

A REVIEW OF THE CUCUMARIID GENUS *PSOLIDIELLA* MORTENSEN
(ECHINODERMATA, HOLOTHUROIDEA)

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Abstract

O'Loughlin, P.M., 2000. A review of the cucumariid genus *Psolidiella* Mortensen (Echinodermata, Holothuroidea). *Memoirs of Museum Victoria* 58(1): 25–37.

The holothurian cucumariid genus *Psolidiella* Mortensen is reviewed. *Psolidiella hickmani* sp. nov. and *Psolidiella maculosa* sp. nov. are described from southern Australia. *Psolidiella adhaerens* Hickman is synonymised with *Psolidiella nigra* Mortensen. *P. nigra* and *P. hickmani* are external brood-protecting species. The genus *Psolidiella* is restricted to New Zealand and southern Australia. A key is provided for the described species of *Psolidiella*.

Introduction

The genus *Psolidiella* Mortensen, 1925 is known principally from the works of Mortensen (1925), Panning (1949, 1961, 1971), Hickman (1962), Pawson (1969, 1970) and O'Loughlin (1994). The initially monotypic genus *Psolidiella* was established for the New Zealand species *P. nigra* Mortensen, 1925. Panning (1949) referred both *Thyone spectabilis* Ludwig, 1883, from the Straits of Magellan, and *Pseudocolochirus mollis* Ludwig and Heding, 1935, from Bouvet Island, to *Psolidiella*, but subsequently (Panning, 1957) referred *T. spectabilis* to *Hemioedema* Hérouard, 1929. *Psolidiella adhaerens* Hickman, 1962, from south-eastern Tasmania, became a third species referred to *Psolidiella*. Panning (1971) finally included only the two species, *P. nigra* from New Zealand and *P. adhaerens* from Tasmania, in *Psolidiella* thus excluding *P. mollis* but not reassigning this species.

O'Loughlin (1994) and O'Loughlin and Alcock (2000) anticipated a synonymy of *Psolidiella adhaerens* Hickman, 1962, from south-eastern Australia, with *Psolidiella nigra* Mortensen, 1925, from New Zealand. This synonymy is confirmed here. Specimens referable to *Psolidiella* have been collected from the rocky shallows across southern Australia — from Tasmania, Victoria, South Australia and Western Australia. With a narrow range of variations,

specimens from the far eastern coasts of Tasmania and Victoria are identifiable as the type species *P. nigra* from New Zealand. Specimens from the Derwent estuary, from both sides of Bass Strait, and from the coast of South Australia west to Robe, differ from *P. nigra* in size and ossicle distribution and density, and represent a new and second species. Specimens from the southern coasts of Western Australia differ again in details of form of ossicles, in the arrangement of ventral tube feet, and in colour, and are a new and third species. Two small specimens from South Australia are not referable to the three species discussed below and indicate the presence of a fourth and possibly a fifth species of *Psolidiella*.

With the exclusion of *P. mollis* from *Psolidiella* by Panning (1971) the genus it is not circumpolar, as indicated by Pawson (1969), but is restricted to New Zealand and southern Australia.

Abbreviations of institutions are as follows: AM, Australian Museum, Sydney, Australia; MNZ, Museum of New Zealand, Te Papa Tongarewa, Wellington, New Zealand; NMV, Museum Victoria, Melbourne, Australia; MPE, Dr Th. Mortensen's Pacific Expedition 1914–1916; TM, Tasmanian Museum, Hobart, Australia; WAM, Western Australian Museum, Perth, Australia; ZMUC, Zoological Museum, University of Copenhagen, Denmark.

The following terms are defined:

Bent and curved. Elongate tentacle and tube foot plates may be straight or bent (angular) in one plane (surface) which itself may be flat or curved or convex (Fig. 3i illustrating straight and curved, and Fig. 4k illustrating bent and curved).

Buttons. Thickened plates which are perforated, regular to irregular in outline, small (typically 0.08 mm long), discretely knobbed or lumpy (Fig. 4c) or smooth (Fig. 3f), typically four perforations.

Capitate. Form of cup spinelets which have a rounded head and short neck (Fig. 3g).

Crosses. Small ossicles (typically 0.05 mm long) consisting of four arms radiating from a common centre or short rod, to varying degrees bifid and distally knobbed (Figs 2d, 2f), flat or concave, sometimes intergrading with cups if concave with some distal ends joined, sometimes intergrading with multiradiate ossicles.

Cups. Thin plates which are perforated, concave, shallow (species in this paper) or deep, oval to rectangular, small (typically 0.04 mm long), cruciform (Fig. 3g) or tripartite centrepiece, typically four large with frequently four small corner perforations, spinelets on rim and sometimes on centrepiece, sometimes with bridging connections across rim.

Denticulate. With pointed to bluntly spinous to rounded teeth-like projections on the rim of ossicles (Figs 2h, 3e).

Multilayered ossicles. Ossicles which are nodular, irregularly oval in outline, large (more than 0.2 mm long), comprising a perforated knobbed base plate with additional layers built on both sides creating low domes bilaterally.

Multiradiate ossicles. Small ossicles (typically 0.05 mm long) consisting of three to five arms radiating from a common centre or short rod, including four-armed crosses, flat or concave, with the arms sometimes distally bifid and sometimes knobbed (Figs 4d, 4g).

Sole. Flattened, delimited, modified ventral body wall, bounded peripherally by tube feet which do not extend in series to the introvert and anus (Figs 1c, 3b); the place of attachment to the substrate.

Ventrum. Modified ventral body wall, bounded laterally by the lateroventral series of tube feet, not bounded peripherally by tube feet; ventrolateral tube feet series either extend to introvert and anus, or do not extend to introvert and anus and create a sole-like ventrum (Fig. 4b); the place of attachment to the substrate.

Order **Dendrochirotida** Grube, 1840,
restricted Pawson and Fell, 1965

Cucumariidae Ludwig, 1894

Psolidiella Mortensen, 1925

Psolidiella Mortensen, 1925: 359–360.—Panning, 1949: 414–415.—Panning, 1957: 35.—Hickman, 1962: 50, 52.—Pawson, 1969: 37, pl. 22 map 1.—Pawson, 1970: 36.—Panning, 1971: 44–45.—Rowe (in Rowe and Gates), 1995: 280.

