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Patricia Kott ^a

^a Queensland Museum, South Brisbane, Australia

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Observations on non-didemnid ascidians from Australian waters (1)

PATRICIA KOTT

Queensland Museum, South Brisbane, Australia

(Accepted 30 January 2006)

Abstract

Thirty-five species (including eight that are new) of non-didemnid aplousobranch species and 25 phlebobranch (including one new) and stolidobranch species are discussed and a further 42 species in non-didemnid taxa in all suborders are newly recorded. Material was taken by scuba diving in the waters around Kangaroo I. and other southern Australian and Tasmanian locations; and further material was taken by dredge from canyons off the southeastern Continental Slope and from inter-reefal areas in the northern Great Barrier Reef region. The known geographic ranges of many southern Australian species are extended into Tasmanian waters and a new species of *Rhopalaea* is described from the Tasmanian Canyons. The genera *Sigillina* and *Pseudodistoma* are found to be diverse in Australian temperate waters, and they have many characters in common, suggesting a probable phylogenetic relationship that formerly was not recognised. The greatest diversity of species reported is from the vicinity of the northern Great Barrier Reef. Almost without exception these are non-indigenous tropical species often extending into Australian temperate locations where they are sympatric with indigenous species found mainly around the southern half of the continent. *Pyura stolonifera* has a similar range in temperate Australian waters but appears also to occur on the South African and Chilean coasts in similar habitats and may represent a Gondwana relict.

Keywords: *Aplousobranch*, *Great Barrier Reef*, *indigenous*, *new species*, *non-indigenous*, *phlebobranch*, *Pseudodistoma*, *Pyura stolonifera*, *Rhopalaea*, *Sigillina*, *stolidobranch*, *Tasmania*, *temperate*, *tropical*

Introduction

The majority of Australian ascidian species were described during the last 50 years. However, many are known from only relatively few locations and few specimens and some are known only from their type specimens. As new surveys are conducted and experienced collectors using scuba equipment access new habitats, additional material becomes available to supplement what is known already of the species diversity of the Australian ascidian fauna and of species parameters and geographic range

Correspondence: Patricia Kott, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia. Email: patricia.mather@qm.qld.gov.au

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The specimens newly recorded in the present work are principally from four major surveys in Australian waters namely:

- Great Barrier Reef northern region seabed diversity (CSIRO, AIMS and Queensland Museum), a survey of inter-reefal benthic habitats by epibenthic sled.
- Tasmanian Canyons (CSIRO), a systematic survey by Sherman sled of deep-water canyons off northeastern and northwestern Tasmania.
- Tasmania: Port Davey and the Tasman Peninsular (South Australian Museum, Karen Gowlett-Holmes; Aquenal Pty Ltd.), systematic surveys by scuba.
- South Australia: Kangaroo I. (South Australian Museum, Karen Gowlett-Holmes), systematic surveys by scuba.

The northern Great Barrier Reef survey is the only one from tropical waters. It is one of the few explorations of the benthic fauna of the lagoon and inter-reefal areas of north-eastern Queensland. The other collections, from temperate waters of the continent, represent the greater part of the material reported on. Specimens of the family Didemnidae (to be reported on separately) were present at most stations and, with solitary species, they appear to dominate the collections from the sea-floor locations in the tropics as indeed they do in coral reef habitats. Both colonial and solitary species were taken from the sea-floor habitats of the deeper waters in the canyons off southern Australia, but the diversity is significantly lower than in the north. In temperate waters, hand collecting by scuba at shallow depths yields a high diversity of colonial species while solitary species are more often taken from deeper benthic habitats. Including the nine new species in the present work, 717 species of the Ascidiacea now are known from Australia (Tables I–III; Kott 2005a, Tables I–III). Of these species, 277 are didemnids, 229 non-didemnid aplousobranchs, and 60 colonial phlebobranch and stolidobranch species. Indigenous colonial species are nearly three times more numerous in temperate waters than in the tropics; while non-indigenous colonial species in tropical waters far outnumber those in temperate waters. Only 151 solitary species are known from around the continent, of which 80 are indigenous, the temperate ones twice the number of the tropical ones. Three-quarters of the 71 non-indigenous solitary species are tropical ones and include the 47 non-indigenous (usually Indo-West Pacific) species initially described from Australian or adjacent waters by Kott (from 1952) and other authors (see Kott 2005a). These data, together with new records from the present surveys, are discussed below (see Geographic Range) and tend to confirm the following hypotheses:

1. Colonial (especially aplousobranch) species dominate the Australian ascidian fauna
2. Indigenous species, both colonial and solitary, are more common in temperate than in tropical waters
3. Non-indigenous species, both colonial and solitary, are more common in tropical than in temperate waters.

That much remains to be learnt of the Australian ascidian fauna is demonstrated by the discovery of six new species (of the nine described in the present work) from the Tasmanian Canyons. These include a species of *Rhopalaea*, a cosmopolitan genus which, although known from a range of locations in the northern and southern hemispheres, was not previously known from Australian waters south of Cockburn Sound and south-eastern Queensland (on the western and eastern coasts, respectively).

Table I. Geographic range of indigenous species recorded principally from temperate waters.



GBR, Great Barrier Reef.

Records are denoted by the black areas and gaps in the recorded range are denoted by the grey areas.

Table II. Geographic ranges of indigenous and non-indigenous, principally tropical species recorded from both the eastern and western Australian seabords.

	Albany and SW Australia	Cockburn Sound	Abrothos to Exmouth Gulf	Shark Bay to NW Australia	Darwin and NT	GBR and NE Queensland	Hervey Bay	Moreton Bay	Coffs Harbour to Port Jackson	Port Jackson to Cape Howe	Victoria and Bass Strait	Tasmania	SA and Gulfs	Great Australian Bight	West Pacific	West Indian Ocean
<i>Clavelina arafurensis</i>																
<i>Nephtheis fascicularis</i>																
<i>Polyclinum psammiferum</i>																
<i>Polycarpa longiformis</i>																
<i>Aplidium crateriferum</i>																
<i>Phallusia julinea</i>																
<i>Polycarpa olitoria</i>																
<i>Polyclinum vasculosum</i>																
<i>Microcosmus australis</i>																
<i>Aplidium caelestis</i>																
<i>Clavelina oliva</i>																
<i>Hypodistoma deerratum</i>																
<i>Herdmania mentula</i>																
<i>Eusynstyela latericius</i>																
<i>Pyura arenosa</i>																
<i>Phallusia millari</i>																
<i>Polycitor circes</i>																
<i>Microcosmus exasperatus</i>																
<i>Polycarpa obscura</i>																
<i>Eucoelium orientalis</i>																
<i>Pycnoclavella diminuta</i>																
<i>Microcosmus helleri</i>																
<i>Polycarpa papillata</i>																
<i>Polycarpa procera</i>																
<i>Cystodytes dellachiajei</i>																
<i>Pseudodistoma australe</i>																
<i>Rhodosoma turcicum</i>																
<i>Styela plicata</i>																
<i>Polycarpa pedunculata</i>																
<i>Botryllus stewartensis</i> ^a																
<i>Ascidia gemmata</i>																
<i>Aplidium clivosum</i>																
<i>Herdmania grandis</i>																
<i>Microcosmus squamiger</i>																
<i>Pyura stolonifera</i> ^a																
<i>Pyura gangelion</i>																
<i>Botryllus schlosseri</i>																
<i>Botrylloides leachii</i>																
<i>Clavelina moluccensis</i>																

GBR, Great Barrier Reef.

Records are denoted by the black areas and gaps in the recorded range are denoted by the grey areas.

^aPossible Gondwana affinity.

Table III. Geographic ranges of indigenous and non-indigenous, principally tropical species not yet recorded from the western coast of Australia.

	Albany and SW Australia	Cockburn Sound	Abrolhos to Exmouth Gulf	Shark Bay to NW Australia	Darwin and NT	GBR and NE Queensland	Hervey Bay	Moreton Bay	Coffs Harbour to Port Jackson	Port Jackson to Cape Howe	Victoria and Bass Strait	Tasmania	SA and Gulfs	Great Australian Bight	West Pacific
<i>Cystodytes ramosus</i>						█									
<i>Synoicum syrtis</i> sp. nov.						█									
<i>Eudistoma amplum</i>															█
<i>Ascidia kreagra</i>															█
<i>Polycarpa stirpes</i>															█
<i>Polycarpa fungiformis</i>							█	█							█
<i>Polycarpa ovata</i>							█	█							█
<i>Monandrocarpa plana</i>							█	█	█						█
<i>Hartmeyera formosa</i>							█	█	█	█					█
<i>Microgastra granosa</i>							█	█	█	█	█				█
<i>Ascidia scaevola</i>							█	█	█	█	█	█	█	█	█
<i>Ecteinascidia maxima</i>							█	█	█	█	█	█	█	█	█
<i>Pseudodistoma inflatum</i>							█	█	█	█	█	█	█	█	█
<i>Cnemidocarpa stolonifera</i>							█	█	█	█	█	█	█	█	█
<i>Pseudodistoma gracile</i>							█	█	█	█	█	█	█	█	█

GBR, Great Barrier Reef.

Records are denoted by the black areas and gaps in the recorded range are denoted by the grey areas.

Solitary stolidobranch species with tough leathery tests abound in the samples dredged from the Tasmanian Canyons as well as in the northern inter-reefal areas. In the former (southern areas), Pyuridae and Molgulidae (*Pyura*, *Microcosmus*, *Molgula*) are most common and in the latter (northern areas) the family best represented is Styelidae (*Cnemidocarpa* and *Polycarpa*). *Herdmania* spp. are common components of the sea-floor benthos in all locations.

In regard to the phylogeny of the aplousobranch ascidians, the genus *Sigillina*, which Kott had placed in the family Holozoidae on the basis of its posterior abdominal vegetative stolon, appears to have more characters in common with the family Pseudodistomidae Kott, 1992a. Both *Pseudodistoma* and *Sigillina* are well represented in temperate Australian waters. In the genus *Synoicum*, a known species, *S. citrum* Kott, 1992a, has been found to have paired rows of stigmata as in the Holozoidae, although a revision of other characters of *Synoicum* and the Holozoidae do not suggest a close phylogenetic affinity.

Geographic range

The geographic ranges of the 102 non-didemnid taxa referred to in this report are summarised in Tables I–III. The gaps (grey areas in the tables) indicating discontinuity in

the known range may have resulted from uneven and unrepresentative sampling of all appropriate habitats and locations. It should be noted also that the apparent centre of biodiversity in northern Australia (Table II: Darwin and the Northern Territory and the Great Barrier Reef) may reflect either the intensity of sampling in this general area and/or a general route for gene flow between Australian and western Pacific locations.

Table I shows indigenous species recorded principally from temperate waters albeit many extend up the western and/or eastern coasts to Cockburn Sound and New South Wales respectively, and occasionally to Houtman's Abrolhos in the west and Moreton Bay and the Great Barrier Reef on the eastern coast.

Table II shows species recorded from tropical waters and from localities down both the western and eastern coasts, often as far south as Houtman's Abrolhos and/or Cockburn Sound and to Bass Strait, Tasmania and into South Australian waters on the eastern and southern seaboard. A significant number of these species have a range all around the continent, including the Great Australian Bight; and most have been recorded from Indonesian and western Pacific locations and sometimes from the West Indian Ocean. Only four species in this group appear to be indigenous, although this could be from a lack of collecting. This group of tropical species, with a range that extends into temperate waters down each side of the Australian continent, includes the unusual and convergent taxa *Ascidia scaevola* and *Microgastra granosa*. Both species are adapted for sandy sea-floor habitats with thin, sandy, brittle, and rigid test, highly modified muscles in the thin, largely non-contractile body wall, a large delicate, flat branchial wall with an accessory fold, but a small, tightly curved gut loop.

Table III shows species from tropical waters with a range down the eastern coast, but not yet recorded from the western coast of the continent. Only seven of these species are apparently indigenous, but this may be a result of lack of collecting in either or both Australian and western Pacific waters.

The new collections represent intensive sampling of the fauna of the northeastern and southeastern parts of the Australian continental shelf but as a consequence of the different collecting methods used they have sampled different habitats. Therefore, to some extent, these factors could distort perceptions of species diversity around the continent. Nevertheless the species collected do reflect a general trend observed in previous studies. Although the number of non-didemnid species recorded here are fewer than those discussed by Kott (2005a) in the family Didemnidae, they reflect similar patterns of species diversity. Like the Didemnidae, the majority of non-didemnid ascidian species taken from tropical waters are non-indigenous western Pacific species (only 38 of the 102 species recorded are not present in the Great Barrier Reef and/or north-east Queensland). Again, as in the Didemnidae, most indigenous species were taken from temperate waters around the southern half of the continent where they are sympatric with those tropical species that extend into the temperate waters in the southern part of their range.

Extensions of the known geographic ranges of tropical species down the eastern and western coasts and often across the southern coast support the view that the Australian continental shelf acts as a bridge between the tropics and the temperate waters of the southern half of the continent. The extension of known geographic range of many known temperate species into southern Tasmanian waters has been detected and it is possible that many ascidian populations in the Great Australian Bight, the South Australian Gulfs, Kangaroo I. and the Victorian coast exchange genes with one another and with populations in deeper waters of Bass Strait and Tasmania. Nevertheless, evidence of speciation in temperate waters supports the hypothesis that isolating mechanisms in these waters are

stringent and that the affinities of many indigenous Australian species may be with the tropical rather than a southern ocean fauna. An exception to this is *Pyura stolonifera* (Heller, 1878) which has an Australian range similar to many indigenous temperate species. However, it appears also to occur in South Africa and South America (Chile) and may be a Gondwana relict. It appears to be a long-term component of the Chilean fauna and the report of its recent introduction to that coast cannot be substantiated.

List of species discussed

Diazonidae

- Pseudodiazona claviformis* (Kott, 1963)
- Rhopalaea meridionalis* sp. nov.

Clavelinidae

- Clavelina simplex* sp. nov.

Pycnoclavellidae

- Pycnoclavella tabella* Kott, 1990a

Stomozoidae

- Stomozoa australiensis* Kott, 1992a

Holozoidae

- Sigillina exigua* sp. nov.
- Distaplia australiensis* Brewin, 1953
- Distaplia florida* Kott, 1990a
- Distaplia pallida* Kott, 1990a
- Sycozoa murrayi* (Herdman, 1886)
- Sycozoa sigillinoides* Lesson, 1830

Polycitoridae

- Eucoelium orientalis* (Kott, 1990a)
- Eudistoma anaematum* Kott, 1990a
- Eudistoma globosum* Kott, 1957

Pseudodistomidae

- Pseudodistoma australe* Kott, 1957
- Pseudodistoma gracile* Kott, 1992a
- Pseudodistoma inflatum* Kott, 1992a
- Pseudodistoma pilatum* Kott, 1992a

Polyclinidae

- Polyclinum incrustatum* Michaelsen, 1930
- Polyclinum marsupiale* Kott, 1963
- Polyclinum vasculosum* Pizon, 1908
- Aplidiopsis confluata* Kott, 1992a
- Synoicum bowerbanki* Millar, 1963
- Synoicum citrum* Kott, 1992a
- Synoicum obscurum* Kott, 1992a
- Synoicum sacculum* Kott, 1992a
- Synoicum sphinctorum* sp. nov.
- Synoicum syrtis* sp. nov.
- Aplidium abditum* sp. nov.
- Aplidium breviarvaceum* Kott, 1963
- Aplidium caelestis* Monniot, 1987

Aplidium clivosum Kott, 1992a

Aplidium formosum sp. nov.

Aplidium laticum sp. nov.

Aplidium opacum Kott, 1963

Aplidium robustum Kott, 1992a

Suborder Phlebobranchia

Asciidiidae

Ascidia saccula sp. nov.

Ascidia scaevola (Sluiter, 1904)

Ascidia thompsoni Kott, 1952

Perophoridae

Ecteinascidia maxima Kott, 1985

Plurellidae

Microgastra granosa (Sluiter, 1904)

Suborder Stolidobranchia

Styelidae—Styelinae

Cnemidocarpa areolata (Heller, 1878)

Cnemidocarpa completa Kott, 1985

Cnemidocarpa radicata (Herdman, 1882)

Polycarpa chinensis (Tokioka, 1967)

Polycarpa flava Kott, 1985

Polycarpa intonata Kott, 1985

Polycarpa olitoria (Sluiter, 1890)

Polycarpa papillata (Sluiter, 1885)

Polycarpa procera (Sluiter, 1885)

Polycarpa rigida Herdman, 1881

Polycarpa viridis Herdman, 1880

Styelidae—Polyzoinae

Monandrocarpa plana Kott, 1972

Stolonica reducta (Sluiter, 1904)

Styelinae—Botryllinae

Botryllus stewartensis Brewin, 1958

Pyuridae

Pyura irregularis (Herdman, 1882)

Pyura stolonifera (Heller, 1878)

Pyura tasmanensis Kott, 1985

Hartmeyeria formosa Herdman, 1882

Herdmania grandis (Heller, 1878)

Herdmania mentula Kott, 2002

Other new records

The following species are newly recorded at the locations indicated, and the most recent reference to each of these species is given:

Clavelina arafurensis Tokioka, 1952 (see Kott 2004): 18.015°S, 146.645°E, depth 55 m.

- Clavelina moluccensis* (Sluiter, 1904) (see Kott 2004): Kangaroo I., Kingsgate Jetty, depth 3–5 m, SAM E3298.
- Clavelina oliva* Kott, 1990a (see Kott 2002): 15.245°S, 145.375°E, depth 24 m.
- Clavelina pseudobaudinensis* (Kott, 1976) (see Kott 1990a): Flinders Pier, depth 2–4 m, SAM E3299.
- Pycnoclavella diminuta* Kott, 1990a (see Kott 2002): off Noosa Heads, depth 8–10 m, QM G308791; Magnetic I., AIMS 17506.
- Hypodistoma deerratum* (Sluiter, 1895) (see Kott 2004): 14.715–17.605°S, 145.325–146.355°E, depth 16–39 m.
- Sycozoa cerebriformis* (Quoy and Gaimard, 1834) (see Kott 1990a): Bass Strait, depth 50 m, Aquenal TAS 01085, QM G308808.
- Cystodytes dellachiajei* (Della Valle, 1877) (see Lopez-Legentil and Turon 2005): Bass Strait, depth 6 m, Aquenal TAS 01236; Kangaroo I., SAM E3276.
- Cystodytes ramosus* Kott, 1992b (see Kott 2003): 15.035°S, 145.485°E, depth 38 m.
- Eudistoma amplum* (Sluiter, 1909) (see Kott 2003): 14.715°S, 145.405°E, depth 26 m.
- Polycitor circes* Michaelson, 1930 (see Kott 2004): 17.645°S, 146.375°E, depth 27 m.
- Polyclinum psammiferum* Hartmeyer, 1911 (see Kott 2004): 16.475°S, 146.015°E, depth 53 m
- Aplidium crateriferum* (Sluiter, 1909) (see Kott 1992a): 18.845°S, 146.795°E, depth 26 m.
- Aplidium multiplicatum* (Sluiter, 1909) (see Kott 2003): 18.025°S, 146.135°E, depth 11 m.
- Rhososoma turcicum* (Savigny, 1816) (see Kott 2004): 18.945°S, 146.365°E, depth 8 m.
- Phallusia julinea* Sluiter, 1919 (see Kott 2004): 7.865°S, 146.645°E, depth 66 m.
- Phallusia millari* Kott, 1985 (see Kott 2004): 15.615–17.605°S, 145.375–146.355°E, depth 21–41 m.
- Ascidia gemmata* Sluiter, 1895 (see Kott 1985): 18.825°S, 146.345°E, depth 9 m.
- Ascidia kreagra* Sluiter, 1895 (see Kott 1985): 18.535°S, 146.565°E, depth 32 m.
- Ascidia sydneyensis* Stimpson, 1855 (see Kott 2002): 17.645–18.275°S, 146.295–146.375°E, depth 13–27 m.
- Styela plicata* (Lesueur, 1823) (see Kott 1985): Port Adelaide, SAM E2873; Streaky Bay jetty, depth 3–5 m, SAM E2886; 17.645–18.945°S, 146.365–146.375°E, depth 8–27 m.
- Cnemidocarpa pedata* (Herdman, 1881) (see Kott 1985; *Cnemidocarpa radicata*, below): Ulladulla, NSW; 16.585–18.945°S, 145.945–146.425°E, depth 8–35 m.
- Cnemidocarpa stolonifera* (Herdman, 1899) (see Kott 1985): 14.685–18.655°S, 145.365–146.835°E, depth 17–69 m.
- Polycarpa fungiformis* Herdman, 1899 (see Kott 1990b): 14.685–18.175°S, 145.365–146.935°E, depth 17–69 m.
- Polycarpa longiformis* Tokioka, 1952 (see Kott 1985): 16.965°S, 146.435°E, depth 42 m.
- Polycarpa obscura* Heller, 1878 (see Kott 1990b): 14.715–18.175°S, 145.404–146.945°E, depth 26–68 m.
- Polycarpa ovata* Pizon, 1908 (see Kott 1985): 16.785–18.615°S, 146.115–146.945°E, depth 31–39 m.
- Polycarpa pedunculata* Heller, 1878 (see Kott, 1985): Kangaroo I., Penneshaw Jetty, depth 4–6 m, SAM E2869.
- Polycarpa stirpes* Kott, 1985 (see Kott, 1985): 16.155–18.615°S, 145.865–146.755°E, depth 26–68 m.

