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# A Review of the ophiocomin Genus *Clarkcoma* Devaney, 1970 (Ophiuroidea: Ophiocomidae)

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The ophiocomin genus *Clarkcoma* Devaney, 1970, and its three species are reviewed. *C. pulchra* (H. L. Clark) is recognized as a valid species. Colour patterns are specific for each of the species *C. canaliculata* (Lütken), *C. pulchra* (H. L. Clark) and *C. bollonsi* (Farquhar). *C. bollonsi*, previously known only from New Zealand, is recorded from southwestern and southeastern Australia.

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## INTRODUCTION

Stimulated by both H. L. Clark's (1921) revision of the Ophiocominae and Murakami's (1963) work on ophiuroid dental and oral plates, Devaney (1970, 1978) began a series of reports dealing with the species and genera of the family Ophiocomidae. In his first report (1970) Devaney re-evaluated the tropical genus *Ophiocoma* and described a new genus, *Clarkcoma*, to accommodate the temperate-water species *Ophiocoma canaliculata* Lütken, with which he concluded *O.c.* var. *pulchra* H. L. Clark and *O. punctata* Koehler to be conspecific, and *O. bollonsi* Farquhar. *Clarkcoma* occurs in southern Australian and New Zealand waters. The purpose of this paper is to review the genus *Clarkcoma*, and its species.

During 1981 and 1982 extensive collections of echinoderms were made along the southern coast of New South Wales (1981) and northern New South Wales (1982) by the Australian Museum. Among the collections were some 500 specimens of the ophiuroid genus *Clarkcoma*. In the field it was apparent that four colour forms of *Clarkcoma* could be recognized. Examination in the laboratory, however, showed that using structural features in combination with colour, only three species could be recognized, the fourth colour form representing juvenile specimens of one of the other species. This material was then compared with established collections of *Clarkcoma* in the Australian and Western Australian Museums, with specimens of *C. bollonsi* borrowed from the National Museum of New Zealand, with the lectotype of *O. canaliculata* borrowed from the Zoologiske Museum, Copenhagen, and with the holotype of *O.c.* var. *pulchra* from the South Australian Museum.

Each of the species of *Clarkcoma* has been adequately described either by its author or by subsequent workers, so that only a diagnosis of the significant features is given for each species in this paper. Because of the bulk of material examined, locality data are kept to a minimum. Additional information can be retrieved from the relevant institution housing the material by quoting the appropriate register number. Numbers of specimens examined from each registered 'lot' are given in parenthesis. The history of each species is discussed in the light of new information now available. As a result, this study has confirmed the identity of *Clarkcoma* and clarified the status and limits of the species contained therein.

## ABBREVIATIONS

AM	Australian Museum, Sydney, N.S.W., Australia.
CM	Zoologiske Museum, Copenhagen, Denmark.
NMNZ	National Museum of New Zealand, Wellington, New Zealand.
SAM	South Australian Museum, Adelaide, South Australia.
WAM	Western Australian Museum, Perth, Western Australia.
dd	disc diameter
R	arm length
l	length (of dental plate)
br	breadth (of dental plate)

## SYSTEMATIC ACCOUNT

Family OPHIOCOMIDAE Ljungman, 1867

Subfamily OPHIOCOMINAE Matsumoto, 1915

Genus *Clarkcoma* Devaney, 1970

*Clarkcoma* Devaney, 1970: 1

**Diagnosis:** A genus of Ophiocominae characterized by thin, compressed arm spines; adoral shields extending proximal to the oral shield and sometimes contiguous; small, vertically-directed buccal tentacle scales, which are separated from the adoral shields, additional small papillae may be present between the outer oral papilla and buccal tentacle scale; oral plate with abradial muscle scar concave, a narrow medial ridge and several short processes; adradial muscle scar restricted to a small part of the adradial side of the plate; radiating grooves and ridges absent from abradial muscle scar; hyaline tipped teeth; well developed teeth foramina in the dental plate.

**Type species:** *Ophiocoma canaliculata*, Lütken, 1869; designated by Devaney, 1970.

**Other species included:** *C. bollonsi* (Farquhar, 1908); *C. pulchra* (H. L. Clark, 1928).

**Distribution:** Dongara, Western Australia, along the south and east coasts of Australia to Mooloolaba, Queensland; New Zealand and the Chatham Rise; 0-630m depth.

**Remarks:** Devaney (1970) considered *Clarkcoma* to be most closely related to *Ophiocomina* and *Ophiopteris*, with which it shares three features: buccal tentacle scales not in contact with the adoral shields; the position of the adoral shields on the proximal edge of the oral shields, where the adorals are often broadly in contact; similarity of the arm spines. Using these features, he separated the three genera from *Ophiocoma*, *Ophiomastix*, *Ophiarthrum* and *Ophiocomella*, in the subfamily Ophiocominae. I can add that in the species of *Ophiocoma* (except *O. pusilla*), *Ophiomastix* and *Ophiarthrum* the abradial muscle scar on the oral plates characteristically bears parallel or slightly radiating grooves and ridges (Murakami, 1963: pl. VII, figs 11-34; Devaney, 1970: figs 30, 44). These ridges and grooves are absent in species of *Clarkcoma*, *Ophiocomina* and *Ophiopteris*. Neither are they present in *Ophiocomella*, but in this case there is an aperture through the abradial muscle scar (Devaney, 1970: fig. 43). I have not found this aperture in any of the other ophiocomin genera. Devaney (1970) found a similar feature in the oral plates of *Ophiactis savignyi*, and concluded that it might be linked to the phenomenon of fissiparity exhibited by both species.