Diagnosis (emended). *Psolus*-like form with thin-walled body and distinct oval sole or sole-like ventrum without an acute angular edge; upturned anal cone; 10 dendritic tentacles, ventral 2 smaller; numerous small tube feet scattered dorsally, laterally, around oral and anal cones; tube feet in 3 radial series ventrally, series not continuing to introvert and anus, sometimes bordering sole to varying degrees anteriorly and posteriorly; absent from introvert; body wall ossicles a combination of distally knobbed concave crosses or multiradiate ossicles and sometimes cups typically 0.05 mm long, and thickened perforated irregularly oval buttons and plates less than 0.3 mm long; lacking multilayered ossicles and a cover of scales; posterior intestine in left ventral interradius.

Type species. *Psolidiella nigra* Mortensen, 1925 (monotypy).

Species referred to genus. *P. nigra* Mortensen, 1925; *P. hickmani* sp. nov.; *P. maculosa* sp. nov.

Distribution of genus. North and South Islands of New Zealand, Stewart Island, The Snares; southern Australia (Gabo Island to Perth). Rocky shallows.

Remarks. Mortensen (1925) distinguished his new genus by its distinct sole and *Psolus*-like form, and gave significance to the location of the posterior part of the intestine in the left ventral interradius by which he distinguished it from a similar genus *Psolidium* Ludwig, 1887 and placed it in the Cucumariidae rather than the Psolidae. The diagnostic significance of the *Psolus*-like form was maintained in subsequent diagnoses of *Psolidiella* by Panning (1949, 1957, 1971) and Pawson (1970). Panning (1949, 1957) continued to recognize the location of the posterior part of the intestine as being of diagnostic significance but this character was then excluded in subsequent diagnoses by Pawson (1970) and Panning (1971). This original diagnostic character is retained here as being true for the material exam-

ined but without judgement as to its universal reliability in distinguishing the Cucumariidae from the Psolidae. It is relevant to note that in their description of *Pseudocolochirus mollis* Ludwig and Heding, 1935, temporarily referred to *Psolidiella* by Panning (1949), the authors reported and illustrated the posterior part of the intestine in the right ventral interradius.

All of the southern Australian specimens referred below to two new species of *Psolidiella* are similar to *P. nigra* in having a well-defined very thin-walled sole or sole-like ventrum without an acute angular edge, ventral radial tube feet series not continuing to the introvert and anus, small tube feet scattered dorsally and laterally, up-turned anal cone, and non-calcareous thin body wall with distally knobbed concave crosses and small perforated plates but lacking scales. The three ventral radial series of tube feet do not continue to the introvert and anus in any of the three species of *Psolidiella*, and in the type species and new species from eastern Australia tube feet are to varying degrees continuous around the periphery of a sole. In the species from western Australia the three ventral series of tube feet are parallel with none occurring transversely to create a distinct sole. This condition is referred to here as a sole-like ventrum.

The presence of distally knobbed concave crosses and sometimes cups in the body wall was not reported by Mortensen (1925) or Panning (1949, 1957) or Hickman (1962) or Pawson (1970), although Panning (1961: fig. 6) did illustrate distally knobbed crosses for specimens of *P. nigra* which he examined. Panning (1971: 45) referred to the presence of crosses (as retrogressive cups) in his final diagnosis of the genus. In the light of a re-examination of type material, and

the availability of further material from southern Australia referable to *Psolidiella*, the presence of concave crosses and sometimes cups is considered here to be diagnostically significant. Distally knobbed concave crosses are abundant in all southern Australian material, while cups are present but rare in the type species and abundant in south-eastern Australian material.

Panning (1949: 426, as *boltonsoni*) referred the New Zealand species *Cucumaria bollonsi* Mortensen, 1925 to *Trachythyone* Studer, 1876, and O'Loughlin and Alcock (2000) have established *T. bollonsi* as a junior synonym of *Psolidiella nigra* Mortensen, 1925. Panning (1971: 45) noted a close relationship between *Psolidiella* and *Trachythyone*. The body wall ossicle combination of cups and smooth perforated plates, and the tentacle form and number, indicate that the genera are closely related. *Psolidiella* is distinguished from *Trachythyone* by the former's distinct sole or sole-like ventrum with the ventral radial tube feet series not continuing to the introvert and anus, upturned anal cone, and concave crosses or multiradiate ossicles in the body wall.

A single small dark grey-brown specimen from Emu Bay on Kangaroo Island in South Australia (NMV F59223), and single small dark blue-grey specimen from Waterloo Bay on the Eyre Peninsula in South Australia (NMV F59224), have the body form of *Psolidiella* and have numerous concave, distally knobbed, multiradiate ossicles dorsally and ventrally. Neither has cups dorsally or ventrally, and neither has buttons dorsally. They do not belong to any of the three species described below, and these South Australia specimens represent one or two more species of *Psolidiella*.

Key to species of *Psolidiella*

1. Dorsal body wall normally with tube foot ossicles only; knobbed crosses and buttons absent or rare in dorsal body wall.....*Psolidiella nigra* Mortensen
- Dorsal body wall normally with tube foot ossicles, numerous crosses or multiradiate ossicles, and numerous thickened buttons or plates..... 2
2. Dorsal body wall with numerous knobbed crosses, cups, smooth buttons and plates; lacking rosettes; midventral radial tube feet series up to two wide; lateral ventral radial series of tube feet joined to varying degrees anteriorly and posteriorly to form a distinct sole.....*Psolidiella hickmani* sp. nov.
- Dorsal body wall with numerous crosses and multiradiate ossicles, lumpy buttons and rosettes; lacking cups; midventral radial tube feet series up to four wide; lateral ventral radial series of tube feet parallel and never joined anteriorly and posteriorly to form a distinct sole.....
.....*Psolidiella maculosa* sp. nov.

***Psolidiella nigra* Mortensen**

Figures 1a–d, f–k, 2a–l

Psolidiella nigra Mortensen, 1925: 360–362, figs 42, 43.—Panning, 1949: 415.—Dawbin, 1950: 35, pl. 1 fig. 3.—Panning, 1957: 35.—Panning, 1961: 192–194, figs 1–6.—Hickman, 1962: 52.—Pawson, 1969: 37, pl. 22 map 1.—Pawson, 1970: 36–38, fig. 7.—Panning, 1971: 45.—Fenwick and Horning, 1980: 441, 443.—O'Loughlin, 1994: 541–543, fig. 2.—Rowe (in Rowe and Gates) 1995: 280.—O'Loughlin and Alcock, 2000: 3, 15–16.