- Monandrocarpa plana* Kott, 1972 (see Kott 1985): 17.955–18.015°S, 146.425–146.645°E, depth 35–55 m.
- Eusynstyela latericius* (Sluiter, 1904) (see Kott 1985): 17.085°S, 145.985°E, depth 18 m.
- Symplegma* ?juveniles, off Noosa Heads, depth 8–10 m, QM G308793.
- Botrylloides leachii* (Savigny, 1816) (see Kott 2004): 17.645°S, 146.375°E, depth 27 m.
- Botryllus schlosseri* (Pallas, 1766) (see Kott 1985): 17.955–18.845°S, 146.425–146.795°E, depth 8–35 m
- Pyura arenosa* (Herdman, 1881) (see Kott 1990b): 15.435–19.035°S, 145.325–146.545°E, depth 11–21 m.
- Pyura gangelion* (Savigny, 1816) (see Kott 2004): 18.825–19.035°S, 146.345–146.545°E, depth 9–11 m.
- Microcosmus australis* Herdman, 1899 (see Kott 2003): 17.895°S, 146.645°E, depth 33 m.
- Microcosmus exasperatus* Heller, 1878 (see Kott 2004): 15.335–19.025°S, 145.385–146.515°E, depth 11–34 m.
- Microcosmus helleri* Herdman, 1882 (see Kott 2004): 15.435–18.815°S, 145.325–146.955°E, depth 16–84 m.
- Microcosmus stoloniferus* Kott, 1952 (see Kott 1990b): 15.435–18.775°S, 145.325–146.355°E, depth 16–12 m.
- Molgula ficus* (Macdonald, 1859) (see Kott 1985): South Australia, Kangaroo I., American River, depth 2–3 m, SAM E2862; Tasmania, Port Davey, depth 3–25 m, SAM E2874.

Taxonomy

Pseudodiazona claviformis (Kott, 1963)

(Figure 8A)

Protopolyclinum claviforme Kott 1963, p 72.

Pseudodiazona claviformis: Kott 1990a, p 31 and synonymy.

Distribution

Previously recorded (see Kott 1990a): South Australia (Great Australian Bight, Gulf St Vincent); Victoria (Port Phillip Bay, off Cape Howe, Eden); New South Wales (Jervis Bay). New records: Tasmania (Bathurst Channel, Port Davey, 6–8 m, SAM E3280; Five Mile Bluff).

The newly recorded location is the most southerly known for this species, which is known only from the southeastern corner of the Australian continent.

Description

The newly recorded colonies consist of thick, sandy vertical stalks arising from a common basal mat, the top half of each stalk expanding slightly into a naked, transparent and glassy head. Vertical, parallel thread-like zooids can be seen opening around the top of the head by separate branchial and atrial apertures that project slightly from the surface. The apertures are each on short siphons of variable length, the length varying with the contraction of the thorax. The thorax is relatively large with numerous long rows of stigmata and internal longitudinal vessels extending the length of the branchial sac. The gut

loop is short, the stomach smooth, and the rectum extends along the side of the pharynx, opening near the base of the atrial siphon. Gonads are in a posterior abdomen as previously reported for this species.

Remarks

Taxa with separately opening atrial and branchial siphons, the anal opening near the top of the relatively large thorax and gonads in a posterior abdomen are discussed in Kott (1990a, 1992a). The type species of *Homoeodistoma*, *H. michaelsoni* Redikorzev, 1927 from the Sea of Okhotsk, was found to be a synonym of *Placentela crystallina* Redikorzev, 1913 (see Kott 1992a; Sanamyan 1993) which lacks internal longitudinal branchial vessels and has the heart in the abdomen. Although Millar (1963) first proposed the Japanese *Homoeodistoma longigona* Tokioka, 1959 as a member of the family Diazonidae, a hypothesis supported by Kott (1990a), its relationship to either *Placentela* or to *Pseudodiazona* Millar, 1963 (with internal longitudinal vessels and the heart at the end of the posterior abdomen) is not

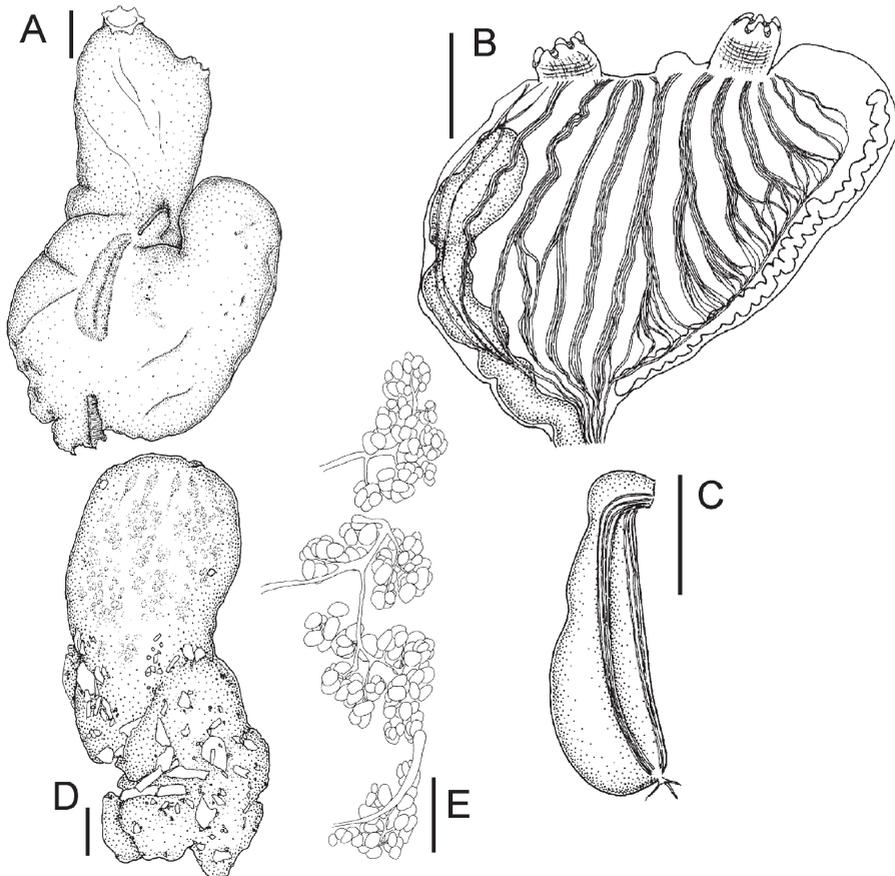


Figure 1. (A–C) *Rhopalaea meridionalis*: (A, C) holotype QM G308821; (B) paratype QM G308825). (A) Whole zooid (in the test, showing position of gut loop); (B) thorax; (C) abdomen. (D, E) *Clavelina simplex* sp. nov. (QM G308824, syntype): (D) colony; (E) branching vascular stolons with terminal ampullae. Scale bars: 5 mm (A, C, D); 1 mm (B, E).

resolved (see Kott 1992a). Kott (1990a) has drawn attention to its similarity to the present species (a relationship so far unresolved).

***Rhopalaea meridionalis* sp. nov.**

(Figure 1A–C)

Distribution

Tasmanian Canyons: Type locality. (King I. Canyon, Sta. 030, Sherman sled, 249 m, holotype QM G308821; Ling Hole, Sta. 052, Sherman sled, 163 m, paratype QM G308825; Pieman Canyon, Sta. 072, Sherman sled, 174 m, QM G308822; Pieman Canyon, Sta. 073, Sherman sled, 249 m, QM G308823).

Description

The contracted zooids are solitary and almost cylindrical, to 5 cm long, although the relaxed specimens could be at least twice that length. The test of the preserved specimens is whitish and translucent, that of the thorax being particularly thin and delicate while the abdominal test is thick and firm. Thoraces are especially contracted and often are severed from the abdomen as a result of contraction into a relatively tight almost spherical mass. The abdomen remains stretched out and securely fixed in the firm test of the posterior end of the body. Only two thoraces, both tightly contracted, were present in the available material. Both apertures are six-lobed with small yellow spots between the bases of the lobes. The branchial aperture is terminal and the atrial opening is a short distance down the dorsum. The thoracic muscles in these contracted specimens number about 12 broad longitudinal bands on each side. At least six extend ventrally from the branchial siphon and divide into separate fibres along each side of the endostyle where they join into a ventral longitudinal band on each side. Each of these bands joins with about six broad dorsal longitudinal muscles (half from between the siphons and the other half from the atrial siphon) to form a single longitudinal band along each side of the mid-dorsal line of the abdomen, converging posteriorly to terminal horns on each side of the fine vascular stolon that projects into the test at the posterior end of the zooid.

At least 50 inner longitudinal vessels extend the length of the branchial sac on each side, and there are at least 50 rows of about the same number of stigmata, although the exact number is obscured by contraction.

The gut forms a simple vertical loop tightly embedded in the abdominal body wall. Neither structural folds in the stomach nor gonads were detected.

Remarks

As in other genera of the Diazonidae, the homogenous genus *Rhopalaea* has independently opening six-lobed apertures, inner longitudinal vessels (supported on papillae) extending the length of the large branchial sac (which has many stigmata in numerous rows), gonads (including a tubular ovary) in the vertical gut loop (which is tightly enclosed in the opaque abdominal body wall). The genus probably is oviparous. It contains 11 confirmed species (including the present one) and is distinguished from other genera in the family by the solitary habit of most of its species. However some may be colonial, although this is not confirmed and the budding mechanism is not known.

Monniot and Monniot (2001) assigned specimens to *R. crassa* (Herdman, 1880) on the basis of their thick opaque test. However, this is a condition that Kott (1990a) observed to occur only in older specimens, probably with regenerated thoraces, and it does not appear to be a species characteristic, but rather one of growth and maturity. This species from the tropical western Pacific (and its synonyms including *R. perlucida* Monniot, 1997, see Kott 1990a, 2003) and *R. abdominalis* (Sluiter, 1898) from the tropical western Atlantic are both solitary species with longitudinal muscles terminating in short branches along the mid-dorsal and the mid-ventral lines on the thorax and not continuing on to the abdomen. The specimens assigned to *R. crassa* by Monniot and Monniot (2001) may have been misidentified for although they lack abdomina, dorsal muscles at least appear to extend posterior to the thorax and although short terminal branches are along each side of the mid-ventral line, similar branches are not present along the mid-dorsal line (as they are in *R. crassa*). *Rhopalaea cloneyi* Vasquez and Young, 1996 from the coastal waters of the north-eastern Pacific (with numerous fine pleats in the stomach wall), *R. tenuis* (Sluiter, 1904) from the tropical western Pacific (in which stomach folds have not been detected), and *R. birkelandi* Tokioka, 1971 from the tropical eastern Pacific (distinguished from the two latter species by its large number of longitudinal muscles), are all solitary with a pair of muscles which terminate each side of the mid-dorsal and mid-ventral lines (as in *R. crassa*). *Rhopalaea desme* Monniot and Monniot, 2003 (from 100–500 m off Vanuatu and Fiji) has an ephemeral posterior abdomen and similar muscles to *Syndiazona chinensis* Tokioka, 1955, but its zooids are connected only by basal stolons and are not embedded in common test as they are in *S. chinensis*. *Rhopalaea circula* Monniot and Monniot, 2001 from the tropical western Pacific also has zooids connected by basal stolons and has paired longitudinal muscles on the abdomen and a posterior abdomen has not been reported. This species is distinguished from *R. desme* by its numerous thoracic muscles which terminate each side of the mid-dorsal and mid-ventral line (as in *R. crassa*). *Rhopalaea hartmeyeri* Salfi, 1927 from the Mediterranean may also be colonial and has a posterior abdominal stolon but longitudinal muscles have not been detected on the abdomen. The solitary *R. neapolitana* Philippi, 1843 (also from the Mediterranean), the type species of the genus, resembles *R. crassa*, lacking muscles on the abdomen (see Salfi 1928).

Monniot (1969) could not detect inner longitudinal vessels in the juvenile thoraces of *R. nordgaardi* Hartmeyer, 1922 that he examined and he assigned the species (together with its synonym (*R. norvegica* Arnböck-Christie-Linde, 1925)) to the genus *Tylobranchion*. However, Millar (1966) found these vessels (albeit sometimes interrupted) in the material he examined and the species (from the northeastern Atlantic to 400 m) appears to have been properly assigned to the genus *Rhopalaea*. It is either solitary, or its zooids are joined by stolons or embedded, its stomach wall has numerous fine longitudinal folds, and muscles are not known to extend on to the abdomen.

Rhopalaea piru Monniot and Monniot, 1987, from French Polynesia, is colonial with embedded zooids and is wrongly assigned to *Rhopalaea*. It appears to be a junior synonym of *Syndiazona chinensis* Tokioka, 1955 (see Millar 1975; Kott 1990a).

Monniot and Monniot (2003) reported numerous buds in the basal test of Fijian specimens of *R. desme*. However, there is no evidence that these are actually buds, nor are buds known to develop in the terminal ampullae of vascular stolons in the Diazonidae, although they do in the Clavelinidae. The Fijian specimen has muscles on a posterior abdomen as well as the thorax and abdomen, a characteristic that distinguishes it from clavelinid zooids and its affinities are not understood.

The present species appears to have some affinity with the tropical *R. circula* although the latter species appears to be colonial, has more longitudinal muscles and stigmata, and is geographically isolated. The distinction between the present species and *Rhopalaea tenuis* is less obvious. Twenty fine longitudinal muscles, half from the branchial siphon and half from the atrial siphon, are recorded for *R. tenuis*, about twice the number detected in the single thorax that is available for the present species. However, this could be affected by contraction, which draws muscle bands together, reducing their apparent number. Nevertheless, the present species, although a similar size to *R. tenuis*, has more stigmata per row and more (about 100) rows, and until more data become available, is considered not to be conspecific. The recorded location for the present species is the most southerly record for this genus in which (with the exception of *R. cloneyi* from the north-eastern Pacific, *R. neapolitana* from the Mediterranean, and *R. nordgaardi* from the north-eastern Atlantic) most known species are tropical.

Clavelina simplex sp. nov.

(Figure 1D, E)

Distribution

Type locality. Tasmanian Canyons (Banks Strait, 168 m, 25 April 2004, Sherman sled, four syntypes, QM G308824).

Description

Colonies are short, rather stumpy cylinders, upright, up to 3 cm high and 1.5 cm diameter with the upper end rounded. The upper half to two-thirds of the colony is naked and transparent and the lower third to half is slightly translucent and has particles of sand and shell adhering to it. The base of the colony is irregular and has some sand attached to it. Up to 10 zooids are in each colony and open in what appears to be a circle around the upper surface. The test is darkly pigmented around the apertures. Conspicuous clusters of terminal ampullae of the fine-branching vascular stolons are in the test around the periphery of the lower two-thirds of the colony. The type material is crushed and mutilated and details of the zooid morphology are obscure. The branchial aperture is terminal and the atrial aperture is sub-terminal. Juvenile gonads are in the gut loop.

Remarks

Although the zooids in the present colonies are not well preserved and few adult organs are distinguishable, the species is readily recognised as belonging to this family Clavelinidae by the conspicuous clusters of crowded terminal ampullae and prolific branches of the test vessels that are known to be the site of replication. Clavelinidae, an aplousobranch family, is separated from others by its unique method of vegetative replication—budding in terminal ampullae of the test vessel.

The new species is distinguished from others in the genus by its very simple colony with a circle of relatively short zooids around the top of each independent vertical lobe and by the profusion of terminal ampullae of test vessels that crowd the central test in the thick, cylindrical stalk behind the zooids. In its short zooids it most resembles the indigenous

southern Australian species *Clavelina cylindrica*, which also has a large number of terminal ampullae. *Clavelina cylindrica* is a commonly encountered species in temperate Australian waters (Cockburn Sound to Bowen; Kott 1990a) but its zooids are only partially embedded clearly distinguishing it from the present species.

In his notes on Distomidae, Caullery (1909) reported on a specimen from Western Port collected by Quoy and Gaimard that resembled *Polyclinum cylindricum* Quoy and Gaimard, 1834 (<*Clavelina cylindrica*) and had terminal ampullae of the test vessels that resemble those found in the present species. He assigned it to *Chondrostachys* Macdonald, 1858 (type species *C. macdonaldi* Bronn, 1862 from Bass Strait), a genus of the Clavelinidae, with relatively few longitudinal muscles, triradial adhesive organs, the anal opening near the atrial aperture and buds forming in the terminal ampullae of test vessels. (It had been noted in a footnote to Macdonald's paper by the editor of the journal *Annals and Magazine of Natural History* (1858) that *Chondrostachys* resembled the Clavelinidae closely; and subsequently *Chondrostachys macdonaldi* was recognised as a junior synonym of *Clavelina cylindrica*).

The genus *Clavelina* is well represented in the temperate ascidian fauna of Australia and world-wide by a number of colonial species with partially embedded zooids (*C. cylindrica*, *C. australis*, *C. moluccensis*, *C. pseudobaudinensis*), some with completely embedded zooids (*C. baudinensis*) and a few solitary or almost solitary ones (*Clavelina dagysa*, *C. ostrearium*). One other monotypic genus of the family, *Euclavella* (*E. claviformis*) with completely embedded zooids, also is known from temperate waters of Australia and New Zealand. Clavelinidae is not represented in the sub-Antarctic or Antarctic and its diversity in temperate Australian waters may be the result of isolation from the tropical fauna. The presence of this new species in the southern Ocean may also be a result of its isolation from a related temperate species.

***Pycnoclavella tabella* Kott, 1990**

(Figure 8B)

Pycnoclavella tabella Kott 1990a, p 77.

Distribution

Previously recorded (see Kott 1990a): South Australia (Spencer Gulf); Victoria (Portsea). New records: South Australia (Kangaroo I., 10–12 m, SAM E3292); Tasmania (Tasman Peninsula, 15–17 m, SAM E3291); Victoria (Portsea, SAM E3290). The species is usually in large aggregates on rocky walls and roofs of caves and overhanging ledges. This species has been recorded by scuba divers from relatively shallow waters.

Description

Specimens have the characteristic tangle of sandy, fragile, thin basal stolons, and narrow, often branching vertical stalks containing the long abdomina, also encased in thin, sandy test. On top of these vertical branches are the small spherical thoraces in thin, transparent, sand-free test, sometimes with a greenish oily appearance in life.

***Stomozoa australiensis* Kott, 1990**

(Figure 8C)

Stomozoa australiensis Kott 1990a, p 157.

Distribution

Previously recorded (see Kott 1990a): South Australia (Great Australian Bight). New records: South Australia (Kangaroo I., 4–8 m, SAM E3228 E3278 E3285).

Description

Firm, cartilaginous, translucent irregularly branching stalks. Rounded heads on the terminal branches have thoraces of the semi-embedded zooids with their separately opening lobed apertures (surrounded by the characteristic dentate lobes) covered by transparent flexible test and projecting free like bubbles from the firmer test of the stalks. Zooids have a red thoracic wall when first preserved but subsequently are brownish yellow in preservative. The long oesophageal neck is very contracted in these specimens. A single large spherical larva is being incubated in the atrial cavity of specimens collected in March (SAM E3228).

Remarks

Specimens are as previously described.

***Sigillina exigua* sp. nov.**
(Figures 2A–C, 8D)

Distribution

Type locality. South Australia (Kangaroo I., “The Arches”, Western River, on rock wall, 10–12 m, coll. K. Gowlett Holmes, 10 December 1999, syntypes SAM E3300).

Description

Colonies are small flat-topped cushions, about 2 cm diameter and to 5 mm high attached to calcareous debris. Zooids open on the upper surface. The test is soft and transparent. Zooids are short, about 3 mm long, the thorax, abdomen and posterior abdomen being each about equal in length. A short vascular stolon is at the posterior end of the body. Both six-lobed apertures are on the anterior end of the thorax.