The hyaline-tipped teeth and the size and/or presence of the foramina in the dental plates were used by Devaney to distinguish *Clarkcoma* from *Ophiocomina* and *Ophiopteris*. Although I can confirm that the foramina are absent in the dental plates of the *Ophiocomina nigra* which I have examined, I have found that those in the dental plates of *Ophiopteris* species are not reduced compared with species of *Clarkcoma*. I have found a remarkable similarity in plate shape, size of tooth foramina and distribution of teeth and of tooth papillae in *C. bollonsi* and the two species of *Ophiopteris*, *O. papillosa* and *O.*

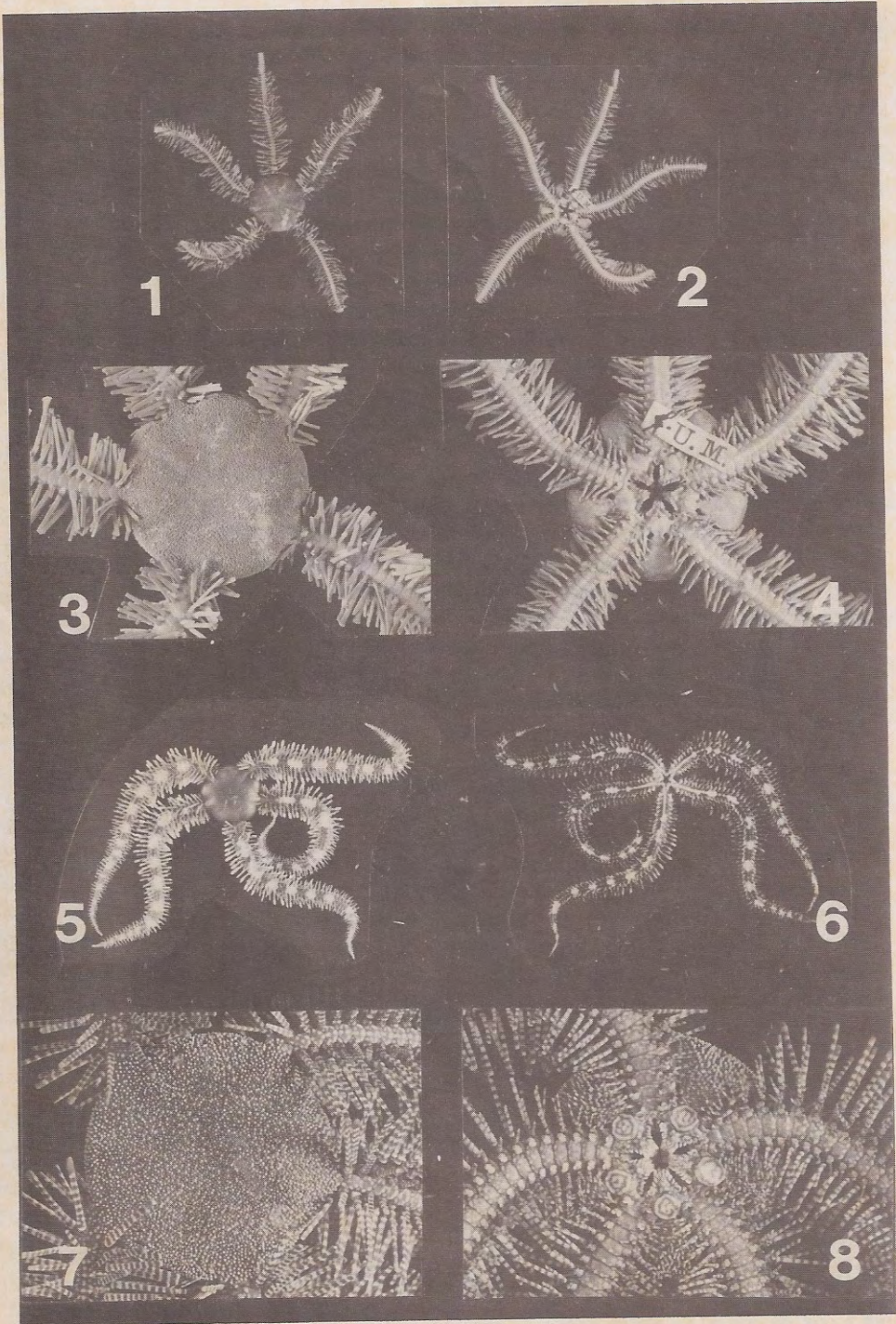


Fig. 1. 1-4, *Clarkcoma canaliculata*, lectotype, (CM), dd = 20 mm. 5-6, *C. canaliculata*, (AMJ14390), dd = 5 mm. 7-8, *C. pulchra*, (AMJ14631), dd = 20 mm.

*antipodum*. The dental plates of *C. canaliculata* and *C. pulchra* are shorter than those of *boltonsi* and the species of *Ophiopteris*, the foramina are relatively larger, and the number and form of the tooth papillae differ. However, as Devaney points out, the teeth of species of *Clarkcoma* are hyaline-tipped, whereas those of *Ophiopteris* and *Ophiocomina* are not.

Differences in the form of the arm spines of *Clarkcoma* and *Ophiopteris* are more marked than is evident from the earlier descriptions. The spines of *Ophiopteris* are in fact more similar to some species of *Ophiocomina* (e.g. *O. scolopendrina*). However, distinctively the uppermost one (or two) spines are reduced and squamate in *Ophiopteris*.

