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New and little-known species of Didemnidae (Asciadiacea, Tunicata) from Australia (part 4)

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Abstract

Forty-eight species (including nine that are new) of the 288 Didemnidae now known from Australian waters are reported on in the present work. Dredged material is from benthic habitats in inter-reefal areas of the Great Barrier Reef and from deeper water canyons off northeastern and northwestern Tasmania. Collections from shallower waters of Port Davey (western Tasmania) and Kangaroo Island (South Australia) were hand-collected by scuba divers. Seven of the eight known genera of the Didemnidae are represented. Despite this emphasis on sampling in temperate waters, only 14 species (all indigenous) are recorded from around the southern half of the continent. The species diversity of this family is greater in the tropics, with 34 species being recorded. Nearly half of these are known also from the tropical western Pacific and some from the Indian Ocean as well. Tropical indigenous species are relatively few.

Keywords: *Asciadiacea, Didemnidae, Indigenous species, Kangaroo I. seabed biodiversity, northern Great Barrier Reef, Port Davey, Tasmanian Canyons*

Introduction

Forty-eight species of the family Didemnidae are discussed in this work, which is based principally on collections of benthic fauna from four recent major surveys and additional material from temperate waters of the continent. Families other than the Didemnidae are reported on separately (Kott 2006). The major surveys reported on are set out below. Of these only the Great Barrier Reef survey is from tropical waters:

- Great Barrier Reef Seabed Biodiversity: one of the few explorations of the benthic fauna of lagoon and inter-reefal benthic habitats of northeastern Queensland, by epibenthic sled (CSIRO, AIMS and the Queensland Museum).
- Tasmanian Canyons: a systematic survey of deep-water canyons northeast and northwest of Tasmania by Sherman sled (CSIRO).
- Tasmania: systematic surveys by scuba diving off Port Davey and the Tasman Peninsula (South Australian Museum, Karen Gowlett-Holmes; Aquenal Pty Ltd).
- South Australia: Kangaroo I., systematic surveys by scuba diving (South Australian Museum, Karen Gowlett-Holmes).

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Species of the Didemnidae (together with solitary species) dominate the ascidian fauna from the sea floor locations in the tropics. Both colonial (including Didemnidae) and solitary species were taken from the sea floor habitats of the deeper waters in the canyons off southern Australia, but the species diversity is significantly lower than in the north. In temperate waters, hand collecting by scuba at shallow depths also yields a high diversity of colonial species while solitary species are less common than they are in deeper benthic habitats.

Including the nine new species in the present work, 728 species of the Ascidiacea now are known from Australia (Kott 2005a, Tables I–III; 2005b; 2006, Tables I–III). Of these species, 151 are solitary phlebobranch and stolidobranch species, 229 are non-didemnid aplousobranchs, 60 are colonial phlebobranch and stolidobranch species, and 288 are didemnids. Of the didemnids, only just over half (150) have been recorded more than once. Examination of new material contributes to the understanding of this important ascidian component of the filter-feeding fauna in which the family Didemnidae is most diverse and, with its rapid replication regimes and two-dimensional colony growth, occupies appreciable areas of hard substrate in sub-littoral habitats in temperate and tropical seas.

Despite the relatively intense collection effort in temperate waters compared with that of the tropics, only 14 species (including *Leptoclinides placidus* which is endemic to the central eastern coast of the continent) are indigenous species recorded from temperate waters, only a few (*Didemnum fragum*, *D. lissoclinum*, and *D. patulum*) extending as far as halfway up the eastern Australian coast. Most have a range across the southern coast of the continent.

Thirty-four species of the 48 discussed below are tropical species, of which 20 are known also from the West Pacific and/or the Indian Ocean. The species recorded not only support the view that the family is more diverse in the tropics than it is in temperate waters but also that tropical didemnid species have relatively extensive ranges. The further 14 tropical species (including six of the new species) discussed below may be indigenous, although with further collecting in the Indo-West Pacific tropical region these species could be found to have a wider range.

Generally the dredged material is not in good condition, colonies being fragmented and/or mutilated and zooids contracted and crushed. However, although it is difficult to determine the colony structure from these damaged specimens, zooid morphology can often be displayed in permanent mounts of stained and cleared, thin, hand-cut, decalcified sections of the colony. Also, the size and form of the calcareous spicules that often comprise unique species characters can be seen in scanning electron micrographs (see Kott 2001).

Species list

- Atrium irregulare* sp. nov.
- Leptoclinides albamaculatus* Kott, 2001
- Leptoclinides dubius* (Sluiter, 1909)
- Leptoclinides durus* Kott, 2001
- Leptoclinides fluxus* sp. nov.
- Leptoclinides placidus* Kott, 2001
- Polysyncraton cuculliferum* (Sluiter, 1909)
- Polysyncraton gratum* sp. nov.
- Polysyncraton magnetae* Hastings, 1931
- Polysyncraton meandratum* Monniot, 1993
- Polysyncraton otuetue* C. and F. Monniot, 1987

- Polysyncraton reticulum* Kott, 2004
Polysyncraton scorteum Kott, 2001
Didemnum abradatum sp. nov.
Didemnum albopunctatum Sluiter, 1909
Didemnum astrum Kott, 2001
Didemnum candidum Savigny, 1816
Didemnum coralliforme Kott, 2004
Didemnum crescente Kott, 2001
Didemnum fragile Sluiter, 1909
Didemnum fragum Kott, 2001
Didemnum grande (Herdman, 1886)
Didemnum granulatum Tokioka, 1954
Didemnum jedanense Sluiter, 1909
Didemnum lissoclinum Kott, 2001
Didemnum mantile Kott, 2001
Didemnum membranaceum Sluiter, 1909
 ?*Didemnum microthoracicum* Kott, 2001
Didemnum molle (Herdman, 1886)
Didemnum moseleyi (Herdman, 1886)
Didemnum parau C. and F. Monniot, 1987
Didemnum patulum (Herdman, 1899)
 ?*Didemnum pellucidum* Kott, 2001
Didemnum perplexum Kott, 2001
Didemnum psammatode (Sluiter, 1895)
Didemnum tantulum sp. nov.
Didemnum tumulatum Kott, 2004
Didemnum vesica sp. nov.
Didemnum viride (Herdman, 1906)
Trididemnum farrago Kott, 2004
Trididemnum nebula sp. nov.
Trididemnum pigmentatum Kott, 2001
Trididemnum sibogae (Hartmeyer, 1910)
Trididemnum titanium sp. nov.
Lissoclinum capsulatum sp. nov.
Lissoclinum reginum Kott, 2001
Diplosoma velatum Kott, 2001
Diplosoma versicolor Monniot, 1994

Taxonomy

Atriolum irregulare sp. nov.
 (Figures 1A, 6A)

Distribution

Type locality: Tasmanian Canyons (King I. Canyon, 236.6 m, holotype QM G323245).

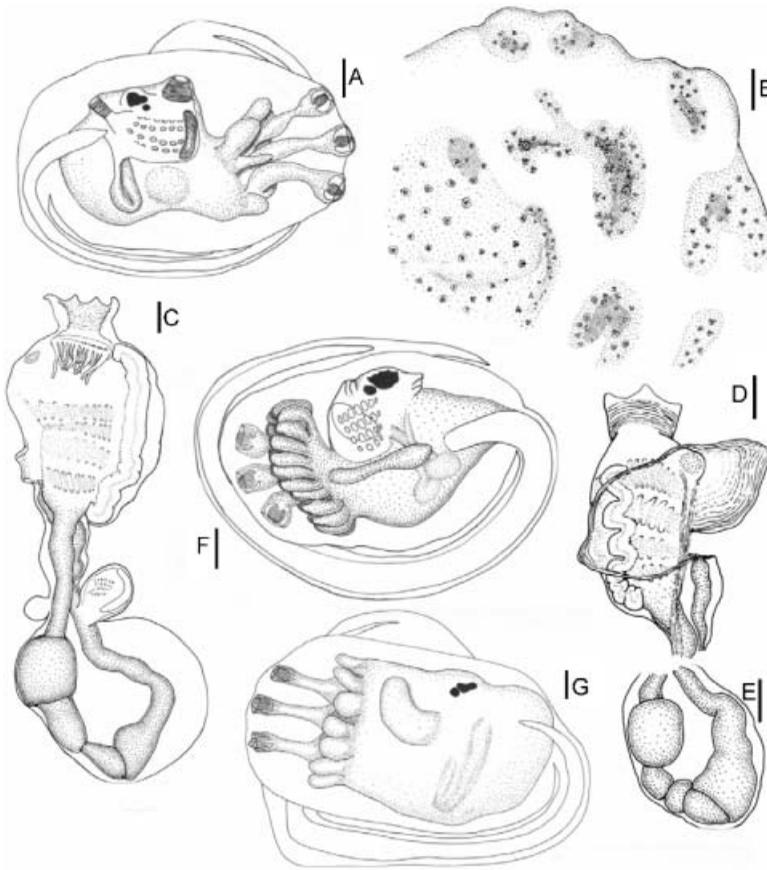


Figure 1. (A) *Atrioolum irregulare* (QM G323245 holotype): larva. (B, C) *Leptoclinides fluxus* (QM G308817 holotype): (B) colony surface; (C) zooid. (D–F) *Polysyncraton gratum* (QM G308891): (D) thorax; (E) abdomen; (F) larva. (G) *Polysyncraton reticulum* (QM G323330): larva. Scale bars: 0.1 mm (A, C–G); 1 mm (B).

Description

The newly recorded specimen is a small (about 1.5 cm maximum dimension), firm, lumpy portion of a larger colony. It grows around a cylindrical (possible weed) stalk, which forms an axis through the centre of the colony. A large horizontal cloacal cavity is beneath the surface zooid-bearing layer. Cloacal apertures were not detected and may not be present in this mutilated portion of a colony. The spicules are crowded in the surface layer of test, which is raspy to the touch. They are less crowded internally. Spicules are stellate, to 0.10 mm diameter, with 11–15 moderately long, pointed, crowded rays in optical transverse section. The zooids are characteristic of this genus, with a long tubular atrial siphon projecting back to open directly into the common cloacal cavity. The branchial siphon is about half the length of the atrial siphon. Four rows of about 8–10 (per side) long rectangular stigmata are in the branchial sac. The gut loop is relatively simple, short, and vertical. Five coils of the vas deferens surround the large undivided testis. A retractor muscle was not detected. Larvae are present in the inner layer of test, behind the zooids. They are large, the trunk to 0.84 mm long, and the tail winds two-thirds of the way around it. Three lateral ampullae are along each side of the three anteromedian adhesive organs.

Median ampullae are not present. The larval oozoid is well developed, occupying the posterior part of the trunk. It has well-developed branchial and atrial siphons, a vertical gut loop, and four rows of stigmata in the larval pharynx. Larvae are well developed, and a brood pouch attached to the top of the thoracic neck was not detected.

Remarks

The present species has pointed conical spicule rays about 0.1 mm diameter that resemble the spicules of *Atriohum buccinum*, a species also recorded from Western Australia. However, the latter species has only 9–11 rays in optical transverse section while the present species has 11–15. *Atriohum robustum* and *A. lilium* both have shorter spicule rays than the present new species and the former species is also distinguished by its small spicules (to 0.04 mm diameter). Spicules of the present species (from the southeastern part of the continental shelf in waters over 200 m) resemble those of *A. tubiporum* Kott, 2001 (from waters to 130 m off the southwestern corner of the continent) but they are larger with longer and more numerous rays and the colonies are not the conspicuously cylindrical lobes of the Western Australian *A. tubiporum*.

The present species has the large undivided testis, coiled vas deferens, long cylindrical atrial siphon, and large larvae that are characteristic of the genus *Atriohum* (see Kott 2001).

***Leptoclinides albamaculatus* Kott, 2001**

(Figure 6B)

Leptoclinides albamaculatus Kott 2001, p 38.

Distribution

Previously recorded (see Kott 2001): Queensland (Heron I., Capricorn Group). New record: Queensland (Great Barrier Reef: 15.615°S, 145.375°E, 21 m, QM G308876).

Description

The newly recorded colony forms a large sheet marbled or flecked with black pigment. The zooids have a long branchial siphon and a posteriorly orientated atrial siphon opens into a posterior abdominal common cloacal cavity. The abdomen is long and narrow and several testis follicles are surrounded by five coils of the vas deferens. The spicules are stellate, occasionally to 0.1 mm diameter, with 11–13 chisel-tipped or conical rays in optical transverse section. Most of the spicules are about 0.06 mm diameter.

Remarks

The newly recorded colony has similar zooids, testis, and vas deferens to those previously described. Spicules are of similar form, although the largest in the previously recorded material (Kott 2001) are only to 0.06 mm diameter. As the largest spicules occur only occasionally it is possible that they were overlooked in the original material. The colour pattern formerly described is created by the black pigment in the surface which sometimes is completely or partially absent thus exposing the underlying white spicules.

Leptoclinides dubius (Sluiter, 1909)

(Figure 6C)

Polysyncraton dubium Sluiter 1909, p 69.

Leptoclinides dubius: Kott 2001, p 54 and synonymy; 2005a, p 2418 and synonymy.

Distribution

Previously recorded (see Kott 2001, 2005a): Western Australia (Port Hedland, Shark Bay, Houtman's Abrolhos, Cockburn Sound); Queensland (Great Barrier Reef, Whitsunday Is, Bowen, Lizard I.); Northern Territory (Darwin); Western Pacific (Indonesia, Philippines, New Caledonia). New records: Queensland (Great Barrier Reef: 17.465°S, 146.375°E, 27 m, QM G308892; 18.945°S, 146.365°E, 7.5 m, QM G308852).

Description

Spicules are crowded in the surface layer of the colony and are in a thick layer on the base, while the remainder of the test, especially the lower half (excluding the thick layer of spicules on the base) is translucent. Large posterior abdominal common cloacal cavities are in the base of the colony. Zooids are large, with a posteriorly orientated atrial siphon and a large branchial siphon about half the length of the thorax with a false siphon in its base. About 12 stigmata per row are in the branchial sac.

Remarks

The spicules and their distribution and the large robust zooids with a velum in the base of the branchial siphon readily identify this commonly encountered species.

Leptoclinides durus Kott, 2001

(Figure 6D)

Leptoclinides durus Kott 2001, p 57 and synonymy; 2004a, p 734.

Distribution

Previously recorded (see Kott 2004a): Western Australia (Bonaparte Archipelago, Port Hedland); Queensland (Capricorn Group to Dingo Reef); Arafura Sea; Micronesia. New records: Queensland (Great Barrier Reef: 17.265°S, 146.425°E, 33 m, QM G308894; 15.615°S, 145.375°E, 21 m, QM G308877).

Description

Thin, hard white encrusting colony with spicules crowded throughout. Both the colony and the zooids are squashed and the thoraces are contracted. However, the posteriorly orientated atrial siphon, about 14 stigmata per row, and a vas deferens coiling about one and a half times around seven or eight testis follicles were detected.

Leptoclinides fluxus sp. nov.
(Figures 1B, C, 6E)

Distribution

Type locality: Great Barrier Reef (GBR Seabed Biodiversity Project SBD 504333 sample 816, 17.865°S, 146.645°E, 66 m, 26 September 2003, holotype QM G308817).

Description

The holotype colony is a firm sheet encrusting pebbles. White bands are in the surface test where spicules at branchial siphon level are crowded over the deeper common cloacal canals. These surround translucent areas where patches of spherical to irregular black pigment cells are mixed with a superficial layer of bladder cells to create a marbled pattern on the surface test. Dark pigment also surrounds some of the zooids. Branchial apertures open to the surface in these translucent areas and a group of three spicules is in the siphonal lining of each aperture. Spicules are chrysanthemum-like, to 0.05 mm diameter, with long, straight rod-like rays, about 15–17 in optical transverse section. The few common cloacal apertures at the junction of some of the canals are sessile with black pigment around the rims. As well as the crowded spicules over the primary common cloacal canals, a less crowded layer is at zooid level but they are only sparse elsewhere.