Cucumaria bollonsi Mortensen, 1925: 345–346, fig. 32.—Dawbin, 1950: 38, fig. 9.

Trachythone bollonsi.—Panning, 1949: 426.—Pawson, 1970: 38–39.

Psolidiella adhaerens Hickman, 1962: 50–52, figs 1–16, pl. 1 fig. 1.—Pawson, 1969: 37, pl. 22 map 1.—Pawson, 1970: 36.—Panning, 1971: 45.—Dartnall, 1980: 12, 51, map 16(1).—Rowe, 1982: 458, 464.—Rowe and Vail, 1982: 222 (part).—O'Loughlin, 1984: 151 (part).—O'Loughlin and O'Hara, 1992: 227, 229.—O'Loughlin, 1994: 543–544, figs 3, 4 (part).—Rowe (in Rowe and Gates) 1995: 280 (part). syn. nov.

Material examined. Holotype, 2 paratypes. New Zealand, Stewart Island, Paterson Inlet, rocky shore, S. Vallin, 6 Apr 1924 (ZMUC).

Other New Zealand material. The Snares, Boat Harbour, covered by plant detritus in rock pools, 18 Dec 1976, MNZ EC4061 (10); AM J12281 (4).

Syntype of *Cucumaria bollonsi* Mortensen, 1925. North Island, Cape Maria van Diemen, MPE, 4 Jan 1915, ZMUC Eh 304–258 (1).

Syntypes of *Psolidiella adhaerens* Hickman, 1962. Australia, Tasmania, Pirates Bay, Eaglehawk Neck, under stones near low tide level, V.V. and J.L. Hickman, 19 Mar 1954, TM H2135 (1); 13 May 1954, H546 (5), H2008 (64), H2009 (microslide, ossicles), H2010 (microslide, ossicles); 9 Mar 1960, H2011 (microslide, body mount).

Other material. Tasmania. Eaglehawk Neck, 22 May 1959, H2136 (11); Adventure Bay, 5 Sep 1993, H2310 (1). Victoria. Gabo Island, rocky shallows, 16 May 1982, NMV F68267 (1); Mallacoota, rocky shallows, 21 Jan 1981, F68264 (1); Cape Conran, rocky shallows, 19 Apr 1976, F73809 (1).

Description of material. Body up to 36 mm long (preserved, tentacles extended), 11 mm diameter; body wall thin; body rounded, distinct very thin-walled oval sole with rim, oral cone and upturned anal cone; on female specimens oral cone wrinkled, folded, pocketed, pockets sometimes extending dorsally and laterally, rarely on male specimens; 5 small spatulate anal scales; 10 dendritic tentacles, ventral 2 smaller; calcareous ring lacking posterior prolongations, 5 radial plates with anterior notched taper and posterior notch, 5 interradiial plates with anterior pointed taper and

posterior broad rounded indentation; single left ventrolateral polian vesicle; posterior intestine in left ventral interradius.

Close cover of small tube feet scattered dorsally, laterally, around oral and anal cones; tube feet in 3 radial series ventrally, not continuing to introvert and anus, bordering sole to varying degrees anteriorly and posteriorly, up to 4 rows wide lateroventrally (paired double to zig-zag rows), up to 2 rows wide midventrally; absent from introvert; 5 radial tube feet anally.

Dorsal body wall predominantly with tube foot ossicles only, rarely with a few buttons (in juveniles), very rarely with a few concave knobbed crosses or cups (in juveniles): tube foot ossicles endplates, frequently fragmentary, up to 0.16 mm wide, some with a narrow rim of support plates; tube foot support plates irregularly oval to elongate, sometimes bent and curved, perforated with large holes centrally, bluntly denticulate around margin, typically 0.10 mm long, never thickened rods; thick, smooth, irregularly oval buttons rarely present dorsally, up to 8 (typically 4) perforations, rarely marginally knobbed, frequently incompletely formed, typically 0.10–0.16 mm long.

Ventral body wall with perforated plates, buttons, very rare spinous plates, knobbed concave crosses, rare cups: plates abundant, thick, smooth, rarely lumpy, irregularly oval, typically about 8 (up to 17) perforations, frequently thickly bluntly denticulate around margin, up to 0.24 mm long; thick plates intergrade with smaller dorsal body wall type buttons; very rare irregular, spinous (surface), marginally denticulate, perforated plates; numerous shallow concave crosses, regular and irregular, arms frequently bifid and distally knobbed, knobs sometimes joined to form incomplete cups, 0.04–0.12 mm long; rare thick to thin shallow concave cups, rim smooth to capitate, 0.04–0.10 (typically 0.06) mm long.

Ventral tube feet with endplates up to 0.32 mm wide, normally with thin rim of support plates, typical ventral body wall plates: support plates irregularly oval to elongate, frequently bent and curved, marginally denticulate, largest perforations centrally, up to 0.19 mm long, very rarely rod-like.

Tentacle ossicles numerous large thick perforated narrow elongate plates and rods, straight or bent, flat or curved, rarely branched, up to 0.50 mm long; some curved to convex, marginally denticulate, perforated, irregularly oval to triangular, smooth plates up to 0.26 mm wide; bent

curved narrow denticulate perforated plates 0.08–0.18 mm long; thin perforated marginally denticulate, irregularly round, convex plates 0.05–0.08 mm wide; sometimes rosettes up to 0.12 mm long.

Colour (preserved). Dorsal and lateral body off-white to pale brown to very dark brown, grey, black; oral and anal cones frequently darker than dorsally; sole off-white to pale brown; tube feet ends white; introvert and tentacles off-white to dark brown.

Reproduction. Externally brood-protects differentiating embryos, up to 0.8 mm long, in pockets and folds around the oral cone of female specimens (December to May; no June to August material observed). Exhibits sexual dimorphism, mature female specimens having pockets and folds around the oral cone, mature male specimens normally having a smooth oral cone. The three type specimens from Stewart Island (April) are all males with a smooth oral cone. The specimens from The Snares (December) include one brood-protecting female. All Eaglehawk Neck lots (March, May) include specimens which have: mature male and female gonads; a gonopore on the oral disc anterior to the middorsal tentacle pair; gonads with eggs ranging from small white to large cream, up to 0.6 mm long; mature females with distinct folds and pockets and small tube feet around the oral cone; mature males with smooth oral cones and some larger males with some lesser degree of anterior pocketing; at least one female with brood embryos in the anterior pockets, one specimen (H2008) with about 100 brood embryos; some brood embryos showing the beginning of differentiation, having numerous crosses; brood embryos which are 0.6–0.8 mm long. The Cape Conran specimen (April) is brood-protecting.