Three long rows of stigmata are in the branchial sac. Gonads are in the abdomen. A large almost spherical brood pouch constricted off from the postero-dorsal corner of the thorax contains a single embryo.

The larval trunk is spherical and 1.1 mm diameter. An otolith and ocellus and three rows of stigmata are in the oozoid. Two large flat-topped adhesive organs, each in a thin-walled epidermal cup and with a short thick stalk, are depressed into the trunk in the antero-median line. Three large median ectodermal ampullae alternate with the adhesive organs and curve around their stalks. The tail winds completely around the trunk.

Remarks

The cushion-like colonies and the zooids are particularly small for this genus. The species most closely resembles *S. signifera*, having flat-topped colonies and two large adhesive organs. However, both zooids and larvae of the present species are smaller (*S. signifera*

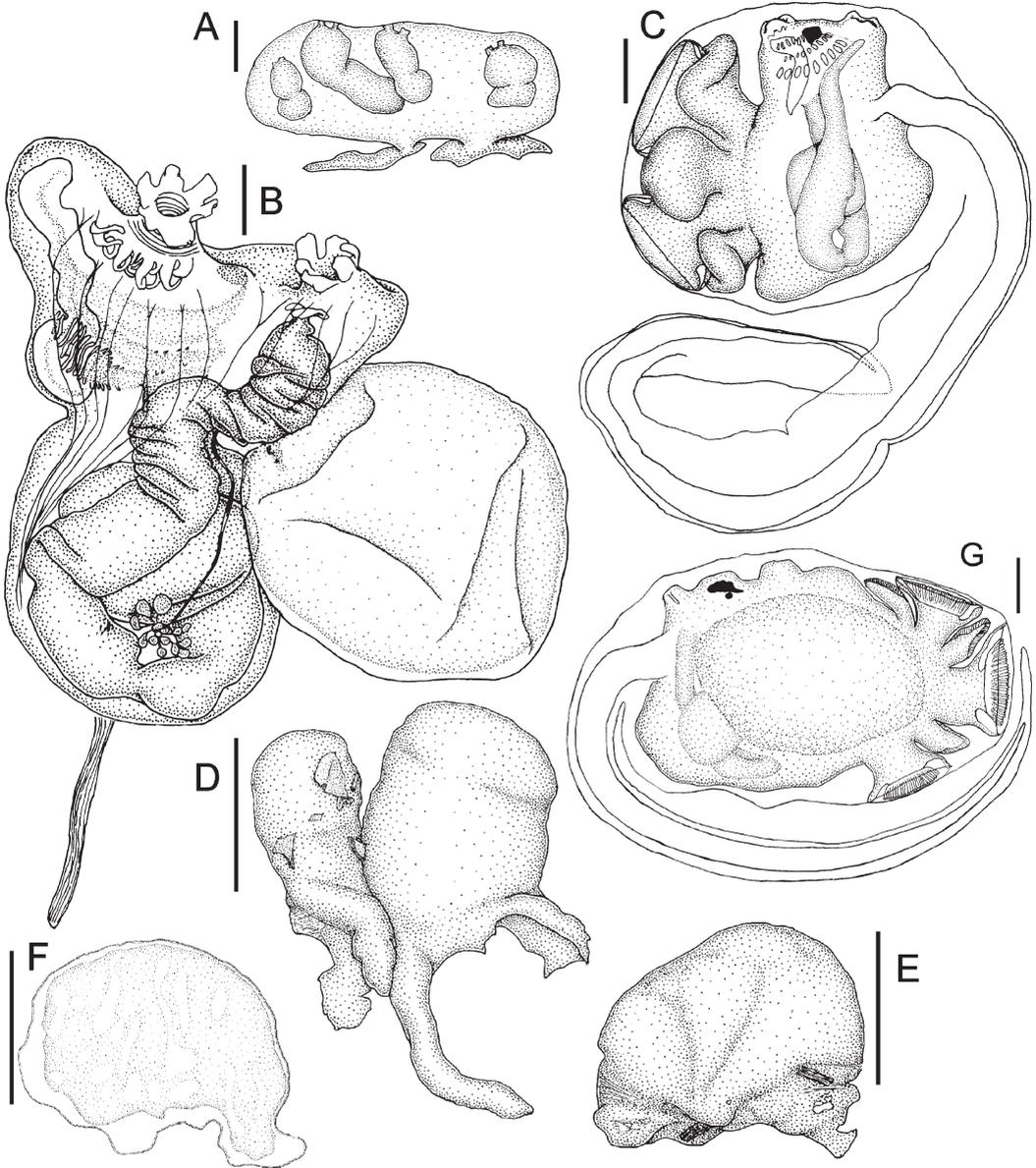


Figure 2. (A–C) *Sigillina exigua* sp. nov. (SAM E3300, syntype): (A) colony; (B) zooid; (C) larva. (D–F) *Eucoelium orientalis*: (D, E) colonies; (F) vertical section through colony showing position of sub-surface spicule layer. (G) *Eudistoma anaematum* (AIMS 17693): larva. Scale bars: 1 mm (A); 0.2 mm (B, C); 1 cm (D–F); 0.1 mm (G).

larvae having a trunk 0.5 mm long). The present species from the southern Atlantic may be a sister species isolated from *S. signifera* which has a wide range and is common in tropical waters.

The separately opening zooids, large larval trunks, wide, flat-topped, thick stalked larval adhesive organs, the three long rows of stigmata and the postero-dorsal thoracic brood pouch are characteristic of both this genus and *Pseudodistoma*, which is distinguished by its

long posterior abdomen containing the gonads and the lack of the posterior abdominal vascular stolon of *Sigillina*. Kott (1992a) overlooked the similarity of *Sigillina* and *Pseudodistoma* and, although she later (Kott 1998, 2005b) emphasized the remarkable, large larval adhesive organs in *Pseudodistoma*, she again overlooked their likeness to the adhesive organs of *Sigillina*. It is possible the relationship of *Sigillina* to the Holozoidae based on the pattern of replication from the large vascular stolon (see Caullery 1909) could be less important than it previously was thought to be; and that the presence of the gonads in a posterior abdomen with conspicuous bands of longitudinal muscles along each side (that distinguishes *Pseudodistomidae* from *Sigillina*) may be less compelling than the characters (listed above) that are shared by these genera and suggest a closer phylogenetic relationship than previously was proposed.

***Distaplia australiensis* Brewin, 1953**

(Figure 8E, F)

Distaplia australiensis Brewin 1953, p 61. Kott 2003, p 1619 and synonymy (part, not specimens from Queensland=*Distaplia turboensis* Kott 2004, p 45).

Distribution

Previously recorded (see Kott 2003 and *D. turboensis* Kott, 2004): South Australia (Spencer Gulf, Gulf St Vincent, Bass Strait, D'Entrecasteaux Channel, Huon Channel. New records: South Australia (Kangaroo I., 4–7 m, SAM E3294–5).

Description

Long cylindrical stalks each with a soft, rounded head surrounded by parallel double rows of zooids extending from the top of the stalk to a terminal common cloacal aperture. Zooids have the usual large atrial aperture opening directly into the vertical common cloacal canal between each row of zooids of the pair. The stomach wall has about 16 parallel longitudinal pleats. Gonads were not detected in the newly recorded colonies, although usually they are in a sac separated from the abdomen by a narrow constriction.

Remarks

Although the arrangement of the zooids in long vertical rows and the presence of the gonads in a posterior abdomen is similar to the tropical *Distaplia turboensis*, the present species is distinguished by its long cylindrical stalks and fewer stomach folds.

***Distaplia florida* Kott, 1990**

(Figure 8G)

Distaplia florida Kott 1990a, p 118.

Distribution

Previously recorded (see Kott 1990a): South Australia (Great Australian Bight); Victoria (King I.); New South Wales (Byron Bay). New records: Victoria (Flinders Pier, QM G308566); Tasmania (Tasman Peninsula, 15–18 m, SAM E3293; Port Davey, 6–8 m, SAM E3233).

Description

Colonies are soft, hemispherical or cushion-shaped (up to 3 cm diameter) to flat encrusting sheets with circular to elongate systems of zooids around large circular common cloacal apertures, about 5 mm apart. They are beige in preservative, and minute crystalline particles in the test give it a cloudy appearance. In the preserved specimens, radial furrows around the common cloacal apertures may be the result of preservation and/or contraction. A shallow concavity in the surface over each circular common cloacal cavity has its margin overhung by the surrounding surface test. Branchial apertures open beneath this overhang. The atrial apertures are large sessile openings around the common cloacal cavity with their anterior lips extending out into the margin of the common cloacal aperture. Black faecal pellets in the base of the circular common cloacal cavities are conspicuous from the surface. About 10 zooids surround each common cloacal cavity.

Zooids have a long oesophageal neck, a smooth stomach wall and gonads in the gut loop. Four rows of about 25 stigmata are each crossed by a parastigmatic vessel. A vegetative stolon projects into the base of the colony.

Remarks

Species of *Distaplia* are difficult to distinguish from one another, often having circular systems and soft cloudy test like the present one. The presence or absence of a posterior abdomen is a useful character but, when zooids are immature as in the present case, the smooth stomach wall helps to distinguish this species from others in which it is folded. The concavities over each common cloacal cavity in the preserved specimens appear to be characteristic of this species, although both species have circular systems, smooth stomachs and gonads in the gut loop. The present species is distinguished from *Distaplia viridis* Kott, 1957 by the more numerous branchial stigmata, and by its colour.

***Distaplia pallida* Kott, 1990**

(Figure 8H)

Distaplia pallida Kott 1990a, p 121.*Distribution*

Previously recorded (see Kott 1990a): South Australia (Great Australian Bight, Gulf St Vincent); Victoria (Portsea); New South Wales (Byron Bay); Tasmania (Tinderbox). New records: Tasmania (Port Davey, 5–7 m, SAM E3273).

Description

The colony is a firm, jelly-like translucent cushion with conical lobes protruding from the upper surface. Zooids are arranged in circular to long oval systems around sessile common cloacal openings. Sometimes the common cloacal apertures are long slits between two apparently parallel rows of zooids, and at each end the opening extends into narrow slits in the roof of the common cloacal canal that expose the atrial apertures directly to the exterior. The translucent internal or basal test contains criss-crossing posterior stolons of the zooids. About 12 stigmata are in each row in the branchial sac and the stomach has about 10 broad, parallel external folds. Gonads were not detected in

the newly recorded specimens, although in previously recorded specimens they are reported to be in the gut loop. Photographs show colonies as pale blue, although they are beige in preservative.

Remarks

The species is distinguished from other species with circular to longitudinal systems by its relatively few branchial stigmata, broad stomach folds, and gonads in the gut loop (see Kott 1990a).

Sycozoa murrayi (Herdman, 1886)

Colella murrayi Herdman 1886, p 115.

Sycozoa murrayi: Kott 1990a, p 146 and synonymy.

Distribution

Previously recorded (see Kott 1990a): South Australia (Great Australian Bight, Gulf St Vincent); Tasmania (Midway Point, NE Tasman); NSW (Bermagui). New records: Tasmanian Canyons (King I. Canyon, 248–249 m; Banks Strait, 168.4 m; Big Horseshoe—west band, 159.6 m; Ling Hole, 163 m; Pieman Canyon, 173.8–176 m; 40.77531°E, 144.22719°S, 94.6 m).

Description

The species has relatively firm spatulate to fan-shaped heads on short fleshy stalks which contain the long posterior abdominal stolons characteristic of this genus. Colonies are yellow in deck photographs, however its living colour is not known. The zooids are immature in these specimens which were collected in April.

Remarks

The species previously has been recorded from depths similar to those newly recorded (e.g. Herdman 1886 off Bermagui and in Bass Strait at 200–250 m). The fan-shaped head sometimes observed in the present species resembles that of *S. brevicauda* Kott, 1990, although the latter species had a longer, narrower and less fleshy stalk.

Sycozoa sigillinoides Lesson, 1830

Sycozoa sigillinoides Lesson 1830, p 436. Kott 1990a, p 153 and synonymy.

Distribution

Previously recorded (see Kott 1990a): South Australia (S. Spencer Gulf); Tasmania (St Helen's and Montague I.). Magellanic area; Falkland Is; Kerguelen, Heard I.; Macquarie I.; Chatham I.; New Zealand and the Antarctic. New records: Tasmania (Tasman Peninsula, 20–22 m, SAM E3247), Tasmanian Canyons (King I. Canyons, 249 m; Banks Strait, 168 m; Ling Hole, 163 m, 174 m; Pieman Canyon, 173–176 m).

Description

The newly recorded specimen from the Tasman Peninsula is a stiff, narrow stalk, with stiff annular thickenings at intervals. It has two short terminal branches, each bearing a small mushroom-shaped head with vertical double rows of zooids and a terminal common cloacal aperture.

Remarks

Australian records of this species are few, but the new records are from Tasmania within the range previously recorded. The newly recorded specimens (taken in April) are either long wiry headless stalks or stalks with very small (regenerating) heads. Millar (1960) reported headless stalks in May, June, and July; stalks with regenerating heads in December, March, May, June, and July; and sexual reproduction at its peak in March. The regenerating post-reproductive stalks of the newly recorded specimens (taken in April) are within this timeframe. The presence of isolated heads of this species in the plankton of the tropical Atlantic and Pacific (see Kott 1990a) has already been reported.

Eucoelium orientalis (Kott, 1990)

Polycitorella orientalis Kott 1990a, p 187 and synonymy; not *E. orientalis*: Kott 2003.

Distribution

Previously recorded (see Kott 1990a): Western Australia (Rottnest I., Houtman's Abrolhos); Queensland (Swain Reefs, Heron I., Coral Sea). New records: Tasmanian Canyons (Banks Strait, 168 m).

Description

Colonies are dome-shaped to stalked, with a single layer of moderately crowded spicules in the surface over an aspiculate layer of variable thickness. Spicules also are present internally in varying concentrations. Spicules are to 0.05 mm diameter with 5–13 stout conical rays in optical section. Large zooids open around the upper domed surface and converge toward the centre of the base of the colony. They are in a vegetative state, the abdomina breaking up into replicates.

Remarks

Eucoelium is known, from only eight species, from Japan, the Gulf of Suez and the western Indian Ocean, New Zealand, and tropical and temperate waters around the Australian continent (where three species are known). The present species has been recorded from the Great Barrier Reef and the Coral Sea, but the present record implies a wider range into temperate waters. All the known species of *Eucoelium* are very variable, but can be distinguished by their spicules, those of the present species being to 0.05 mm diameter with 5–15 rays. *Eucoelium mariae* (Michaelsen, 1924) from New Zealand has smaller spicules than the present species and the principally temperate *E. coronaria* Monniot, 1988 has larger spicules and its zooids are arranged in conspicuous circular systems. *Eucoelium orientalis*: Kott 2003 has large (to 0.09 mm diameter) globular spicules as well as smaller stellate ones and appears not to be a synonym of the present species.

This genus and another polycitorid genus, *Cystodytes*, are the only aplousobranch genera outside the Didemnidae with the capacity to create calcareous spicules in the test. Although the spicules are very similar to those of the Didemnidae, a phylogenetic relationship is not implied.

Like other species taken from the Tasmanian Canyons, the new record of the present species from so much further south than it was previously known provides further evidence that the Australian continent may constitute a route for gene flow of shallow-water tropical species into temperate waters.

***Eudistoma anaematum* Kott, 1990**

(Figure 2G)

Eudistoma anaematum Kott 1990a, p 196.

Distribution

Previously recorded (see Kott 1990a): Queensland (Great Barrier Reef). New record: Queensland (Bowden Reef, AIMS 17693).

Description

The newly recorded colony has firm gelatinous test containing the usual long polycitorid zooids, which are arranged in circles with the long atrial siphons opening in the centre of the circle. Sand is not present either in or on the colony. The living colony was transparent and bluish beige. Dark, spherical pigment particles are scattered sparsely through the test of the preserved specimen. Zooids are robust, as previously described, with up to 30 stigmata in each of three rows and there is a long prestigmatal unperforated area in the pharynx. The almost spherical stomach is at the end of the long oesophageal neck, at the posterior end of the body. Zooids have up to two embryos developing in the atrial cavity. Larvae are similar to, although the trunk (0.75 mm long) is about half the length of the larval trunk of, *E. globosum*. The three antero-median adhesive organs have wide platforms of adhesive cells on short thick stalks, each surrounded by a shallow epidermal cup; and three narrow, median, ectodermal ampullae alternate with the adhesive organs. A large oval yolk mass almost completely occupies the larval trunk. The tail winds about halfway around the trunk.

Remarks

The species is distinguished from others in this homogenous genus by its naked, sand-free, translucent colony. Its larva is described here for the first time.

***Eudistoma globosum* Kott, 1957**

Eudistoma globosum Kott 1957, p 72; Kott 1990a, p 210.

Distribution

Previously recorded (see Kott 1990a): Western Australia (Houtman's Abrolhos, Cockburn Sound, Margaret River); Queensland (Capricorn Group). New records: Tasmanian Canyons (Ling Hole, 174 m).

Description

Colonies are about 3 cm high, simple, upright lobes with a short, thick, cylindrical stalk and a conical naked head. The long zooids, characteristic of the genus, open all around the head and extend crowded and parallel to one another down into the base of the stalk. Sand is crowded in the stalk and projects up into the centre of the lower half of the head.

Remarks

Zooids of species in the genus *Eudistoma* are very similar. The zooids all have short thoraces with numerous stigmata, characteristic long oesophageal necks with the stomach and gonads in the pole of the gut loop at the posterior end of the zooid and muscular body wall with an almost continuous outer coat of transverse fibres and inner longitudinal bands that continue into the abdomen. Because of this lack of diversity in the zooids, distinguishing characters are often more likely to be found in the colonies and the larvae.

The form of the small, simple, compact colonies of the present species and the distribution of sand in them is characteristic. The genus is not known from the sub-Antarctic south of New Zealand and the Tasmanian Canyons, and its original provenance may be from the tropics, where it is most diverse. However, the record from Margaret River and its occurrence south of Tasmania suggests that it is a temperate species which extends northwards on each side of the continent.

***Pseudodistoma australe* Kott, 1957**

Pseudodistoma australis Kott 1957, p 101.

Pseudodistoma australe: Kott 1992a, p 428 and synonymy; 2003, p 1625 [not 1985 (*sic*) = 1992a].

Distribution

Previously recorded (see Kott 2003): Western Australia (Exmouth Gulf to Cockburn Sound); South Australia (Great Australian Bight, Cape Jaffa); Victoria (Port Phillip Heads); Queensland (Swain Reefs). New record: Tasmania (Port Davey, 8–10 m, SAM E3231).

Description

The colony is soft and translucent, its upper surface expanded into four short conical lobes like a crown. It converges slightly toward the base, where it appears to have been fixed to a wide, flat surface about 4 cm in diameter. Zooids extend up the colony parallel to one another and the independently opening six-lobed apertures are around the outside of the terminal lobes. Thorax and abdomen are, together, relatively short. Three rows, each of about 12 branchial stigmata, are in each half row and a short gut loop with a smooth-walled stomach is about halfway down the short abdomen. The posterior abdomen is very long, with strong bands of muscles along each side. Gonads were not detected in the newly recorded colonies, which appear to be in a vegetative stage, although there is a large embryo in the brood pouch (at the postero-dorsal end of the thorax) in a few of the zooids.

Remarks

These gelatinous, translucent rose-coloured colonies with a thick, soft stalk consisting of one or more terminal lobes, are characteristic of this wide-ranging apparently indigenous species. The new record is the most southern location known and confirms its wide range, often from temperate localities albeit extending into the tropics on both sides of the continent.

***Pseudodistoma gracile* Kott, 1992a**

(Figure 9A)

Pseudodistoma gracilum Kott 1992a, p 433 and synonymy.

Distribution

Previously recorded (see Kott 1992a): South Australia (Great Australian Bight, Investigator Group, Kangaroo I.); Victoria (Beachport, Western Port); New South Wales (Jervis Bay, Port Jackson); Queensland (Great Barrier Reef); New Caledonia. New records: South Australia (Kangaroo Is, 8–10 m, SAM E3270); Tasmania (Maria Is; Port Davey, 4–6 m, SAM E3269).

The new records from Tasmania are the most southerly locations yet recorded for this species.

Description

The colonies have the robust, contractile zooids of the usual form entangled in the soft, disintegrating mucus-like test as described previously.

Remarks

Although colonies and zooids resemble those of the Japanese *P. fragile* Tokioka, 1958, the present species broods only a single embryo at a time, while the Japanese species has a long brood pouch with up to five embryos being brooded at a time and a significantly longer larval trunk (see Kott 1992a). Like other species in this genus it is more often recorded from temperate locations than from tropical ones.