Zooids are robust with a relatively long branchial siphon, a large, square branchial sac with eight or nine stigmata per row, and a posteriorly orientated atrial siphon. As in all *Leptoclinides* spp. the zooids lack a retractor muscle. Oesophageal buds are present, each with four rows of stigmata. Gonads were not detected.

Remarks

Despite the lack of gonads, the present colony is assigned to the genus *Leptoclinides* on the basis of its robust zooids, posteriorly orientated atrial siphon and lack of a retractor muscle.

The colony is unusual in having crowded spicules forming a white opaque band over the common cloacal canals and less crowded spicules around the clumps of zooids where the test is more translucent. The spicules also are unusual, resembling some in the genus *Lissoclimum*. In *Leptoclinides*, *L. levitatus* Kott, 2001, recorded from northeastern and northwestern Australia and the Northern Territory (see Kott 2004b), is the only known species with spicules of similar size and numbers of rays, although the latter are long pointed cones rather than the rod-like rays of the present species. Kott (2005a), in discussing the relationship of *L. levitatus* and *L. echinus* Kott, 2001, distinguished the former species by the presence of some smaller burr-shaped spicules, although their spicules are more readily distinguished by the fewer rays in those of the latter species.

Leptoclinides placidus Kott, 2001
(Figure 6F)

Leptoclinides placidus Kott 2001, p 75; 2004b, p 2473.

Distribution

Previously recorded (see Kott 2004b): central eastern coast (Byron Bay, Solitary I., Hervey Bay). New record: Queensland (Noosa Heads, QM G308766).

Description

The colony is robust and sheet-like and looks the same in life as it does in preservative, being white with black spots about 5 mm apart in the surface test. Spicules are absent from the superficial layer of test and the lower half of the colony, but are present on the base of the colony and they line the common cloacal cavities, which consist of deep primary cavities extending into posterior abdominal cavities. The spicules are stellate, to 0.08 mm diameter, and have 9–13 sturdy conical rays with pointed or chisel-shaped tips.

Remarks

The colony, with its three-dimensional common cloacal cavity and spotted appearance, resembles the South Australian *L. maculatus* Kott, 2001 (see Kott 2004b). However, the spicules of the latter species have fewer rays. The colony also resembles that of *L. constellatus* Kott, 2001 in the distribution and size of its spicules although *L. constellatus* has fewer rays. *Leptoclimides tuberculatus* Kott, 2004a has similar spicules but they have fewer rays and colonies lack the superficial bladder cell layer. The tropical *Leptoclimides erinaceus* Kott, 2001 and *L. cavernosus* Kott, 2001 both have spicules of similar form but they are significantly larger and the colonies are different from the present species. The present specimen conforms to descriptions of those previously assigned to this species except for the presence of black spots in the test, although Kott (2001) did report the presence of black pigment. Also, although a maximum number of 11 spicule rays in optical transverse section were reported previously for this species, some with 13 rays have been detected in the newly reported specimen.

The present species has been recorded only from the central eastern coast of Australia.

Polysyncraton cuculliferum (Sluiter, 1909)

(Figure 6G)

Diplosomoides cuculliferum Sluiter 1909, p 90.

Polysyncraton cuculliferum: Kott 2005a, p 60 and synonymy.

Distribution

Previously recorded (see Kott 2005a): Queensland (Great Barrier Reef); Northern Territory (Darwin); Western Pacific (Solomon Is, Indonesia). New record: Queensland (Great Barrier Reef: 17.935°S, 146.785°E, 36 m, QM G308858).

Description

The colony is a small scrap, with a typically pointed surface papillum associated with each branchial aperture and a thin layer of surface test over large common cloacal canals lined on each side by zooids. Large conspicuous common cloacal openings are elevated above the surface. Spicules are stellate, to 0.08 mm diameter or more, with 9–13 long, pointed, conical rays in optical transverse section, and they are present throughout the colony. The delicate

zooids have a moderately short but wide thorax, about 10 stigmata per half row, a wide open atrial aperture with a long bifid anterior lip, six conspicuous pointed branchial lobes, an oval lateral organ about halfway down the body wall on each side of the thorax, a retractor muscle of variable length, and four coils of the vas deferens around four or five testis follicles.

***Polysyncraton gratum* sp. nov.**

(Figures 1D–F, 6H)

Distribution

Type locality: Tasmania (Tasmanian Canyons: Banks Strait, 168 m, Sherman Sled, 25 April 2004, holotype QM G308891).

Description

The colony is a fleshy, robust encrusting sheet. It is a cream colour in preservative but may have been orange in life. The surface test has a loose or inflated appearance, with a superficial layer of spicules that make it raspy. Spicules are present throughout the colony, although a thin layer of test beneath the thoracic common cloacal cavity is aspiculate. Spicules are stellate, to 0.075 mm diameter, with seven to nine conical pointed rays in optical transverse section. Stellate branchial apertures are evenly spaced and the margins of the openings are lined with spicules. The anterior rim of the large, sessile atrial opening is produced out into a pointed lip exposing most of the branchial sac to the common cloacal cavity. Zooids are whitish or translucent. Four or five immature testis follicles were detected although a vas deferens was not. Larvae are being incubated in the basal test. The larval trunk is 0.8 mm long and the tail is wound the whole way around it. Up to 12 pairs of lateral ampullae, created by subdivision from four primary pairs, encircle the three antero-median adhesive organs. A large conspicuous horizontal lateral ampulla is on the left side of the trunk, extending back from the waist between the adhesive array and the oozoid. Four rows of stigmata are in the larval pharynx. Blastozooids were not detected. The ocellus is large.

Remarks

Although gonads are not conspicuous in this specimen, it is assigned to *Polysyncraton* on the basis of its sessile atrial aperture with a long anterior lip and larvae with four rows of stigmata, a long horizontal external lateral ampulla and numerous finger-like lateral ampullae surrounding the adhesive organs. Although *Lissoclinum* spp. have larvae with four rows of stigmata and sometimes numerous lateral ampullae, the latter are only rarely thick finger-like lobes like the present species and although some have an anterior atrial lip it is not long and pointed as it is in most *Polysyncraton* spp. Some *Didemnum* spp. also have larvae with numerous lateral ampullae and stellate spicules with relatively few conical rays. However, only three rows of stigmata are in the larval pharynx in species of that genus.

The southern Australian *Polysyncraton infundibulum* Kott, 2001 and *P. montanum* Kott, 2004c have similar-sized spicules (but with more rays than the present species); and in *P. papyrus* Kott, 2001 the spicules are significantly smaller than in the present species. *Polysyncraton jugosum* (Herdman and Riddell, 1913), known only from the central coast of New South Wales, has similar spicules and larval ampullae to the present species, although their larvae are about twice the size of the present species.

Polysyncraton galaxum Kott, 2004b (also 2005a) has similar-sized larvae with 12 pairs of lateral ampullae, a large horizontal external ampulla and similar-sized spicules but they have only five to seven rays in optical transverse section and a large number of small-sized (to 0.02 mm diameter) spicules. Also, separate common cloacal systems are a conspicuous feature of *P. galaxum*, *P. polysystema* Kott, 2005a and related species (see Kott 2005a), but they were not detected in the present species.

Characteristics of the present new species that distinguish it from others in this genus are its large horizontal common cloacal cavity without separate systems, stellate spicules to 0.75 mm diameter with seven to nine conical rays in optical transverse section found throughout the colony, a large atrial tongue, a large larva with up to 12 pairs of lateral ampullae, but without blastozooids and with a large ocellus.

***Polysyncraton magnetae* Hastings, 1931**

(Figure 7A)

Polysyncraton magnetae Hastings 1931, p 100; Kott 2001, p 109 and synonymy; 2004a, p 741.

Distribution

Previously recorded (see Kott 2004a): Queensland (Great Barrier Reef). New record: Queensland (Great Barrier Reef: 18.615°S, 146.645°E, 30 m, QM G308818).

Description

The newly recorded colony consists of large vertical lamellae with two sorts of spicules crowded throughout. Spicules, to 0.05 mm diameter, are both stellate (with 13–15 conical pointed rays) and globular (with rod-like, flat-tipped rays).

Zooids each have a large yellow egg at the posterior end of the abdomen and two loose coils of the vas deferens around seven or eight male follicles.

Remarks

Larger spicules (to 0.05 mm) are present than the 0.035 mm diameter previously recorded for this species. Also, the number of spicule rays in optical transverse section (15–17) that Kott (2001, Figure 162I) recorded appears to be too high. Other characteristics, including the yellow egg at the posterior end of the zooid, are reported previously for this species.

***Polysyncraton meandratum* Monniot, 1993**

(Figure 7B)

Polysyncraton meandratum Monniot 1993, p 6; Kott 2001, p 111 and synonymy.

Distribution

Previously recorded (see Kott 2001): Queensland (Caloundra, Capricorn Group); New Caledonia. New records: Queensland (Great Barrier Reef: 17.855°S, 146.585°E, 43 m, QM G308849; 17.605°S, 146.355°E, 39 m; 17.645°S, 146.375°E, 27 m, QM G308850).

Description

The colony surface is quilted, the common cloacal canals being deep with the surface depressed over them. A superficial layer of bladder cells overlies a layer of spicules, which is interrupted only over the circular common cloacal canals. Spicules are also present around the zooids but are sparse elsewhere. Black spherical pigment cells are in the basal test. The robust zooids have a long retractor muscle from halfway down the oesophageal neck, the branchial siphon half the length of the thorax and four rows of about 10 stigmata per half row are in the oesophageal buds as well as in the adult pharynx. One colony (QM G308849) is very squashed but the spicules are seen to be similar in form, size and distribution to those previously described for this species.

Remarks

The newly recorded material is as previously described for this species, although the long branchial siphon is reported here for the first time.

Polysyncraton otuetue C. and F. Monniot, 1987
(Figure 7C)

Polysyncraton otuetue C. and F. Monniot 1987, p 45; Kott 2001, p 118.

Distribution

Previously recorded (see Kott 2001): Queensland (Swain Reefs); French Polynesia. New records: Queensland (Great Barrier Reef: 18.815°S, 146.955°E, 35 m; 16.985°S, 146.065°E, 32 m, QM G308851).

Description

The two specimens are thin, more or less rectangular sheets. Thoraces are large. The wide, open atrial aperture with an anterior lip exposes a large part of the branchial sac to the common cloacal cavity. A fine retractor muscle projects from the posterior end of the thorax. The large branchial sac has about 10 stigmata per half row. The oesophagus is very short and the abdomen is bent up at right angles to it. One of the newly recorded species (QM G308851) has about eight male follicles although a vas deferens was not detected. Four coils of the vas deferens can be seen in the other specimen. Spicules are characteristic, to 0.08 mm diameter, stellate, with 13–15 rays in optical transverse section.

Polysyncraton reticulum Kott, 2004
(Figures 1G, 7D)

Polysyncraton reticulum Kott 2004b, p 2484.

Distribution

Previously recorded (see Kott 2004b): South Australia (Kangaroo I.). New records: Tasmanian Canyons (King I. Canyon, 195.8 m, QM G323330).

Description

The newly recorded colony is a small, hard, white strip encrusting a calcareous worm tube. Spicules are crowded in the surface and basal test, but are sparse elsewhere. They are burr-like to globular, to 0.06 mm in diameter with 15–19 long, crowded, rod-like, fusiform or flat, pointed- and irregular-tipped rays in optical transverse section. A roomy common cloacal cavity is at thorax level. The zooids are muscular and very contracted and most details of their structure are obscured. A wide transverse atrial opening has an anterior lip. The stigmata are in four rows with 10 per half row. A very short retractor muscle (contracted) projects from the top of the oesophageal neck. A large egg projects from the side of the long gut loop in some of the zooids. Testes are not present. Large larvae in the basal aspiculate layer of test have a trunk 1.0 mm long. At the anterior end of the trunk, a corona of 16 L-shaped lateral ampullae surrounds the three anteromedian adhesive organs that each has a long, straight, parallel, thick cylindrical stalk and a deep epidermal cup surrounding the relatively narrow cone of adhesive cells that is more or less the same diameter as the stalk. The lateral ampullae project out around the base of the stalks of the adhesive organs and then bend forwards at right angles to the longitudinal axis of the trunk. Four rows of small circular stigmata are in the larval pharynx, and an ocellus and otolith are present. The tail is relatively short and curves about halfway around the trunk. The oozoid is relatively rudimentary and blastozooids were not detected.

Remarks

Despite the poor condition of this specimen and the lack of information about the zooids, the large larvae with long, thick parallel stalks supporting the deep narrow, epidermal cups that surround the narrow adhesive cones of the adhesive organs and the numerous lateral ampullae bent at right angles to encircle the anterior end to the trunk are similar in many other *Polysyncraton* spp. Also, the rudimentary condition of the organs of the oozoid (e.g. the pharynx) is consistent with *Polysyncraton* spp. The larvae of the present species, previously not known, resemble those of *P. circulum* Kott, 1962, which has more spicule rays and is tropical. Known species of *Polysyncraton* spp. with about 20 crowded spicule rays in optical transverse section with a range of flat to pointed ray-tips are *P. rugosum* Monniot, 1993, *P. discoides* Kott, 1962, and *P. dromide* Kott, 2001. Their spicules are smaller than those of the present species and only *P. discoides* is known from temperate waters (Port Davey). *Polysyncraton dentatum* Kott, 2001 has spicules to 0.04 mm diameter with more compact rays than the present species, and *P. pulchrum* Kott, 2001 has spicules to 0.05 mm diameter with more needle-like rays. The latter species, known only from Western Australia, has a unique soft, vase-like colony. Although the present specimen has a range of 15–19 spicule rays in optical transverse section, Kott (2004b) recorded a range of 13–15. In view of the variations in the number of rays in these burr-like spicules with large number of rays and the difficulty of counting them, this difference is not significant and the specimens appear to be conspecific. The assignation of this newly recorded species is based on the similar zooids and the size, form and distribution of its spicules.

***Polysyncraton scorteum* Kott, 2001**

(Figure 7E)

Pyura scorteum Kott 2001, p 135.

Distribution

Previously recorded (See Kott 2001): South Australia (Great Australian Bight). New records: Tasmanian Canyons (King I. Canyon, 195 m, QM G323343).

Description

A small club-shaped colony to 3 mm diameter has spicules crowded throughout and is raspy on the even, smooth outer surface. Spicules are spherical, to 0.9 mm diameter, with about 15–17 short, rounded to conical rays protruding from the surface. These rays are not crowded together and parts of the globular core of the spicule can be seen between them. Zooids are contracted, appearing as small brown patches crowded in amongst the spicules in this rather crushed and contracted specimen. The atrial aperture is sessile, with a larger anterior lip, the branchial aperture is large and daffodil-shaped and stigmata are in four rows of about seven. A retractor muscle projects from halfway down the oesophageal neck. Gonads were not detected in these zooids.

Remarks

Although gonads were not detected in this specimen, the daffodil-shaped branchial aperture and the long atrial tongue resemble those often found in this genus. Although the spicules are the same size and have numerous short conical rays like those of *Didemnum chartaceum*, the latter species also has globular spicules with flat-tipped rays that were not detected in the present species. The spicules are identical with those previously described for *P. scorteurum* Kott, 2001, having rays that vary from rounded to conical. The latter species also has spicules crowded throughout the tough colony and it has a large atrial tongue and branchial siphon like the present species, and it appears to be conspecific with the newly recorded material.

***Didemnum abradatum* sp. nov.**

(Figures 2A, B, 7F)

Distribution

Type locality: Queensland (Great Barrier Reef: 18.325°S, 146.595°E, 41 m, Biodiversity Survey SBD 504398 sample 2419, 11 October 2003, holotype QM G308870).