*Clarkcoma canaliculata* (Lütken)

Fig. 1, 1-6

*Ophiocomina canaliculata* Lütken, 1869: 46; Koehler, 1904: 75, figs 30-32

*Clarkcoma canaliculata*, Devaney, 1970: 5 (part) (for reference to *O. canaliculata* only) figs 8-9, 11; Baker, 1982: 431 (part) fig. 10, 18b; Rowe and Vail, 1982: 223

*Clarkcoma pulchra*, Rowe and Vail, 1982: 223 (non *C. pulchra* (H. L. Clark 1928) )

**Diagnosis:** A species of *Clarkcoma* with dd up to 24mm, dd/R=c.3:1; granules relatively fine, close, up to 120/mm<sup>2</sup>, ventral disc scaling mostly bare, only a shallow v-shaped wedge of granules extending below the ambitus of the disc; dental plates with lateral and central tooth papillae similar in size, central papillae few, up to c.14; some arm spines, to about 1/2R, with reddish-orange, thick-skinned sacculle covering their tips in life; colour in life varies with size, juveniles with disc dark brown-black, arms with wide, transverse bands of cream-white (Fig. 1, 5-6); adults are uniformly reddish-brown-black (Fig. 1, 1 and 3), a longitudinal cream line extends along the mid ventral line of the arms, (Fig. 1, 2, 4, 6), distributed from Rottneest Island, W.A., to Long Reef (Collaroy), N.S.W., also circumscribing Tasmania; depth, 0-40m.

**Material examined:**

CM: Lectotype, Bass Strait, 1866.

AM: New South Wales; Long Reef (Collaroy) J12417(1); Port Jackson, J4485(1), J6812(1); Port Hacking, J10063(2); Shellharbour, J4358(2), J4415(11), J4509(2), J4602(1), J4712(1), J4718(1); Jervis Bay, 4.5-33m, J9731(1), J11057(1), J14392(1), J14393(4), J14720(16), J14724(8), J15731(2); Ulladulla, 9.5-19m, J14389(4), J15730(2); Bateman's Bay, 6.5-36m, J13988(6), J13996(16), J13999(13), J14384(2), J14388(4), J14721(4), J14723(2), J14725(10); Montague Island, 9.5-38m, J13968(24), J13976(3), J14387(3), J14390(2), J14623(5), J15432(1); Bermagui, 26m, J14625(7); Merimbula, 9.5m, J14626(3); Eden, 23m, J14622(1).

Tasmania; Rocky Cape, 1.5-4.5m, J11385(1); Maria Island, 22m, J11318(1); Devonport, J10545(2); Hunter Island, J6844(1).

Victoria; Warrnambool, J10788(2); Port Fairy, G10968(2).

South Australia; Kangaroo Island, 5m, J12612(1); Gulf St Vincent, J6211(2).

Western Australia; King George Sound, J3971(1), J3974(1), J3976(1); Bunker's Bay, J6208(2); Point Peron, J6304(2); Garden Island, J17037(1); Rottneest Island, 13m, J17611(5).

WAM: Victoria; Barwon Heads, 385-79(2).

South Australia; Port Willunga, 265-39(part) (3).

Western Australia; Doubtful Islands Bay, 358-75(1), 516-75(1); Two-People's Bay, 625-76(1); King George Sound, 203-76(part) (4); Augusta, 600-78(1); Cowaramup Bay, 199-76(2), 598-78(1); Wyadup, 71-72(1), 72-72(1); Yallingup, 200-76(1); Cape Naturaliste, 35-74(1), 36-74(1), 38-74(1), 48-74(1), 1505-74(1), 196-76(1), 198-76(1), 19-1979(1); Dunsborough, 44-74(2); Point Peron, 265-39 (part) (1); Cockburn Sound, 230-70(part) (1),

37-71(1), 197-71(1), 20-74(1), 22-74(1), 23-74(1), 24-74(1), 183-76(1), 186-76(1); Fremantle, 1319-75(1); Rottneest Island, 180-76(2), 181-76(1).