***Pseudodistoma inflatum* Kott, 1992**

(Figure 9B)

Pseudodistoma inflatum Kott 1992a, p 435.

Distribution

Previously recorded (see Kott 1992a): New South Wales (South Solitary Is, Byron Bay, Coff's Harbour); Queensland (Mooloolaba). New record: New South Wales (Coff's Harbour, 5–7 m, SAM E3297). The new record is from the restricted geographic range previously recorded for this species (from northern New South Wales to the Queensland/New South Wales border).

Description

The colony is small, sessile, its upper surface divided into two rounded lobes that narrow toward the base, where some sand is embedded, although there is none in the gelatinous and translucent test of the upper part of the colony.

Pseudodistoma pilatum Kott, 1992

(Figures 3A–C, 9C)

Pseudodistoma pilatum Kott 1992a, p 439.*Distribution*

Previously recorded (see Kott 1992a): South Australia (Great Australian Bight, Gulf St Vincent). New records: Tasmania (Tasman Peninsula, 12–14 m, SAM E3244; 10–14 m, E3296). The newly recorded location is the most southerly recorded for this species.

Description

The colonies are as previously described, with the long, narrow, cylindrical sandy stalks arising from a common base and a terminal cylindrical glassy, transparent head with the relatively crowded zooids opening all around it. The sand becomes less crowded toward the top of the stalk and is only sparse in the head. In this species the oesophagus is long and

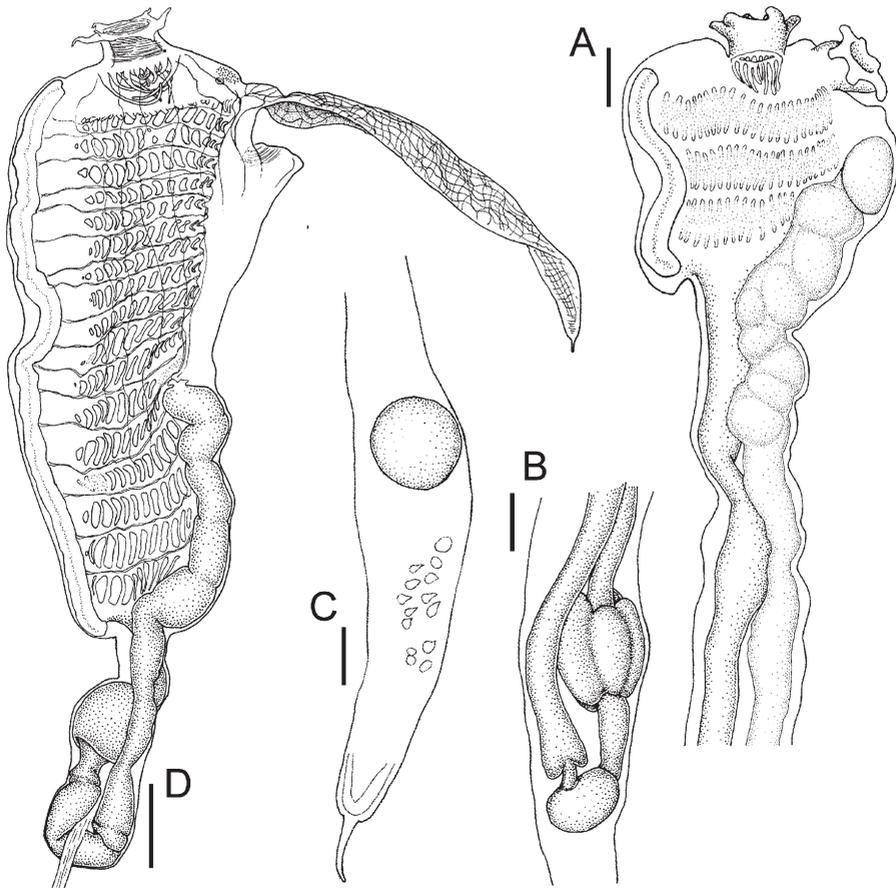


Figure 3. (A–C) *Pseudodistoma pilatum* (SAM E3244): (A) thorax and oesophageal neck; (B) posterior end of abdomen; (C) end of posterior abdomen. (D) *Polyclinum incrustatum* (SAM E3274): thorax and abdomen. Scale bars: 0.2 mm.

the four-chambered pseudodistomid stomach is in the distal one-third of the relatively long abdomen. The posterior abdomen is long and narrow, about twice to three times the length of the abdomen, with two broad bands of muscles and a short row of gonads at the posterior end (in the base of the stalk).

***Polyclinum incrustatum* Michaelsen, 1930**

(Figures 3D, 9D)

Polyclinum neptunium f. *incrustatum* Michaelsen 1930, p 542.

Polyclinum incrustatum: Kott 1992a, p 450 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Bunbury, Albany); South Australia (Great Australian Bight, Spencer Gulf); Victoria (Portland). New record: Tasmania (Port Davey, 4–6 m, SAM E3274).

Description

The colonies are as previously described, soft, grey oval pillows, with sand in the surface, although it is only sparse internally. Common cloacal apertures, slightly orange in the newly recorded specimens, are evenly distributed and protrude slightly from the otherwise smooth surface of the colony. Each cloacal aperture contains the very long, narrow atrial lips of the circle of zooids that surround it. These atrial lips project from the body wall just anterior to the small, round atrial opening of each zooid and they appear to close down over the forward-projecting atrial opening. A small post-atrial papillum also projects from the mid-dorsal line. Zooids have 18 rows of about 14 stigmata per half row, and about the same number of flat, rounded branchial papillae on each of the transverse interstigmatal vessels. Gonads were not detected in the newly recorded colonies, and a long, narrow posterior abdominal vegetative stolon is present.

Remarks

The specimens are consistent with those described previously for this species. It is distinguished from *Poyclinum marsupiale* by its more numerous rows of stigmata, the less protuberant common cloacal apertures and the crowded zooids in complex systems rather than the circular systems of zooids that surround each common cloacal aperture in *P. marsupiale*, and when embryos are present, by the lack of a brood pouch projecting from the thorax.

***Polyclinum marsupiale* Kott, 1963**

(Figure 9E)

Polyclinum marsupiale Kott 1963, p 83; 1992a, p 452 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Rottneest I., Albany); South Australia (Kingston, Victor Harbour); Victoria (Portland, Deal I.); Tasmania (Hunter I.). New record: South Australia (Kangaroo I., SAM E2866–7, E3298).

Description

Sandy, more or less circular cushions with rounded margins are fixed to the substratum by most of the under surface, although one specimen (SAM E2867) has an extension of part of the under surface attached to a bryozoan skeleton that holds the circular plate-like colony aloft, like a mushroom. Elevations, each containing a circle of zooids around a terminal cylindrical common cloacal aperture, project from the upper surface. The test is colourless and brown zooids are visible through it. Sand is only sparse in the internal test. A long narrow atrial lip from the body wall anterior to the small circular atrial aperture of each zooid is inserted into the test around each common cloacal aperture. The atrial lip has a straight or a pointed tip, or it is produced into a fringe of four or five pointed lobes or up to 10 minute denticulations. A small post-atrial papillum projects from the body wall just behind the atrial aperture. About 16 rows of stigmata have about 15 stigmata per half row and about the same number of flat branchial papillae on each transverse vessel. The stomach is small and smooth-walled; the gonads are in a sac constricted off from the abdomen. The proximal part of the vas deferens runs a convoluted course over the surface of the gonads and it may straighten out as the gonads mature. Embryos are crowded in a brood pouch protruding from the thorax behind the atrial cavity in the newly recorded specimens (SAM E3298 collected in November).

Remarks

The specimens are consistent with those described previously for this temperate species. It is distinguished from *Polyclinum incrustatum* by its brown zooids, presence of a brood pouch constricted off from the thorax, fewer rows of stigmata and cloacal systems that consist of a simple circle of zooids around a protruberant common cloacal aperture.

***Polyclinum vasculosum* Pizon, 1908**

Polyclinum vasculosum Pizon 1908, p 223; Kott 1992a, p 464 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Broome, Shark Bay); New South Wales (Arrawarra); Queensland (Moreton Bay to Lizard I.); Indonesia?, Philippines, Hawaii, West Indian Ocean. New record: 17.605°S, 146.355°E, Great Barrier Reef lagoon south of Cairns.

Description

The colony is a naked, robust encrusting sheet growing over mud and calcareous debris including worm tubes. Zooids have black squamous epithelium anteriorly, and it is particularly conspicuous over the large rectangular atrial tongue, with a straight fringed outer margin, which is separated from the body wall just anterior to the atrial aperture by a narrow constriction. The large atrial tongues are inserted into the test over the common cloacal canals that converge to the common cloacal apertures. The systems are conspicuous. Gonads are in a sac posterior to the abdomen. Two or three larvae, each with a trunk 0.75 mm long and the tail wound three-quarters of the way around it are in the

atrial cavity. They each have four median and four pairs of lateral ampullae and the usual antero-dorsal and postero-ventral clumps of vesicles.

Remarks

The robust colonies with black zooids and yellowish pigment in life and conspicuous common cloacal canals converging to the common cloacal apertures are common components of tropical rubble fauna. The species is an Indo-West Pacific tropical species.

***Aplidiopsis confluata* Kott, 1992**

(Figure 9F, G)

Aplidiopsis confluata Kott 1992a, p 468.

Distribution

Previously recorded (see Kott 1992a): Tasmania (Ninepin Point). New record: Tasmania (Port Davey, 4–6 m, SAM E3281).

Description

The colony is soft, mushroom-shaped with a circular flat head on a short narrow stalk from the centre of the under surface. Sand, present on the outer surface of the head, is sparse in the soft internal test of the head but is crowded in the stalk. Conspicuous common cloacal apertures are present around the margin of the upper surface of the colony and zooids form circular systems around them or they line the canals that radiate to them. Photographs show the colony to have been red in life. Zooids have a long strap-like atrial lip from the body wall anterior to the opening and it has a fringe of four to six pointed projections along its free edge. A small papillum is present behind the atrial aperture. Six fine longitudinal muscles on the anterior part of the thorax fade out halfway down the sides. Sixteen rows of about 14 stigmata are on each side of the body. The stomach is smooth. The posterior abdomen is long and narrow and muscles were not detected on it.

Remarks

Previously the species was known only from its holotype, which is a larger colony with more crowded zooids and systems but otherwise is similar to the newly recorded specimen.

***Synoiicum bowerbanki* Millar, 1963**

Synoiicum bowerbanki Millar 1963, p 697; Kott 1992a, p 480.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Fremantle); Victoria (Portland Canyons). New record: Tasmanian Canyons (Banks Strait, 168 m).

Remarks

The newly recorded specimen has been assigned to this temperate species on the basis of the upright club-shaped colony, narrowing to the base, identical with one previously reported from Portland, Victoria (see Kott 1992a, Figure 42a). The test is soft and translucent. The species is characterised principally by the presence of only four rows of stigmata and identification of the newly recorded specimen cannot be firm because zooids are in vegetative state, with minute regenerating thoraces and long vegetative posterior abdomina.

Synoicum citrum Kott, 1992

(Figures 4A–C, 9H)

Synoicum citrum Kott 1992a, p 486.*Distribution*

Previously recorded (see Kott 1992a): South Australia (Port MacDonnell); Victoria (Wilson's Promontory); Tasmania (D'Entrecasteaux Channel, Bruny I.). New records: South Australia (Kangaroo I., 10–12 m, SAM E3277; 10–14 m, E3287); Tasmanian Canyons (Big Horseshoe, 159 m).

Description

Colonies are soft, rounded translucent cushions with whitish zooids in small circular systems showing through the translucent test and a slightly lobed surface. Zooids are crowded and although the circular systems that Kott (1992a) thought would be present can be seen in the *in situ* photographs, they were not always detected in the preserved specimens. Zooids have atrial apertures produced on short siphons, each with a large forked lip from the anterior rim of the opening. Fine longitudinal muscles are in the pallial wall of the thorax and continue in an inconspicuous band along each side of the abdomen and the posterior abdomen. The branchial sac has four pairs of rows of about 18 stigmata per half row, apparently formed by the transverse subdivision of four primary rows, the stigmata at the ventral end of each pair of rows being reduced in length to leave a triangular imperforate area of pharyngeal wall between successive pairs of rows. The large smooth-walled barrel-shaped stomach is halfway down the relatively short abdomen which contains the vertical gut loop. The anal opening, between the third and fourth secondary rows of stigmata, is bilabiate. Gonads were not detected in this specimen. However, there is a stout, contracted posterior abdomen containing a conspicuous tightly undulating (presumably epicardial) tube. A V-shaped tubular heart is at the posterior end of the posterior abdominal extension.

Remarks

The colony resembles *Distaplia pallida* and the zooids (especially the paired rows of stigmata and the presence of the epicardial tube in the posterior abdomen) are not unlike those of *Distaplia* spp. However, in other characters, the present species appears to belong to the genus *Synoicum* in the family Poyclinidae (see Kott 1992a). In the latter family and related families, as in the present species (but not in the Holozoidae), muscles continue on to the posterior abdomen which has the heart at its posterior extremity, the gut loop is vertical, the atrial aperture is small and usually does not expose the branchial sac directly to

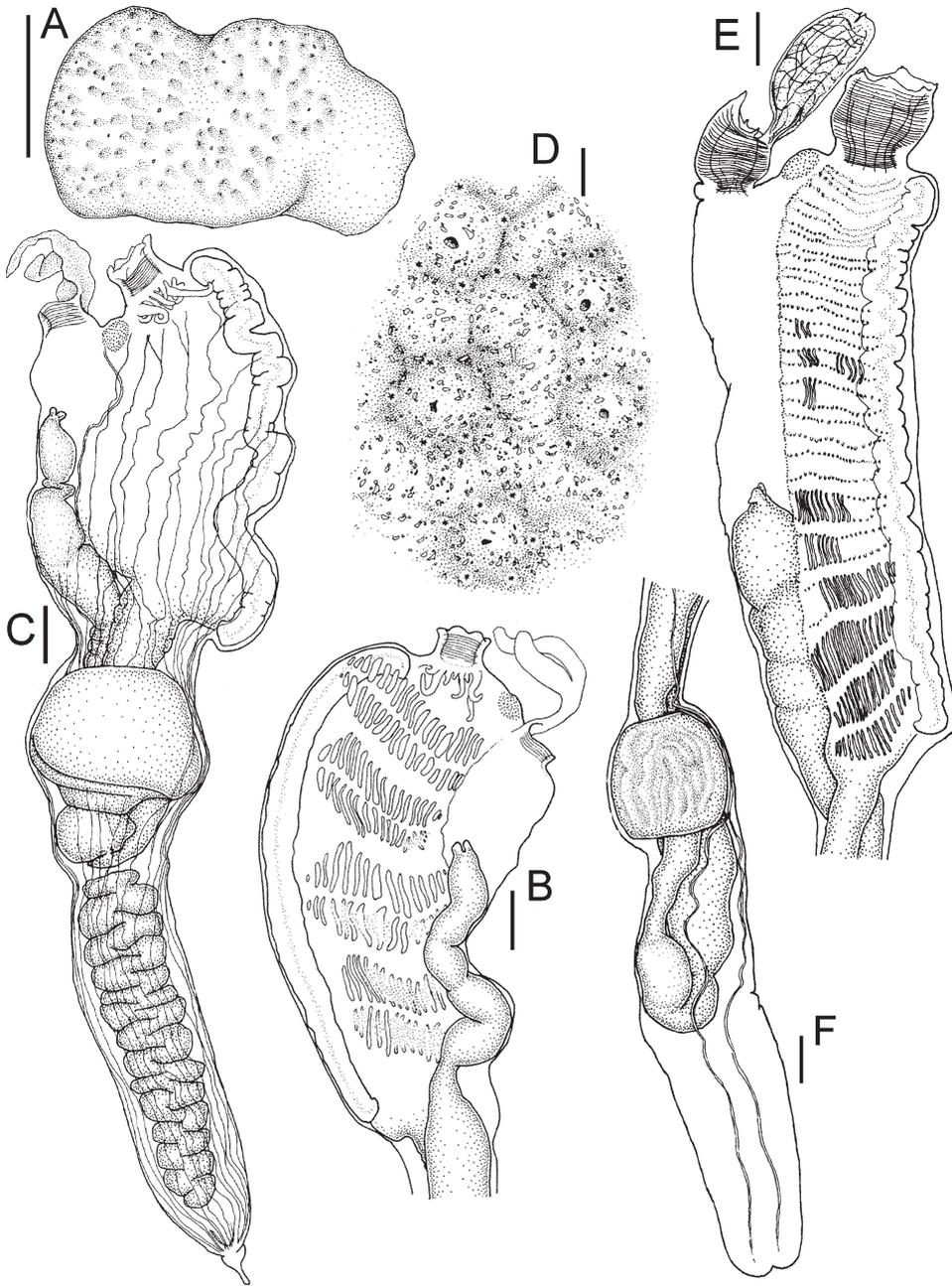


Figure 4. (A–C) *Synoicum citrum* (holotype SAM E3287): (A) colony; (B) thorax showing branchial sac; (C) whole zooid showing longitudinal muscles. (D–F) *Synoicum sphinctorum* (holotype SAM E3283): (D) colony; (E) thorax; (F) abdomen and posterior abdomen. Scale bars: 1 cm (A); 0.2 mm (B, C, E, F); 2 mm (D).

the common cloacal cavity. *Sigillina* also has an epicardial tube in the posterior abdomen and has body muscles on it, but it has only three rows of stigmata and its apertures open separately to the exterior. Further, although the larva of the present species is not known,

Synoicum is distinguished from both Holozoidae and *Sigillina* by its larva which has small adhesive organs in the antero-median line and characteristic polyclinid epidermal vesicles.

Synoicum bowerbanki Millar, 1963 has only four rows of stigmata, but these are not divided as they are in the present species.

***Synoicum obscurum* Kott, 1992**

Synoicum obscurum Kott 1992a, p 496.

Distribution

Previously recorded (see Kott 1992a): Victoria (Lakes Entrance); New South Wales (Arararra). New record: Tasmanian Canyons (MPA2 area—40.79269°E, 144.210916°S, 94.6 m).

Description

The newly recorded colony is a large clump of inverted cones, fixed at their apices to one another. Three or four circles of zooids around common cloacal apertures open on the flat base of the cone, which is at the top of the colony. The internal test is soft and translucent and a thin layer of sand adheres to the outer surface of the cone. The atrial tongue arises from the body wall just anterior to the atrial opening. The stomach is smooth.

Remarks

The present temperate species is distinguished from *S. sacculum*, which has a lobed colony, by the shape of its conical (rather than cushion-like) lobes and irregular creases in the stomach wall (rather than the mulberry-like stomach wall of *S. sacculum*). Only three specimens of this species previously were known. The newly recorded colony has multiple colony lobes rather than the single one previously known.

Kott (1992a) found the irregular creases in the stomach wall that are present also in the newly recorded specimen. These probably are artefacts.

***Synoicum sacculum* Kott, 1992**

(Figure 10A, B)

Synoicum sacculum Kott 1992a, p 499 and synonymy.

Distribution

Previously recorded (see Kott 1992a): South Australia (Great Australian Bight, Gulf St Vincent, West I., Thorny Passage); Victoria (Flinders); Tasmania (W. Granville Harbour). New records: South Australia (Kangaroo I., Vivonne Bay, 2–3 m, SAM E2864; “The Arches”, 10–12 m, E3288).

Description

The colonies consist of irregular sandy cushions to 3 cm diameter or lobes up to 1 cm high and 0.5 cm diameter. The lobes are concave on the upper surface. Basally they are attached

to a common basal mat. Sand is present on and in the test and is absent only from around the thoraces at the top of each lobe. The especially small (4 mm long) zooids, obscured by sand, are arranged in two or three circular systems (each of up to 10 zooids) per lobe. The common cloacal openings can be seen only when the sand is removed from the delicate test. Zooids have the usual short synoicid atrial siphon with an atrial lip from the upper rim of the opening and a small median papillum from the mid-line just behind the atrial aperture. Stomach walls are mulberry-like with rounded pouches in the internal lining. In preservative the test and zooids are a yellowish colour and the preservative is also stained yellow.

Remarks

The specimens, including their colour and the colour of the preservative, are consistent with previous descriptions of this species. A projecting brood pouch containing a single embryo from the postero-dorsal corner of the thorax has been reported in previously described specimens although these pouches were not found in the present material. The mulberry-like stomach, small colony lobes together with the numerous larval lateral ampullae help to distinguish this temperate species.