Distribution. New Zealand, North Island (Cape Maria van Diemen), South Island (Banks Peninsula and Otago Peninsula), Stewart and The Snares; far eastern coast of southern Australia (Gabo Island, Mallacoota, Cape Conran, Eaglehawk Neck, Adventure Bay). Rocky shallows.

Remarks. O'Loughlin (1994: 544) and O'Loughlin and Alcock (2000) anticipated that *P. adhaerens* might be a junior synonym of *P. nigra*. A synonymy is formally established here. Hickman (1962) based his new species *P. adhaerens* on abundant material which was collected exclusively from Eaglehawk Neck on the eastern coast

of southern Tasmania, and distinguished *P. adhaerens* from *P. nigra* on the grounds of differing colour, possessing anal teeth, and lacking ossicles in the walls of the tube feet. The type material of both species has small anal teeth, and the ventral and at least some dorsal tube feet have a thin rim of support ossicles. The colour is variable, and material from New Zealand and eastern Australia exhibits a similar colour range. Neither Mortensen (1925) nor Hickman (1962) reported the rare small concave distally knobbed crosses and very rare cups which are present in the body wall of the type material of both *P. nigra* and *P. adhaerens*. The form and distribution and size of the ossicles, the external morphology and size, and the mode and seasonality of the distinctive external brood-protective reproduction are indistinguishable for the New Zealand and Australian material referred to above.

Psolidiella hickmani sp. nov.

Figures 1d–f, 3a–l

Psolidiella adhaerens.—Rowe and Vail, 1982: 222 (part).—O'Loughlin, 1984: 151 (part).—O'Loughlin, 1994: 541 (part), 543–544 (part), fig. 4.—Rowe (in Rowe and Gates), 1995: 280 (part).

Material examined. Holotype. Victoria, Phillip Island, Kitty Miller Bay, silt, rocky shallows, 0–1 m, J. Monagle and M. O'Loughlin, 20 Apr 1987 (NMV F74912).

Paratypes. Type locality and date, NMV F68266 (14); 25 Oct 1987, F68259 (2); 23 Dec 1987, F68257 (4); 13 Feb 1988, F68260 (6); 22 Nov 1997, F65928 (7).

Other material. Victoria. Wilsons Promontory, Oberon Bay, 7 Mar 1984, F68271 (1); Cape Paterson, 29 Jan 1988, F68254 (4); Kilcunda, 26 Jan 1987, F73815 (1); Harmers Haven, 27 Mar 1989, F57357 (1); Phillip Island, Cowrie Beach, 27 Nov 1985, F68263 (11); Flinders, 16 Nov 1980, F68268 (1); Port Phillip Bay, Altona, 8 Apr 1991, F73821 (2); Marengo, Hayley Point, 26 Mar 1977, F68253 (42); Crayfish Bay, 31 Dec 1980, F68270 (1); Armstrong Bay, 5 Apr 1998, F82973 (2). South Australia. Cape Northumberland, 16 May 1990, F74908 (1); Beachport, 9 Jan 1988, F74906 (5); Robe, 10 Jan 1988, F74907 (2). Tasmania. Derwent Estuary, Opossum Bay, 15 Nov 1982, F68258 (8); Bass Strait, Lulworth, 22 Nov 1982, F74910 (2); mouth of Tamar River, Greens Beach, 7 Mar 1981, F74911 (1).

Description of material. Body up to 17 mm long (preserved, tentacles withdrawn), 11 mm diameter; body wall thin; body rounded, distinct very thin-walled oval sole with rim, oral cone and upturned anal cone; on female specimens oral cone wrinkled, folded, pocketed, pockets sometimes extending dorsally and laterally; 5 small

spatulate scales anally; 10 dendritic tentacles, ventral 2 smaller; calcareous ring lacking posterior prolongations, 5 radial plates with anterior notched taper and posterior notch, 5 interradial plates with anterior pointed taper and posterior broad rounded indentation; single left ventrolateral polian vesicle; posterior intestine in left ventral interradius.

Close cover of small tube feet scattered dorsally, laterally, around oral and anal cones; tube feet in 3 radial series ventrally, not continuing to introvert and anus, bordering sole to varying degrees anteriorly and posteriorly, up to 4 rows wide lateroventrally (paired double to zig-zag rows), up to 2 rows wide midventrally; absent from introvert; 5 radial tube feet anally.

Dorsal body wall ossicles crosses, cups, thickened plates, thin spinous plates, tube feet endplates and support ossicles: crosses numerous, concave, some irregular and multiradiate, arms frequently bifid and knobbed distally, knobs sometimes joined to create incomplete rim or cup, typically 0.04–0.06 mm long; cups, regular, shallow, concave, rim smooth or with capitate spinelets, typically 0.05–0.06 mm long, some cups thick and large; numerous thickened smooth perforated plates, irregularly oval, frequently with small rounded denticulations marginally, up to 16 perforations, up to 0.24 mm long, intergrade with four-holed buttons; rare thin irregular perforated plates, surface spines, marginally strongly denticulate, up to 18 perforations, up to 0.19 mm long.

Ventral body wall ossicles crosses, cups, thickened plates: rare knobbed crosses; abundant cups, rim complete or incomplete, predominantly capitate spinelets on rim, cups typically 0.05–0.07 mm long; abundant thickened perforated plates similar to dorsally, up to 14 perforations, up to 0.22 mm long, intergrade with rare buttons.

Tube feet ossicles endplates, tube foot support plates and rods, body wall ossicles: endplates up to 0.32 mm diameter, fairly irregular perforations, smallest centrally; support ossicles frequently curved or bent thick perforated rods and narrow elongate plates, up to 0.30 mm long.

Tentacle ossicles thickened, elongate, frequently bent and curved, perforated rods up to 0.32 mm long; frequently bent and curved elongate narrow perforated plates up to 0.22 mm long; irregularly round, marginally denticulate, concave, thin perforated plates typically 0.08–0.12 mm diameter; some rosettes up to 0.07 mm long.

Colour (preserved). Dorsal and lateral body off-white to pale brown to very dark brown, grey, black; oral and anal cones frequently darker than

dorsally; sole off-white to pale brown; tube feet ends white; introvert and tentacles dark brown.

