Long delicate arms are common to both *O. aequalis* and *O. angusta* sp. nov., in contrast to the relatively shorter, stouter arms of *O. assimilis* and *O. yoldii*. However, *aequalis* is easily separated from *angusta* on differences in arm spine arrangement and from the New Zealand species *O. maculata* on the shape of dorsal arm plates. Characters separating *aequalis* from its congeners are illustrated in the key.

Ophiopsammus assimilis (Bell, 1888)

Fig. 7A-C

Pectinura assimilis. Bell, 1888: 282, pl. 16, fig. 5. H. L. Clark, 1909a: 118; 1946: 257. A. M. Clark, 1966: 327. ?Baker, 1982: 436.

?*Ophiopeza cylindrica*. Farquhar, 1898a: 190; pl. 14, figs 4, 5 [non *cylindrica* Hutton, 1872.]

Pectinura dyscrita. H. L. Clark 1909b: 534, pl. 49, figs 5-7. Dartnall, 1980: 42, 71. H. L. Clark, 1946: 256.

?*Pectinura cylindrica*. Mortensen, 1924: 172, fig. 35(1-2) [non *cylindrica* Hutton, 1872.]

Pectinura nigra. H. L. Clark, 1938: 344. H. L. Clark, 1946: 256.

Ophiopeza dyscrita. A. M. Clark, 1968: 313. Baker, 1982: 436.

Ophiopeza nigra. A. M. Clark, 1968: 313.

Material examined: **Holotype** of *assimilis* BM(NH) 86.6.9.23, Port Jackson, N.S.W., no coll. depth or date; **holotype** of *nigra* MCZ 5257, Koombana Bay, Bunbury, W.A., 9-15m, 26.x.1929; 1 **lectotype** of *dyscrita* AM J849, off Wata Mooli, N.S.W., 129-144m, no coll. date; 2 spec., AM E5941, 30 mls S. of Mt Cann, Gippsland, Vic., 129-185m, 19.x.14; 1 spec., AM J11637, Long Reef, Collaroy, N.S.W., 40m, 14.iv.72; 1 spec., AM G11418, Port Jackson, N.S.W., no coll. depth or date; 4 spec., AM J15991, (32° 52.51' S, 152° 34.35' E), 151m, 6.xii.78; 1 spec., AM G11440, Port Jackson, N.S.W., no coll. depth or date; 1 spec., AM J10008, E of Cronulla, N.S.W. (34° 09' S, 151° 16' E), 127-132m, 17.iv.75; 3 spec., AM J14978, Julian Rocks, Byron Bay, N.S.W., 12m, 4.ii.82; 1 spec., AM J18557, nr Mistaken Id, Albany, W.A. (35° 04' S, 117° 56' E), 2m, 13.x.83; 1 spec.,