Synoicum sphinctorum sp. nov. (Figures 4D–F, 10C)

Distribution

Type locality. South Australia (Kangaroo I. between Western River Cove and Snug Cove, “The Arches”, on rock wall, 10–14 m, coll. K. Gowlett Holmes, 14 November 2001, holotype SAM E3283).

Description

The colony is a solid sandy mass, although the sand is crowded only on the surface and is sparse internally. The upper surface has dome-like elevations surrounded by about 10 branchial apertures and with a terminal common cloacal aperture. Broad sandy rounded ridges surround the domes. The branchial apertures are in the groove between the central dome and the marginal rounded ridge. The atrial aperture is on a brown-coloured siphon with a large, rounded muscular atrial lip projecting from the anterior rim of the opening. About three fine-pointed papillae are on the posterior rim of the atrial opening. Distinct sphincter muscles surround the atrial and branchial siphons. Gonads were not detected in the type colony. A small papillum projects from the mid-dorsal line just behind the atrial opening. The zooids are obscured by the sand on the colony. The branchial sac has 18 rows of stigmata with about 20 in each half row. The anus opens level with the seventh row of stigmata. The stomach is relatively small with 12 shallow, internal longitudinal folds, although these are not always seen in smaller zooids. Gonads were not detected, but the posterior abdomen is present with two narrow longitudinal muscles from the thorax extending along it.

Remarks

Although the zooids and the systems are like those of *S. concavatum* Kott, 1992a, the sphincter muscles around the siphons are more conspicuous and the colony has more sand.

Synoicum obscurum Kott, 1992a has different colonies with two or three systems per lobe and only irregular creases (rather than longitudinal folds) in the stomach wall. The larva of the present species is not known.

***Synoicum syrtis* sp. nov.**
(Figure 5A–D)

Distribution

Type locality. Queensland (site no. 144, 17.905°S, 146.815°E, 63 m, 25 September 2003, CSIRO Biodiversity Survey, holotype QM G308757).

Description

The mushroom-like colony (about 5 cm diameter across the flat upper surface) narrows abruptly to a short basal stalk from the centre of the lower surface. Sand is thick in the outer layer of test but is only moderately crowded in the central test. Long, thin zooids criss-cross in the central transparent test. Zooids of the holotype are darkly pigmented. They have relatively long abdomina and long and thread-like posterior abdomina. The atrial tongue arises from the body wall just anterior to the opening. Both zooids and their arrangement are obscured by sand.

Remarks

The species differs from many others in this genus by the origin of the atrial lip from the body wall anterior to the atrial opening. The atrial opening itself often is on a small siphon with a distinct sphincter muscle. The only other species of the genus which have a similar arrangement of the atrial lip and siphon are *Synoicum macroglossum* (Hartmeyer, 1919) which also is a tropical species, and *S. papilliferum* (Michaelsen, 1930), a temperate Australian species. Both these species have large, tough, irregular colonies unlike the mushroom-like colonies of the present species. They all have an external layer of sand, although in the present species and *S. papilliferum* some sand is present throughout the colony and the external layer is thicker than it is in *S. macroglossum*, which also lacks sand on the upper surface. Zooids of *S. macroglossum* and *S. papilliferum* are similarly long and thread-like, although the former may be larger and have slightly more stigmata. Zooids of the present species are obscured by contraction.

***Aplidium abditum* sp. nov.**
(Figures 5E, F, 10D)

Distribution

Type locality. Tasmania (Port Davey, 6–8 m, coll. K Gowlett Holmes, 12 March 2003, holotype SAM E3268).

Description

A whitish, flattened, sandy colony with numerous zooids and common cloacal systems. Zooids are along each side of the narrow common cloacal canals that appear to converge to

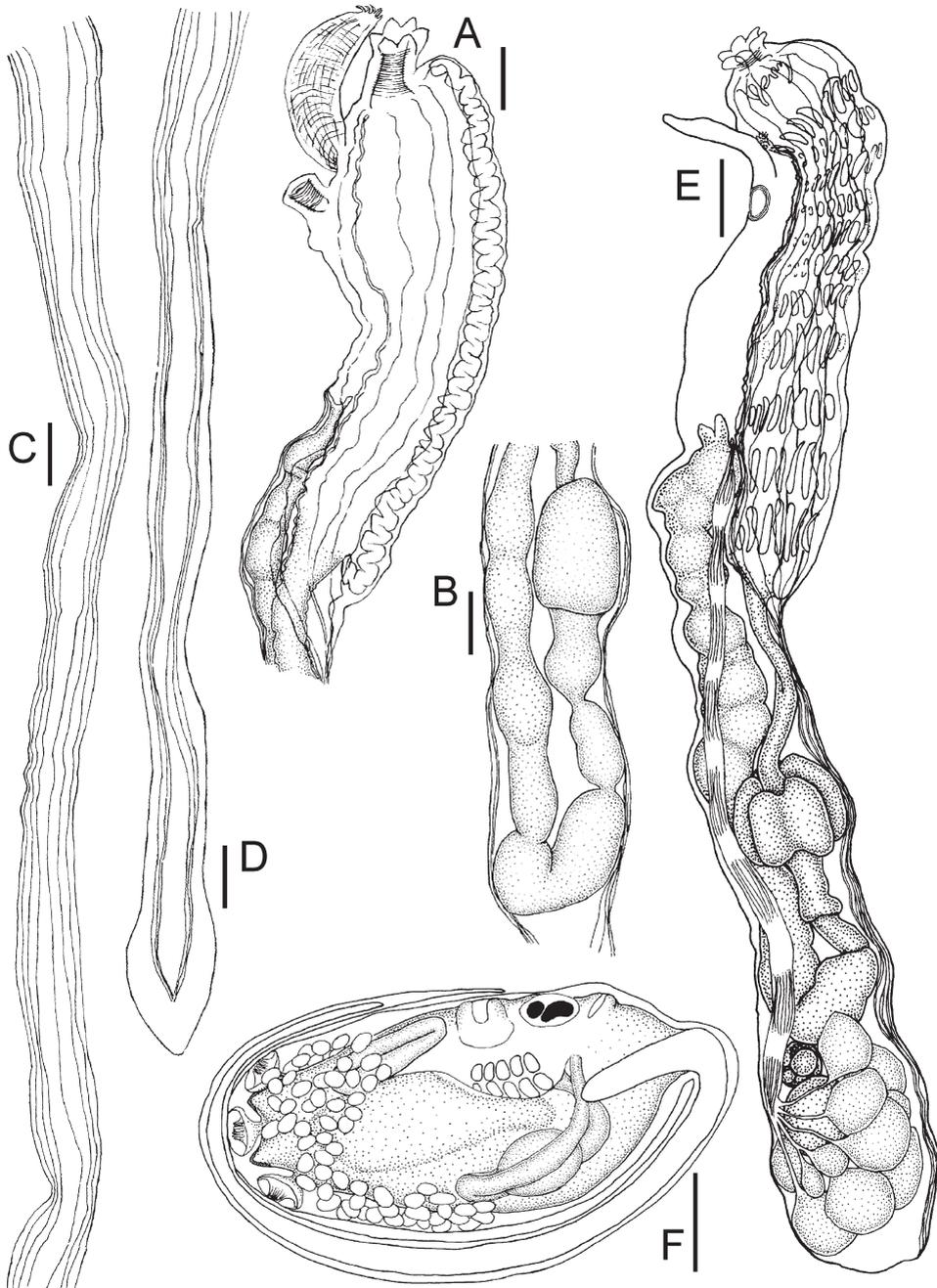


Figure 5. (A–D) *Synoicum syrtis* (holotype QM G308757): (A) thorax; (B) abdomen; (C) anterior part of posterior abdomen; (D) end of posterior abdomen. (E, F) *Aplidium abditum* (holotype SAM E3268): (E) whole zooid; (F) larva. Scale bars: 0.2 mm (A–E); 0.1 mm (F).

the numerous common cloacal apertures, which sometimes are conspicuous, sessile openings, or they are on the top of slight surface elevations. The translucent zooids sometimes look black owing to the black faecal pellets in their gut. However, there also are

some black spherical bodies in the test over the zooids. Zooids have a long pointed atrial lip arising from the upper rim of the atrial aperture. Muscles are relatively delicate. The thorax is long with 11 rows of about eight stigmata per side, a short stomach with five longitudinal folds in the abdomen. The posterior abdomen is short with bunched testis follicles. Two to four cigar-shaped larvae are being incubated in the atrial cavity. The larval trunk is 0.44 mm long and the long tail is wound about three-quarters of the way around the trunk. Single median ampullae alternate with the three antero-median adhesive organs and epidermal vesicles were not detected.

Remarks

The Gulf of Suez/Red Sea tropical species, *Aplidium lobatum* Savigny, 1816 has similar cloacal systems, the same number of rows of stigmata, and a short posterior abdomen with bunched testis follicles like the present species, although it has more stigmata and the present species appears to be a temperate one. *Aplidium ritteri* (Sluiter, 1895) is a tropical species with a similar branchial sac, small zooids, five stomach folds, and testis follicles bunched in the posterior abdomen, but its larva is more decorated than the present species, having crowded epidermal vesicles. The present species is distinguished by its relatively small branchial sac, short posterior abdomen with bunched male follicles, and small larvae with median ampullae but without lateral ampullae or epidermal vesicles.

Aplidium breviarvacium Kott, 1963

(Figure 10E)

Aplidium breviarvaceum Kott 1963, p 113; 1992a, p 527 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Point Peron, Cape Naturaliste); South Australia (northern Great Australian Bight). New record: South Australia (Kangaroo I., 14–17 m, SAM E3284). Kott (1992a) reports a specimen from Heron I., but this may be incorrect as all other records are from temperate waters.

Description

Sandy cylindrical stalks, branching once or twice along their length, have terminal translucent heads that slightly overlap the stalks. Sand is crowded in and around the stalks but is sparse in and on the heads.

Zooids open all around the head and they appear to be arranged in double rows, a row along each side of a longitudinal common cloacal canal. Common cloacal canals converge to a terminal common cloacal aperture. Thoraces and abdomina are about the same, relatively short, length. Stomachs have about 10 vertical parallel stomach folds.

Remarks

The long, branched stalks are characteristic of colonies of this species, and these stalks, short terminal heads and long vertical double rows of zooids resemble colonies of *Distaplia turboensis* Kott, 2004 or *Distaplia australiensis* Brewin, 1953, both of which can be readily

distinguished by generic characters. The species has been reported on only four previous occasions. The newly recorded specimen conforms to previous descriptions of this species.

***Aplidium caelestis* Monniot, 1987**

Aplidium caelestis Monniot 1987, p 517. Kott 1992a, p 528 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Shark Bay, Mullaloo Beach, Rottneest I., Hillary's Boat Harbour); South Australia (St Vincent Gulf, Spencer Gulf); Victoria (Bass Strait); New South Wales (Norfolk I.); Queensland (Capricorn Group); New Caledonia; Marianas Is. New record: Queensland (south-eastern coast, QM G321403).

Description

The newly recorded specimen is a robust, thick slab overgrowing ascidians and other organisms. Sessile common cloacal apertures occur at the junctions of the long canals that are lines on each side. Sand is crowded in the colony, especially in the ridge that protrudes from the surface between the rows of zooids, although it is absent from the surface over the common cloacal canals. In the preserved specimens oval masses of black granular bodies also are in the test between the rows of zooids. Zooids have pale yellow thoraces, yellow-orange abdomina, and white posterior abdomina (with two rows of male follicles). The atrial tongue is well separated from the aperture.

Remarks

Generally the newly recorded colony resembles those previously described. The sandy test, long double rows of yellowish zooids, dark granular bodies, long narrow zooids with conspicuous siphons, separate atrial tongue and a narrow gut loop with a small five-folded stomach appear to be characteristic.

The geographic range of this species, from Western Pacific tropical locations to Australian temperate waters, is vast. It appears to be one of the species that can be said to use the Australian coast as a bridge between tropical and temperate waters.

***Aplidium clivosum* Kott, 1992**

(Figure 10F)

Aplidium clivosum Kott 1992a, p 530 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (from Port Hedland to Hamelin Bay on the south-western coast); South Australia (Great Australian Bight to Nuyts and Eyre Peninsulas, Kangaroo I., Gulf St Vincent); New South Wales (Jervis Bay); Queensland (Capricorn Group). New record: Tasmania (Forestier Peninsula, 8–15 m, SAM E3390).

Description

The newly recorded specimen has the characteristic appearance of these large, conspicuous cushion- to tabular-shaped colonies, with a more or less horizontal upper surface where rows of zooids are along each side of common cloacal canals converging to large protuberant common cloacal apertures. Rounded marginal elevations on the upper surface surround each large cloacal system as well as the outside margin of the colony. The sides of the colonies are encrusted with sand, which also is present throughout the test, absent only from around the thoraces along each side of the shallow radial common cloacal canals. The sand can be seen in radial lines intruding in toward the common cloacal apertures between the double rows of zooids.

Zooids are distinctive with conspicuous sphincter muscles, a large atrial lip well removed from the apertures and five gastric folds. Colonies are invariably some shade of pink to red.

Remarks

Other species with similar systems depressed into the upper surface of the colony and similar zooids with conspicuous siphonal muscles and separate atrial tongues are *A. cratiferum* (Sluiter, 1909) and *A. grisiatum* Kott, 1998. The former can only be distinguished by its cloacal systems with the zooids opening around a central cavity rather than along each side of converging canals. The latter can be distinguished only by its more numerous gastric folds. Many of the *Aplidium* spp. (see Kott 1992a) have similar zooids to the present species, with conspicuous sphincters, separate atrial apertures and five stomach folds, but they have long, branched or circular common cloacal canals rather than central chambers or cavities or radial canals.

Species in other genera, namely the temperate *Aplidiopsis mammillata* Kott, 1992a, and the tropical *Synoicum castellatum* Kott, 1992a, also have similar colonies, although the latter has cloacal systems more like *A. cratiferum* and both are readily distinguished by their generic characters.

The present species, unlike *A. caelestis*, appears to be an indigenous Australian species. It has been recorded from temperate locations more often than from the tropics, although it does extend up both the western and eastern coast of Australia.

***Aplidium formosum* sp. nov.**
(Figure 6A–E)

Distribution

Type locality. South Australia (Port Adelaide, pylon 3, 3 m, holotype SAM E2899).

Description

The holotype is a wedge-shaped gelatinous colony to 2 cm high, with the upper surface partially divided into lobes. It is pinkish in preservative although the colour (which is caused by pigment in the body wall of the zooids) fades to colourless and translucent towards the base of the colony. The *Aplidium* colony mingles with, and possibly is being overgrown by, a colony of *Botrylloides leachii*. Small, crowded, thread-like zooids open on to the flat surface

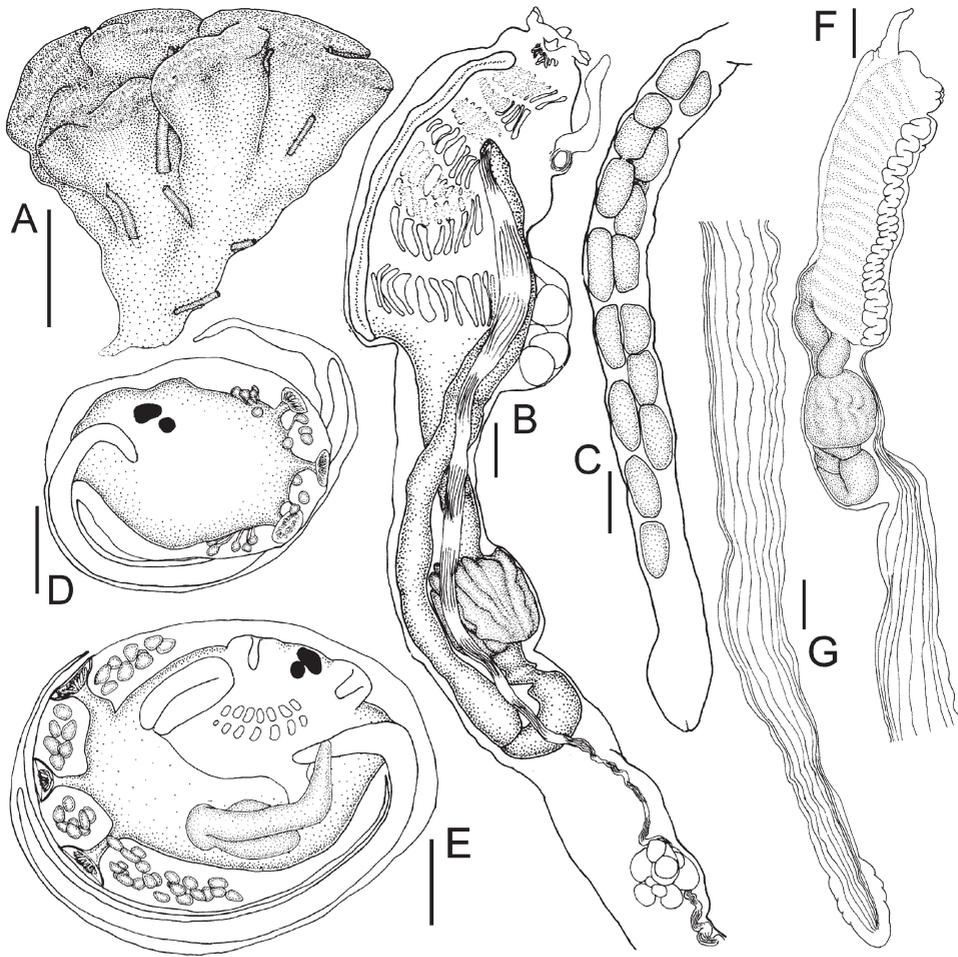


Figure 6. (A–E) *Aplidium formosum* (holotype SAM E2899): (A) colony; (B) thorax, abdomen, and proximal part of posterior abdomen, showing ovary; (C) posterior abdomen showing male follicles; (D, E) larvae. (F, G) *Aplidium laticum* (syntype QM G308832): (F) thorax and abdomen; (G) posterior abdomen. Scale bars: 1 cm (A); 0.2 mm (B, C, F, G); 0.1 mm (D, E).

of the *Aplidium* colony. Their arrangement is obscure. They have a short six-lobed branchial aperture and an antero-dorsal atrial aperture with a pointed tongue from the anterior rim of the opening. Eight rows of relatively long rectangular stigmata are in the branchial sac. The gut loop is about the same length as the thorax. The stomach has 16 parallel folds. A large ovary with up to seven eggs is at the top of the long posterior abdomen anterior to the double row of testis follicles. Up to eight embryos are in a developmental sequence in the narrow atrial cavity, the most advanced at the top near the atrial aperture.

The larval trunk (to 0.4 mm long) is almost cylindrical and the tail is wound around it about two-thirds of the way. The larval pharynx has two rows, each of about eight stigmata per side and the gut forms a horizontal loop behind the pharynx. About six epidermal vesicles project from small conical median ampullae that alternate with the adhesive organs

but regress and disappear as the vesicles separate from them. Patches of about six vesicles are also suspended in the larval test in the median line behind the upper and the lower adhesive organs, respectively.

Remarks

The zooids of the present species are shorter than the thread-like zooids of many *Aplidium* spp. but the stigmata are relatively long. The zooids of the present species resemble those of *Aplidium rosarium* Kott, 1992a, having similar numbers of stigmata in a similar number of rows, its larvae lined up in the atrial cavity and clumps of antero-median vesicles in the larval test alternating with the adhesive organs. However, *A. rosarium* also has lateral larval vesicles, which are not in the larvae of the present species.

Aplidium laticum sp. nov. (Figure 6F, G)

Distribution

Type locality. Tasmanian Canyons (38.11482°S, 149.3565°E, Banks Strait, 168 m, 25 April 2004, Sherman sled, species 10, syntypes two QM G308832; King I. Canyon, 294 m; Pieman Canyon, 176 m; Big Horseshoe, 159 m).

Description

Colonies are sessile globes or cones or stumpy upright lobes, fixed to the substratum by a sandy hold-fast in the centre of the lower surface. The test in all the recorded specimens is soft and almost liquid and the arrangement of the zooids was not determined.

In most of the specimens, the zooids are in vegetative phase, with small, juvenile regenerating thorax and abdomen on a long posterior abdomina. Details of the zooid structure could be determined in only a few zooids in the syntype colonies. The zooids are long and thin as in many species in this genus. The atrial tongue arises from the anterior rim of the aperture and the thorax is long and narrow with 18 rows of about 20 stigmata. The abdomen is relatively short with five gastric folds and the posterior abdomen is long and narrow.