Reproduction. Externally brood-protects differentiating embryos, up to 0.5 mm long, in pockets and folds around the oral cone of female specimens (October to April). Exhibits sexual dimorphism, mature female specimens having pockets and folds around the oral cone, mature male specimens normally having a smooth oral cone. Lots from Oberon Bay, Cape Paterson, Kitty Miller Bay, Marengo, Armstrong Bay and Opossum Bay all include at least one externally brood-protecting female, one female from Opossum Bay (November) having about 40 brood embryos in oral pockets.

Distribution. Australia, Tasmania (Opossum Bay in Derwent Estuary, and Bass Strait coast); Victoria (west of Wilsons Promontory) to South Australia (west to Robe). Rocky shallows, 0–1 m.

Etymology. Named in recognition of the contribution to our knowledge of Tasmanian holothurians by the late Prof. V.V. Hickman (formerly of the University of Tasmania).

Remarks. *Psolidiella hickmani* differs consistently from *P. nigra* by having numerous thick, smooth, perforated plates and buttons, and numerous knobbed concave crosses, in the dorsal body wall. No specimens of *P. hickmani* from Victoria have been observed with more than three brood embryos in pockets, while one from southern Tasmania has about 40 brood embryos in pockets. Specimens from southern Tasmania are up to 17 mm long (tentacles withdrawn) and from coastal Victoria are up to 14 mm long (tentacles withdrawn). Although based on limited evidence, these observations reflect a pattern previously noted by Materia et al. (1991) for the cucumariid holothurians *Staurothyone inconspicua* (Bell, 1887) and *Neoamphicyclus lividus* Hickman, 1962. In *S. inconspicua* more numerous colomic juveniles are brood-protected in southern Tasmanian specimens that in Victorian specimens, and in both species mature adults in southern Tasmania are larger than on coastal Victoria.

Psolidiella maculosa sp. nov.

Figures 1d, f, 4a–l

Psolidiella sp.—Marsh, 1991: 473, 477.

Material examined. Holotype. Western Australia, Perth, Marmion Marine Park, Mettams Pool, sandy pockets on reef flat, midtidal, B.R. Wilson, 3 Jan 1987 (WAM Z4781).

Paratypes. Type locality and date, WAM Z4782 (2); Cottesloe, reef off Rosendo Street, in sand amongst *Caulerpa* holdfasts, 0–1 m, 6 Feb 1985, WAM Z4931 (13); Trigg Island, with *Caulerpa*, 22 Nov 1969, NMV F59222 (2); Quaranup, boat ramp, intertidal sand near *Posidonia*, 20 Jan 1988, WAM Z4932 (1).

Other material. Western Australia, Duke of Orleans Bay, Little Wharton Beach, off algae, 0–2 m, 19 Dec 1991, NMV F66253 (1).

Description of material. Up to 27 mm long (preserved, tentacles withdrawn, anal cone extended), 8 mm diameter; body wall thin; oral extension and anal cone upturned; oral cone lacking folds and pockets; 10 dendritic tentacles, ventral 2 smaller; distinct introvert, lacking tube feet; distinct sole-like ventrum, narrower than body, not extending to introvert or anus; 5 microscopic spatulate anal scales; calcareous ring solid, lacking posterior prolongations, anterior tapering projections radially and interradially, posterior notches radially, wide indentations interradially; single left ventrolateral polian vesicle; posterior intestine in left ventral interradius.

Close cover of large and small tube feet scattered dorsally and laterally and around oral and anal cones; 3 parallel radial series of tube feet ventrally, series up to 4 irregular rows wide on lateral ventral radii, irregular 2–4 rows wide on the midventral radius, radial series not extending to introvert and anus, rows not joined anteriorly and posteriorly to border a distinct sole; paired radial tube feet at introvert; 5 radial tube feet anally.

Dorsal body wall with epidermal multiradiate ossicles and crosses, buttons, rosettes, tube foot ossicles: numerous multiradiate ossicles including crosses, frequently concave, frequently irregular, 3–5 arms frequently branched and distally knobbed, up to 0.06 (typically 0.04) mm long; numerous buttons, oval to irregular, predominantly 4–7 holes, frequently with thickenings or lumps or knobs, buttons up to 0.17 (typically 0.13) mm long; numerous rosettes up to 0.07 mm long; cups not present.

Ventrally multiradiate ossicles and crosses similar to dorsally; rosettes; buttons more irregular than dorsally, intergrading with small thick lumpy perforated plates, up to 12 holes, frequently slightly knobbed marginally, similar size to dorsally, perforations smaller; cups not present.

Tube feet with endplates up to 0.28 mm wide, perforations frequently smaller centrally; elongate, narrow, thick, straight or bent, sometimes branched, perforated support rods up to 0.28 mm long; irregular elongate perforated support plates, straight to bent, frequently curved, up to 0.18 mm long.

Tentacles with abundant plates and elongate, narrow ossicles, thickened, irregular, perforated, straight or bent, flat or curved, up to 0.45 mm long; convex perforated plates, irregularly oval to rectangular, typically 0.07–0.13 mm long, marginal perforations smallest; abundant rosettes, typically 0.05 mm long.

Colour (preserved). Body dark blue-grey to brown with white spots, sometimes pale ventrally; tube feet ends white; small white calcareous spots around tube feet, sometimes between tube feet dorsally and laterally.

Reproduction. The material, collected in November to February lacks mature female gonads. Long, thin, smooth, white gonad tubules are present. There are no pockets or folds around the oral cone of any specimens in the material examined.

Distribution. South-western Australia, from Duke of Orleans Bay to Perth in Western Australia; 0–2 m.

Etymology. From the Latin *maculosa* (spotted), referring to the body appearance.

Remarks. A body wall ossicle combination of numerous distally knobbed crosses and multiradiate ossicles, lumpy buttons and rosettes, and an absence of cups, distinguishes this species from *P. nigra* and *P. hickmani*. Distinctive small white spots in the dark body wall (in addition to the white tube feet ends, and created by aggregations of ossicles), midventral tube feet series up to four rows wide, and the absence of any interradiate tube feet anteriorly and posteriorly delineating a distinct sole, also distinguish *P. maculosa* from the other two species. There are no mature female specimens in the material available, and it is not possible to determine whether or not *P. maculosa* has the same external brood-protecting habit as *P. nigra* and *P. hickmani*.