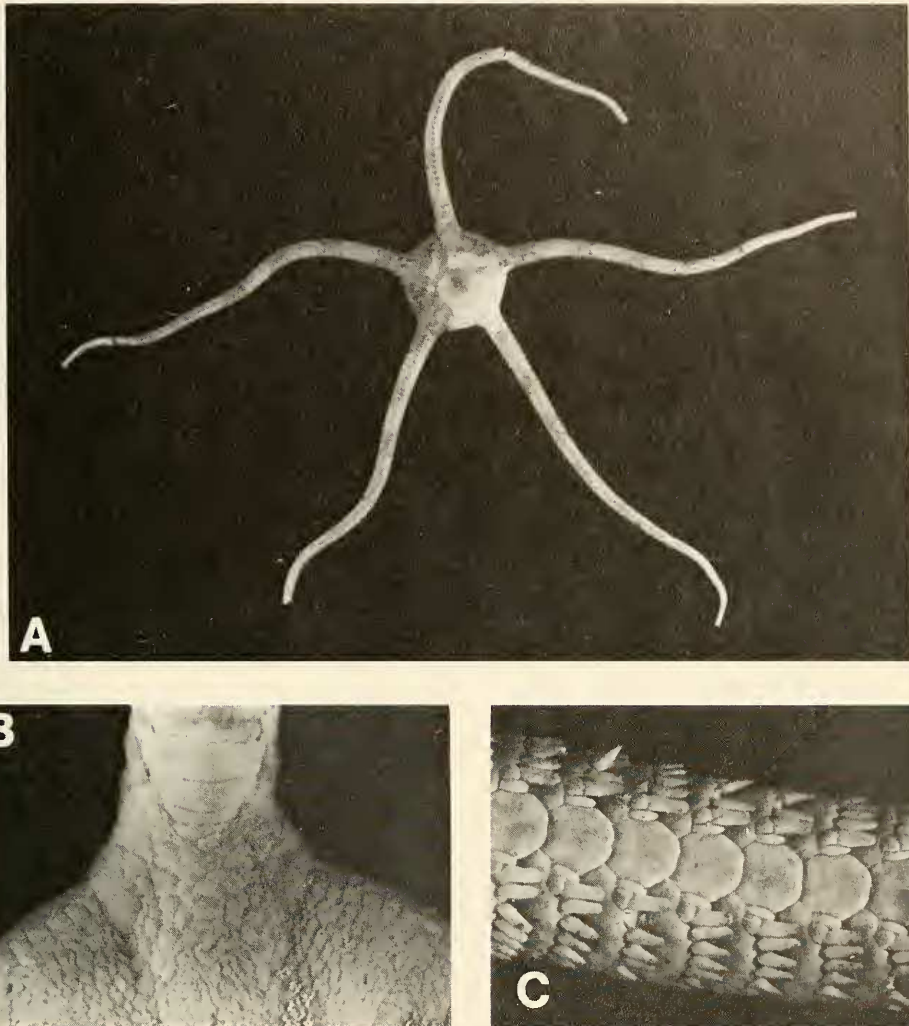


Fig. 7. *Ophiopsammus assimilis*, holotype (BM (NH) 86.6.9.23), dd = 24mm. A and B, dorsal view, some disc granules were removed; C, ventral arm plates and arm spines (proximal).

AM J14979, Julian Rocks, Byron Bay, N.S.W., 9-15m, 3.ii.82; 1 spec., AM E4717, Gabo Id, Vic., 368m, no coll. date; 1 spec., AM G7115, Port Hacking, N.S.W., 55-74m, 1961; 1 spec., AM J12564, NE side Kangaroo Id, S.A., 5m, 9.iii.78; 1 spec., AM G11419, Port Jackson, N.S.W., no coll. depth or date; 1 spec., AM J17621, Triggs Id, Perth, W.A., 6m, 22.v.83; 3 spec., AM E5212, E of Babel Id, Tas., 129m, 1914; 4 spec., AM J11086, 40mls ENE of Sydney, N.S.W., 184-232m, 18.vi.59; 1 spec., AM G11027, Port Jackson, N.S.W., no coll. depth or date; 2 spec., AM J13975, Montague Id, N.S.W., 28-31m, 16.iii.81; 1 spec., AM J14159, Ulladulla, N.S.W., 25m, 27.iii.81; 1 spec., AM J13991, Montague Id, N.S.W., 31m, 16.iii.81; 1 spec., AM J14015, Burrewarra Pt, N.S.W. (35° 50' S, 150° 14' E), 28m, 15.iii.81; 2 spec., AM J14162, Jervis Bay, N.S.W., 25-28m, 21.iii.81; 3 spec., AM G2032, Wellington, N.Z., no coll. depth, xi.1896; 2 spec., AM G11423, Port

Jackson, N.S.W., no coll. depth or date; 1 spec. AM J4306, Shell Harbour, N.S.W., no coll. depth, 21.iii.77.

Diagnosis: Disc diameter to 28mm, densely covered with rounded granules, 8-15 per mm; very fine, overlapping scales underlying the granules. Each interradius with 8-14 marginal plates, all concealed by granulation. Radial shields 0.2 x d.r., obscured by granules, up to seven overlapping scales separating the two plates of each pair of radial shields. Arms to 100mm, 2.3-4.7 x d.d.; dorsal arm plates convex to carinate, transversely rectangular (1.7-2.7 times wider than long); ventral arm plates as wide as long. Arm spines stout, tapering, slightly swollen at the base, ca half an arm segment long, 4-11 spines per lateral plate. Two tentacle scales per pore, inner one the longer. Oral shields usually without a supplementary oral plate, poorly developed if present; adoral plates small, not contiguous. Oral plates covered with granules. Seven to eight blunt oral papillae on each half jaw; penultimate conspicuously wider than the others; tooth papillae stout, blunt.

Colour (dried): Variable, cream to reddish brown to grey; arms sometimes with faint banding.