Remarks

The almost liquid test of this species is reminiscent of the test of *Pseudodistoma fragilis* Tokioka, 1958 (from Japan) and *P. gracile* Kott, 1992a from the tropical Western Pacific (see Kott 1992a). However, the zooids in the syntype material are characteristic of the genus *Aplidium*. Although known species often have zooids and even colonies that generally resemble those of the present species, an *Aplidium* species with its very soft test has not been encountered and the species is not readily assigned to any known Australasian or sub-Antarctic species.

Aplidium opacum Kott, 1963

Aplidium opacum Kott 1963, p 108 and synonymy.

Distribution

Previously recorded (see Kott 1992a): Western Australia (Rockingham); South Australia (Great Australian Bight to Spencer and St Vincent Gulfs, Yorke Peninsula); Tasmania (Fluted Cape); Victoria (Balnarring Beach, Westernport); New South Wales (Port Hacking). New record: Victoria (Western Port).

Remarks

The newly recorded specimen has the characteristic zooids (with short abdomina and about 20 stomach folds) in crowded double rows along branching common cloacal canals. The species appears to be an Australian indigenous species known only from the temperate half of the continent.

***Aplidium robustum* Kott, 1992**

Aplidium robustum Kott 1992a, p 582.

Distribution

Previously recorded (Kott 1992a): Western Australia (King George Sound); South Australia (Great Australian Bight); Tasmania (Dunalley). New records: Tasmania (Bass Strait, 70 m, QM G308806–7).

Remarks

The newly recorded colonies are identical with those previously assigned to the species, being soft, irregular, fleshy masses with sand embedded only in the base. The crowded zooids, their long, narrow thoraces, orange in preservative and with about 20 longitudinal folds in the small stomach, are arranged in circular systems. The soft test contains white, opaque corpuscles in the layer that closely surrounds the zooids. The newly recorded zooids have the atrial tongue separate from the aperture, although this has not previously been reported for this species. The species resembles *A. multiplicatum* Sluiter, 1909 although the larvae and the cloacal systems are different (see Kott 1992a).

***Ascidia saccula* sp. nov.**

(Figure 7A–D)

Distribution

Type locality. Tasmania (Bellerive Bluff, Derwent River estuary, 6 m low reef, coll. Aquenal L. K. Lyell, R. B. Mawby, and K. O. Redburn, holotype QM G308839; paratype QM G308828).

Description

In life, the specimens are more or less ovoid, to about 4 cm long, with a terminal branchial aperture and sessile atrial aperture one-third to half of the body length along the dorsum. In preservative they are dorso-ventrally flattened. The test is firm and translucent with seven

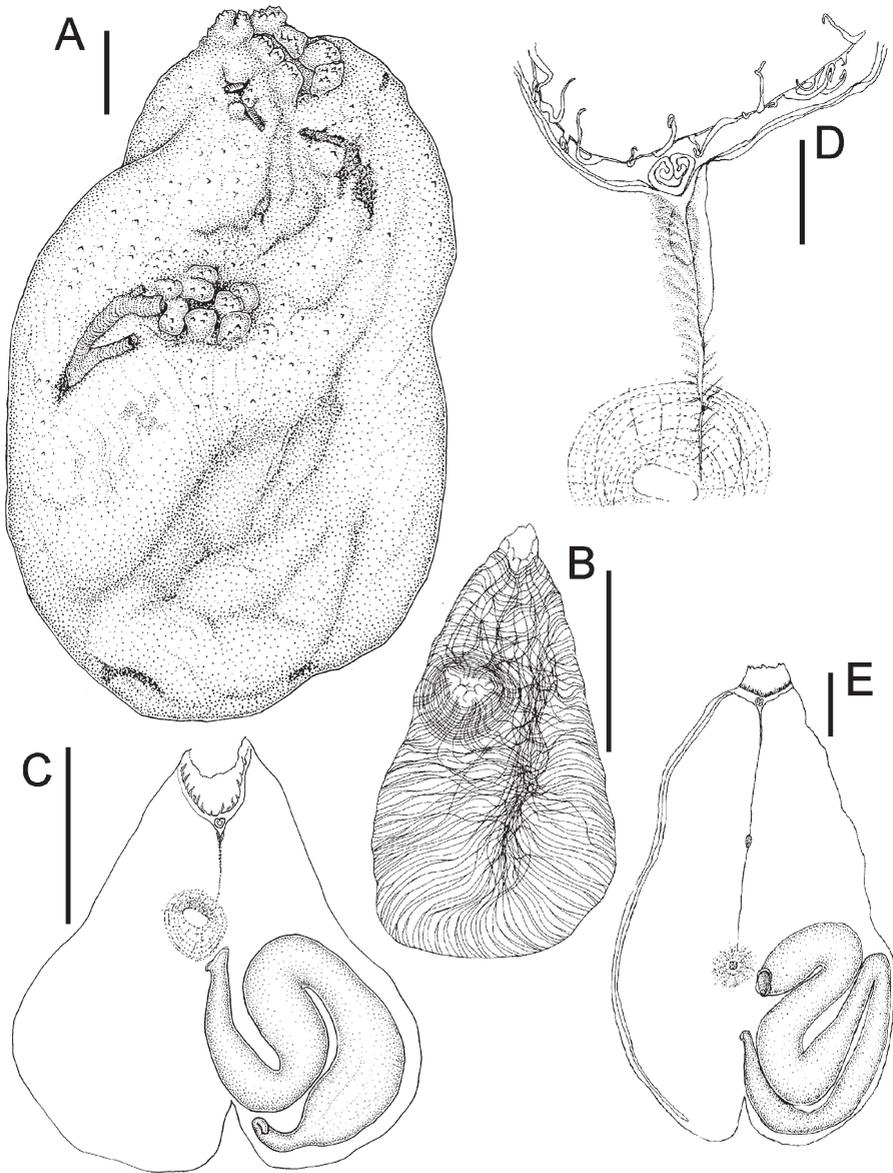


Figure 7. (A–D) *Ascidia saccula* (holotype QM G308839): (A) external view showing pointed surface papillae around apertures; (B) body wall muscles; (C) internal view showing gut loop; (D) branchial tentacles, dorsal tubercle, neural ganglion, and dorsal lamina. (E) *Ascidia thompsoni* (QM G308827): internal view showing gut loop. Scale bars: 2 mm (A, D); 1 cm (B, C); 2 cm (E).

lobes around the branchial aperture and six around the almost sessile atrial aperture. Small, pointed papillae are on the outside of these lobes. About 20 branchial tentacles are well separated from one another in a single circle at the base of the branchial siphon. The prebranchial area is narrow and a large dorsal tubercle with a U-shaped slit fills a shallow peritubercular V at the anterior end of the ribbed dorsal lamina, which is a double membrane in its anterior half. The horns of the slit on the dorsal tubercle are both rolled inwards. The dorsal ganglion is beneath and slightly behind the dorsal tubercle. About four

stigmata are in each mesh and papillae are at the junctions of the internal longitudinal branchial vessels and the transverse vessels. The gut forms a double loop. The descending limb forming the inner curve of the secondary loop is filled with an accumulation of mud. Gonads are obscured by the mud-filled gut.

Remarks

The species has much in common with others that accumulate mud in the gut, namely *A. challengeri*, *A. sydneyensis*, and *A. thompsoni* (Table IV). These species all have a translucent test, and all except *A. sydneyensis* have a mesh of muscles on the right side of the body and a relatively simple U-shaped slit on the dorsal tubercle. All except *A. thompsoni* have the dorsal ganglion close to the dorsal tubercle and lack a postero-dorsal bend of the distal part of the rectum. *Ascidia thompsoni* also has more branchial tentacles (about 100) than the present species. The species most closely related to the present one is the Antarctic *A. challengeri* which is distinguished only by its more numerous stigmata in each mesh and the arrangement of the branchial tentacles, which are in two circles in the prebranchial area and connected to an oral flange at the base of the branchial siphon by a thin vertical ridge in the pharyngeal lining.

The present specimens have small black spherical bodies in the body wall although they seem not to be related to the colour of living specimens.

Ascidia scaevola (Sluiter, 1904) (Figure 10G)

Styelopsis scaevola Sluiter 1904, p 89.

Ascidia scaevola: Kott 1985, p 53 and synonymy.

Distribution

Previously recorded (see Kott 1985): South Australia (Great Australian Bight, St Vincent Gulf); Victoria (Lakes Entrance, Sale, Port Phillip Bay); Queensland (Moreton Bay, Gladstone, Bowen Townsville, Nymph I.); Indonesia. New records: South Australia (Edithburgh, 3–4 m, SAM E2871); Tasmanian Canyons (40.79269°S, 144.21916°E, 94 m).

Table IV. Comparison of *Ascidia* spp. known to accumulate mud in the gut.

	Conspicuous network of muscles on right	Slit on dorsal tubercle	Ganglion distance from dorsal tubercle	Postero-dorsal bend of distal part of rectum
<i>A. sydneyensis</i>	Not present	Complex convoluted	Overlap	Not present
<i>A. challengeri</i>	Present	U-shaped, horns in or out	Overlap	Not present
<i>A. saccula</i>	Present	U-shaped, horns in or out	Overlap	Not present
<i>A. thompsoni</i>	Present	U-shaped, horns in or out	Ganglion halfway between atrial siphon and dorsal tubercle	Present

Description

The specimens are up to 14 cm long. As usual, they are dorso-ventrally flattened with the body wall closely adherent to the stiff, brittle, thin, sandy test. The sessile branchial and atrial openings, respectively, are at the base of the incurrent and excurrent pseudosiphons, which rise vertically from the upper surface. In the largest specimen the outer half of each tube is bent in the same direction. Internally the thin body wall, branchial wall, short transverse muscle bands, large branchial fold and flat, double gut loop are as previously described (Kott 1985).

Remarks

The collector has noted that the Edithburgh specimens are buried in sand, only the pseudosiphons projecting above the sea floor. The pseudosiphons of the present species are distinctive, as are the short muscle bands. But in some respects the species resembles *Phallusia polytrema* (Herdman, 1906) and *Microgastra granosa* (see below) and they all appear to occupy sea-floor habitats where they are buried in sand. They all have thin, brittle sand-filled test, a thin body wall adhering closely to the test and delicate branchial sacs. However, in the former species, the descending limb of the gut loop accumulates sand and the gut forms a simple J-shaped loop; while in the latter species (which has a dorsal branchial fold like *A. scaevola*), the small gut loop is evaginated from the body wall and the distinctive gonads and neural organs with their associated part of the body wall, are embedded in the test.

Ascidia thompsoni Kott, 1952

(Figure 7E)

Ascidia thompsoni Kott 1952, p 312; 1985, p 56 and synonymy.*Ascidia challengeri*: Kott 1985, p 32.*Distribution*

Previously recorded (see Kott 1985): Tasmania (Great Taylor Bay, Port Davey); South Australia (St Vincent Gulf). New records: Tasmania (Port Davey, SAM E2889); Tasmanian Canyons (Pieman Canyon, 472.8 m, QM G308827).

Description

The newly recorded individuals are 10 and 15 cm long, respectively, narrow anteriorly and increasing to about 4 cm wide posteriorly. The surface is even but rough and the test is firm, even and translucent. The body is laterally flattened. The terminal branchial aperture has about eight lobes and the margin is fringed (although this is obscured in this specimen). The sessile atrial aperture is two-thirds of the body length along the dorsal surface. About 100 long, curved branchial tentacles are crowded around the base of the branchial siphon. The dorsal ganglion can be seen about halfway between the dorsal tubercle (behind the tentacular ring) and the atrial siphon. The slit on the dorsal tubercle is basically U-shaped with the opening directed anteriorly. The horns are turned in or out and sometimes it is interrupted or slightly convoluted and sometimes the dorsal tubercle slit is pulled out into sharp angles (see QM G9325 from St Vincent

Gulf and the newly recorded specimen QM G308827). A meshwork of muscles is on the right side of the body. The branchial sac has about six stigmata per mesh. The inside curve of the tight secondary gut loop is swollen with mud. The long stomach with its fine longitudinal fold occupies at least half of the outer (ascending) limb of the primary loop, and is overlaid by this mud-filled portion of the gut. The distal part of the rectum is bent back postero-dorsally to terminate at the base of the short atrial siphon. Shallow lobes are on the anal border. Gonads are usually in the primary loop of the gut, although they appear to be senescent in the large specimen from Pieman Canyon. Small intermediate branchial papillae are only at the junctions of parastigmatal with internal longitudinal vessels.

Remarks

The species is distinguished from *Ascidia sydneyensis* (which has a mud-filled gut and translucent test) by its numerous branchial tentacles, body musculature, the position of the dorsal ganglion and the relatively simple U-shaped slit on the dorsal tubercle, and the postero-dorsal bend of the distal part of the rectum. With the exception of its musculature, these characters distinguish the species from *A. saccula* n. sp. and the Antarctic *A. challengeri* Herdman, 1882 (which both have translucent tests and mud-filled gut).

***Ecteinascidia maxima* Kott, 1985**

Ecteinascidia maxima Kott, 1985, p 93.

Distribution

Previously recorded (see Kott 1985): Lord Howe I. New record: Queensland (Noosa Heads, 8–10 m, QM G308786).

Remarks

The newly recorded colony from the mid-eastern coast of Australia is the only one outside the type locality. The specimens are similar to the type material. Zooids are robust, with large blotches of red colour around the anterior part of the zooid, including bands of colour around the base of each protruding siphon, relatively long siphons, about 15–20 rows of stigmata and an almost continuous coat of transverse muscles on each side of the body.

***Microgastra granosa* (Sluiter, 1904)**

Ascidia granosa Sluiter 1904, p 36.

Microgastra granosa: Kott 1998, p 163 and synonymy.

Distribution

Previously recorded (see Kott 1998): Queensland (Low Is, Bowen, Townsville, Innisfail, Princess Charlotte Bay, Gordonvale); Indonesia, Japan. New records: Tasmanian Canyons (Ling Hole, 174 m); Queensland (14.685–18.755°S, to 66 m).

Description

The largest newly recorded specimen is 10 cm long. As usual, the sandy test is thin, flaccid to brittle with some sandy, irregular tags from the posterior end of the body. The newly recorded specimens range from relatively short, cylindrical bodies to long, narrow ones about 1 cm diameter and 10 cm long. The branchial siphon is terminal and the atrial is two-thirds of the way down the body. About 50 single branchial tentacles are short and well-spaced and the dorsal membrane is double. That part of the body wall containing the dorsal tubercle and ganglion and ciliated funnel-like openings of the branches of the neural duct (opening along the body wall behind the branchial sac) is closely attached to the test. The body wall is thin, diaphanous, transparent, closely applied to the test. Parallel transverse muscles forming an almost continuous coat are along the right but muscles were not detected on the left side of the body. In the branchial sac are many rows of short stigmata with papillae on the transverse vessels about every two or three stigmata. Internal longitudinal vessels were not detected in the larger specimens. The prepharyngeal groove loops across to the right in front of the dorsal tubercle creating a dorsal fold in the branchial sac. The small gut loop lies embedded in an outgrowth of the body wall that is constricted off from the rest of the body. The stomach is small and oval with internal longitudinal folds. The post-pyloric part of the gut loop is flat and forms a tight primary loop, with the distal end of the gut folded back to the descending limb to form a secondary loop. The gonads are in external pouches of the body wall embedded in the test. The testis, consisting of small crowded follicles, is on the left about one-third of the body length from its posterior end. The ovarian sac associated with a seminal vesicle is embedded in the test of the posterior rim of the atrial opening. The vas deferens, embedded in the test, extends posteriorly from its origin halfway down the testis and loops around its posterior margin before extending anteriorly to the atrial aperture.

Remarks

This is a remarkable species, its body held in place by the parts of it (along the dorsal mid-line and around the gonads) that are embedded in the test. It is the thin, sand-strengthened test that protects both the gonads and the neural elements of the individual. The filtering area is large but the gut loop is small and entirely evaginated from the body wall in a tight nucleus, presumably held in place between the inflated pharynx and the test. The species has much in common with *Ascidia scaevola*, which has a similar sandy test, a branchial fold, compact, flattened gut loop and thin body wall closely adhering to the test. These two species also occupy similar sea-floor habitats and have a similar geographic range from temperate and tropical waters (although *A. scaevola* has not been recorded from Japan).

In a survey extending from north of Cooktown (14.5°S) to Broad Sound (about 22°S), the species was taken at 12 stations (of a total of 383). It was one of the best represented sea-floor species of ascidians in this region, 30 specimens having been taken at one of the stations. *Polycarpa chinensis*, *P. decipiens*, and *P. obscura* are the only species taken in similar numbers at any one station. The record from the temperate water of the Tasmanian Canyons (174 m) is unusual, being the only time the species is recorded outside the tropics, except for the Japanese record. Apparently it has a wide range both north and south of tropical waters.

Cnemidocarpa areolata (Heller, 1878)

Styela areolata Heller 1878, p 26.

Cnemidocarpa areolata: Kott 1985, p 122 and synonymy; Monniot and Monniot 1984, p 577.

Cnemidocarpa irene: Nishikawa 1991, p 96.

Distribution

Previously recorded (see Monniot and Monniot 1984; Kott 1985; Nishikawa 1991): Western Australia (Dampier Archipelago, Cape Jaubert, NW Cape, Port Hedland, Carnarvon, Shark Bay, Cockburn Sound, Albany); South Australia (Spencer Gulf); Victoria (Bass Strait); New South Wales (Port Hacking, Long Reef); Queensland (Moreton Bay, Capricorn Group, Low Isles); Northern Territory (Darwin); Palau Is, Philippines, Noumea, New Caledonia, Marianas Is, Japan, Fiji, South China Sea, Japan, Sri Lanka. New record: Queensland (18.845°S, 146.795°E, 26 m)

Remarks

Monniot and Monniot (1984) examined material from Heller's type locality, Sri Lanka, and found it agreed with the type specimen of *Styela areolata* Heller, 1878, in having a deeply curved gut loop and about 12 openings of the short vas deferens on the surface of the ovary. Nishikawa (1991) found three to four similar openings in some from Japan but never as many as the Sri Lanka specimens. As a consequence, these authors proposed that *C. irene* (Hartmeyer, 1906) from Japan (with *C. valborgi* Hartmeyer, 1919 and *C. irma* Hartmeyer, 1927 from northwestern Australia as junior synonyms) was distinct from *C. areolata* Heller, 1878 from Sri Lanka. Specimens assigned to this species by Kott (1985) from Australian locations (Heron Is, Cockburn Sound, South Australia) have been re-examined together with specimens from Fiji and the South China Sea (see Kott 1981; Kott and Goodbody 1982). In all the specimens examined the general morphology is similar, the vas deferens of each gonad opens by a single simple opening on top of the oviducal opening and multiple openings were not detected.

Nevertheless in view of Nishikawa's (1991) reports of openings of the male duct similar to those in the Sri Lanka specimen, albeit not so numerous, it appears that the openings of the male duct are sometimes subdivided in this species. At this stage, it appears that such subdivision may be the result of intra-specific variation rather than an indication of speciation.

Cnemidocarpa completa Kott, 1985

Cnemidocarpa completa Kott 1985, p 124.

Distribution

Previously recorded (see Kott 1985): Victoria (Deal I., Bass Strait); New South Wales (Ararwarra). New record: Tasmania (Port Davey, Bathurst Channel, 3–37 m, SAM E2879–81).

Description

The newly recorded specimens were attached to clumps of *Pyura irregularis* on a vertical rock wall. The individuals are conical with terminal branchial apertures and atrial apertures

on short siphons halfway down the dorsum. The test is thin and flexible, encrusted with sand on the upper half, which has a warty appearance, the lower half being smooth and rounded. On the left are three to six gonads. Sometimes the anterior one divides and both branches continue around the pole of the gut loop. Seven to nine gonads are on the right. The body wall is thin and the branchial sac and gut, gonads, and endocarps are as previously described.

Remarks

The new record confirms the temperate range of this species, which previously was known from Bass Strait to Arrawarra on the central New South Wales coast.

Cnemidocarpa radicata (Herdman, 1882)

Styela radicata Herdman 1882, p 163.

Cnemidocarpa radicata: Kott 1985, p 136 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Cockburn Sound); South Australia (St Vincent Gulf); Tasmania (Bruny I. and western and southern coast); Victoria (Bass Strait, Port Phillip Bay); New South Wales (Port Kembla, Port Jackson); Queensland (Tallebudgera). New records: South Australia (Kangaroo I., 10–12 m, SAM E3286), Tasmania (Bass Strait, 60 m, QM G308810; Port Davey, 3–18 m, SAM E2882–5; Banks Strait); New South Wales (Bass Point—near Wollongong).