**Discussion:** Lütken (1869) described *canaliculata* from an unspecified number of specimens collected from Bass Strait. He did not figure the species but gave measurements for the species of 'dd=20 mm' and 'R=65 mm or less'. Lyman (1882) commented that *O. canaliculata* possessed small scales at the base of the first dorsal arm spines. Neither Koehler (1922) nor I have found scales described by Lyman. In a key to the species of *Ophiocoma*, Lyman separated *canaliculata* from other species he included in the genus, by virtue of its spatulate arm spines. Koehler (1904) redescribed and figured what he believed to be Lütken's only specimen of *canaliculata* in the Copenhagen Museum. Koehler pointed out that the arms measure about 40mm in length rather than the 65mm given by Lütken. Presumably Lütken's other specimens are lost. Clark (1921) reported that he had examined only one specimen of *canaliculata* from Victoria, though the collector (of the specimen) had indicated that '... he feels sure that 10 or 12 years ago it was quite common at the spot which has been spoiled as a collecting ground by certain harbour improvements'. Clark reported the colour of the dried specimen as 'light brown, with a distinctly greenish tinge on the disc and with arms quite reddish'. He commented that *canaliculata* was a particularly rare and little-known form. Clark drew attention to the close relationship between *O. bollonsi* Farquhar and *canaliculata*, and in particular to the large adoral plates which both species possess. However, because of Farquhar's description of spiniform granules near the disc margin, he placed *bollonsi* in the *pumila* section of his key of *Ophiocoma* species, acknowledging in his text little relationship between those two species. Prophetically, Koehler (1922) suggested that *canaliculata* may need to be placed in a new genus primarily because of the form and position of the adoral plates, this differing from all other species of *Ophiocoma*. Interestingly Koehler (1922) considered *O. bollonsi* to be closest to *O. scolopendrina*, differing from it in having 6 arm spines at the base of the arm. Clearly he had not examined any specimens of *bollonsi*, and was not aware of the form of the adoral plates. Presumably, also, Koehler (1922) would not have been aware of Clark's (1921) comments about *canaliculata* and *bollonsi* at the time he was preparing his manuscript. Clark (1928) recorded 14 specimens of *canaliculata* from South Australia, and described the colour of two juveniles with a dark grey disc and widely scattered white marks occurring irregularly along the dorsal side of the arms, and a broad white band ventrally. He described adults as light blackish-brown with arm spines lighter and, on the underside of the arms, a longitudinal white band. In 1938, Clark reported some 93 specimens, extending in geographic range from Shellharbour, N.S.W. to Rottneest Island, Western Australia. He also recorded live colour for specimens from Port Willunga, South Australia: 'all uniformly black in life with a reddish cast on sides and orally', and Point Peron, Western Australia: 'pale alive, light brown to dark brown'. In 1946, Clark considered *canaliculata* to be an endemic Australian species and one of the most characteristic brittle-stars of temperate Australian waters. However, he noted that the species had not been recorded from Tasmania. A. M. Clark (1966) recorded *canaliculata* from Port Phillip. Devaney (1970) examined 19 specimens, including a paratype of *O. punctata* Koehler and two paratypes of *O. canaliculata* var *pulchra* H. L. Clark. He concluded that *punctata* and *pulchra* are conspecific with *canaliculata* and designated *canaliculata* as type-species for the new genus *Clarkcoma*. Rowe and Vail (1982) record *C. canaliculata* from Tasmania for the first time.

I have examined the remaining type specimen, herein designated the lectotype, of *canaliculata* (Fig. 1, 1-4) and some 231 specimens from the coast of New South Wales (167), Tasmania (5), Victoria (6), South Australia (2) and Western Australia (51).

I can confirm Koehler's (1904) description and measurements of the lectotype. The only additional information necessary relates to the number of tooth papillae present in the lectotype. There are 3-4 lateral papillae on each side of the dental plate and 7-8 central papillae. Mortensen (1924) and Devaney (1970) describe and count the tooth papillae in *transverse rows* across the plate in *bollonsi*, though Devaney (1970) describes the papillae in *irregular columns* for *canaliculata*. A more standardized description of the arrangement of tooth papillae can be given since a longitudinal row of papillae can be recognized along each side of the dental plate, between which the remaining (central) papillae are regularly or irregularly arranged. Because these central papillae are slightly (*pulchra* and *canaliculata*) or markedly (*bollonsi*) smaller than the laterals, they are relatively easy to count. The central papillae count includes those papillae seen clustered at the apex of the oral angle, since they occur on the dental plate. The papillae occurring along the margin of the oral plates are not counted. Devaney (1970) used the difference between dental plate shape and number of tooth papillae as major characters separating *canaliculata* from *bollonsi*. However, the shape of the plate and papillae number offer no differences with which to separate *canaliculata* from *pulchra*.

I can confirm, also, the range of live and preserved colour described by H. L. Clark (1928, 1938, 1946). There is, however, no doubt that both H. L. Clark and Koehler (1930) were correct in recognizing a second species, the name for which is *pulchra*. The colour pattern alone is constant for each species. In addition the coarser granulation, more extensive ventral granulation and shape of the dorsal arm plates of *pulchra* afford reliable characters which separate these two species.

A character not hitherto reported for *canaliculata* is the presence, in life, of an orange-red, thick-skinned sacculle covering the tip of a number of the larger arm spines (see Fig. 1, 5-6). These occur to about 1/2R. The spines bearing this structure are usually slightly thicker than adjacent spines and flaring at the tip. In preserved state the skin is retracted, giving the spine a thickened, club-tipped appearance. Similar structures occur on spines of *C. bollonsi* and some other ophiocomins, but are absent from *C. pulchra*. This feature is discussed further for *C. bollonsi*.

*Clarkcoma pulchra* (H. L. Clark)

(Fig. 1, 7-8, Fig. 2, 1-2)

*Ophiocoma canaliculata* var. *pulchra* H. L. Clark, 1928: 439, figs 131a-b

*Ophiocoma punctata* Koehler, 1930: pl. 14, figs 2-5

*Clarkcoma canaliculata*, Devaney, 1970: 5 (part; reference to *O. pulchra*) fig. 15. Baker, 1982: 431 (part), fig. 10, 19b (non *C. canaliculata* (Lütken) )

**Diagnosis:** A species of *Clarkcoma* with dd up to 21mm, dd/R c.3.5, granulation coarse, spaced, up to 40-50 granules/mm<sup>2</sup>, extending on to ventral surface of disc almost to oral shields, only a narrow area of naked scales bordering the genital slits and oral shield; dental plates with lateral and central tooth papillae of similar size, central papillae few, up to c.14; spine sacculae absent; colour in life of both juveniles and adults variegated maroon and cream/white, arm spines banded (Fig. 1, 7-8, Fig. 2, 1-2); distributed from Byron Bay, N.S.W., to Dongara, W.A. but not recorded from Tasmania; 0-40m depth.