Colour (live): Some specimens may have a bright red disc and arms with alternating bands of red and grey while others have a red/cream mottled disc.

Distribution: A few individuals have been collected near Perth and Albany, W.A. and one from Kangaroo Id, S.A. This species has been more commonly found in Tas. and from off Gabo Island, Vic., to Byron Bay, N.S.W., on the Australian coast. It also occurs in New Zealand, at least along the northern coasts from Three Kings Id to Cook Strait. This species is quick moving and is found under rocks (pers. obs. L.V.), at least in shallower depths; depth range 2-368m.

Remarks: The original description of *Ophiopeza assimilis* Bell, 1888, is based on one specimen with a disc diameter of ca 100mm and arm length of 24mm. We have examined a specimen from the British Museum (86.6.9.23) labelled as a type of *assimilis* with a disc diameter of 24mm and arm length of ca 90mm. We consider this specimen the holotype of *assimilis* since it fits Bell's description and has the same locality data. Only its disc diameter and arm length measurements disagree with the original description and these have obviously only been reversed.

As discussed previously (p. 272), figures given for *Ophiopeza cylindrica* by both Farquhar (1898a) and Mortensen (1924) probably represent *assimilis*. This view is supported by material in the Australian Museum collections from New Zealand (AM G2032). Positive identification of the material figured by them would have required removal of some dorsal disc granules in order to reveal the pattern of disc scaling between the plates of each pair of radial shields, but this material was not available.

In a revision of the genus *Pectinura*, H. L. Clark (1909a) separated *arenosa* (now regarded as a synonym of *Ophiopeza cylindrica*) and *assimilis* on the size of their dorsal arm plates and on the presence or absence of supplementary oral shields. Specimens described herein as *cylindrica* have supplementary oral plates associated with most oral shields (Table 1). These plates are generally absent in *assimilis*, although some individuals (AM; G7115, J14978 (2), E5941) have rudimentary supplementary oral plates. The disc granules of *cylindrica* and *assimilis* have never featured in descriptions of these species and consequently two characters which readily separate them have been over-

looked: namely the arrangement of scales separating the two plates of each pair of radial shields, and the type of disc scaling.

Shortly after his revision of *Pectinura*, H. L. Clark (1909b) described a new species, *dyscrita*, from two specimens collected off central N.S.W. (**lectotype** AM J5849; **paralectotype** MCZ 590, designated herein). He noted they were most similar to *assimilis* but differed in having fewer (6-8) arm spines. Another species, *nigra*, was described by H. L. Clark (1938) from one specimen collected near Bunbury, Western Australia. H. L. Clark (1946) separated *nigra* and *dyscrita* on arm spine number and by the black coloration of *nigra*. We have examined the holotype of *nigra* (d.d. 7mm) and the lectotype of *dyscrita* (d.d. 10mm) and confirm that their disc scaling is the same as that of *assimilis*. Furthermore, differences in their arm spine number and coloration are within the range of variation found in *assimilis*. However, as more material is collected, it may be shown that the darker coloration which Clark attributed to *nigra* is more common in specimens from South Australia and westwards. H. L. Clark (1909; 1946) also distinguished *dyscrita* from other species of *Ophiopeza* by its large lowest arm spine. Our examination of the lectotype material of *dyscrita* has shown its lowest arm spine is only marginally longer, if any, than the other arm spines. Thus, we now regard both *dyscrita* and *nigra* as synonyms of *assimilis*.

Interestingly, an enlarged lowest arm spine is one character readily separating adults of *Ophiopsammus angusta* sp. nov. (p. 285) and *assimilis*. In addition, the lowest arm spine of *angusta* is broader than the other spines and its arm spines have straight marginal edges in contrast to the tapering ones of *assimilis*. *O. assimilis* is most readily separated from its other congeners on arm spine arrangement and dorsal arm plate shape as shown in the key. Large New Zealand specimens, however, occasionally have fragmented dorsal arm plates (A. N. Baker, pers. comm.).

Ophiopsammus angusta sp. nov.