Acknowledgements

I am grateful for the assistance, variously with fieldwork and materials and resources, provided by Dr Margot Jensen (ZMUC); Helen Clark (MNZ); Dr John L. Hickman (formerly of the University of Tasmania); Alison Green and Elizabeth Turner (TM); Loiset Marsh, Shirley Slack-Smith and Dr Jane Fromont (WAM); Sue Boyd, Tim Stranks and Chris Rowley (NMV); and Susan Lockhart, Jane Monagle, Christine Rowland and Peter Tintera. I am particularly grateful to Dr David Pawson and Tim O'Hara for their helpful comments, and to Ben Boonen for the presentation of the figures.

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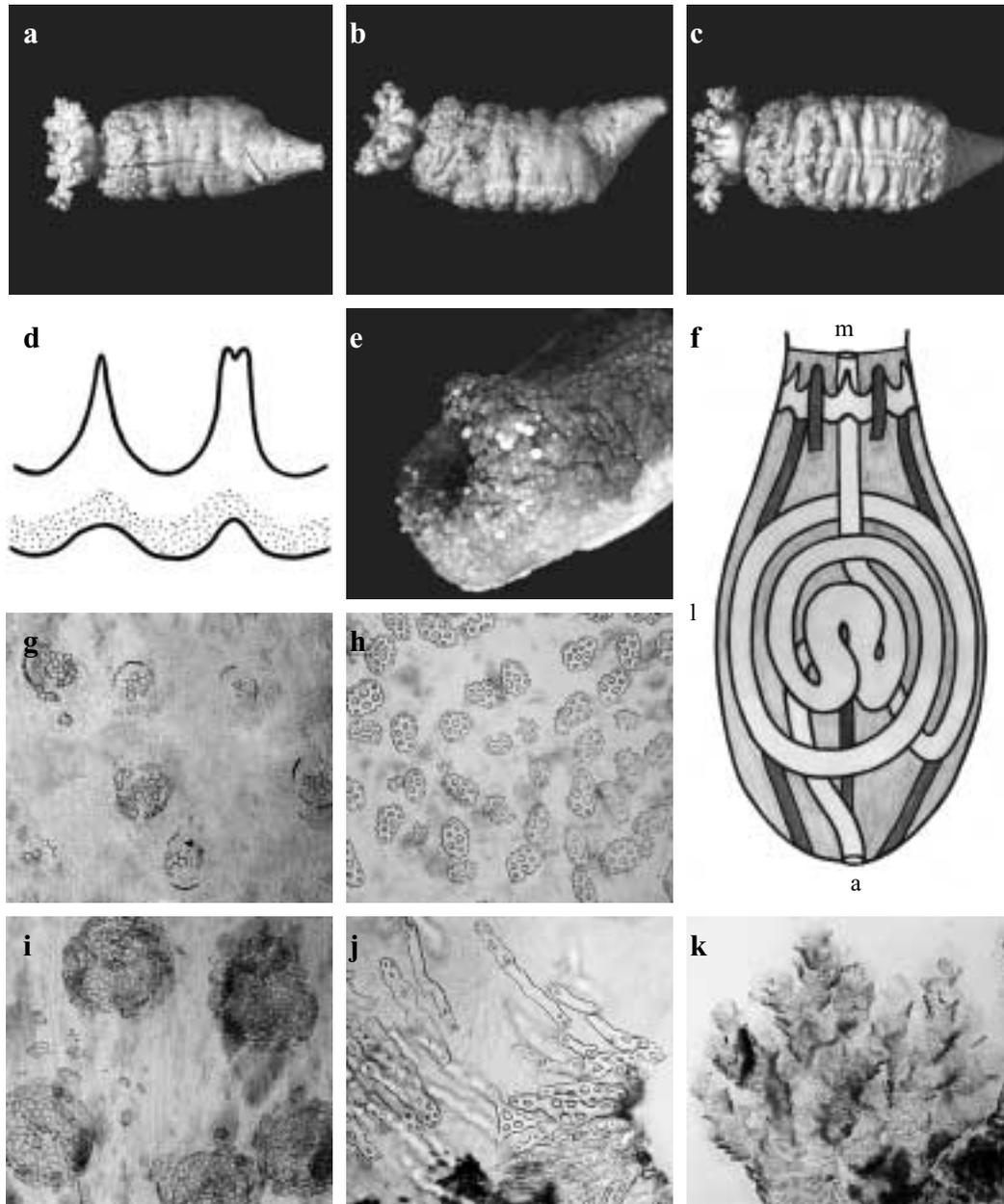


Figure 1. a–c, views of *Psolidiella* type species *P. nigra* (H2135, 26 mm long) with oral cone brood embryos. a, dorsal; b, lateral, showing oral and anal cones; c, ventral, showing sole with two rows of midventral tube feet. d, cucumariid calcareous ring of *Psolidiella* species. e, brood-protection of embryos (white, round, 0.5 mm long) around oral cone of *P. hickmani* (F68258, 15 mm long). f, dorsal view of alimentary canal of *Psolidiella* species from mouth (m) to anus (a) with posterior intestine left (l) ventral. g–k, body mount showing form and distribution of ossicles of *Psolidiella* type species *P. nigra* (H2011). g, dorsal; h, ventral interradii; i, ventral tube feet; j, tentacle trunk; k, tentacle ends.