Description

Encrusting colonies have spicules crowded throughout and a thoracic common cloacal cavity. Spicules, to 0.0375 mm diameter, have 13–15 not particularly crowded short conical rays in optical transverse section. Zooids are small with a moderately long branchial siphon which is wine glass-shaped when contracted. A tapered retractor muscle projects from halfway down the long oesophageal neck. The atrial aperture is a sessile opening without an anterior lip. The testis is entire but the vas deferens was not detected. Larvae have the usual three rows of stigmata in a rounded trunk 0.4 mm long. The tail almost completely encircles the trunk (five-sixths of the way around it). Four long, club-shaped ectodermal ampullae are on each side of the three anteromedian adhesive organs.

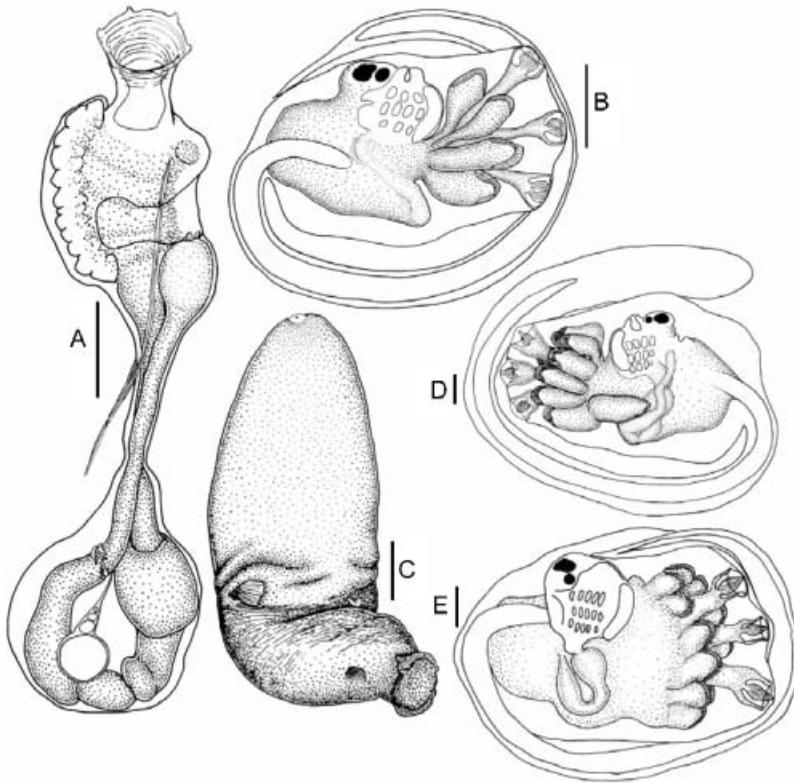


Figure 2. (A, B) *Didemnum abradatum* (QM G308870, holotype): (A) zooid; (B) larva. (C, D) *Didemnum fragum* (QM G308826): (C) colony; (D) larva. (E) *Didemnum jedanense* (QM G308862): larva. Scale bars: 0.1 mm (A, B, D, E); 1 cm (C).

Remarks

Didemnum paa C. and F. Monniot, 1987 has similar spicules, although they are larger than the present species, have long, crowded rays and the larvae have a trunk about 0.3 mm long and four pairs of ectodermal ampullae. *Didemnum fibriae* Kott, 2004a has spicules of a similar size and form, but a larger larval trunk with blastozooids and more ectodermal ampullae than the present species. *Didemnum mutabile* is distinguished from the present species by its five pairs of larval ampullae and an atrial tongue.

Didemnum albopunctatum Sluiter, 1909

Didemnum albopunctatum Sluiter 1909, p 58 (part, specimens from Ambon Anchorage only); Kott 2001, p 148 and synonymy.

Distribution

Previously recorded (See Kott 2001): Queensland (Capricorn Group, Swain Reef, Whitsunday Is); Western Pacific (Indonesia, Fiji, New Caledonia, Palau Is). New records: Queensland (Northern Great Barrier Reef: 18.275°S, 146.455°E, 30 m).

Remarks

The thin colony has small zooids and globular spicules (to 0.0275 mm diameter) crowded throughout. Its spicules are a similar size to those of *D. jedanese*, but are more compact. The pigment usually observed in the test of this species was not detected in the newly recorded specimen.

***Didemnum astrum* Kott, 2001**

(Figure 7G)

Didemnum astrum Kott 2001, p 151; 2005a, p 2437.

Distribution

Previously recorded (see Kott 2005a): Western Australia (Cape Preston, near Green I. off Grey); Queensland (S. Great Barrier Reef); Indian Ocean (Cocos Keeling). New records: Queensland (Great Barrier Reef: 17.298°S, 146.205°E, 31 m, QM G308853; 16.705°S, 146.125°E, 34 m, QM G308857).

Description

The colonies are thin, encrusting sheets with delicate zooids, each crossing the common cloacal cavity in a separate sheath of test that sometimes encases the whole zooid but at least the thorax, abdomina being embedded in the basal test. Spicules are characteristic, to 0.06 mm diameter, with numerous long, predominantly pointed, and crowded rays. Branchial apertures are on short siphons or funnels. The atrial aperture is wide open, with the upper rim sometimes extended out into a rounded lip. A fine retractor muscle projects from halfway down the relatively short oesophageal neck. About six long stigmata are in each row. Stolonial vessels are long. Ten coils of the vas deferens surround each undivided testis.

Remarks

The species is distinguished by its spicules, circular common cloacal canals lined on each side by zooids, 10 coils of the vas deferens, and small larvae with long tails, four pairs of ectodermal ampullae and lacking blastozooids.

Didemnum paa C. and F. Monniot, 1987 from New Caledonia has similar larvae, 10 coils of the vas deferens and similar-sized spicules. However, the present specimens have more and longer spicule rays and appear to represent a distinct species. The small rose-coloured colonies assigned erroneously to *Didemnum ligulum* by Monniot and Monniot (1987) also have spicules to 0.06 mm diameter (see Monniot and Monniot 1987, Plate IIc) but they have larval blastozooids, numerous larval ectodermal ampullae, and different cloacal systems that distinguish the colonies from the present species.

***Didemnum candidum* Savigny, 1816**

(Figure 7H)

Didemnum candidum Savigny 1816, p 194; Kott 2001, p 157 and synonymy; 2004b, p 2489.

Distribution

Previously recorded (see Kott 2004b): Western Australia (Ashmore Reef, Kimberley coast); Queensland (Great Barrier Reef); Gulf of Suez; Gulf of Arabia; West Indian Ocean. New record: Queensland (Noosa Heads, QM G308765).

Description

In life, the colony is a red sheet, with relatively small (to 0.05 mm diameter) stellate spicules crowded throughout. The spicule rays are rod-shaped, but sometimes obelisk-shaped with a blunt conical rather than rounded tip.

Remarks

Its location on the New South Wales coast is the most southerly so far recorded for this species. Its morphology is very conservative and the species is similar to *Didemnum coralliforme* Kott, 2004a and *D. madeleinae* (F. and C. Monniot, 2001) which have spicules the same size, but with more pointed rays, the former with longer rays, and the latter with short and conical rays. *Didemnum delectum* Kott, 2001 is temperate and has smaller spicules, but it otherwise resembles the present species.

***Didemnum coralliforme* Kott, 2004**

(Figure 8A)

Didemnum coralliforme Kott 2004a, p 748; 2004b, p 2490.*Distribution*

Previously recorded (see Kott 2004a, 2004b): Western Australia (W. of Port Hedland); Northern Territory (Angler Reef, Meigs Reef). New records: Queensland (Great Barrier Reef: 16.705°S, 146.125°E, 34 m, QM G308861; 17.865°S, 146.645°E, 66 m, QM G308847).

Description

Newly recorded colonies have small zooids with eight coils of the vas deferens and characteristic spicules to 0.06 mm diameter, stellate, with seven to nine long almost rod-like arms in optical transverse section. Larvae, present in the basal test, are described for the first time. They have a long tail wound about three-quarters of the way around an unusually small, 0.3 mm long, larval trunk. Four long, cylindrical lateral ampullae are along each side of the usual three anteromedian adhesive organs.

***Didemnum crescente* Kott, 2001**

(Figure 8B)

Didemnum crescente Kott 2001, p 166; 2004b, p 2491 and synonymy.*Distribution*

Previously recorded (see Kott 2004b): South Australia (Waterloo Bay); Victoria (Mallacoota Inlet, Westernport); Tasmania (Triabunna); New South Wales (Eden). New record: Tasmania (Bass Strait, QM G308815).

Description

The colony has large thin branching vertical lamellae. It is red in preservative and the preservative is stained yellow. A superficial layer of bladder cells overlies crowded spicules that become less crowded in the central test. Spicules are stellate, to 0.06 mm diameter, with seven to nine robust conical rays in optical transverse section. Zooids are in clumps surrounded by deep primary common cloacal canals that project behind the zooids to isolate the outer zooid-containing layer of the colony from the central test. The zooids have a long retractor muscle. Nine coils of the vas deferens surround the undivided testis. Larvae, in the central test, have a trunk 0.7 mm long, four pairs of lateral ampullae and a mass of yellow yolk.

Remarks

The species is distinguished from *D. lissoclinum* (which has similar spicules and larvae) by its nine coils of the vas deferens (*D. lissoclinum* has only seven), superficial bladder cell layer, and the absence of crowded spicules in the central layer of test.

***Didemnum fragile* Sluiter, 1909**

Didemnum fragile Sluiter 1909, p 56; Kott 2005a, p 2441 and synonymy.

Distribution

Previously recorded (see Kott 2001, 2005a): Western Australia (The Kimberley); Queensland (Great Barrier Reef); Northern Territory (Bynoe Harbour); Western Pacific (Indonesia, Palau Is, Fiji). New record: Queensland (Northern Great Barrier Reef: 17.855°S, 146.585°E, 43.4 m, QM G308856).

Remarks

The specimen is as previously described with small (to 0.04 mm diameter) burr-like spicules with rod-like rays.

***Didemnum fragum* Kott, 2001**

(Figures 2C, D, 8C)

Didemnum fragum Kott 2001, p 179 and synonymy; 2005a, p 2441.

Distribution

Previously recorded (see Kott 2005a): South Australia (Eyre Peninsula, Spencer Gulf, Gulf St. Vincent); Victoria (Bass Strait, Westernport, Port Phillip Bay); Tasmania (eastern coast, Port Davey); New South Wales (Coffs Harbour, Manning Bight). New record: Tasmania (Bass Strait, QM G308826; Tasmanian Canyons: Banks Strait, 168 m, QM G308884–5).

Description

The colony from Bass Strait is vertical and paddle-shaped, white in preservative and orange in life. The specimens from the Tasmanian Canyons are grey, smooth-surfaced cylinders

that superficially look like the *Polysyncraton chondrilla*, each with a white, star-shaped terminal common cloacal aperture (see Michaelsen 1924, p 345, Figure 14 as *Didemnum chondrilla*). The colony surface is always raspy, although the internal test is soft. A posterior abdominal common cloacal cavity with a terminal common cloacal aperture separates the zooid layer from the central test. In all colonies a thick opaque layer of crowded spicules is in the surface test and a thinner layer lines the common cloacal cavity. The soft, gelatinous central test has only sparse spicules and often it is aspiculate. Spicules are relatively small (to 0.07 mm and occasionally to 0.08 mm diameter) and stellate (with 9–13 relatively short, pointed, conical rays in optical transverse section).

Zooids are in clumps just beneath the surface layer of spicules. Each clump is surrounded by the deep primary common cloacal cavity which extends into a network of posterior abdominal canals that get larger toward the common cloacal chamber and its terminal aperture on the top of the colony. Zooids are relatively large with a long branchial siphon, a wide sessile atrial aperture and a fine retractor muscle. They have about eight stigmata in the anterior half row on each side of the body. Twelve coils of the vas deferens have been reported previously. Gonads were not detected in the present specimens. Nevertheless, those from the Tasmanian Canyons contained larvae in the central test. The larval trunk is 0.8 mm long and is deep, and almost spherical. An ocellus and otolith are present. Six lateral ampullae are along each side of the antero-median adhesive organs. A large horizontal ampulla lies along the left side of the larval trunk. The tail is wound the whole way around the trunk. Three rows of stigmata are in the larval pharynx. Other larval organs are not developed.

Remarks

The species has relatively small, regular, stellate spicules with sturdy, pointed conical rays. Although the gonads are not developed and the zooids are robust for this genus, its relatively few stigmata and the three rows of stigmata in the larval trunk distinguish it from the genus *Polysyncraton*. The colony, with its single terminal common cloacal aperture, is characteristic of *D. fragum*. The colour in life reported for the present specimen (QM G308826) falls within the wide range of colours (from beige to pink) recorded for the living specimens assigned to this species.

Polysyncraton chondrilla (Michaelsen, 1924) from New Zealand has almost identical colony form to some of the present specimens, and the same spicule distribution, but its spicules are not larger than 0.035 mm diameter (see Millar 1982).

In addition to the present species, the following frequently recorded temperate Australasian species *Didemnum lambitum* (Sluiter, 1900), *Polysyncraton jugosum* (Herdman and Riddell, 1913), and *Polysyncraton pedunculatum* Kott, 2001 also have large, robust, vertical colonies with a large terminal common cloacal aperture. These colonies usually comprise a single system and have a large posterior abdominal cavity separating the zooid layer from the central test mass. *Didemnum lambitum* has smaller spicules (to 0.05 mm diameter) and only 10 coils of the vas deferens and four pairs of larval lateral ampullae (see Kott 2001, p 181). The Australian species *Polysyncraton jugosum* has large (to 0.08 mm) diameter spicules like the present species, but only seven to nine rays in optical transverse section and 10 pairs of larval lateral ampullae; and *P. pedunculatum* has a similar colony but is completely aspiculate and its larvae are not known. *Polysyncraton chondrilla* (Michaelsen, 1924), despite its colonies that superficially look identical to newly recorded colonies of *D. fragum* from the Tasmanian Canyons, can be distinguished by their generic characters as well as their small spicules to 0.03 mm diameter (see Millar 1982).

Some *Trididemnum* spp. also have colonies resembling the present species although rather than single-system colonies, they are more often vertical branches with terminal common cloacal apertures (e.g. *Trididemnum amiculum* Kott, 2001).

Michaelsen (1924) drew attention to the identical, albeit convergent, cloacal systems of the large western Indian Ocean specimens of *Didemnum sycon* Michaelsen, 1920, a junior synonym of *Didemnum molle* (Herdman, 1886). These also are single-system colonies, although they are soft and have a very different consistency from the firm colonies of the present species and they are further distinguished by the symbiotic *Prochloron* in their common cloacal cavities.

Didemnum grande (Herdman, 1886)

(Figure 8D)

Leptoclinum grande Herdman 1886, p 291.

Didemnum grande Kott 2001, p 185 and synonymy; 2005a, p 244 and synonymy.

Distribution

Previously recorded (see Kott 2004b): Western Australia (Port Hedland, Cockburn Sound); Queensland (Hervey Bay, Whitsunday Is, Great Barrier Reef); Northern Territory (Darwin); Western Pacific (Indonesia, Philippines). New record: Queensland (Great Barrier Reef: 17.935°S, 146.785°E, 36 m, QM G308867).

Description

A long, narrow strip of an encrusting colony with brown pigment but lacking spicules over the circular common cloacal canals, which have the surface test depressed over them. A pointed projection is on the surface just ventral to each branchial aperture as in *D. jedanense*, *D. stragulum* Kott, 2001, and some colonies of *Polysyncraton cuculliferum*, but not previously recorded for this species. The sturdy spicules are stellate, to 0.07 mm diameter with 9–11 long, pointed conical rays in optical section.

Remarks

The newly recorded specimen has characteristics in common with *Didemnum stragulum*, including the surface papillae associated with each branchial aperture. However, its spicules are smaller; those of *D. stragulum* being up to 0.12 mm diameter.

Didemnum granulatum Tokioka, 1954

(Figure 8E)

Didemnum (Didemnum) moseleyi f. *granulatum* Tokioka 1954, p 244; Kott 2001, p 188 and synonymy; 2004b, p 2493 and synonymy.