**Material examined:**

SAM: Holotype, K241, ?South Australia.

AM: New South Wales; Byron Bay, 9.5-26m, J14872(2), J14879(2), J14883(1); Solitary Islands, 9.5-28m, J11604(1), J1276(1), J14838(5), J14850(3), J14895(1), J14906(1), J14925(3), J15020(3), J15022(5), J15023(1), J15024(3), J15048(1); S.W. Rocks, 26m, J14890(12), J15021(1); Long Reef (Collaroy), J4184(1), J6307(1), J7297(1), J7372(2), J10386(2), J11351(1), J12413(1), J12414(1), J12415(1), Port Jackson, G7737(1), G11439(2),

G11440(1), J461(1), J1653-5(3), J1980(2), J1985(1), J2389(1), J3316(13), J3321(1), J3360(4), J3361(1), J3364(2), J4623(1), J6786(1), J9858(1), J11568(2); Coogee, G1278(1), J2370-5(5); Botany Bay, 8m, J11386(1); Shellharbour, J4357(1), J4359(2), J4512-4(3), J4529(1), J4534(2), J4547(1), J4548(1), J4800(2), J14726(1), J14738(5), J14739(3); Jervis Bay, 4.5-28m, J14383(1), J14391(10), J14731(2); Ulladulla, 9.5-26m, J14735(5), J14737(3); Bateman's Bay, 9.5-36m, J13971(4), J14727(6), J14729(1), J14730(1), J14732(3), J14734(2), J14736(9); Montague Island, 6-38m, J13987(21), J14386(2), J14627(3), J14728(6), J14733(1); Bermagui, 19-26m, J14628(1), J14630(12), J15583(1); Merimbula, 9.5m, J14631(9); Eden, 0-28m, J6699(1), J1429(2), J14632(1). Western Australia; Cockburn Sound, 0-1m, J16326(3); Perth, 6m, J17351(1); W.A., J2369(1).

WAM: New South Wales; Long Reef (Collaroy), 64-73(1). Western Australia; King George Sound, 203-76(part) (1); Cape Naturaliste, 37-74(1), 189-76(2), 603-78(1); Dunsborough, 77-72(1); Bunbury, 1074-81(1), 1085-81(1); Penguin Island, 36.5m, 28-78(3); Cockburn Sound, 0-33m, 39-71(1), 187-71(1), 188-71(1), 196-71(1), 198-71(1), 223-71(1), 225-71(1), 229-71(1), 1061-75(12), 182-76(1), 184-76(1), 185-76(4), 187-76(1), 26-78(2), 59-78(1), 24-80(1); Fremantle, 6-14m, 1957-75(1), 179-76(1), 87-80(3), 88-80(3); Perth, 0-21.9m, 50-74(3), 201-76(2), 797-76(2), 800-76(1); off Dongara, 18.3m, 631-77(1).

**Discussion:** *C. pulchra* was described by H. L. Clark (1928) as a variety of *Ophiocoma canaliculata*. He examined six specimens, two of which (including the holotype) were without definite locality in South Australia, whilst the remainder were documented from 'Dr Verco's collection in Spencer or St Vincent Gulf. Clark considered that the specimens were similar to *canaliculata* in everything but colour, and that since they would probably be found to intergrade with the sympatric *canaliculata*, he concluded that it was '... not likely they represent a different species'. Koehler (1930) gave a very detailed account of two specimens he described as a new species, *Ophiocoma punctata*, collected from Port Jackson, New South Wales. He concluded that although closely related to *canaliculata*, *punctata* differed in the form of the dorsal arm plates, the non-canalicate arm spines, the form of the oral shields and in coloration. H. L. Clark (1938) concluded not only that *punctata* and *pulchra* are conspecific but, since he had found no intermediate forms (of colour) between *pulchra* and *canaliculata*, that it would be better to retain these two as separate species. In 1946 Clark maintained the identity of *pulchra* and *canaliculata*, noting that the cross-banding of the arm-spines and variegated ventral arm plates were very obvious and constant characters distinguishing *pulchra*. He was, however, still somewhat doubtful about the relationship between the two species, which he found occurred together and over a similar geographical range. After examining a paratype of *punctata* and two paratypes of *pulchra*, together with 14 other specimens he identified as *canaliculata*, Devaney (1970) concluded that all three nominal species were conspecific, believing differences between them to reflect variation in a single species. Rowe and Vail's (1982) record of *pulchra* from Tasmania is based on the misidentification of juvenile *canaliculata*. However, considering the widespread distribution of *pulchra*, its occurrence, at least on the northern coast of Tasmania, might be expected.

I have examined the holotype of *Ophiocoma canaliculata* var. *pulchra*, together with nearly 300 specimens of *pulchra* from New South Wales (228) and Western Australia (67). The colour pattern of the species is remarkably constant, even in juvenile specimens (dd = 5mm; Fig. 2, 1-2), and conforms with both H. L. Clark's (1928, 1938, 1946) and Koehler's (1930) descriptions (Fig. 1, 7-8; Fig. 2, 1-2). I can confirm, also, the characters outlined by Koehler (1930) which distinguish *punctata* (i.e. *pulchra*) from *canaliculata*. In addition, the coarse disc granulation and greater extension of granules onto the ventral surface of the disc in *pulchra* serve to separate the two species. *C. pulchra*,