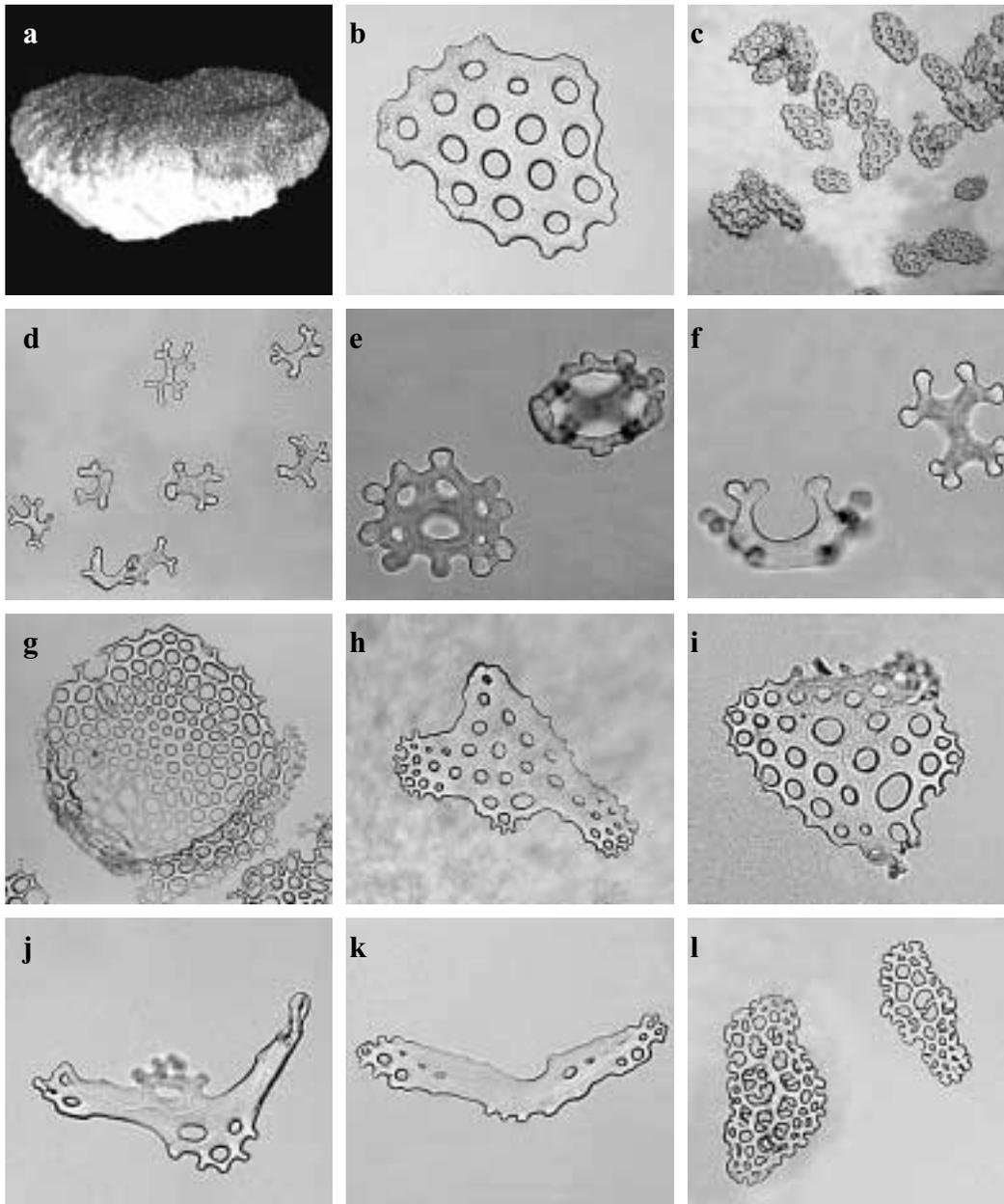


Figure 2. a–l, *Psolidiella nigra* Mortensen. a, lateral view of holotype (ZMUC, 24 mm long). b–l, ossicles (measurements of lengths). b, ventral plate (0.19 mm, paratype); c, ventral buttons and plates (0.13–0.20 mm, paratype); d, ventral crosses (0.06–0.08 mm, EC4061); e, ventral cups (0.06 mm, EC4061); f, ventral crosses (0.05–0.06 mm, H2008); g, ventral tube foot support plates and endplate (endplate 0.32 mm, H2009); h, tentacle plate (0.24 mm, holotype); i, curved tentacle plate (0.13 mm, paratype); j, elongate tentacle plate (0.15 mm, EC4061); k, elongate tentacle plate (0.26 mm, EC4061); l, tentacle rosettes (0.10–0.12 mm, holotype).