Distribution

Previously recorded (see Kott 2004b): Western Australia (Cervantes, Montebello Is); Queensland (Whitsunday Is, Hardy Reef, Bowden Reef); Northern Territory (Darwin,

Bathurst I.); Western Pacific (Palau Is, French Polynesia, Tokara Is, Fiji, Hawaii). New record: Queensland (Great Barrier Reef: 18.325°S, 146.595°E, 42 m, QM G308843).

Description

A thin sheet-like colony. The stellate spicules are crowded throughout and are small (to 0.038 mm diameter) with five to nine rays in optical transverse section. Zooids are small with a long oesophageal neck. The spicules resemble, but are smaller than, those of *Didemnum perplexum* and the zooids are a similar size but with a shorter branchial siphon.

***Didemnum jedanense* Sluiter, 1909**

(Figures 2E, 8F)

Didemnum jedanense Sluiter 1909, p 59; Kott 2001, p 194 and synonymy; 2004c, p 55.

Distribution

Previously recorded (see Kott 2004c): Western Australia (Cape Ruthiers); Queensland (Hervey Bay, S. Great Barrier Reef, Abbott Point, Lizard I., Low Isles, Mossman); Northern Territory (Darwin); Western Pacific (Indonesia, New Caledonia). New records: Queensland (Great Barrier Reef: 14.715°S, 145.405°E, 26 m, QM G308846, G308862, G308872; 16.155°S, 145.865°E, 57 m, QM G308848; 16.955°S, 146.425°E, 55 m).

Description

Large encrusting gelatinous sheet growing over bryozoan skeletons have black pigment in the surface test and in upper half of colony or throughout. Zooids are in clumps in branching test connectives that cross the extensive common cloacal cavity. Thoraces are separate, enclosed in an independent sheet of test at the surface. The surface test is quilted, being depressed over the deep, uninterrupted common cloacal cavity that surrounds each clump of zooids and is lined on each side with zooids. A layer of bladder cells is in the surface test, overlying the spicules which are not present over the deep primary common cloacal cavities. Spicules are burr-shaped, to 0.04 mm diameter with rod-shaped rays, occasionally with pointed tips. Zooids have large (but contracted) thoraces, long fine retractor muscles of varying lengths, short oesophageal necks and double gut loops. The testis is entire and surrounded by eight coils of the vas deferens. Larvae are sturdy with a large trunk to 0.75 mm long with up to two blastozooids and six ectodermal ampullae along each side of the three antero-median adhesive organs.

Remarks

Despite a superficial resemblance to *Polysyncraton meandratum* (also with a quilted surface), the roomy common cloacal cavities, the rod-like spicule rays (compared with the conical pointed ones in the latter species), the small burr-like spicules, the dark pigment, and the eight coils of the vas deferens are all characteristic of *D. jedanense*, as are the larvae with blastozooids and six pairs of ectodermal ampullae.

***Didemnum lissoclinum* Kott, 2001**

(Figure 8G)

Didemnum lissoclinum Kott 2001, p 2496 and synonymy; 2004b, p 2496.*Distribution*

Previously recorded (see Kott 2004b): South Australia (Great Australian Bight, Yorke Peninsula, Gulf St. Vincent, Kangaroo I.); Victoria (Mallacoota Inlet, Deal I.); New South Wales (Jervis Bay, Port Hacking). New records: Tasmania (Bass Strait, QM G308813–4).

Description

Large, upright, branching colonies, a whitish colour in preservative. Spicules are crowded in the surface test. In some places small spicule-filled papillae are crowded on the surface. Spicules also are crowded in the central test to form a stiff supporting skeleton. Spicules are stellate, to 0.07 mm diameter, with seven to nine sturdy pointed rays.

Zoids are in clumps, each clump surrounded by the deep primary cloacal spaces that separate them from the central test. Gonads were not detected in the present specimens. Larvae, present in the central test, have a trunk 0.7 mm long, with the tail wound three-quarters of the way around it. Four lateral ampullae are along each side of the antero-medial adhesive organs.

Remarks

Although it has similar vertical colonies, the species differs from *D. fragum* in having crowded spicules forming a skeleton in the central test (as in *Trididemnum amiculum*) and in its fewer spicule rays (9–11 in optical transverse section in *D. fragum*). Also, the larvae of *D. fragum* have six pairs of lateral ampullae and the eggs are large and yellow. *Didemnum crescente* Kott, 2001 has similar spicules and a similar larva to the present species, but its larvae are yellow, it has a superficial layer of bladder cells, its spicules are less crowded in the central core of test (as in *D. fragum*) and the preservative is stained yellow. Although the testes have not been detected in the newly recorded colony, seven coils of the vas deferens have been reported (Kott 2001) while *D. crescente* has nine.

***Didemnum mantile* Kott, 2001**

(Figures 3A, 8H)

Didemnum mantile Kott 2001, p 203; 2005a, p 2447.*Distribution*

Previously recorded (see Kott 2005a): South Australia (eastern end of Mason Bay, Franklin I.); Victoria (Westernport). New record: Tasmanian Canyons (Banks Strait, 40.64025–40.68686°S, 148.78784–148.80762°E, 168 m, QM G308887).

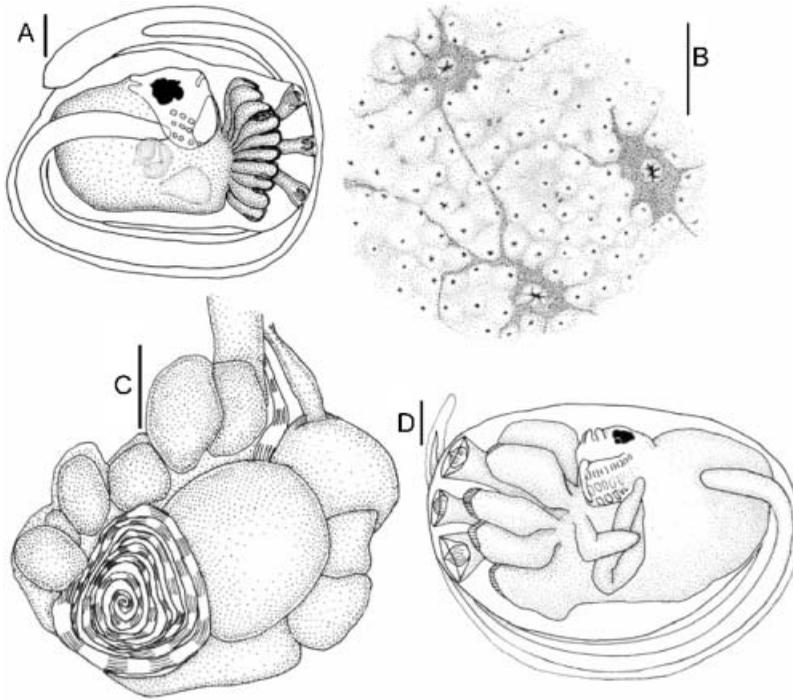


Figure 3. (A) *Didemnum mantile* (QM G308887): larva. (B) *Didemnum microthoracium* (SAM E3259): colony. (C, D) *Didemnum parau* (QM G308859): (C) abdomen; (D) larva. Scale bars: 0.1 mm (A, C, D), 5 mm (B).

Description

The mosaic of small, translucent, pink, single system colonies, each with a single common cloacal aperture in the middle of the upper surface, are epibionts on the test of a specimen of *Polycarpa viridis*. Some are small, from about 0.5 cm diameter, and one is a larger, irregular scrap of about 1.5 cm maximum diameter. The small, stellate spicules (to 0.04 mm diameter, with seven to nine stumpy conical rays in optical transverse section) are crowded throughout the colony. The horizontal, thoracic common cloacal cavity is shallow. The small brownish zooids have four rows of stigmata and a large atrial aperture with its upper lip produced out from the zooid. A short retractor muscle projects from one-third of the way down the oesophageal neck. Well-developed larvae have 10 pairs of rounded lateral ampullae, although fewer are in less well-developed larvae. The larval trunk is 0.6 mm long.

Remarks

A number of species with small colonies and zooids are known in this genus. These usually can be distinguished by aspects of their colonies, larvae and/or spicules, namely *Didemnum minisculum* Kott, 2001 has fewer spicule rays and smaller and more transparent colonies; *D. incanum* (Herdman, 1899) also has fewer spicule rays and different colonies and larvae; and both *D. lissoclinum* Kott, 2001 and *D. pecten* Kott, 2001 have different colonies and larger spicules with more rays.

The larvae of the present species, described here for the first time, are distinctive in their 10 pairs of larval lateral ampullae in a relatively short trunk.

Didemnum membranaceum Sluiter, 1909

(Figure 9A)

Didemnum membranaceum Sluiter 1909, p 58; Kott 2001, p 205 and synonymy; 2002, p 36 and synonymy including *Diplosomoides* [*sic*] *membranaceum*: Kott 2002; 2004c, p 56 and synonymy.

Distribution

Previously recorded (see Kott 2004c): Western Australia (Montebello Is, Houtman's Abrolhos, Dongara, Shark Bay, Cockburn Sound); Queensland (Moreton Bay, Caloundra, Great Barrier Reef); Western Pacific (Timor Sea, Andaman Is, Indonesia, Micronesia, French Polynesia, Hong Kong). New records: Queensland (Northern Great Barrier Reef: 17.855°S, 146.585°E, 43 m, QM G308868; 14.685°S, 145.535°E, 27.3 m, QM G308854).

Description

Sheet-like encrusting colonies have characteristic spicules crowded throughout, only about six stigmata per row in the small thoraces, a short retractor muscle, a short branchial siphon and a wide, open atrial aperture.

?*Didemnum microthoracicum* Kott, 2001

(Figures 3B, 9B)

Didemnum microthoracicum Kott 2001, p 207; 2005a, p 2448.

Distribution

Previously recorded (see Kott 2005a): South Australia (Great Australian Bight, Kangaroo I.). New record: South Australia (Kangaroo I., SAM E3259).

Description

The colony is a robust encrusting sheet, white in preservative. In life, brown pigment, in irregular granular bodies, is over the common cloacal canals that converge to large protuberant common cloacal apertures, the brown pigment forming evenly spaced dendritic bodies with about five long, tapering, radial arms. Branchial apertures are stellate with their margins lined with spicules. Spicules are moderately crowded throughout the test and the surface is raspy. Up to eight radial ribs of crowded spicules strengthen the roof of the common cloacal cavity around the common cloacal apertures. The spicules are stellate, to 0.086 mm diameter, with seven to nine robust, pointed, conical rays in optical transverse section. The common cloacal cavity is thoracic, with deeper primary canals. Thoraces have up to seven stigmata per half row. Gonads were not detected.

Remarks

The form of the spicules and their size and distribution are the same as those in previously recorded specimens of this species. All known specimens are from South Australian waters, and it has been recorded previously from Kangaroo I. The latter specimen was blue in life,

while the newly recorded one has brown pigment over the common cloacal canals where they converge to the common cloacal apertures. For this reason the present assignation is uncertain.

Didemnum corium Kott, 2005a (from Tasmania) has similar spicules, although their distribution is different from the present species.

Didemnum molle (Herdman, 1886)

Diplosomoides molle Herdman 1886, p 310.

Didemnum molle: Kott 2001, p 208 and synonymy.

Distribution

Previously recorded (see Kott 2001): the species is known to have a wide geographic range in tropical coralline habitats from the West Indian Ocean to the West Pacific (Fiji) and from Okinawa (Ryukyu Is, Japan) to the southern Great Barrier Reef and Houtman's Abrolhos, Cockburn Sound and Esperance (southwestern Australia). New records: Queensland (Great Barrier Reef: 14.685°S, 145.365°E, 17 m, with larvae QM G308878; 14.685°S, 145.535°E, 27 m, QM G308865).

Remarks

The newly recorded colonies are the characteristic soft, flask-shaped form, their shape in life maintained by the positive pressure gradient between the incurrent stream of water through the branchial aperture of each zooid and the excurrent stream through the rounded terminal common cloacal aperture. Colonies are known to subdivide across the common cloacal aperture which maintains its terminal position in the replicates. The occurrence of this species in inter-reefal areas is presumably dependent on the availability of stable hard substrata in order for the filtering activity (which maintains the shape of the colony) to be sustained without interruption. The central common cloacal cavity is filled with green symbiotic *Prochloron* that adhere to the lining of the common cloacal cavity and are released in the streams of mucus that are secreted when the colony is disturbed. Usually the species is taken from relatively shallow depths and colonies are known to move up coral debris toward the light, presumably to ensure requirements for photosynthesis in the symbionts of this (probably at least partially) autotrophic species. A depth of 27 m for one of the newly recorded colonies is greater than that usually recorded for the species. One of the newly recorded specimen lots (QM G308878) collected in October contains developing larvae of the usual form.

Didemnum moseleyi (Herdman, 1886)

(Figure 9C)

Leptoclinium moseleyi Herdman 1886, p 272; Kott 2001, p 2211 and synonymy; 2005a, p 2448 and synonymy.

Distribution

Previously recorded (see Kott 2005a): Western Australia (off Port Hedland); Queensland (Currumbin to Capricorn Group, Mackay); Western Pacific (Indonesia, Philippines, Palau

Is, Tokara Is, New Caledonia); Indian Ocean. New record: Queensland (Great Barrier Reef: 17.955°S, 146.425°E, 35 m, QM G308866).

Description

The colonies are as previously described, with globular and stellate spicules (with 11–13 conical rays in optical transverse section) to 0.05 mm diameter.

Didemnum parau C. and F. Monniot, 1987 (Figures 3C, D, 9D)

Didemnum parau C. and F. Monniot 1987, p 39; Kott 2002, p 37.

Distribution

Previously recorded (see Kott 2002): Northern Territory (Darwin); Western Pacific (French Polynesia, Philippines). New record: Queensland (Great Barrier Reef: 15.245°S, 145.435°E, 29 m, QM G308859).

Description

Spicules are crowded throughout the colony. Pigment cells are not present in the preserved colony. The spicules (to 0.023 mm diameter) are burr-shaped, with straight rod-like rays. Zooids are relatively small, the vas deferens coils eight times around the undivided testis. Almost spherical larvae with a trunk 0.7 mm long, and four ectodermal ampullae on each side, are crowded in the basal test. Blastozooids were not detected. The tail is wound about two-thirds of the distance around the trunk. These larvae were present in October.

Remarks

The larvae are smaller than those described previously for this species (Monniot and Monniot 1987) but otherwise the specimens appear to have similar characters. Although they report six coils of the vas deferens, drawings of the present species (Monniot and Monniot 1987, Figure 12B, C) show seven and eight coils respectively. The newly recorded specimen appears to be conspecific with the French Polynesian specimen.

Didemnum patulum (Herdman, 1899) (Figure 9E)

Leptoclinum patulum Herdman 1899, p 92.

Didemnum patulum: Kott 2001, p 219 and synonymy; ? 2005a, p 2450 and synonymy.

Didemnum cilicium Kott 2005a, p 2438.

Distribution

Previously recorded (see Kott 2005a): South Australia (Kangaroo I.); Tasmania (Triabunna); Victoria (Bass Strait, Western Port, Cape Woolamai); New South Wales (Port Jackson, ?Jervis Bay). New record: Queensland (Noosa, QM G308767).

Description

In preservative, the newly recorded colony is a fleshy grey sheet, although in life it has yellow-pinkish patches in the surface, and black borders around the common cloacal apertures. There is a relatively thick superficial layer of bladder cells. In preservative, the surface is marked with a network of grey where it is depressed over the circular primary common cloacal canals. The grey over the common cloacal canals results from the interruption of the spicule-containing test by the deep canals. In the zooid-containing elevated areas surrounded by the canals, the greater depth of spicule-containing test creates whiter, opaque areas. Spicules, crowded throughout the test, are stellate, to 0.075 mm diameter, with 9–11 (and occasionally more) robust, conical, pointed rays in optical transverse section. The common cloacal canals are deep, sometimes the whole depth of the zooids, but are never posterior abdominal.