Description

Individuals are upright, the posterior two-thirds expanded into an almost spherical postero-dorsal swelling. The short atrial siphon projects laterally from where the postero-dorsal swelling narrows abruptly to an anterior cone with a terminal branchial aperture. The test is thin, flaccid, and wrinkled, but tough, posteriorly produced into root-like projections that may form a bulbous holdfast entangled with sand and shell. The body wall is muscular and only loosely attached to the test. The prebranchial area is narrow and the dorsal tubercle has a horizontal S-shaped slit. The dorsal lamina is wide and smooth-edged. Up to 19 internal longitudinal vessels are on the folds and five between the folds. Two gonads are on the left, the posterior one in the secondary gut loop is almost spherical. Like the anterior gonad on the left, the four or five on the right are sausage-shaped. Gut and gonads are embedded in the body wall, which is thickened across the posterior part of the body.

Remarks

The external shape of the individuals of this species and their wrinkled, tough test resembles that of *Cnemidocarpa pedata* (Herdman, 1881) in which gonads may also be firmly embedded in the test, but which is distinguished by the lack of posterior thickening of the body wall, having instead numerous small upright endocarps in the loop of the gut and between the long, branched gonads. *Cnemidocarpa stolonifera* is another robust species with a similar body shape, although it has deep furrows and grooves rather than wrinkles in

the test. It has similar gonads to *C. pedata* but its apertures are on siphons marked by four deep parallel grooves and they originate close to one another on the anterior part of the body. The siphons of both *C. pedata* and the present species are separated by at least one-third of the body length. Kott (1985) found that *C. stolonifera* was distinguished from *C. pedata* also by its longer stomach and rectum and more numerous stigmata in each mesh.

Cnemidocarpa radicata has a range around the southern half of the continent, from Cockburn Sound in the west to the Queensland–New South Wales border.

Polycarpa chinensis (Tokioka, 1967)

Cnemidocarpa chinensis Tokioka 1967, p 188.

Polycarpa chinensis: Kott 1985, p 157 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Dampier Archipelago to Cockburn Sound); Victoria (Bass Strait); Queensland (Moreton Bay to Murray I.), China (Tsia-men), Vietnam. New records: Queensland (16.235–18.815°S, 145.955–146.955°E, 12–60 m).

Remarks

The external appearance of smaller specimens of this species often closely resembles *Polycarpa procera* (see below) although the long, curved larger specimens with apertures produced on short siphons can be confidently assigned to the present species. These two species are often sympatric and both are found over a great tropical-temperate range—*P. chinensis* from the South China Sea to Cockburn Sound and Bass Strait, and *P. procera* with an even wider north–south range from Japan to South Australia.

The present species is also one of the most frequently encountered species in the benthic fauna of the sea floor of north-eastern Queensland, occurring in about one-third of the stations at which ascidians were taken, only *Polycarpa decipiens* and *Herdmania grandis* being recorded more often. *Polycarpa papillata* is also recorded at about one-third of the stations, but in much smaller numbers than the present species.

Polycarpa flava Kott, 1985

Polycarpa flava Kott 1985, p 165 and synonymy.

Distribution

Previously recorded (see Kott 1985): South Australia (Great Australian Bight, Spencer and St Vincent Gulf, Kingston); Victoria (Point Nepean, Cape Woolamai, Bass Strait). Tasmania (Orford). New records: Tasmanian Canyons (King I. Canyon, 249 m, 348 m; Banks Strait, 168 m).

Description

The body shape is variable in this species, sometimes being stalked, and other specimens being sessile, fixed by basal roots and props. The test is dark brown in preservative and a

thin layer of sand is in the surface. Large colourless vesicles are in the muscular body wall, the gut always enclosed a teardrop-shaped endocarp, small rounded lobes are around the anal rim and flask-shaped gonads are in the pallial body wall.

Remarks

The species appears to be a common component of the benthic fauna in the southeastern part of the continent. It is distinguished mainly from other robust species in the *pedunculata* group of this genus by its black to black-brown colour.

***Polycarpa intonata* Kott, 1985**

Polycarpa intonata Kott 1985, p 168.

Distribution

Previously recorded (Kott 1985): Queensland (Abbot Point, Cleveland Bay). New records: Queensland (15.245°S, 145.435°E, 29 m; 15.495°S, 145.385°E, 25 m, 18.615°S, 146.465°E, 23 m).

Remarks

Previously the species was known only from two locations in the vicinity of Townsville and the new records extend the known range to the north (from Cooktown to Ingham). As previously described, the oval, sandy specimens, with thin sandy test, have two irregular rows of rounded ovarian sacs with their ducts directed ventrally on each side of the endostyle. Up to four specimens have been taken at each of the three newly recorded locations. The species is known to be one of the few known solitary viviparous species.

***Polycarpa olitoria* (Sluiter, 1890)**

Styela olitoria Sluiter 1890, p 341.

Polycarpa olitoria Kott 1985, p 180 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Kendrew I., Shark Bay, Cape Jaubert); Victoria (Bass Strait); Queensland (Capricorn Group, Abbot Point, Twonville, Cleveland Bay, Lloyd Bay, Cape Melville, Murdoch Point); Indonesia, Madagascar, Sri Lanka. New records: Queensland (15.495°S, 145.385°E, 25.6 m; 17.445°S, 146.205°E, 26 m; 17.605°S, 146.355°E, 39 m; 17.655°S, 146.225°E, 26.5 m; 18.035°S, 146.205°E, 18 m; 18.615°S, 146.645°E, 30.5 m).

Description

Flabby translucent whitish test covered in shell fragments and adherent and semi-embedded sand. Apertures close on anterior surface, often obscured by rough test although the siphons often are naked. Row of eight relatively long polycarps down middle of each side of the body. Tall, rather leaf-like endocarps in gut loop and long, finger-like anal lobes,

the usual pointed spines are around and in the siphon linings. Newly preserved material is bright yellow, the colour especially conspicuous on the naked siphons.

Remarks

Only a single specimen was taken from each newly recorded location. Kott (1985) reported red-coloured specimens of this species, although relatively freshly preserved newly recorded specimens are bright yellow.

Polycarpa papillata (Sluiter, 1885)

Styela (Polycarpa) papillata Sluiter 1885, p 192.

Polycarpa papillata: Kott 1985, p 184 and synonymy.

Distribution

Previously recorded (see Kott 1985): the species has been recorded from all around the Australian continent, Indonesia, the western Pacific and Madagascar. New record: Tasmanian Canyons (King I. Canyon, 249 m).

Remarks

The species characteristically ejects its gut, including the pharynx, through the atrial siphon when collected. Despite variations, its general body shape, with short cylindrical siphons separated by half the body length, help to distinguish it, as does its white test with strips of pink-red colour.

The species has a wide range through the Indo-West Pacific. The new record from the Tasmanian Canyons represents the most southerly location yet reported.

Polycarpa procera (Sluiter, 1885)

Styela procera Sluiter 1885, p 196.

Polycarpa procera: Kott 1985, p 196 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Cape Jaubert, Shark Bay, Cockburn Sound); South Australia (Upper Spencer Gulf); Victoria (Ninety Mile Beach, Bass Strait, Warnambool); New South Wales (Byron Bay); Queensland (Maroochydore, Hervey Bay, Gladstone, southern Great Barrier Reef, Innisfail); Indonesia, Singapore, Sri Lanka, Japan. New records: Queensland (17.165–17.935°S, 146.535–146.8°E, 35–68 m).

Remarks

The species is plentiful in inter-reefal locations in northeastern Queensland and a wide range in the Indo-West Pacific between Japan in the north to Sri Lanka and around the southern coast of the Australian continent. The species range supports the view that the Australian continental shelf acts as a bridge for gene flow between the tropics and temperate regions.

Externally the species resembles *Polycarpa chinensis* (Tokioka, 1967) which has a similar range and habit to the present species. Both have a test brittle with embedded sand, more or less sessile apertures, rootlets on the ventral surface and the gut usually forming a simple arc between the posterior oesophagus to the base of the atrial aperture. However, the branchial sac of *P. procera* has distinct folds with up to 26 internal longitudinal vessels on each fold and at least seven, but sometimes many more between the folds; and it lacks the dorsal gonads and has lobes only on one lip of the bilabiate anal border. *Polycarpa chinensis* has dorsal gonads as well as ventral ones, both lips of the anal border are lobed, and its branchial folds are low, each having only four or five vessels and only one or two vessels are between the folds (see Kott 1985). These two species are difficult to distinguish externally and often are sympatric.

***Polycarpa rigida* Herdman, 1881**

Polycarpa rigida Herdman 1881, p 76; Kott 1985, p 199.

Distribution

Previously recorded (see Kott 1985): Tasmania (Thobin Bay Vansittart I., NW and NE Tasmania, Shouten Passage, Banks Strait, Port Arthur, Port Davey); Victoria (Bass Strait, Cape Howe); New South Wales (Port Jackson). New records: Tasmanian Canyons (Banks Strait, 168 m; Pieman Canyon, 176 m; King I. Canyon, 249 m).

Description

Newly recorded specimens are the usual large (up to 10 cm long) wedge- to crescent-shaped individuals, with a concave dorsal surface and the terminal branchial aperture and antero- dorsal atrial opening each on short naked siphons. The remainder of the test is thin, sand filled, but flaccid. The delicate body wall is closely applied to the test. Eight fine branchial tentacles are around the base of the branchial siphon. The dorsal tubercle has a U-shaped slit with the horns turned out. Branchial folds are low and narrow with about 12 internal longitudinal vessels and about eight stigmata per mesh between them and more than twice that number of internal longitudinal vessels on the folds. The gut forms an almost circular arc between the oesophagus and the atrial aperture. The stomach is small, spherical with longitudinal folds. Gonads are senescent in the newly recorded specimens.

Remarks

The species differs from *P. chinensis*, *P. procera*, and *P. tinctor* in its flaccid rather than hard firm test. *Polycarpa tinctor* has distinctive separate male and female gonads and the other species have hermaphrodite gonads. These are scattered over the body wall in the present species, rather than being arranged in a line on each side of the endostyle (*P. procera*) or each side of the dorsal lamina (*P. chinensis*). Records of the present species are from more southerly latitudes than other species of *Polycarpa* except *P. zeteta* Millar, 1982 and *P. pegasus* Michaelsen, 1922.

***Polycarpa viridis* Herdman, 1880**

Polycarpa viridis Herdman 1880, p 74; Kott 1985, p 208 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Cockburn Sound); South Australia (Great Australian Bight, Spencer and St Vincent Gulfs); Victoria (Bass Strait); New South Wales (Cape Jervis, Port Jackson). New records: Tasmanian Canyons (Pieman Canyon, 168 m, 174 m).

Description

The newly recorded specimens are of the usual conservative form for this species, with an atrial aperture about one-third of the body length distant from the terminal branchial aperture. Both apertures are on small conical protrusions and props or hair-like roots are on the postero-ventral part of the body. The gonads are embedded in the body wall amongst large spherical blister-like vesicles and a large fleshy endocarp is in the rather short post-pyloric part of the gut loop and there is the usual long rectum. The preservative of one of the specimens is orange-red and the specimen itself is a maroon colour, although this may have been affected by other specimens preserved with it.

Remarks

There is no trace of the green colour said to characterise this species and its distinction from *P. flava* depends greatly on its rather thin test without sand while the latter species has a thicker, tougher test, black in preservative.

Monandrocarpa plana (Kott, 1972)

Monoandrocarpa plana Kott 1972, p 250.

Monandrocarpa plana: Kott 1985, p 210 and synonymy.

Distribution

Previously recorded (see Kott 1985): New South Wales (Cronulla); Philippines. The species has been taken from the Philippines on rocks supplied to the aquarium industry. New records: Queensland (18.015°S, 146.645°E, 55 m).

Description

The newly recorded colony is a collection of small grey domes, each to 1 cm diameter with sessile apertures on the upper surface, the branchial aperture halfway between the atrial aperture (in the centre) and the anterior margin of dome. The whole of the lower flat surface adheres to the substratum. The test is thin and slightly translucent. Sometimes the basal test spreads out around the zooids, but a connection between them was not detected. The stomach is folded. About 10–12 hermaphrodite polycarp gonads, each consisting of a sac-like ovary associated with a single testis follicle, are in a row along each side of the endostyle.

Stolonica reducta (Sluiter, 1904)

Styela reducta Sluiter 1904, p 72.

Stolonica reducta: Kott 1985, p 236 and synonymy.

Distribution

Previously recorded (see Kott 1985): Western Australia (Trigg I.), Coral Sea (Lihou and Marian Reefs); Indonesia. New record: Queensland (18.845°S, 146.795°E, 7.5 m).

Description

Zooids are small, dome-shaped, sessile and black in preservative, the black spherical pigment cells obscuring the body organs. Three branchial folds are on each side. The open gut loop on the posterior half of the left side is slightly curved; the pear-shaped stomach with about eight branchial folds and a slightly curved caecum occupies the proximal half of the ascending limb of the gut loop. Small endocarps are on the body wall but gonads were not detected in the newly recorded highly contracted zooids.

Remarks

The newly recorded zooids resemble those previously described in their size, shape, naked test, number of branchial folds, course of the gut loop and shape of the caecum. The stomach has fewer folds and is shorter than Kott (1985) reported in specimens from the Coral Sea and the spherical black pigment cells have not previously been reported. These differences could be the result of intraspecific variation or two species could be involved.

***Botryllus stewartensis* Brewin, 1958**

(Figure 10H)

Botryllus stewartensis Brewin 1958, p 444; Kott 1990b, p 286 and synonymy.

Distribution

Previously recorded (see Kott 1990b): Western Australia (Albany); South Australia (Spencer and St Vincent Gulfs); Victoria (Ninety Mile Beach, Port Phillip Bay); New South Wales (Port Kembla, Port Stephens, Port Hacking); Queensland (Moreton Bay); New Zealand (South I. and Stewart I.). New record: South Australia (Edithburgh, 3–4 m, SAM E3289).

Description

The newly recorded colonies are squat, sandy lobes (to 1 cm high and 1 cm diameter) on a basal mat. Each lobe contains a single common cloacal system consisting of a circle of zooids around a central common cloacal aperture. The zooids open from the upper flat surface, which is slightly depressed in the preserved colonies. The test is delicate and soft, and covered with sand, although sand is not present internally. Zooids are as previously described with about 10 rows of about 15 stigmata and three delicate internal longitudinal vessels running the length of the branchial sac. The ventral internal longitudinal vessel is close to the endostyle. A small, curved gastric caecum is at the pyloric end of the stomach.

Remarks

The species shows little variation, despite its wide geographic range. The height of the flat-topped colony lobes does vary, sometimes reaching 3.5 cm but their diameter is less variable, reaching only 1.5 cm. The presence of a circular zooid system and the sandy external covering are characteristic. Other temperate species have a similar recorded range, across the southern Australian coast from Albany and up the eastern coast to Moreton Bay. However, the occurrence of the species in the South Island and Stewart I. (New Zealand) suggest a possible sub-Antarctic affinity.

Sandy species of the subfamily Botryllinae are unusual. *Botrylloides saccus* Kott, 2003 from Kangaroo I. has similar circular systems but small almost spherical colony lobes on short, thin stalks. *Botryllus purpureus* (Oka, 1932) has encrusting colonies with sand embedded throughout the test. Other ascidian species with a similar distribution in temperate Australia and New Zealand are *Asciadiella aspersa* (Mueller, 1776), *Asterocarpa humilis* (Herdman, 1899), *Dumus areniferus* Brewin, 1952, *Euclavella claviformis* (Herdman, 1899), and *Sigillina australis* Savigny, 1816. Also, a few species groups and genera, namely the *pachydermatina* group (*Pyura*), certain *Polycarpa* spp. (*P. zeleta*, *P. pegasus*, and *P. tinctor* and related species), some *Molgula* spp. and *Hypsistozoa* spp., also indicate a biogeographic relationship between temperate Australian waters and New Zealand (see Kott forthcoming).

Pyura irregularis (Herdman, 1882)

Cynthia irregularis Herdman 1882, p 141.

Pyura irregularis: Kott 1985, p 305 and synonymy.

Distribution

Previously recorded (see Kott 1985): Tasmania (Hobart, d'Entrecasteaux Channel, Port Davey), Victoria (Bass Strait, Port Phillip Bay, Westernport), New South Wales (Port Jackson). New records: Tasmania (Port Davey, SAM E2876, E2878, E2888; Tasmanian Canyons (Big Horseshoe—Broken Reef, 115 m)).

Description

These specimens resemble other material assigned to this species, which is indigenous and confined to a limited geographic range in southeastern Australia from south of Tasmania to the mid-eastern coast of the continent. The test is dark brown in preservative and is sandy and brittle, ridged and wrinkled. Anteriorly the body narrows to the terminal branchial aperture and the atrial opening on a conspicuous siphon about halfway down where the body suddenly increases in diameter. The siphons usually are turned away from each other. The peritubercular-V is characteristically long and narrow (about half the length of the dorsal lamina). The U-shaped slit on the dorsal tubercle (deep in the V) has both horns turned in. There are seven or eight branchial folds with up to 20 tough internal longitudinal vessels on the folds and three or four between. The gut forms a simple open D-shaped loop. The anal border is divided into pronounced rounded lobes. Gonads (one on each side of the body) are separated into double rows of hermaphrodite sacs each side of the gonoducts and endocarps are on gonads and the descending limb of the gut loops.

Remarks

The species is readily identified by its tough wrinkled test, long siphons turned away from each other, the dorsal tubercle deep in the long peritubercular V and the open D-shaped gut loop with endocarps on it.

Pyura stolonifera (Heller, 1878)

Cynthia stolonifera Heller 1878, p 10.

Pyura stolonifera: Kott 1985 and synonymy; Monniot et al. 2001, p 113.

Pyura praeputialis: Castilla et al. 2002, p 1579.

Distribution

Previously recorded (see Kott 1985): Western Australia (Shark Bay, Albany); South Australia (Gulf St Vincent); Tasmania (Spring Bay, Eaglehawk Neck, Kingstons, Bruny I., Roches Beach); Victoria (Ninety Mile Beach, Port Phillip Bay, Western Port, Wilson's Promontory); New South Wales (Port Jackson, Arrawarra, Hastings Point); Queensland (Currumbin, Moreton Bay, Point Cartwright, Alexander Heads, Fraser I.); Chile; Peru; Ecuador; Africa (Port Nolloth, Cape Town to Algoa Bay, Luderitz Bay, Dakar, Morocco, Namibia). New record: South Australia (Smokey Bay—western Eyre Peninsula, 2–3 m, SAM E2887).

Description

Populations of this species on rocky shores on each of the continents are crowded, forming thick mats extending from low tide into deeper waters. Individuals adhere closely to one another and become tall, almost cylindrical pillars to about 20 cm high, although the body of the individual is in the top of the pillar, and its basal part (up to two-thirds of the total height) is solid gelatinous test with a hard, leathery surface, either adhering to neighbouring individuals or with weed epibionts.

In specimens on sandy substrata the basal pillar is not present, although crowded root-like processes penetrate into the substrata. These substantial organisms are readily distinguished by the two adjacent four-lobed apertures on the upper surface surrounded by a high rounded marginal rim of test, the loss of a dorsal lamina, the double coil of the slit on the dorsal tubercle, the fringed lobes around the apertures and long, overlapping pointed siphonal spines.

Remarks

There has long been debate regarding the status of the African, Australian, and western South American proposed synonyms of this species. Monniot et al. (2001) state categorically (without any evidence) that the Chilean populations were introduced from Australia and are conspecific, while the South African ones are a different species. Most recently Castilla et al. (2002, 2004a, b) also propose that *P. praeputialis* Heller, 1878 has been recently introduced to South America from Australia; while the African populations are a different species. These authors also maintain that the populations recently introduced from Australia are confined to Antofagasta (Chile). However, the Chilean populations appear to be more widespread: those from Antofagasta being apparently

conspecific with specimens collected in Peru (Zorritos) in 1866–67 by F. H. Bradley. These specimens (in the Yale Peabody Museum registration number YPM 2934) became the types for *Pyura bradleyi* Van Name, 1931. These specimens, collected 140 years ago, can hardly be said to be recent introductions. Further, Van Name (1945) also reported specimens from Ecuador. The wide geographic range of this species in South America does not support an hypothesis of recently introduced or alien species. In fact, it appears to be a long-established and probably indigenous component of the ascidian fauna of the Pacific coast of the South American continent. It does not support Monniot's statement (*vide* Melville 1979) that *Pyura chilensis* was the only large ascidian in Chilean coastal waters in the late 18th century. *Pyura bradleyi* (<*P. stolonifera*) was undoubtedly also present.