Fig. 8A-C

Material Examined: **Holotype**, AM E4693, E of Flinders Id, Bass Strait, Tas., 148-553m; no coll. date; 1 **paratype**, AM E5025, E of Maria Id, Tas., 144m, no coll. date; 1 **paratype**, AM E5376, NE of Cape Pillar, Tas., 148m, 1914; 1 **paratype** AM E5946, Bay of Fires, Tas., 102m, 7.xi.14; 1 **paratype**, MV F52197, S of Cape Nelson, Vic., 406m, 10.iii.77; 1 spec., AM E5116, E of Maria Id, Tas., 236m, no coll. date; 10 spec., MV F52196, Bass Strait, 38° 52.6'S, 148° 25.2'E, 140m, 15.xi.81; 1 spec., MV F52194, S of Bemm River, Vic., 38° 15.1'S, 149° 00'E, 223m, 22.xi.73; 1 spec., MV F52195, W of Cape Nelson, Vic., 165-201m, 6.vi.69.

Diagnosis: Disc diameter to 21mm; rounded granules, 7-14 per mm; fine overlapping scales on the dorsal and ventral surfaces; 9-14 marginal disc plates per interradius, middle one largest. Radial shields ca 0.1-0.2 x d.r., about twice as long as wide, the two plates of each pair separated by ca 8 disc scales, radial shields obscured by disc granulation. Arms to 116mm, 5.5-7.9 x d.d., dorsal arm plates transversely rectangular (ca 1.5 x wider than long), slightly carinate, distal margins slightly convex; ventral arm plates roughly hexagonal with rounded corners (ca as wide as long), distal margin convex; 8-10 arm spines, ca half the length of an arm segment; lowest arm spine the longest, conspicuously wider than the other arm spines. Lateral margins of arm spines generally parallel, tapering on the distal $\frac{1}{3}$ of their length. Two tentacle scales per pore, inner one the longer. Oral shields roughly triangular with round edges, supplementary plates usually absent; adoral plates longer than wide, not contiguous. Oral plates covered with