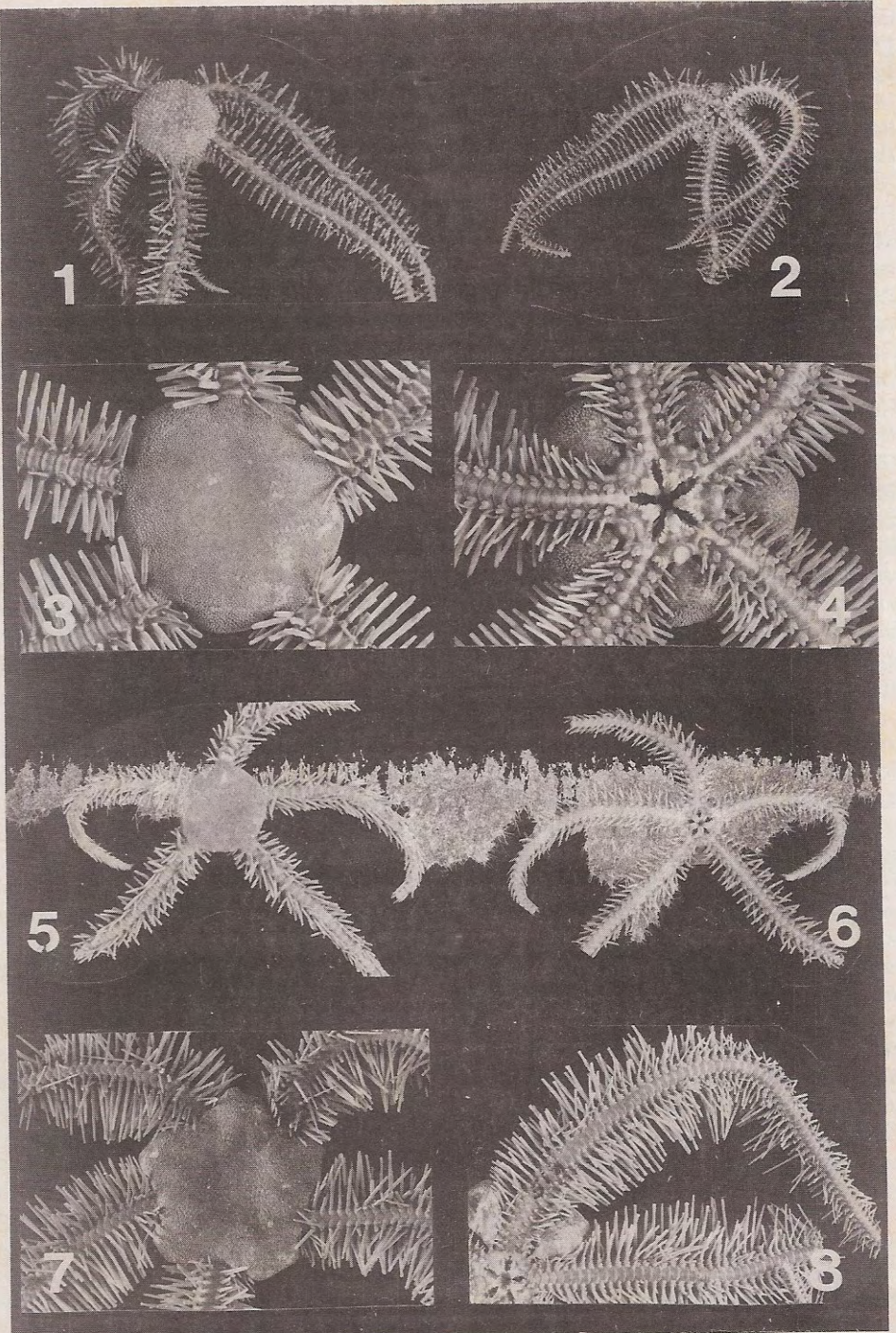


Fig. 2. 1-2, *Clarkcoma pulchra*, (AMJ13987), dd = 5 mm. 3-4, *C. bollonsi*, (AMJ15506), dd = 11 mm. 5-6, *C. bollonsi*, (AMJ15509), dd = 5 mm. 7-8, *C. bollonsi*, (NMNZ, E3778), dd = 27 mm.

like *canaliculata*, has dental plates with relatively few tooth papillae. This character, alone, easily separates these two species from *bollonsi*. Additionally, the colour pattern of *pulchra* distinguishes it from *bollonsi*.

Finally, unlike either *canaliculata* or *bollonsi*, none of the arm spines of *pulchra* has a sacculate skin covering.

*Clarkcoma bollonsi* (Farquhar)

Fig. 2, 3-8

*Ophiocoma bollonsi* Farquhar, 1908: 108

*Clarkcoma bollonsi*, Devaney, 1970: 5 (for references), figs 10, 12, 14

**Diagnosis:** A species of *Clarkcoma* with dd up to 27mm, dd/R = c.3:1; granulation relatively fine, up to 120/mm<sup>2</sup>, ventral disc scaling mostly bare, only a shallow, v-shaped wedge of granules extending below the ambitus of the disc; dental plates with lateral papillae larger than central papillae, central papillae numerous, up to c.20-25; some arm spines, to about 1/2R, with reddish-orange, thick-skinned saccule covering their tips in life; colour in life of both juvenile and adults uniformly reddish-brown, with a light transverse line across the distal edge of each of the dorsal arm plates, a cream line extends midventrally along the arms for a short distance from the mouth (Fig. 2, 3-8), rarely mottling occurs on parts of the arms in juveniles; present known distribution disjunct, Dongara to Hamelin Bay, W.A., Cape Everard, Victoria to Mooloolaba, southern Queensland, coasts of New Zealand and on the Chatham Rise; 9-630m depth.