Zooids have a long thorax, wide open, sessile, atrial aperture without an anterior lip, long lateral organs, a fine long retractor from halfway down the oesophageal neck, and a double gut loop. Gonads were not detected in this specimen.

Remarks

Moderate-sized stellate spicules with robust conical rays occur in *Didemnum lissoclinum* and *D. crescente*, which also have deep primary common cloacal canals around clumps of zooids, but in which the number of spicule rays is less than in the present species. Although *D. crescente* also has a superficial bladder cell layer it is not as conspicuous as in the present species.

Didemnum fragum has similar spicules but it also has a thin superficial layer of bladder cells rather than the conspicuous one of the present species, and its colonies are large vertical cones with terminal common cloacal apertures and extensive three-dimensional common cloacal systems rather than sheet-like colonies.

Didemnum plebium Kott, 2005a from tropical northwestern Australia has similar but smaller spicules and small colonies.

Didemnum cilicium Kott, 2005a appears to be a junior synonym of the present species.

Didemnum patulum: Kott, 2005a is a specimen from Jervis Bay that may be assigned incorrectly. It has a fleshy colony and, although the spicules are a similar shape, they are smaller and less crowded than the present ones, becoming sparse in the basal test. They have 9–11 rays in optical transverse section but the conical rays have pointed or chisel-shaped tips and the spicules (to 0.05 mm diameter) are smaller than those of *D. patulum*.

?*Didemnum pellucidum* Kott, 2001

(Figure 9F)

Didemnum pellucidum Kott 2001, p 222; 2005a, p 2450.

Distribution

Previously recorded (see Kott 2005a): Western Australia (Rottnest I., Yallingup); South Australia (Yorke Peninsula); Tasmania (Port Davey). New record: Tasmanian Canyons (Big Horseshoe, 160 m, QM G308886).

Description

The colony forms a thin smear on some rocks. Spicules are present throughout, but are more crowded in the surface test than around the abdomina. The zooids are small and mutilated. Spicules are stellate, to 0.09 mm with 9–11 conical rays in optical transverse section.

Remarks

The spicules are like those of *Didemnum patulum* (Herdman and Riddell, 1913) but are significantly larger. It has been questionably assigned to *Didemnum pellucidum* solely on the basis of its spicules which are the same size and have the same number of rays. The colony and its spicules closely resemble those reported by Kott (2005a).

***Didemnum perplexum* Kott, 2001**

(Figure 9G)

Didemnum perplexum Kott 2001, p 224 and synonymy; 2004a, p 757 and synonymy.

Distribution

Previously recorded (see Kott 2004a): Queensland Capricorn Group, Swain Reefs, Big Bradhurst Reef; New Caledonia; Indonesia (Great Barrier Reef: 17.275°S, 146.345°E, 13 m; 16.705°S, 146.125°E, 34 m, QM G308860; 18.275°S, 146.455°E, 29 m, QM G308863).

Description

Generally, the colonies are irregular scraps of encrusting sheets with thoracic common cloacal cavities. Spicules are crowded throughout and usually are up to 0.05 mm diameter, although occasionally some larger ones to 0.062 mm diameter are present. They are stellate, with five to nine conical rays in optical transverse section. A fine retractor muscle projects from about halfway down the long oesophageal neck. The branchial aperture is short and trumpet-shaped and the atrial opening is sessile, without an anterior lip. About six stigmata are in a row on one side of the body.

The sturdy but immature larval trunk (present in QM G308860, collected in September) is about 0.45 mm long with the tail wound almost the whole way around it. The lateral ampullae are not developed in these specimens although larger larvae (0.6–0.88 mm long trunk) in the holotype (Kott 2001) have six pairs of long ampullae.

Remarks

Didemnum coralliforme and *D. grande* have similar spicules with long, narrow conical rays but they are larger and have more rays than those of the present species. *Didemnum candidum* and *D. granulatum* have smaller spicules. All these species are, to some extent, convergent, the colonies, zooids and larvae, as well as the spicules, being conservative and the species readily confused.

Didemnum psammatode (Sluiter, 1895)

(Figures 9H, 10A–C)

Leptoclinum psamathodes Sluiter 1895, p 171.

Didemnum psammatode: Kott 2001, p 229 and synonymy; 2004c, p 40 and synonymy.

Distribution

Previously recorded (see Kott 2002): Australia (tropical and temperate locations); Indian Ocean (Red Sea, Sri Lanka); Western Pacific (Indonesia, Philippines); Japan; China. New records: Tasmania (McGuinness Gutter, 6 m, QM G308831); Queensland (Great Barrier Reef, 18.015°S, 146.295°E, 25 m, QM G308879; 14.685°S, 145.535°E, 30 m, QM G308820).

Description

Kott (2001) noted the variability in the small spicules (to 0.035 mm diameter), some being stellate with 11–13 short conical rays while others are burr-shaped with rod-shaped to fusiform or paddle-shaped rays. The newly recorded specimens from the northern Great Barrier Reef to Tasmania reflect this variation, although, unlike the specimen from the Capricorn Group (QM G308143, see Kott 2001, Figure 168A) with a mixture of burr-like spicules with rod-shaped rays to stellate spicules, the full range of spicules is not present in any one of the newly recorded colonies. A specimen from the northern Great Barrier Reef (QM G308820, see Figure 10A, B) and another (an epibiont on *Polycarpa flava*) from Tasmania (QM G308831, see Figure 10C) have stellate spicules with only 9–11 rays. However, another specimen from the northern Great Barrier Reef (QM G308879) has exclusively burr-shaped spicules with rod-shaped rays (see Figure 9H). These spicules are all less than 0.05 mm diameter and the small zooids and the colonies all fall within the parameters reported for the species.

Remarks

Some species of *Trididemnum* are reported to have faeces pellets embedded in the basal test. The only other species in which this condition has been observed are *Didemnum corium* Kott, 2005a and the present species. *Didemnum corium* is distinguished by its large spicules (to 0.1 mm diameter with seven to nine robust pointed rays in optical transverse section) and their even distribution in the surface and base of the colony and lining the deep primary posterior abdominal common cloacal cavities.

Didemnum tantulum sp. nov.

(Figures 4A–C, 10D)

Distribution

Type locality: Queensland (Great Barrier Reef: 17.855°S, 146.585°E, 43 m, 26 September 2003, holotype QM G308890).

Description

Colonies are lumpy, encrusting and overgrowing coral rubble, with large black pigment cells in the base of the colony and occasional small patches in the surface, but not in the

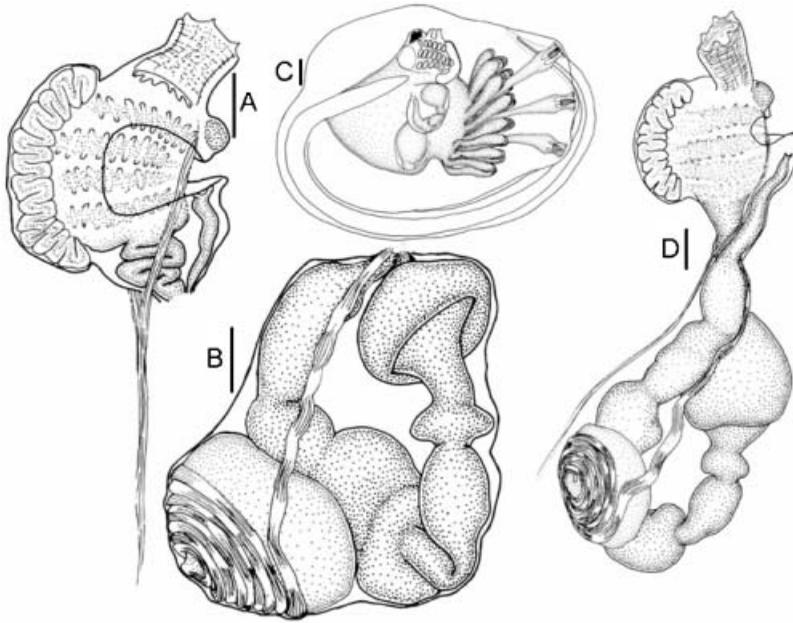


Figure 4. (A–C) *Didemnum tantulum* (QM G308890, holotype): (A) thorax; (B) abdomen; (C) larva. (D) *Didemnum vesica* (QM G308874, holotype): zooid. Scale bars: 0.1 mm.

middle layer (around the zooids). Colonies have a quilted surface owing to the deep circular common cloacal canals that surround large clumps of zooids. Primary common cloacal canals are deep but not posterior abdominal. Spicules are in the surface test, become sparse around the zooids, and are absent from the central and basal test. The spicules (to 0.035 mm diameter) are burr-like with 15–17 long, crowded rays in optical transverse section. The ray tips are conical or irregular. Zooids have thoraxes with a rather rectangular outline, a long, fine retractor muscle, a large, sessile atrial aperture and a long branchial siphon. They have nine coils of the vas deferens and an undivided testis. The large larvae (1.0 mm long trunk) have eight pairs of ectodermal ampullae, one blastozoid and three deep tulip-shaped anteromedian adhesive organs on long stalks. The cerebral vesicle projects up from the upper surface of the larval thorax.

Remarks

The spicules and the zooids with nine coils of the vas deferens resemble those of *D. hiopaa* C. and F. Monniot, 1987, but the larvae are larger with more ampullae and a blastozoid. Spicules also are like *D. tabulatum* but are significantly smaller and the present species has more coils of the vas deferens. The larva of *D. tabulatum* has not been described.

Didemnum fibriae Kott, 2004a from Cockburn Sound (WA) has similar, but larger, spicules and a similar large larva with a blastozoid. However, it has more (11) vas deferens coils that, with its fewer spicule rays, distinguish it from the present species.

Didemnum vesica sp. nov., *D. jedanense*, and *D. parau* have rod-like rather than the long, pointed or irregularly tipped spicule rays of the present species, and *D. vesica* has bladder cells in a superficial layer and in the test, and black pigment cells mostly around the zooids rather than in the base of the colony as in the present species.

The small spicules and their distribution, nine coils of the vas deferens and the large number (eight pairs) of larval ectodermal ampullae are the principal characteristics of this species.

Didemnum tumulatum Kott, 2004
(Figure 10E)

Didemnum tumulatum Kott 2004c, p 58.

Distribution

Previously recorded (see Kott 2004c): Ashmore Reef. New record: Queensland (Great Barrier Reef: 18.325°S, 146.595°E, 41 m, QM G308873).

Description

The colony is a thin sheet encrusting a *Murex* shell. Black pigment is in the upper half of the colony including the surface test over the common cloacal canals and around the common cloacal apertures, which are on the higher parts of the colony. Zooids line each side of the common cloacal canals, which surround irregular zooid-free areas that appear from the surface as blotches. Spicules (to 0.06 mm diameter) are stellate, with 9–11 long conical rays in optical transverse section. Zooids are small with a long retractor muscle projecting from halfway down the oesophageal neck. Seven coils of the vas deferens surround the undivided testis.

Remarks

Spicules are like those of *Didemnum caesium* Sluiter, 1909 and *D. stragulum* Kott, 2001 but are smaller. The spicules of *D. granulatum* Tokioka, 1954 are similar, although its common cloacal cavity is a large horizontal space unlike the circular canals in the present species. *Didemnum via* Kott, 2001 has similar colonies but slightly larger spicules and 11 coils of the vas deferens.

Didemnum vesica sp. nov.
(Figures 4D, 10F)

Distribution

Type locality: Queensland (Great Barrier Reef: 14.715°S, 145.405°E, 26 m, SBD 504379 sample 1751, 5 October 2003, holotype QM G308874; 17.445°S, 146.205°E, 26 m, paratype QM G308875).

Description

The holotype colony is a large encrusting sheet with a dark mesh on the surface over the primary common cloacal canals which are lined by zooids and surround the zooid-free areas where spicules are crowded. Spicules are not in the test over the common cloacal canals. Spicules are small, to 0.03 mm diameter, burr-like with rod-shaped rays.

A spicule-free layer of bladder cells is over the surface and bladder cells are present throughout the test. Black pigment particles are in patches in the surface, as well as in the middle layer of the colony (around the zooids). Deep circular primary common cloacal canals are lined on each side by zooids. Zooids are robust with a moderately long branchial aperture and a long, very fine retractor muscle. Seven coils of the vas deferens surround the undivided testis.

Remarks

The specimens resemble *Didemnum parau* C. and F. Monniot, 1987. Although six coils of the vas deferens are reported, there are seven and eight coils, respectively, in the figures of the type material of *D. parau* (Monniot and Monniot 1987, Figure 12B, C). The small burr-shaped spicules (to 0.03 mm diameter) with rod-like rays and the larvae (with four pairs of ectodermal ampullae) are in *D. parau* as well as in the present species. The type specimens of *D. parau* had various organic particles embedded in the basal test of the soft colonies, although the clumps of plant cells found in the present specimens were not reported. The present species is distinguished from *D. parau* by the surface layer of bladder cells and their presence throughout the test and the large black pigment cells in the test.

Kott (2001) compared *D. parau* and *D. fragile* Sluiter, 1909, which both have burr-shaped spicules and similar zooids. *Didemnum fragile* has larger spicules than either *D. parau* or the present species; like *D. parau*, it lacks the bladder cells and pigment of the present species; it has only six coils of the vas deferens; and it has five pairs of larval ampullae rather than the four of the present species.

Didemnum chartaceum Sluiter, 1900 resembles the present species in its superficial bladder cells and their presence throughout the colony and in its large pigment cells. However, it has different spicules, nine coils of the vas deferens, and a large larva.

Didemnum viride (Herdman, 1906)

(Figure 10G)

Leptoclinum viride Herdman 1906, p 340.

Didemnum viride: Kott 2001, p 248 and synonymy.

Distribution

Previously recorded (see Kott 2001): Western Australia (Montebello Is); Queensland (Heron I., Swain Reefs); Western Pacific (Papua New Guinea; French Polynesia); Indian Ocean (Sri Lanka). New record: Queensland (Great Barrier Reef: 18.275°S, 146.455°E, 29 m, QM G308864).

Description

Stellate spicules (to 0.055 mm diameter) are crowded throughout the test. They have five to seven conical rays in optical transverse section. Oval patches of green algal cells (*Cyanophyta*) are in the basal test. Conspicuous terminal ampullae of stolonial vessels are also in the basal test. The branchial siphon is moderately long, the thorax is small, and a retractor muscle projects from halfway down the short oesophageal neck. The testis is undivided and is surrounded by seven coils of the vas deferens.

Remarks

The patches of algal cells in the basal test and the size and form of the stellate spicules contribute to the identification of this species.

***Trididemnum farrago* Kott, 2004**

(Figure 10H)

Trididemnum farrago Kott 2004c, p 61 and synonymy.

Distribution

Previously recorded (see Kott 2004c): Torres Strait. New records: Queensland (Great Barrier Reef: 18.615°S, 146.465°E, 23 m, QM G308819).

Description

Colony is a smooth, irregular, thin sheet. Dark pigment is in the thick spicule-free superficial bladder cell layer, beneath which is a layer of crowded spicules (at thorax level). Another layer of spicules is beneath the thoracic common cloacal canals. Spicules are stellate, to 0.1 mm diameter with 11–15 stumpy to long conical rays in optical transverse section, although many of the rays are broken off.

The zooids have six pointed branchial lobes, a short retractor muscle from halfway down the oesophageal neck, and a posteriorly orientated atrial siphon.

Remarks

Spicules are relatively large although smaller than those of *T. amiculum*, and sometimes they have more stumpy rays and rays of varying lengths. The spicules, with their relatively short stumpy rays, are also similar to those of *T. planum* (see Kott 2001, 2002, 2004c) although the spicule rays of the latter species are less variable and the spicules themselves are smaller than those of *T. farrago*.