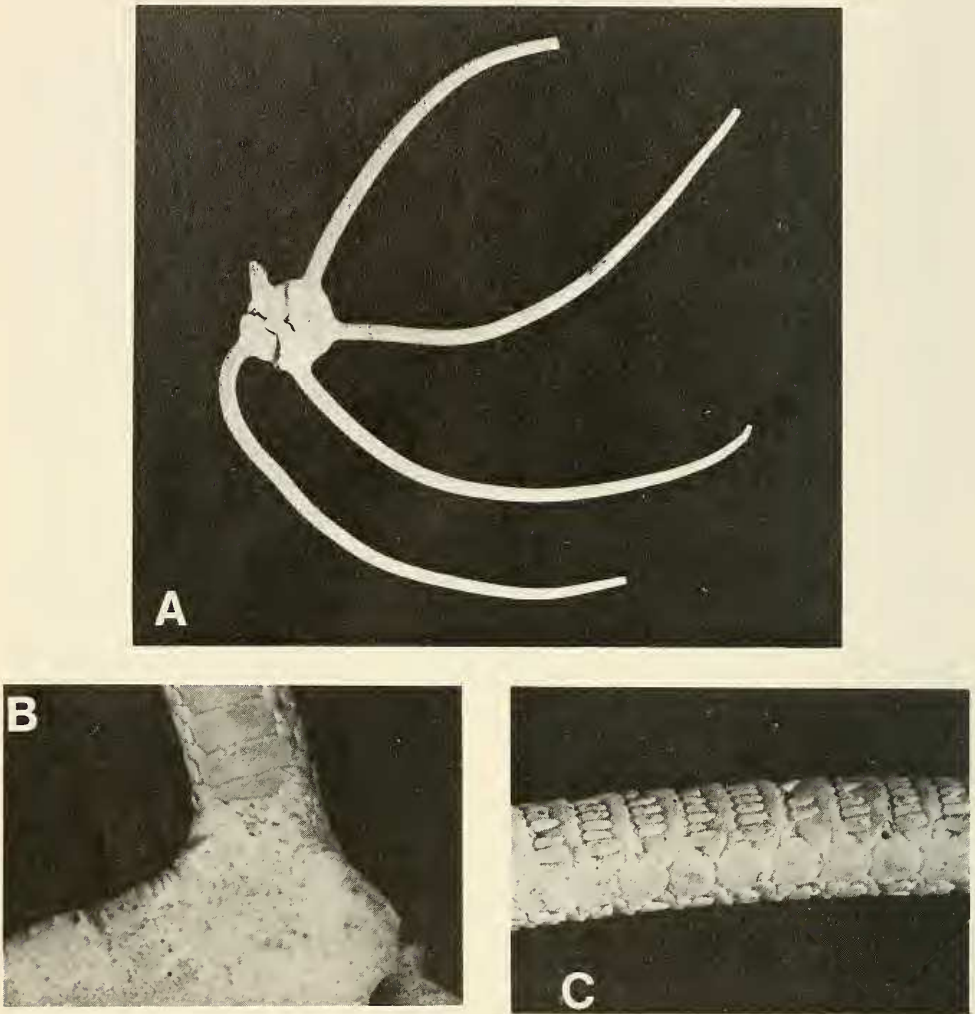


Fig. 8. A-C, *Ophiopsammus angusta* sp. nov., holotype (AM E4693), dd = 17.5mm. A and B, dorsal view, some disc granules were removed; C, ventral arm plates and arm spines (proximal).

granules. Six to seven oral papillae on each half jaw, penultimate at least 2 x wider than the remainder; tooth papillae stout, blunt.

Description of Holotype: Disc diameter 17.5mm; covered with granules both dorsally and in the ventral interradiar areas, 7-9 granules/mm. Fine, overlapping disc scales occur both on the dorsal and ventral surfaces. Each interradius with thirteen marginal disc plates, middle one the largest. Radial shields 0.2 x d.r. (ca twice as long as wide), the two plates of each pair separated by ca 8 disc scales. Disc scales, marginal plates and radial shields obscured by disc granulation.

Arms broken, to ca 100mm, 5.7 x d.d., very finely tapered, slightly carinate dorsally. Dorsal arm plates transversely rectangular with a slightly convex distal margin (ca 1.5-

1.7 x wider than long), distally becoming more fan shaped with a convex distal margin. First ventral arm plate transverse diamond shaped (ca 2 x wider than long), distal margin convex. Succeeding arm plates roughly hexagonal with rounded corners (ca as wide as long), distal margin convex; distal plates becoming slightly longer than wide. First lateral arm plate with 2 arm spines, 2nd and 3rd-4, 4th and 5th-6, 6th-8, thereafter 9, decreasing at the distal end of the arm to 6 spines. Lowest arm spine longest ($\frac{3}{4}$ -1 arm segment long) and widest (ca 1.25 x wider than the other spines). Remaining arm spines ca $\frac{1}{2}$ an arm segment long, proximal $\frac{2}{3}$ of each spine with parallel lateral margins, becoming slightly tapered distally with a blunt tip; adjacent spines contiguous or almost contiguous. Two tentacle scales per pore; inner one the longer, tapering distally; outer one covering proximal portion of lowest arm spine (ca as broad as long), with a blunt distal margin.

Oral shields roughly triangular with very rounded edges (ca as long as broad), one shield with a rudimentary, distal, supplementary plate; adoral plates triangular (longer than wide); not contiguous. Oral plates densely covered with granules about equal in size to the disc granules. Six to seven oral papillae on each half jaw, penultimate ca 3 x wider than the other papillae. Tooth papillae stout with pointed or blunt tips.

Paratypes: Disc diameters ranged from 11-21mm and maximum arm lengths from ca 60-116mm. Except for overall size and arm spine number, the paratypes do not differ from the holotype. Arm spine size number ranged from 8-10 per plate, with the smallest specimen (d.d. 11mm) having the fewest arm spines and the largest (d.d. 21mm) the most.

Colour (dried): Holotype, creamy white; other material, creamy white to light grey; one specimen (NMV F52195) is a uniform light purple.

Distribution: Endemic to southeastern Australia; off Tas. and Vic.; 102-201m.

Etymology: The species is named from the Latin *angustia* for the straight sided arm spines.

Remarks: *O. angusta* appears most closely related to *assimilis*. Characters separating them are: the R/d.d. ratio; shape of the lowest arm spine; and shape of the other arm spines. In *angusta*, R/d.d. is 5.5-7.9 for individuals with a d.d. >9mm while in similar-sized specimens of *assimilis*, this ratio is 2.3-4.7. Consequently, the arms of *angusta* appear delicate while those of *assimilis* seem stout and robust. The lowest arm spine of *angusta* is noticeably longer, wider, and more robust in appearance than other arm spines whereas in *assimilis*, this spine is only slightly, if any, longer and wider than the other spines. In larger specimens of *angusta* (d.d. >9mm), lateral margins of arm spines are nearly parallel, except near the tip where they begin to taper. In contrast, specimens of *assimilis* (d.d. > 9mm) have more tapered arm spines. In addition, lateral margins of arm spines in *angusta* are almost contiguous whereas in *assimilis* they are separated.