**Material examined:**

WAM: Western Australia; Dongara to Hamelin Bay, 47-183m, 188-76(15), 190-76(1), 191-76(1), 192-76(3), 193-76(2), 194-76(1), 195-76(1), 197-76(1), 227-77(1), 228-77(19), 233-77(1), 234-77(1), 603-77(6), 605-77(1), 637-77(2), 817-77(1), 818-(1), 819-77(1), 839-77(9), 840-77(1), 841-77(1), 842-77(25), 843-77(7), 845-77(1), 269(1), 272-78(1), 309-78(1).

AM: Victoria, 126-135m, J5404(1).

New South Wales; Bermagui, 26m, J15514(1); Montague Island, 28-144m, J4764(2), J15505(21), J15512(3), J15513(5); Bateman's Bay, 26-36m, J15506(5), J15507(4), J15508(2), J15509(6), J15515(2), J15521(1); Ulladulla, 9.5m, J14382(1), J14722(3); Jervis Bay, 9.5-35m, J9343(2), J14385(5), J15510(15), J15519(6); Shellharbour, J15520(2), J15516(1); Port Hacking, 15m, J15511(1); Port Jackson, G11443(1), J1935(2); Long Reef (Collaroy), 21-30m, J12416(1), J10561(1); Solitary Islands, 16-24m, J15116(6), J15117(1), J15118(1), J15119(6), J15123(3), J15124(2), J15126(1); Byron Bay, 9.5-16m, J15125(1). Queensland; Mooloolaba, 9.5-19m, J15120-1(3), J15122(2).

New Zealand; Cook Strait, 256-276m, J14767(3).

NMNZ: New Zealand; Between southern Rangitoto Islands and D'Urville Island, 59-64m, E3165(3), E3173(4); off Three Kings Islands, 90m, E3777(1); Mayor Island, 46m, E3156(1); Cook Strait, 256-274m, E3184(4); off Otago, depth not recorded, E3778(1).

**Discussion:** *O. bollonsi* was described by Farquhar (1908) from a single specimen collected near Stephens Island in New Zealand's Cook Strait. Like Lütken (1869), Farquhar did not figure his species. Mortensen (1924) identified a number of specimens from localities around the North Island of New Zealand. He considered there was little to add to Farquhar's (1908) description but included illustrations of the species. However, Mortensen did include two important observations. He described the arrangement of tooth papillae, commenting that they were 'exceptionally numerous for an *Ophiocoma*'. Mortensen also described some of the arm spines as being club-shaped, due to thickening of skin towards their tips. He thought this was due to some infesting, para-

sitic organism but was unable to confirm this histologically. In 1936, Mortensen recorded a specimen collected from Cook Strait, and described the colour: 'Each dorsal arm plate has a narrow, white transverse band, the ground colour being brownish. This gives the arm a fine banded appearance'. Fell (1952) recorded the colour as 'dark brownish-purple' and agreed with Mortensen's conclusion that the club-shaped spines represent a pathological condition. Fell (1958) commented that the species was not as rare as previously thought, and recorded the colour of specimens preserved in alcohol as 'reddish-brown'. Pawson (1965) described the colour of specimens preserved in alcohol as 'dark greyish-brown on the aboral surface, light reddish-brown adorally', recording the species as occurring along 'the entire New Zealand coast, in 9-630m'. McKnight (1967) has recorded *bollonsi* from the Chatham Rise. Devaney (1970) examined 7 specimens of *bollonsi* from New Zealand waters and referred the species to *Clarkcoma*. He gave a joint diagnosis for *canaliculata* (incorporating *pulchra*) and *bollonsi*, which showed little difference between the species in disc diameter, granulation, arm spine sequence, number and shape. However, he did find major differences in the shape of the dental plate,  $l/br = 2.9-3.1:1$  in *bollonsi*,  $2.0-2.7:1$  in *canaliculata* (and *pulchra*) and in the number and distribution of tooth papillae — 'several transverse rows' in *bollonsi* 'irregularly placed in three or four columns, relatively larger and less extensive than for *bollonsi* of similar size' — in *canaliculata* (and *pulchra*).

Devaney commented that he had not seen evidence of the elongate granules towards the margin of the disc, as described by Farquhar (1908), concluding this to be a variable character and of no specific value.

I have now examined some 245 specimens from Western Australia (107), Victoria (1), New South Wales (117), Queensland (5) and New Zealand (17). It is evident that *C. bollonsi* is widespread in southern Australian and New Zealand waters. Occurrence of the species might be expected in the little-sampled Great Australian Bight and around the coast of Tasmania. *C. bollonsi* is a shelf species occurring at greater depth than either *C. canaliculata* or *C. pulchra*.

The specimens from Western Australia are relatively small, with  $dd$  up to 10mm. They are more or less bleached, but sufficient colour remains to indicate the typical colour pattern on the dorsal arm plates. The material from south-eastern Australia has disc diameter ranging up to 20mm, whilst the largest specimen examined was collected from north of Otago (New Zealand) (depth unknown) with a  $dd = 27$ mm. With the exception of a few specimens from New Zealand which are reddish-orange in colour, and the more or less bleached specimens from Western Australia, the colour of the remaining specimens is dark brown. In all specimens, the distal edge of each dorsal arm plate bears a cream transverse line. Ventrally, a light median line extends a short way along the arms. This concurs with Mortensen's (1936) description of a specimen from Cook Strait.