***Trididemnum nebula* sp. nov.**

(Figure 5A, B)

Distribution

Type location: Lord Howe I. (Lagoon Beach: 1.5 m, sandy bottom, coll. Aquenal, 17 February 2006, syntypes QM G328001; sheltered lagoon, boat ramp, 2 m, QM G328002).

Description

Colonies are small (to 2 cm maximum diameter) soft, low cushions. The test is cloudy, a brownish colour in preservative. Spicules are in irregular thin patches in the surface test and line the floor of the thoracic common cloacal canals. They are globular, to 0.05 mm diameter. However, spicules are present only in some colonies, others are aspiculate.

Zooids are small, the thorax and abdomen about equal lengths. The branchial aperture is divided into six rounded, conspicuous lobes on a short branchial siphon. The atrial

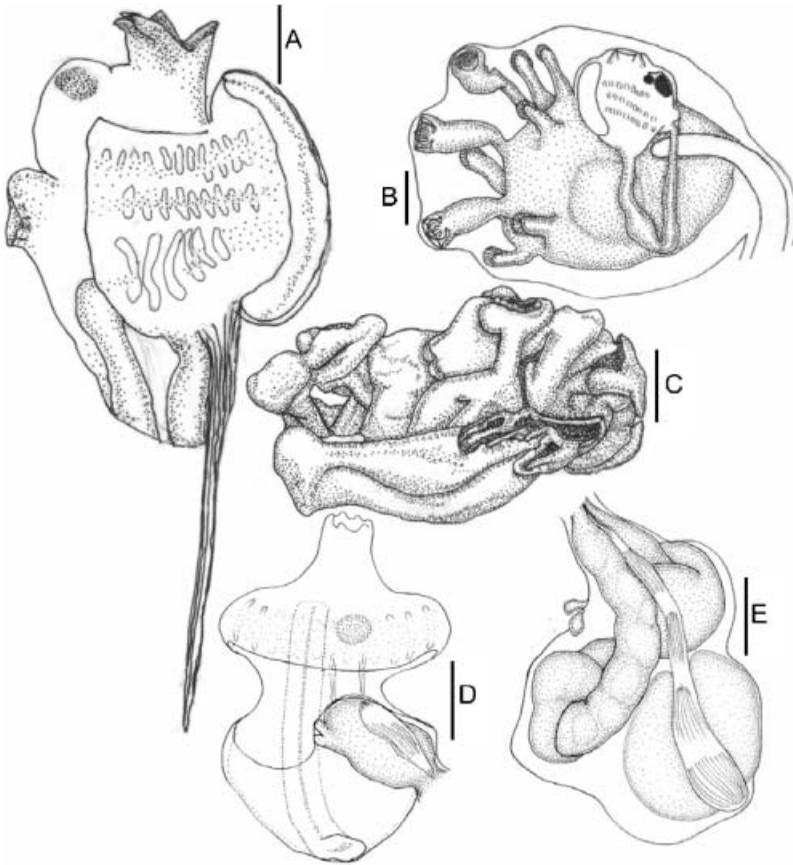


Figure 5. (A, B) *Trididemnum nebula* (QM G328001 syntype): (A) thorax; (B) larva. (C) *Trididemnum titanium* (QM G323351 holotype): colony. (D, E) *Lissoclinium capsulatum* (QM G308804 holotype): (D) thorax; (E) abdomen. Scale bars: 0.1 mm (A, B, D, E), 1 cm (C).

aperture is on a short siphon halfway down the thorax and directed horizontally. Although the exact number is obscured by contraction, about 10 stigmata per half row are in the three rows halfway down the pharynx. A strong, tapering retractor muscle of variable length projects from the top half of the oesophagus, but depending on the contraction of the zooid, it may appear to originate from the posterior end of the thorax.

The gut forms an open loop slightly flexed ventrally over the undivided testis surrounded by eight coils of the vas deferens. The zooids are surrounded with black squamous epithelium, which obscures their structure. An endostylar cap was not detected.

Small, spherical larvae are being incubated in the basal test. The tail is wound three-quarters of the way around the 0.4 mm diameter trunk. Three lateral ampullae are on each side of the three anteromedian adhesive organs.

Remarks

Superficially, the small, soft, cloudy colonies resemble those of *Trididemnum miniatum* Kott, 1977 and *T. clinides* Kott, 1977. However, the cloudiness of the test is not indicative of embedded symbionts, nor are there any symbiotic cells in the common cloacal cavity,

and the larval trunks lack the coat of the symbiotic cells present in the former two species. Further, *T. miniatum* has a sessile atrial aperture rather than the laterally orientated atrial siphon of the present species and it has smaller spicules. *Trididemnum clinides* Kott, 1977 is distinguished by its large spicules. Species that, like the present one, have a small mid-thoracic, horizontal atrial siphon, three pairs of larval lateral ampullae, black squamous epithelium, 10 or more stigmata per half row, and eight coils of the vas deferens are *T. areolatum* Herdman, 1906 (distinguished by its large stellate spicules) and *T. caelatum* Kott, 2001 (also distinguished by its large stellate spicules).

Spicule distribution, the vas deferens and atrial siphon in *T. pusillum* Kott, 2004a are similar to the present species. Further, although Kott (2004a) remarks that larvae for *T. pusillum* are not known, a larva from the holotype is shown in Kott (2004a, Figure 18d) and this also is similar to the present species. Despite these similarities, these species are distinguished by their spicules, which, in *T. pusillum*, have relatively few pointed spiky rays.

In *T. tectum* Kott, 2001, globular spicules are in the same position, in the floor of the cloacal cavity, as the present species, but spicules and zooids are larger, zooids have fewer coils of the vas deferens and the larvae have more lateral ampullae. *Trididemnum nobile* Kott, 2001 is occasionally aspiculate, has a similar (but larger) larval trunk, a posteriorly orientated atrial siphon and its spicules (when present) are stellate.

The present species, with its small soft cloudy colonies, occasional small globular spicules around the common cloacal cavity, black squamous epithelium, horizontally orientated atrial siphon, small zooids with relatively numerous vas deferens coils and stigmata, and small larvae with three pairs of lateral ampullae appears to be a previously undescribed species.

***Trididemnum pigmentatum* Kott, 2001**

(Figure 11A)

Trididemnum pigmentatum Kott 2001, p278 and synonymy; 2005a, p2457 and synonymy.

Distribution

Previously recorded (see Kott 2005a): Western Australia (Kimberly, Montebello Is); Queensland (Hervey Bay-Lizard I.); Northern Territory (Bynoe Harbour, Darwin); West Pacific (Indonesia, Fiji). New records: Queensland (Great Barrier Reef: 14.715°S, 145.405°E, 26 m, QM G308842; 17.645°S, 146.375°E, 27 m, QM G308897; 17.935°S, 146.785°E, 35 m, QM G308840; 18.615°S, 146.645°E, 30 m, QM G308841; 17.865°S, 146.645°E, 66 m, QM G308844; 18.015°S, 146.295°E, 25 m, QM G308893; 17.645°S, 146.375°E, 27 m, QM G308898).

Description

Small, lumpy three-dimensional scraps of colony, with the largest containing zooids with eight coils of the vas deferens around an undivided testis.

The spicules are large, stellate, to 0.15 mm diameter with 11–15 long attenuated rays with very pointed tips. Spicules are present throughout the colony but are most crowded at the surface. Zooids are covered with dark squamous epithelial cells. They have the usual short posteriorly orientated siphon, about 10 rows of stigmata, and eight coils of the vas deferens.

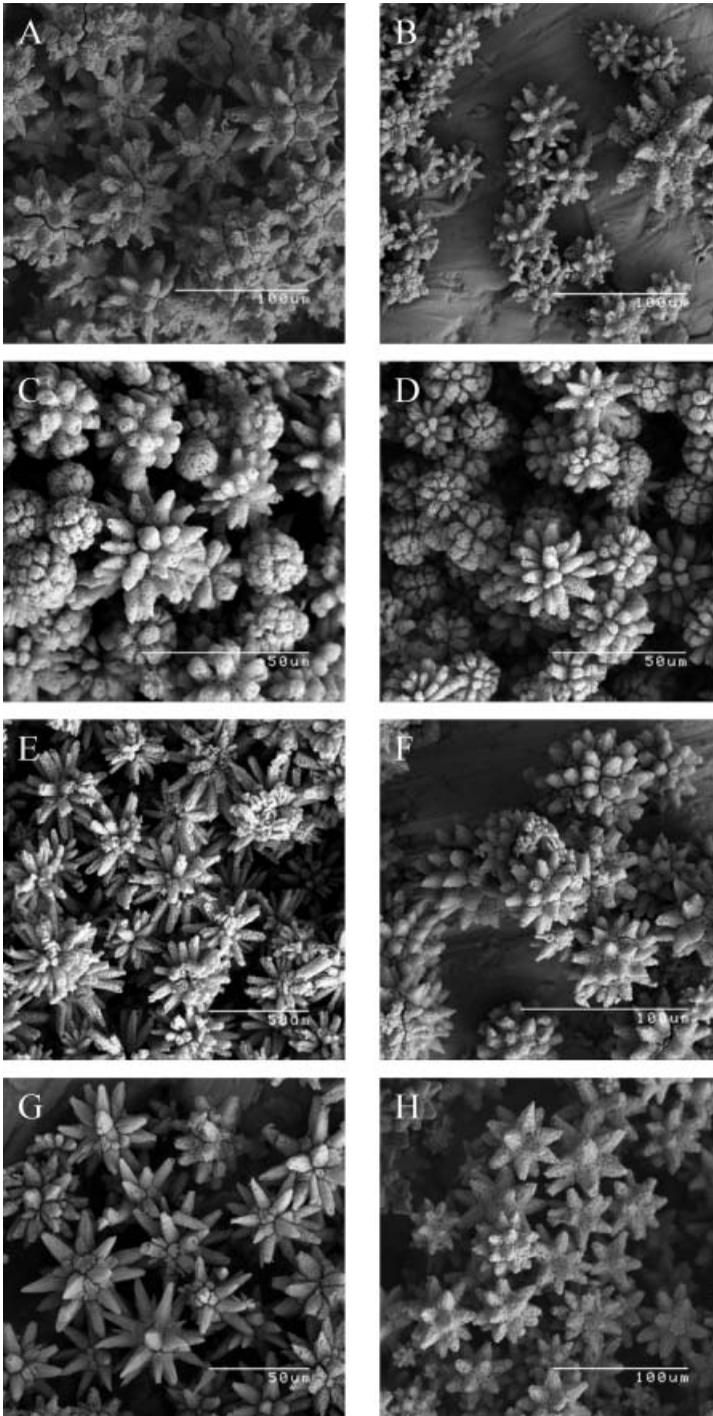


Figure 6. Scanning electron micrographs. (A) *Atrioium irregulare* (QM G323245); (B) *Leptoclinides albamaculatus* (QM G308876); (C) *Leptoclinides dubius* (QM G308892); (D) *Leptoclinides durus* (QM G308894); (E) *Leptoclinides fluxus* (QM G308817); (F) *Leptoclinides placidus* (QM G308766); (G) *Polysyncraton cuculliferum* (QM G3088458); (H) *Polysyncraton gratum* (QM G308891).

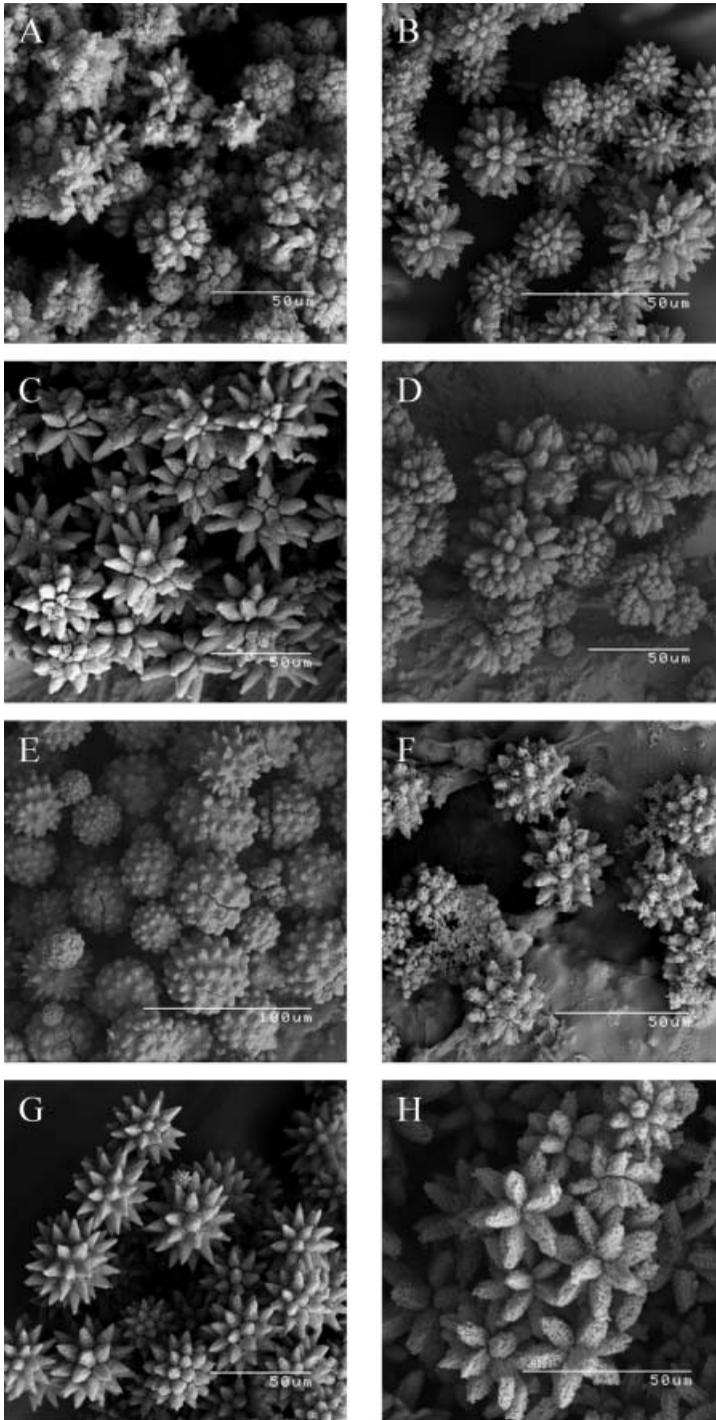


Figure 7. Scanning electron micrographs. (A) *Polysyncraton magnetae* (QM G308818); (B) *Polysyncraton meandratum* (QM G308849); (C) *Polysyncraton otuetue* (QM G308851); (D) *Polysyncraton reticulatum* (QM G323330); (E) *Polysyncraton scorteum* (QM G323343); (F) *Didemnum abradatum* (QM G308870); (G) *Didemnum astrum* (QM G308857); (H) *Didemnum candidum* (QM G308765).