Attempts to establish that the South African and the Australian populations are separate species (Monniot et al. 2001) fail to take into account the great diversity in variations found in this species in both locations.

At this stage, there is no evidence that these populations of *P. stolonifera* on all three continents are not relics of a Gondwana component of the marine fauna on these three continents, although (as Kott 1985 suggested) it seems unlikely that there is any contemporary gene flow between them.

Pyura lignosa Michaelsen, 1908 from the western coast of Panama has apertures at opposite ends of the upper surface, distinctive gonads and a well-developed dorsal lamina with distinct languets. None of these characters are present in *P. stolonifera* and there appear not to be grounds for the suggestion (Monniot et al. 2001) that the species is closely related to the present one.

***Pyura tasmanensis* Kott, 1985**

Pyura tasmanensis Kott 1985, p 331.

Distribution

Previously recorded (see Kott 1985): Tasmania (Ralph's Bay, Roches Beach, Tasman Head, Port Davey). New records: Tasmania (Port Davey, 3–25 m, SAM E2875; Tasmanian Canyons (Big Horseshoe—Broken Reef, 115 m)).

Description

The newly recorded specimens do not appear to be in aggregates. In preservation both specimens are almost spherical with a wrinkled test. Apertures are close together on the upper surface, although the dorsal lamina is moderately long. Branchial tentacles usually are long, with short primary and smaller secondary and tertiary branches, although the specimen from the Tasmanian Canyons has short, inconspicuous tentacles without secondary or tertiary branches. Siphons are lined with long overlapping siphonal spines. Six folds are on each side of the branchial sac with up to 28 internal longitudinal vessels per fold and up to 12 between. Crowded endocarps are on the descending limb of the gut loop and on the gonads. A conspicuous green liver diverticulum branches off the gut in the pyloric region. Each of the two lips of the anal border is divided into two.

Remarks

The species is distinguished from *P. stolonifera* by its long dorsal lamina and the more numerous internal longitudinal vessels between the folds. The siphonal spines of

P. stolonifera are seldom more than 0.1 mm long, while those of *P. tasmanensis* sometimes are as much as 0.2 mm (see Kott 1985) and the gut loop of the latter species has a narrower curved gut loop with up to 15 pairs of polycarp sacs. *Pyura stolonifera* has a more open gut loop with only about eight pairs of hermaphrodite gonads.

Hartmeyeria formosa Herdman, 1882

Cynthia formosa Herdman 1882, p 139.

Hartmeyeria formosa: Kott 1985, p 363 and synonymy.

Distribution

Previously recorded (see Kott 1985): Victoria (Bass Strait, Port Phillip Bay); New South Wales (Port Jackson); Queensland (Moreton Bay, Gladstone, Abbot Point, Townsville, Mossman); Torres Strait. New record: Queensland (15.245°S, 145.375°E, 23 m; 16.705°S, 146.125°E, 34 m; 18.94°S, 146.365°E, 8 m).

Remarks

The newly recorded specimens are within the geographic range previously recorded for this species from Torres Strait in the north to Bass Strait in the south along the eastern coast. They are small and only one has been taken from each location. As previously reported, the specimens are top-shaped with the test produced into branched papillae that are longer anteriorly, sometimes forming a ring of bristles around each aperture. The six wide branchial folds on each side and the long, flat dorsal lamina with a fringe of papillae on the edge are as previously described (see Kott 1985).

Hartmeyeria psammiferus (Monniot et al., 2001), as *Microcosmus psammiferus* in Monniot et al. 2001, from South Africa, has gut loop and gonads arranged as in the present species. The spines in the outer part of the siphons also may be similar to those of the present species, although this is difficult to determine as their bases cannot be seen in the scanning electron micrographs (which obscure the base of the spines) of Monniot et al. (2001, Figure 51B, C: *Microcosmus psammophorus* sic!). However the urn-shaped spicules at the base of the siphons have not been detected in *H. formosa*. Further, the dorsal lamina of the latter species is fringed with tongue-shaped lobes that are not present in the South African species (which has irregular indentations) and the species appear to be distinct. Nevertheless, they appear to be congeneric. In both species, as in others in this genus, the branchial sac has six folds on each side and the second most dorsal folds on each side are significantly narrower than the others. Monniot et al. (2001) appear to have overlooked the fact that *H. formosa* has a stalk when suggesting that the absence of a stalk separated it from the genus *Hartmeyeria*. The absence of a stalk from *H. psammiferus* (which has all the other generic characters of the genus and is similar to *H. formosa* in so many characters) suggests that the presence or absence of a stalk may not always be significant at the generic level.

Herdmania grandis (Heller, 1878)

Cynthia grandis Heller 1878, p 15.

Herdmania grandis: Kott 2002, p 363 and synonymy.

Distribution

Previously recorded (see Kott 2002): Western Australia (Geraldton to Albany); South Australia (Gulf St Vincent); Tasmania (Burnie); Victoria (Bass Strait); New South Wales (South Ulladulla, Wollongong, Shell Harbour, Arrawarra, Byron Bay); Queensland (Tweed River, Moreton Bay, Mooloolaba, off Murdoch Point, Cairns); Papua New Guinea. New records: Tasmania (Bass Strait; King I. Canyon, 348 m, QM G308809; Banks Strait, 168 m); Queensland (benthic fauna, 14.705–18.655°S, 145.375–147.075°E, 11–69 m).

Description

A large specimen newly recorded from King I. Canyon has an opaque, leathery but flexible test with fine horizontal wrinkles and some irregular tags and processes on the lower half of a turnip-shaped body. The body wall is translucent despite the strong muscles that extend down each side to the endostyle. A horizontal S-shaped slit is on the dorsal tubercle with both horns turned in. Seven branchial folds are on each side. The atrial velum is divided into 16 rounded lappets. The gut loop is only slightly curved and compact clumps of liver lobes are on the gut loop. A long endocarp is on each side of the body, the one on the left curving around the ventral mid-line and covering the descending limb of the gut loop. Clumps of male follicles surround the ovarian tube. The male duct opens on a short projection from the surface of the distal end of the oviduct just behind the simple, sessile oviducal opening. The anal opening is bilabiate, and the margin of each lip is divided into conspicuous rounded lobes.

This specimen differs from others of this species in the absence of languets on the dorsal lamina and the relatively few branchial folds. These differences may be the result of isolation from other temperate populations; or it may be an aberrant individual. Smaller cushion-like specimens to about 2 cm long from Banks Strait and Bass Strait have the usual complex, convoluted slit on the dorsal tubercle. Up to 30 small specimens of the present species to 1–3 cm but occasionally to 6 cm occur at over 25% of the 88 benthic locations sampled on the continental shelf of north-eastern Queensland. Although gonads are not always present, these specimens have gonoducal openings, lobed anal border, and the numerous branchial folds characteristic of *H. grandis*.

Remarks

The large number of small specimens taken from the northeastern Queensland continental shelf in September and October 2003 suggest that the species may dominate the benthic communities there; and that settlement takes place in autumn in these waters. Although some variation is apparent in the number of branchial folds, the relatively straight ovarian tube, simple gonoducal openings that lack of associated membranes from the body wall, the lobed anal border, and the long muscles that extend over the whole body wall are consistent characters defining the species.

***Herdmania mentula* Kott, 2002**

Herdmania mentula Kott 2002, p 365.

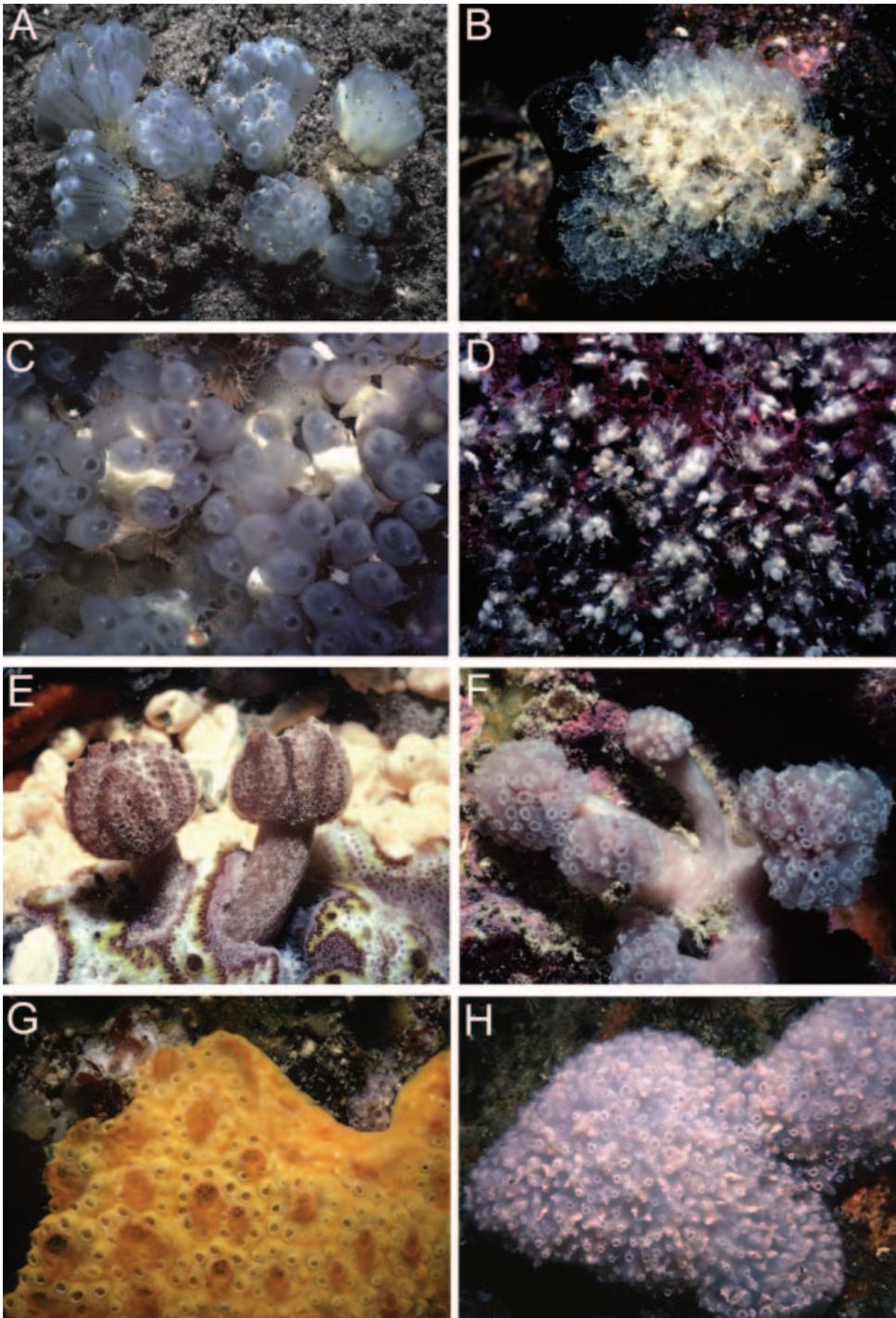


Figure 8. *In situ* images of: (A) *Pseudodiazona claviformis* (SAM E3280); (B) *Pycnoclavella tabella* (SAM E3290); (C) *Stomozoa australiensis* (SAM E3285); (D) *Sigillina exigua* (SAM E3300, syntype); (E) *Distaplia australiensis* (SAM E3294); (F) *Distaplia australiensis* (SAM E3295); (G) *Distaplia florida* (SAM E3293); (H) *Distaplia pallida* (SAM E3273).

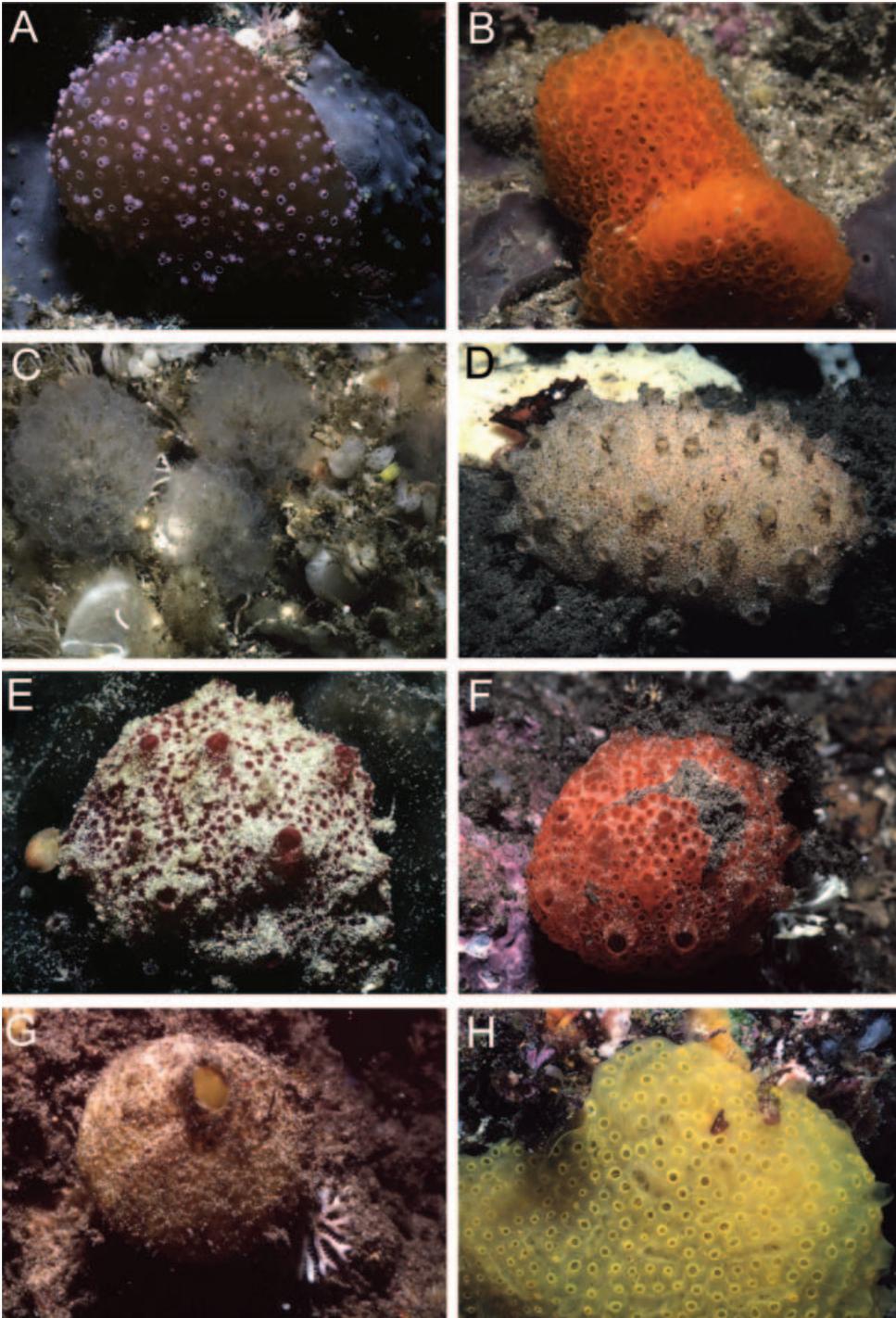


Figure 9. *In situ* images of: (A) *Pseudodistoma gracile* (SAM E3270); (B) *Pseudodistoma inflatum* (SAM E3297); (C) *Pseudodistoma pilatum* (SAM E3296); (D) *Polyclinum incrustatum* (SAM E3274); (E) *Polyclinum marsupiale* (SAM E2866); (F) *Aplidiopsis confluata* (SAM E3281); (G) *Aplidiopsis confluata* (SAM E3282); (H) *Synoicum citrum* (SAM E3277).

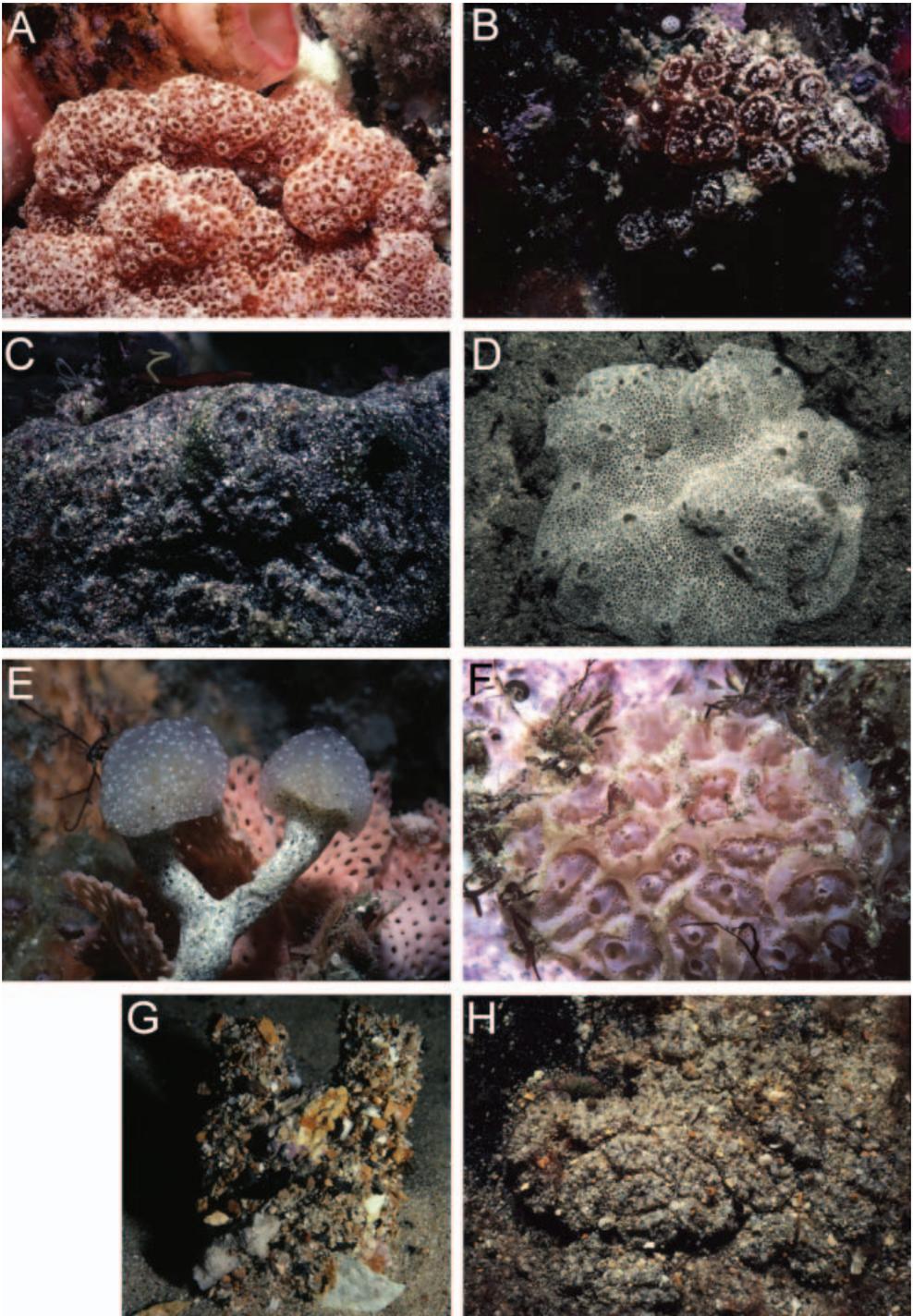


Figure 10. *In situ* images of: (A) *Synoicum sacculum* (SAM E2864); (B) *Synoicum sacculum* (SAM E3288); (C) *Synoicum sphinctorum* (SAM E3283); (D) *Aplidium abditum* (SAM E3268); (E) *Aplidium breviarvacium* (SAM E3284); (F) *Aplidium clivusum* (SAM E3390); (G) *Ascidia scaevola* (SAM E2871); (H) *Botryllus stewartensis* (SAM E3289).

Distribution

Previously recorded (see Kott 2002): Western Australia (Barrow I., Rowley Shoals, Dampier Archipelago, Cape Preston, Montebello Is, North West Cape, Learmouth, Shark Bay, Cervantes). New records: Queensland (18.845°S, 146.795°E, 26 m; 17.655°S, 146.225°E, 26 m; 17.145°S, 146.205°E, 36 m).

Remarks

Although only one to three small specimens were taken at the newly recorded locations, these do establish that the species known formerly only from the northwestern coast of the continent also occurs on the northeastern continental shelf. The species is readily distinguished by its short muscles that do not extend over the lower half of the body, the simple bilabiate anal border with each lip subdivided, the plain-edged oviducal membrane, and projecting distal end of the vas deferens.

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