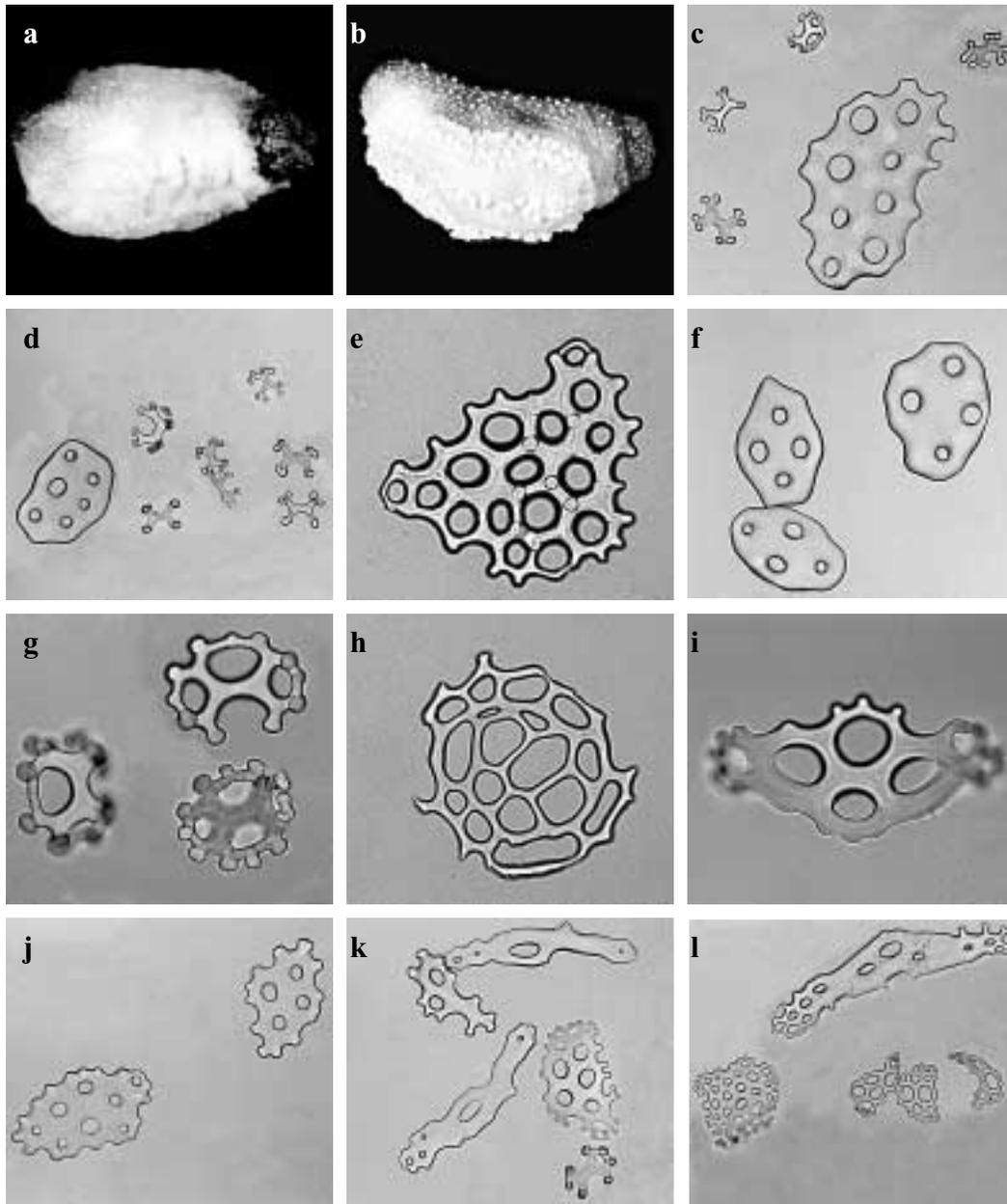


Figure 3. a–l, *Psolidiella hickmani* sp. nov. a, lateral view of holotype (11 mm long). b, ventrolateral view of specimen showing sole with two rows of midventral tube feet (F68258, 16 mm long). c–l, ossicles from types (measurements of lengths). c, dorsal plate (0.21 mm) and crosses (0.05 mm); d, dorsal button (0.13 mm) and crosses (0.05–0.06 mm); e, dorsal spinous plate (0.17 mm); f, dorsal buttons (0.11–0.13 mm); g, dorsal cups (0.05 mm); h, dorsal tube foot endplate (0.11 mm); i, dorsal tube foot support plate (0.12 mm); j, ventral plates (0.14–0.18 mm); k, ventral tube foot ossicles (plate 0.13 mm, cross 0.06 mm); l, tentacle ossicles (0.06–0.24 mm).

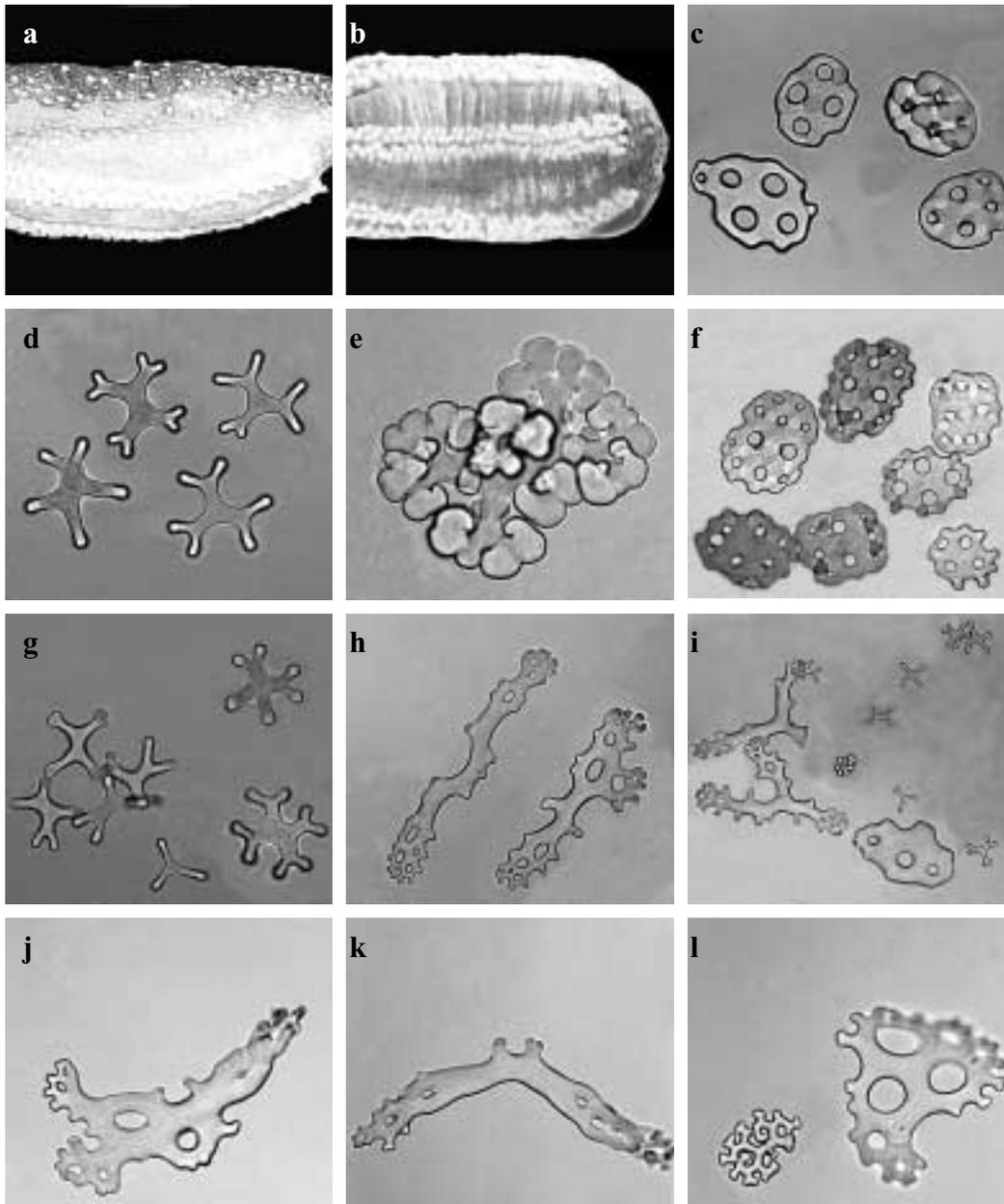


Figure 4. a–l, *Psolidiella maculosa* sp. nov. a, lateral view of holotype (19 mm wide shown); b, ventral view of paratype showing sole-like ventrum with four rows of midventral tube feet (18 mm shown). c–l, ossicles from types (measurements of lengths). c, dorsal buttons (0.10–0.15 mm); d, dorsal multiradiate ossicles (0.03 mm); e, dorsal rosette (0.07 mm); f, ventral plates (0.09–0.15 mm); g, ventral multiradiate ossicles (0.04–0.05 mm); h, ventral tube foot plate (0.18 mm) and rod (0.24 mm); i, ventral tube foot ossicles (button 0.11 mm); j, tentacle plate (0.16 mm); k, tentacle rod (0.32 mm); l, convex tentacle plate (0.06 mm) and rosette.