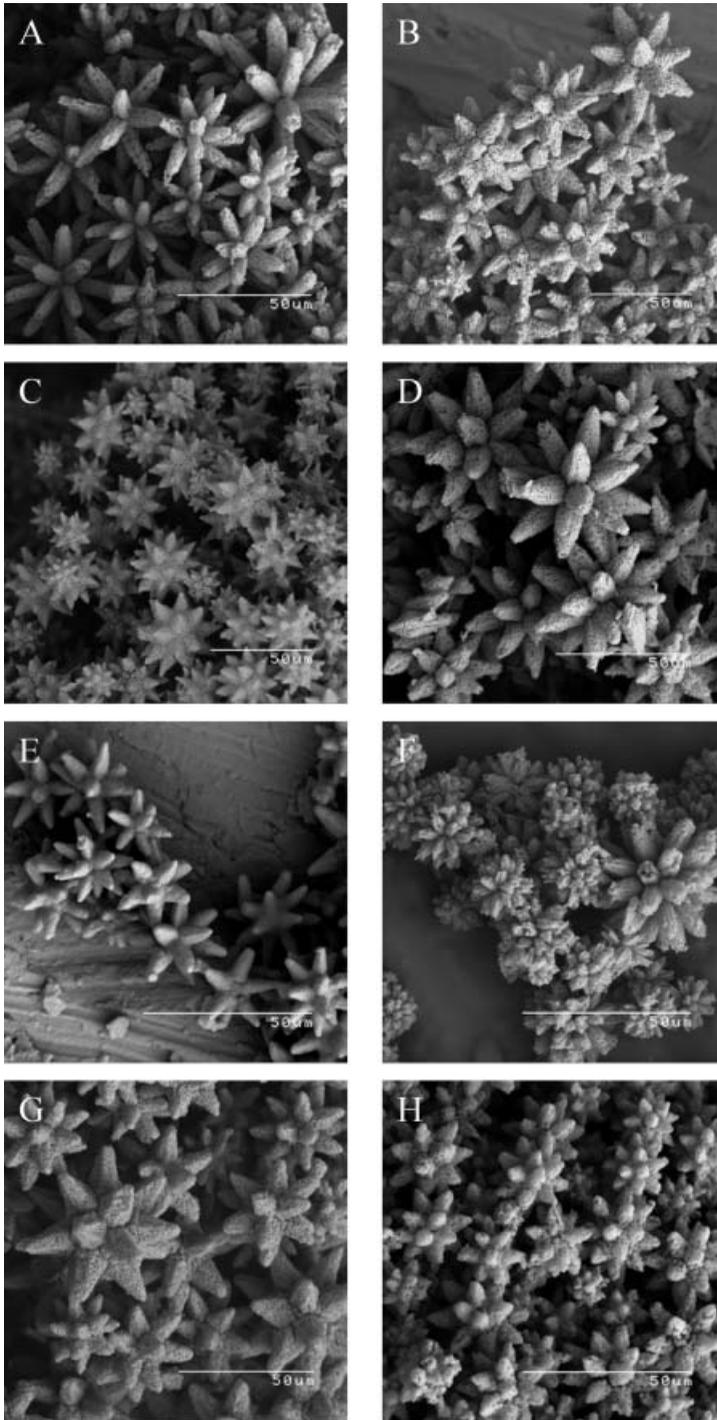


Figure 8. Scanning electron micrographs. (A) *Didemnum coralliforme* (QM G308861); (B) *Didemnum crescente* (QM G308815); (C) *Didemnum fragum* (QM G308826); (D) *Didemnum grande* (QM G308867); (E) *Didemnum granulatum* (QM G308843); (F) *Didemnum jedanense* (QM G308846); (G) *Didemnum lissoclinum* (QM G308814); (H) *Didemnum mantile* (QM G308887).

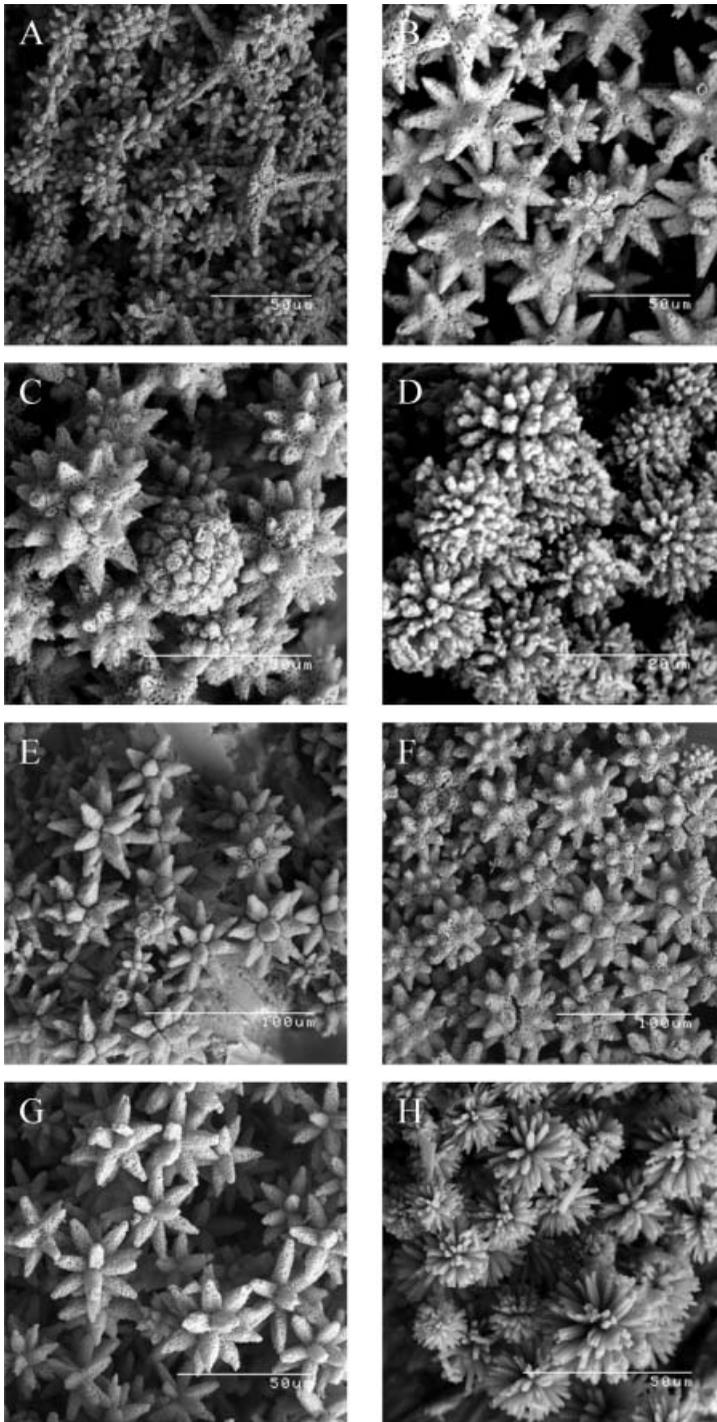


Figure 9. Scanning electron micrographs. (A) *Didemnum membranceum* (QM G308854); (B) *Didemnum microthoracium* (SAM E3259); (C) *Didemnum moseleyi* (QM G308866); (D) *Didemnum parau* (QM G308859); (E) *Didemnum patulum* (QM G308769); (F) *Didemnum pellucidum* (QM G308886); (G) *Didemnum perplexum* (QM G308860); (H) *Didemnum psammatoide* (QM G308879).

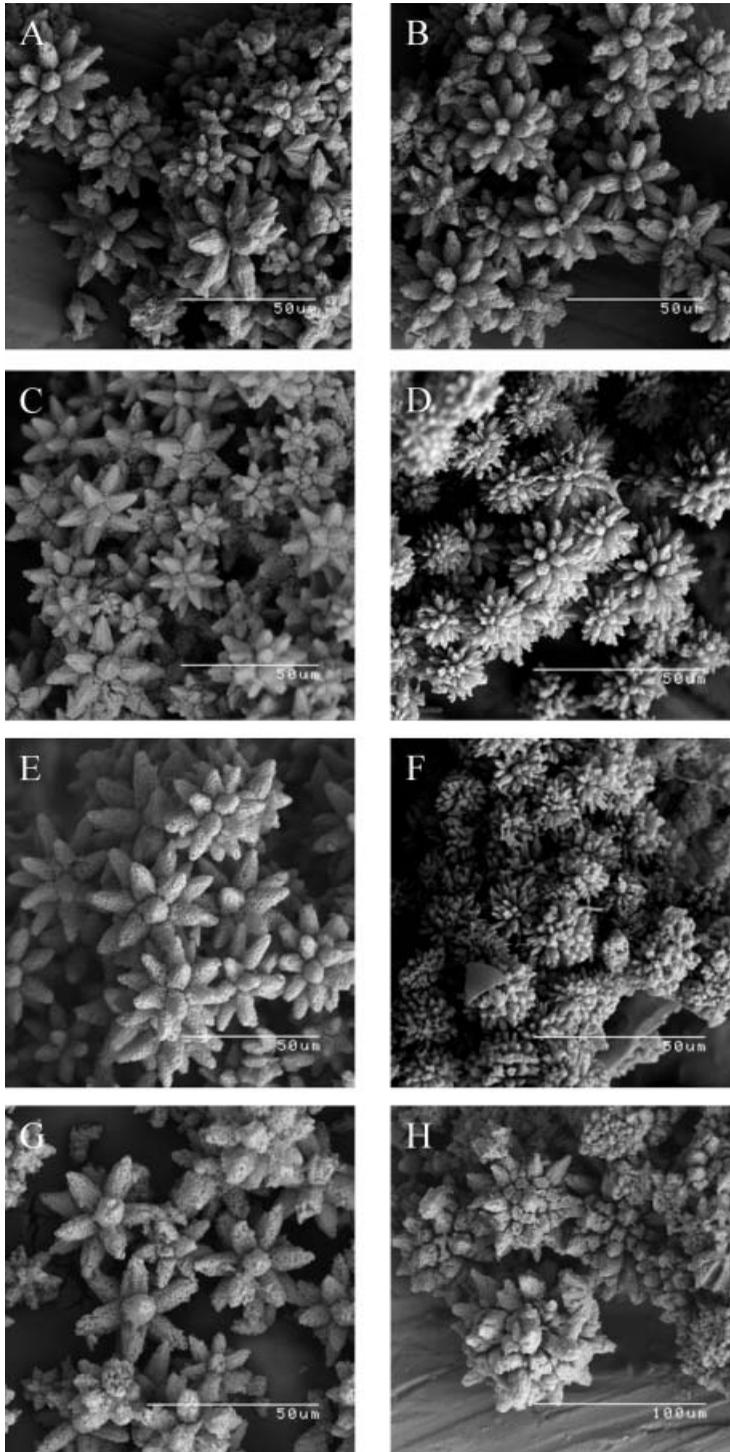


Figure 10. Scanning electron micrographs. (A–C) *Didemnum psammatoide* [(A, B) QM G308820; (C) QM G308831]; (D) *Didemnum tantalum* (QM G308860); (E) *Didemnum tumulatum* (QM G308873); (F) *Didemnum vesica* (QM G308875); (G) *Didemnum viride* (QM G308864); (H) *Trididemnum farrago* (QM G308819).

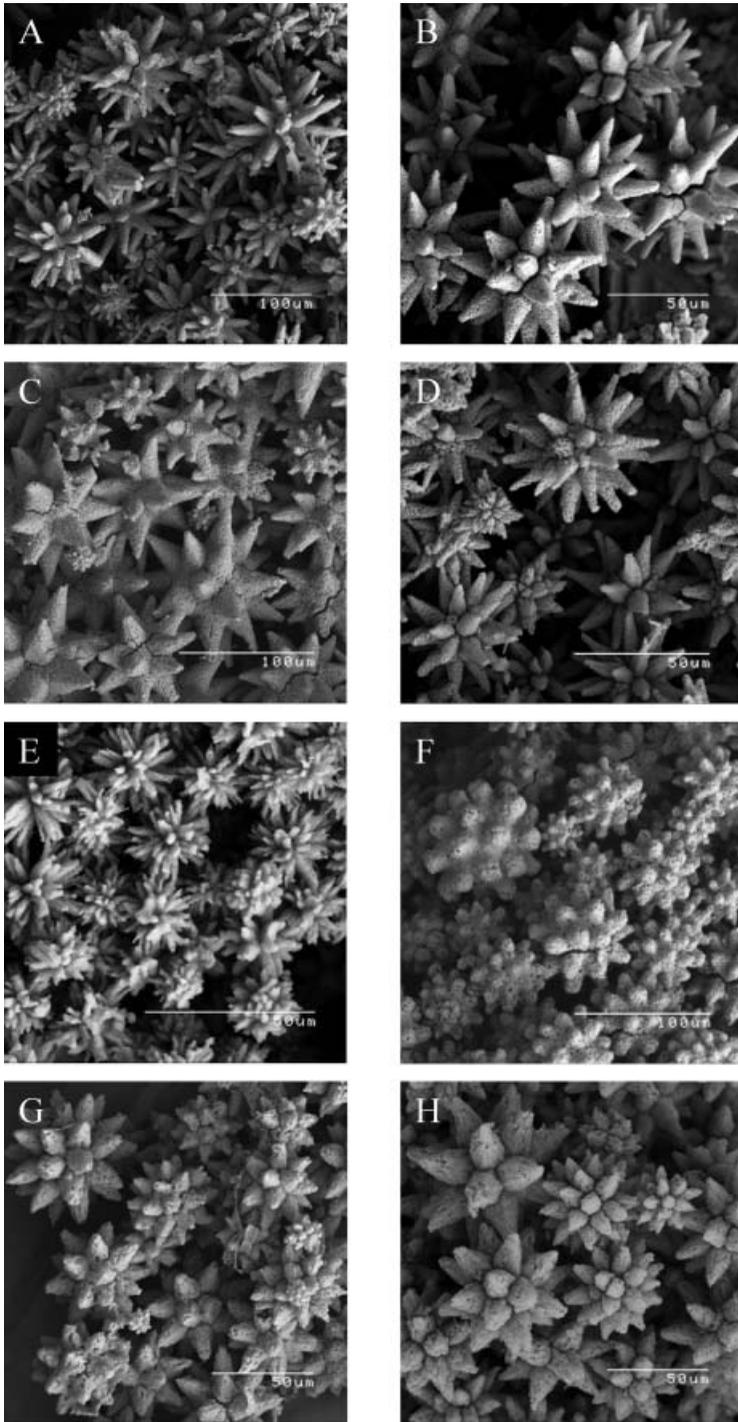


Figure 11. Scanning electron micrographs. (A) *Trididemnum pigmentatum* (QMG308842); (B) *Trididemnum sibogae* (QM G308893); (C) *Trididemnum titanium* (QM G308816); (D) *Lissoclinum capsulatum* (QM G308804); (E) *Lissoclinum reginum* (QM G308871); (F) Didemnidae ?genus ?species (QM G308889); (G, H) Didemnidae ?genus ?species [(G) QM G308888; (H) QM G308900].

Remarks

The specimens are assigned to this species on the basis of the large stellate spicules with numerous long, attenuated, pointed rays. Dark squamous epithelium and eight coils of the vas deferens are also characteristic of the species, which has not been reported outside tropical waters.

Trididemnum sibogae has smaller spicules and more complex colonies than the present species. *Trididemnum titanium* sp. nov. has larger spicules (to 0.17 mm diameter), but they have fewer spicule rays than the present species.

***Trididemnum sibogae* (Hartmeyer, 1910)**

(Figure 11B)

Didemnum sibogae Hartmeyer 1910, p 1489 (nom. nov. for *Didemnum ramosum* Sluiter 1909, p 63); Kott 2001 part (see below), p 283 and synonymy; 2004b, p 2505; 2005a, p 2458 and synonymy. *Not* Kott 2001, p 283 from: Westernport, QM G300955 (2001, Figure 132A) and QM G300971 (2001, Plate 17B); Kingston, QM G302875 (2001, Plate 17F); and Port Davey (Tasmania) QM G302884 = *Trididemnum titanium* sp. nov.

Distribution

Previously recorded (see Kott 2005a): Western Australia (Cape Jaubert); South Australia (Cape Jaffa; Victoria (Western Port); Tasmania (Port Davey); New South Wales (Port Hacking, Port Jackson, Arrawarra); Queensland (Fraser I., Bargara, Cairns, Princess Charlotte Bay); Northern Territory (Darwin, Gulf of Carpentaria); West Pacific; Indian Ocean. New records: Queensland (Great Barrier Reef: 17.865°S, 146.645°E, 66 m, QM G308844; 17.645°S, 146.375°E, 27 m, QM G308898; 18.015°S, 146.295°E, 25 m, QM G308893; 18.615°S, 146.645°E, 30.5 m, QM G308841).

The species has a wide Indo-West Pacific tropical range, and is around the southeastern corner of Australia (including Tasmania), where it is sympatric with *T. titanium* sp. nov.