For about  $1/2R$ , some of the long spines of living specimens collected in New South Wales were tipped with an orange-reddish, thick-skinned sacculae. The sacculae contracted after preservation, forming a thickened epithelial covering to the spine tip. This is obviously related to Mortensen's (1924) observation of club-shaped spines. Interestingly, these sacculae occur on the spines of *C. canaliculata* but not on *C. pulchra*. Among other ophiocomids, this structure has been reported on *Ophiocoma pusilla* and a number of species of *Ophiomastix* (Devaney 1970, 1978). The function of these sacculae is unclear, though accordingly histological investigation has revealed glandular tissue present and it has been suggested that these organs secrete a poisonous substance which may kill small animals, but apparently the toxicity has not been confirmed either in laboratory or clinical reports (Devaney, 1978).

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## References

- BAKER, A. N., 1982. — Brittle-stars (Class Ophiuroidea). In SHEPHERD, S. A., and THOMAS, I. M., (eds), *Marine Invertebrates of Southern Australia*, Part 1: 418-437, figs 10.10-10.19, pl.29 figs 3-4. Adelaide: South Australian Government Publications.
- CLARK, A. M., 1966. — Port Phillip Survey, 1957-63. Echinodermata. *Mem. nat. Mus. Vict.* 27: 289-355, 10 figs, 4 pls.
- CLARK, H. L., 1921. — The echinoderm fauna of Torres Strait. *Pap. Dep. mar. Biol. Carnegie Instn Washington* 10: vii+233 pp., 38 pls.
- , 1928. — The sea-lilies, sea-stars, brittle-stars and sea-urchins of the South Australian Museum. *Rec. S. Aust. Mus.* 3: 361-382, figs 108-142.
- , 1938. — Echinoderms from Australia. *Mem. Mus. comp. Zool. Harvard* 55: 1-596, 63 figs, 28 pls.
- , 1946. — The echinoderm fauna of Australia. *Publ. Carnegie Instn* 566: 1-567.
- DEVANEY, D. M., 1970. — Studies on ophiocomid brittle-stars. 1. A new genus (*Clarkcoma*) of Ophiocominae, with a re-evaluation of the genus *Ophiocoma*. *Smithson. Contrib. Zool.* No. 51: 1-41, 50 figs.
- , 1978. — A review of the genus *Ophiomastix* (Ophiuroidea: Ophiocomidae). *Micronesica* 14(2): 273-359 42 figs.
- FARQUHAR, H., 1908. — Description of a new ophiuroid. *Trans. Proc. N.Z. Inst.* 40: 108.
- FELL, H. B., 1952. — Echinoderms from southern New Zealand. *Zool. Publs Vict. Univ. Wellington* No. 18 1-37.
- , 1958. — Deep-sea echinoderms of New Zealand. *Zool. Publs Vict. Univ. Wellington* No. 24 1-40.
- KOEHLER, R., 1904. — Ophiures nouvelles ou peu connues. *Mém. Soc. zool. France* 17: 54-119, 98 figs.
- , 1922. — Ophiurans of the Philippine Seas. *Bull. U.S. natn Mus.* 100(5) x + 486 pp., 103 pls.
- , 1930. — Ophiures recueillis par le docteur Th. Mortensen dans les Mers d'Australie et dans l'Archipel Malais. *Vidensk. Meddr dansk. naturh. Foren.* 89: 1-295, 22 pls.
- LJUNGMAN, A., 1867. — Ophiuroidea viventia huc usque cognita enumerat. *Öfvers K. Vetenskakad. Förh.* 1866(9): 303-336.
- LÜTKEN, C., 1869. — Addimenta ad historiam ouphiuridarum. 3. Beskrivende og kritiske Bidrag til kundskab om Slanestjernerne. *K. danske Vidensk. Selk. Skr.* 5(8): 24-109, 3 figs.
- LYMAN, T., 1882. — Ophiuroidea. *Rep. scient. Results Voy. 'Challenger'* (Zool.) 5:1-386, 46 pls.
- MATSUMOTO, H., 1915. — A new classification of the Ophiuroidea: with descriptions of new genera and new species. *Proc. Acad. Nat. Sci. Philadelphia* 67(1): 43-92.
- MCKNIGHT, D. G., 1967. — Additions to the echinoderm fauna of the Chatham Rise. *N.Z.J. mar. Freshw. Res.* 1(3): 291-313.
- MORTENSEN, TH., 1924. — Echinoderms of New Zealand and Auckland-Campbell Islands. II. Ophiuroidea. *Vidensk. Meddr dansk. naturh. Foren.* 77: 91-177, 36 figs., 2 pls.
- , 1936. — Echinoidea and Ophiuroidea. *Discovery Reports* 12: 199-348, 53 figs. 9 pls.
- MURAKAMI, S., 1963. — The dental and oral plates of Ophiuroidea. *Trans. R. Soc. N.Z., Zool.* 4(1): 1-48, 1 fig., 7 pls.
- PAWSON, D. L., 1965. — New records of echinoderms from the Snares Islands to the south of New Zealand. *Trans. R. Soc. N.Z., Zool.* 6(25): 253-260.
- ROWE, F. W. E., and VAIL, L. L., 1982. — The distributions of Tasmanian echinoderms in relation to southern Australian biogeographic provinces. In LAWRENCE, J. M., (ed.), *Echinoderms: Proceedings of the International Conference, Tampa Bay*: 219-225, 1 fig. Rotterdam: Balkema.