We have been unable to satisfactorily separate small specimens (d.d. < 9mm) of *angusta* and *assimilis* as their R/d.d. ratio is very similar (ca 3.0-4.0) and their arm spines appear similar. Relative size of the lowest arm spine is most useful when separating small specimens. A collection of 9 small specimens (d.d. 6-8mm) of *Ophiopsammus* from Bass Strait (MV F52196) are probably *angusta* because of their long and wide innermost arm spines.

O. angusta shares with *aequalis* and *anchista* a high R/d.d. ratio and thus delicate-appearing arms, although the very carinate dorsal arm plates in *aequalis* readily separate

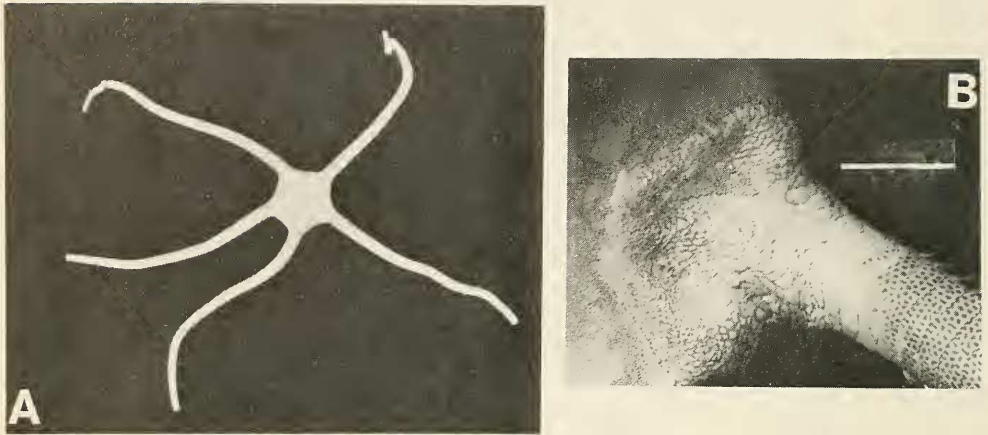


Fig. 9. A, *Ophiopsammus anchista*, holotype (USNM 25645), dorsal view, dd = 13mm. B, *Ophiopsammus maculata*, (AM J10208), dorsal view, scale line = 10mm.

it from these two other taxa. Differences between *angusta* and its other congeners are demonstrated in the key.

Notes on *Ophiopsammus anchista* (H. L. Clark, 1911)

During this study, we examined a holotype (USNM 25645, Fig. 9A) and two paratypes (USNM 26214) of *anchista* H. L. Clark, 1911 from Japan. The species is referable to *Ophiopsammus*. However, the smallest paratype (d.d. \approx 4mm) is misidentified, being identified by us as a species of the genus *Cryptopelta* H. L. Clark, 1909a.

O. anchista is most readily separated from its other congeners on the shape of its arms, dorsal arm plates, and arm spines, as shown in the key.

Key to the species of *Ophiopsammus*

- 1 Dorsal arm plates often very fragmented, usually spotted. *O. maculata* (Fig. 9)
- 1' Dorsal arm plates entire, except for *O. yoldii* which may have a few fragmented plates; not spotted 2
- 2 Arms long, delicate appearance (R/d.d. ratio 5-8 in adults) 3
- 2' Arms relatively short, stout appearance (R/d.d. ratio 1.8-4.7) 5
- 3 Dorsal arm plates strongly carinate *O. aequalis*
- 3' Dorsal arm plates round to only slightly carinate 4
- 4 Lowest arm spines distinctly longer and wider than adjacent arm spines; lateral margins of arm spines parallel on proximal $\frac{2}{3}$ of spine; arm segment no. 10 with ca 9 arm spines *O. angusta*
- 4' Lowest arm spines ca the same length as adjacent arm spines; arm spines tapered, arm segment no. 10 with ca 6 arm spines *O. anchista*
- 5 Arm spines on each segment of ca same length, about $\frac{1}{2}$ an arm segment long . . . *O. assimilis*
- 5' Middle arm spines the longest, to about one arm segment long *O. yoldii*

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