Description

Colonies are complex, with cylindrical projections from the surface overgrowing and joining with other parts of the colony surface to form a three-dimensional trabeculum enclosing external spaces within the colony. These enclosed spaces (which maintain their connection to the external environment through gaps of various sizes and shapes), together with the extensive posterior abdominal common cloacal cavities, result in a spongy colony. Stellate spicules with 11–13 long attenuated pointed rays are present throughout although they are most crowded at the surface. The rays are conical, their base spread out to form an obtuse angle with adjacent rays.

Zooids are relatively small with a large branchial siphon and the incurrent fringed with six short, pointed lobes. The atrial siphon is posteriorly directed. A fine retractor muscle of variable length projects from the posterior end of the thorax. Eight coils of the vas deferens surround the undivided testis.

Remarks

The present damaged specimens have been identified by their three-dimensional colonies and the spicules, which are distinguished from the spicules of *T. pigmentatum* by their

smaller size, not exceeding 0.1 mm diameter, and spicule rays, which are wider basally than the long and narrow attenuated, crowded spicule rays of *T. pigmentatum*. The temperate Australian species *T. amiculum* Kott, 2001 has similar colonies and the spicules are the same size, but the rays are relatively shorter and stumper, and there are only seven coils of the vas deferens. The tropical *T. lapidosum* Kott, 2001 has larger spicules, also with more stumpy rays than those of the present species. *Trididemnum pusillum* Kott, 2004a from northwestern Australia has similar spicules although their distribution is different and the colonies are fleshy plates unlike the three-dimensional trabeculae of the present species. The species has been confused with *T. titanium* sp. nov. Its distinctions from that species are discussed below.

***Trididemnum titanium* sp. nov.**

(Figures 5C, 11C)

Trididemnum sibogae: Kott 2001, p 285 (part, as set out in “Previously recorded”, below).

Trididemnum nobile: Kott 2005a, p 2456.

Distribution

Previously recorded (see Kott 2001, part, as *T. sibogae*, and Kott 2005a, as *T. nobile*): Westernport, QM G300955 (Kott 2001, Figure 132A); QM G300971 (2001, Plate 17B); Kingston, QM G302875 (2001, Plate 17F); Tasmania (Port Davey, QM G302884). New records: type locality (Tasmanian Canyons: Pieman Canyon, 174 m, paratype QM G323145; King I. Canyon, 250 m, holotype QM G323351); Tasmania (Banks Strait, 168 m, QM G328101); Tasmania (Bass Strait, QM G308816).

Description

Colonies are invariably three-dimensional trabeculae created by branching and anastomosing of parts of the colony, which sometimes are narrow or flattened lamellae, but often are more rounded. Irregular, dark patches and streaks of pigment are sometimes on the surface test of preserved specimens. Colonies are stiff and brittle with spicules crowded throughout. The specimen from Bass Strait (QM G308816) is an extensive array of thin irregular double-sided lamellae with spicules crowded throughout, especially in the central test where they are especially packed together to form a hard calcareous plate supporting the upright lamellae. Spicules are stellate to 0.17 mm diameter, with seven to nine and sometimes eleven sturdy conical rays in optical transverse section. The diameter of each ray expands towards its base; but the rays are not crowded.

Zooids are large, with posteriorly orientated atrial siphons and conspicuously lobed branchial siphons. A short retractor muscle was sometimes detected, but often was obscured by the contracted zooids. Nine coils of the vas deferens around a large beehive-shaped undivided testis were detected in one specimen (QM G308816) from Bass Strait and in the holotype the remains of the proximal part of the vas deferens filled with sperm probably serves as a seminal vesicle. Gonads were not detected in the newly recorded specimens.

Larvae are present in the basal or central core of the test. The trunk is 0.1 mm long. Four lateral ampullae are on each side of the three anteromedian adhesive organs.

Remarks

The form of the complex colony, the black squamous ectoderm and the large, stellate spicules (to 0.15 mm diameter or more) with relatively short but pointed conical rays are characteristics of the species and help to distinguish it. Other *Trididemnum* spp. with complex three dimensional colonies from southeastern Australia have smaller spicules, namely *T. amiculum* Kott, 2001 (with seven coils of the vas deferens) and *T. nobile* Kott, 2001 (with nine coils of the vas deferens). *Trididemnum lapidosum* Kott, 2001 is a tropical species with similar large spicules but with longer and spikier rays, paddle-shaped branches of the colony and seven coils of the vas deferens. *Trididemnum pigmentatum* and *T. sibogae* have eight coils of the vas deferens although the former is a tropical species with smaller zooids and large spicules, but with more, and more crowded, spicule rays and less complex colonies. *Trididemnum sibogae* has smaller spicules with fewer rays. Similar large spicules in relatively complex colonies and zooids with posteriorly orientated atrial apertures are in the genus *Leptoclinides*, although in this genus the spicules very often have chisel-shaped tips, zooids tend to be larger than *Trididemnum* spp. and they lack the retractor muscle usually present in the latter genus.

Kott (2001) records *T. sibogae* from a range of temperate and tropical locations. The specimens have complex three-dimensional colonies and spicule diameters to 0.16 mm with 7–13 long spiky rays in optical transverse section. However, a revision of the scanning electron micrographs of spicules in the specimens assigned to this species reveals that they are in two groups. One group of specimens mainly from temperate locations with spicules to at least 0.12 mm, but often to 0.17 mm diameter, with 7–11 long, tapering points in optical transverse section and nine coils of the vas deferens appears to be the present species (*Trididemnum titanium* sp. nov.). The other group, mainly from tropical locations but sympatric with the first group in the southern part of its range, appears to consist of specimens of *T. sibogae* (described above) with 9–13 spicule rays in optical transverse section, spicules to 0.1 mm diameter, and eight coils of the vas deferens.

Trididemnum nobile: Kott, 2005a (from Tasmania, Port Davey) appears to be a specimen of the present species, with large spicules to 0.135 mm (Kott 2005a: 1.35 mm *sic*) diameter and seven to nine rays in optical transverse section and a similar number of coils of the vas deferens.

Leptoclinides grandistellus Kott, 2004a from Dongara (WA) has spicules of the same form, with 9–11 conical rays, but they are larger (to 0.22 mm diameter) and, although *L. grandistellus* has large posterior abdominal cavities, its colony does not form the three-dimensional mass of the present species. Further, unlike the present species, its spicules become less crowded toward the base, but are never crowded throughout.

L. magnistellus Kott, 2001 also has spicules to 0.24 mm diameter, but they have 11–13 rays and are crowded and the colonies are brittle.

***Lissoclinum capsulatum* sp. nov.**

(Figures 5D, 11D)

Distribution

Type locality: Queensland (Northern Great Barrier Reef: 18.845°S, 146.795°E, 26.83 m, GBR Seabed Biodiversity Project sample 651, 25 September 2003, holotype QM G308804).

Description

Clumps of four or five zooids, each enclosed in a white capsule of crowded spicules, are embedded in a thin, cloudy mucus-like sheet of delicate test. The cloudiness is caused by minute (to 0.1 mm diameter) spherical to irregular and sometimes granular cells with a slightly greenish tint. Spicules are stellate, to 0.05 mm diameter with up to 15 long pointed rays in optical section. Amongst these relatively small, regularly conical spicules are some with narrow, supplementary rays crowded between the longer stellate rays and some smaller, bilaterally symmetrical spicules (to 0.03 mm diameter) which have longer, conical rays at the apices of triangular or quadrangle outlines and shorter central rays, consisting of needle-like rods.

The zooids have the usual large thorax, with the rim of the atrial aperture lacking an anterior lip, and often drawn back to expose the branchial sac directly to the common cloacal cavity. The gut forms an almost horizontal loop, bent ventrally behind the branchial sac. The testis is divided into two follicles and the straight vas deferens is expanded into a seminal vesicle at its proximal end where it lies between the two testis follicles. A single egg is in a brood pouch constricted off from the posterior end of the zooid.

Remarks

A few bilaterally symmetrical spicules with rays of unequal length like the majority of the spicules reported for *L. pacificense* (Kott, 1981) and *L. taratarata* C. and F. Monniot, 1987 (see Kott 2004a) were detected in the present species but these are rare, and far outnumbered by the stellate spicules, which are almost unique in *Lissoclinum*, *L. stellatum* Kott, 2004b being the only other known species with similar (albeit fewer) conical rays. Both *L. taratarata* and *L. pacificense* are also distinguished from the present species by their undivided testis and the former species is further distinguished in that its spicules do not encapsulate the zooids. *Lissoclinum cornutum* Monniot, 1992 from New Caledonia has large stellate spicules that distinguish it from the Australian species (see below), but also it has a number of testis follicles arranged in a circle like *L. concavum* n. sp. from southern Australia and *L. testiculatum* (Kott, 1983) from Port Essington. Divided male gonads also occur in *L. conchylum* Kott, 2001, *L. diversum* Kott, 2004b, and *L. durable* Kott, 2001, but these species all have burr-like rather than stellate spicules.

Embryos are brooded in a pouch constricted off from the posterior end of the abdomen also in *L. caliginosum* Kott, 2001, *L. calycis* Monniot, 1992, *L. laneum* Kott, 2004b, *L. maculatum* Kott, 2001, and *L. roseum* Kott, 2001, which also have burr-like spicules.

The minute spherical to irregular cells found scattered in the test that make it cloudy are known in the larval test of many species in this genus (see Kott 2001, p 294). Similar bodies also occur in the adult test of many *Diplosoma* species and some other species of *Lissoclinum*, e.g. *L. laneum* Kott, 2004b and *L. multifidum* (Sluiter, 1909) (see Kott 2001). They do not appear to be symbiotic plant cells.

Zooids are encapsulated in burr-like rather than stellate spicules in *L. roseum* and *L. punctatum*. In *L. pacificense*, *L. limosum*, and *L. calycis* (in the “*verrilli*” group: Kott 2001) the zooids are also encapsulated in spicules, although the spicules are bilaterally rather than radially symmetrical.

***Lissoclinum reginum* Kott, 2001**

(Figure 11E)

Lissoclinum reginum Kott 2001, p 319 and synonymy; 2004c, p 65 and synonymy.

Distribution

Previously recorded (see Kott 2001, 2004a, 2004b, 2004c): Western Australia (Port Hedland); Queensland (Capricorn Group, Swain Reefs, Lizard Island); Northern Territory (Ashmore Reef, Darwin); Indian Ocean (Cocos Keeling Islands). New records: Queensland (Great Barrier Reef: 17.835°S, 146.695°E, 68 m, QM G308871; 16.955°S, 146.425°E, 55 m).

Description

The newly recorded colony (QM G308871) is a small, irregular scrap of an encrusting colony growing around weed. Clumps of spherical black cells are on each side of the branchial openings in the superficial bladder cell layer of the colony. The spicules, present throughout the test, are globular, to 0.03 mm diameter with occasional larger ones to 0.065 mm diameter. The rays are numerous, flat-ended rods. The common cloacal cavity is deep with clumps of zooids embedded in the test connectives that cross the common cloacal cavity between the basal and the surface test.

The other specimen has some lobes projecting from the surface and the basal test extends up into a central test mass. Dark pigment is in the basal or central test. Zooids are in clumps in test connectives that span the extensive common cloacal cavity between the central or the basal test and the surface layer where they branch to separate the thoraces from one another. The thoraces are large but contracted in all these specimens. They have a short oesophageal neck with a long, fine retractor muscle projecting from it and a large abdomen.

Remarks

The structure of the zooids is obscured by the poor condition of the colony and its identification is based on the form and size of the spicules and the disposition of the common cloacal cavities.

***Diplosoma velatum* Kott, 2001**

Diplosoma velatum Kott 2001, p 345; 2005a, p 2468 and synonymy.

Distribution

Previously recorded (see Kott 2005a): Southern Australia from Albany to Western Port (Victoria) and Port Davey (Tasmania). New record: Tasmania (Bellerive Bluff-Derwent Estuary, QM G308829).

Remarks

The specimen is as previously described for this species, and confirms its range as a temperate indigenous Australian species. The colony was reported to have been yellow in life but it is orange in the deck photo.

***Diplosoma versicolor* Monniot, 1994**

Diplosoma versicolor Monniot 1994, p 9; Kott 2004c, p 67 and synonymy.

Distribution

Previously reported (see Kott 2004c): Western Australia (Ashmore Reef, Montebello Is, Houtman's Abrolhos); New South Wales (Lord Howe I.); Queensland (Capricorn Group to Lizard I.); Northern Territory (Darwin); Philippines; New Caledonia; Micronesia. New record: Queensland (Noosa Heads, QM G308797).

Description

The newly recorded colony is a soft slab about 5 mm diameter and 2–3 mm thick. It has the characteristic white patches in the surface with clouds of a yellowish colour between.

Remarks

The newly recorded colony is the most southerly location so far recorded for this wide-ranging tropical species. The specimen demonstrates the colour variation previously observed in this species (see Kott 2004c).

Didemnidae ?genus ?species

(Figure 11F)

Distribution

Tasmanian Canyons (King I. Canyons, 348 m, QM G308889).

Description

The colony is thin and encrusting with the spicules crowded throughout and a very hard surface. The structure of the zooids is obscured by contraction and mutilation. The spicules are large (to 0.1 mm diameter) with 11–13 short, blunt or truncated rays.

Remarks

Although apparently an undescribed species, the information necessary to assign this specimen to a genus is not available from this specimen. The spicules have slightly fewer rays but otherwise resemble those of the tropical *Trididemnum areolatum* (Herdman, 1906) and are significantly larger than the spicules of *Polysyncraton pseudomagnetae* Kott, 2004b and *Polysyncraton linere* Kott, 2004a from Western Port.

Didemnidae ?genus ?species

(Figure 11G, H)

Distribution

Tasmanian Canyons (King I. Canyons, 241 m, QM G308888, G308900).

Description

Both colonies are thin encrusting sheets and orange in life with a horizontal and thoracic common cloacal cavity. The spicules appear to be identical, being stellate, to 0.09 mm diameter with 9–11 strong robust, pointed, conical rays with their broad bases crowded toward the centre of the spicule. One colony (QM G308888) is white in preservative with thin surface test crowded with spicules, but these become sparse in the lower half of the colony. In this specimen, large vesicles displace the surface spicules in a circle around each branchial aperture. The other colony (QM G308900) is a more extensive, encrusting sheet with brownish zooids, and is flesh-coloured to brownish beige in preservative and its spicules are crowded throughout the test. The zooids have long fine retractor muscles but are mutilated and the specimen could be either *Didemnum* spp. or *Polysyncrator* spp., neither larvae nor gonads being present to reliably indicate the correct genus.

Remarks

Although *Didemnum spadix* Kott, 2001 has similar colonies and vesicles arranged in a circle around each branchial aperture as in one of the colonies (QM G308888). However, although the spicules are a similar shape they are never more than 0.046 mm (not 0.45 mm *sic* Kott 2001). Also the brown cells lying free in the test and often around zooids of *Didemnum spadix* were not detected in either of the present specimens. The vesicle cells in the surface test also occur in *Polysyncrator orbiculum* Kott, 1962 and *P. circulum* Kott, 1962, although both these species have smaller differently shaped spicules, those of the latter being burr-shaped and the former having club-shaped rays.

In view of the similarity of the spicules it is possible that these specimens are the same species at different stages of maturity. Nevertheless it is possible that the similarity of the spicules is a coincidence and that they are different. They appear not to belong to any known taxon in either *Didemnum* or *Polysyncrator*.

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Appendix 1. Corrigenda

The following corrigenda are to Kott 2005a, New and little-known species of Didemnidae (Asciacea, Tunicata) from Australia (part 3). *Journal of Natural History* 39:2409–2479:

- p 2447, line 25: delete “(stellate ones ... section)”.
- p 2432, line 12: “0.66 mm” to read “0.06 mm”.
- p 2457, line 3: “1.35 mm” to read “0.135 mm”.