New and little-known species of Didemnidae (Ascidiacea, Tunicata) from Australia (part 2)

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Eighteen new species of Didemnidae are included in the 71 species discussed. Two hundred and forty-one species of this family now are known from around the Australian continent. Newly recorded material is from the Western Australian Museum (principally from north-western Australia), the South Australian Museum (from Kangaroo I. and Tasmanian waters) and the Queensland Museum (from Darwin and the Northern Territory). Many of the species recorded from north-western, north-eastern and the north of Australia have a range that extends into the western Pacific and sometimes the western Indian Ocean. Tropical didemnid species seldom extend into temperate Australian waters, where the species are largely indigenous. The genus Didemnum dominates the fauna in both tropical and temperate waters. Of the new species, half are in the genus Polysyncraton (five tropical and four temperate species), four are Lissoclinum spp., two are described in each of the genera Didemnum and Leptoclinides, and one in the genus Diplosoma. Spicules are confirmed as reliable, genetically controlled characters showing little intraspecific variation. Amongst the known species, the unusual colonial organization reported for Leptoclinides glauerti Michaelsen, 1930, with its atrial apertures opening directly on the under surface of the colony, is confirmed. Originally described from a single mutilated part of a colony, the species has been redescribed, and its status in the genus Atriolum validated. Trididemnum pseudodiplosoma (Kott, 1962), formerly known only from South Australia, is found to extend into tropical waters of the Northern Territory and the Coral Sea; and Didemnum incanum (Herdman, 1899) appears to be one of the few known species with a trans-Tasman range.

KEYWORDS: Didemnidae, Australia, tropical, temperate, trans-Tasman, new species, Atriolum, Leptoclinides, Polysyncraton, Didemnum, Trididemnum, Lissoclinum, Diplosoma.

Introduction

Of the 222 species of the family Didemnidae from Australia discussed by Kott (2001, 2002c, 2004), 131 were described as new, 41 were recorded from Australia for the first time, and only 50 were already known from around this continent. In the
present work 71 species of Didemnidae are discussed and, with the exception of the
18 new species, they have all been recorded at least once from around the
Australian continent. *Atriolum glauerti* (Michaelsen, 1930), previously imperfectly
known from one incomplete specimen, is newly recorded and its status as a valid
species is confirmed. The total number of Didemnidae known from Australia is
now 241. In other taxa of the Asciidae, 437 species are known in Australia (Kott,
1985, 1990a, 1990b, 1992a, 1992b, 2002a, 2002b, 2003). At this stage, Didemnidae
comprise more than one-third of the ascidian species known from Australian seas.
Nevertheless, that only 25% of the previously recorded species (Kott 2001, 2002c,
2004) are amongst the present material, reinforces the view that the Australian
didemnid fauna is still inadequately sampled. However, nearly half of the species
reported from Darwin Harbour (Kott, 2002c) are in the present collection.

The taxonomy of the Didemnidae, which contains the smallest zooids known in
the Class Ascidiacea, has been neglected, especially in the tropics and in the Indo-
West Pacific where the family is now being shown to be particularly diverse. This
neglect has been largely because of the difficulties encountered in studying the small
and simplified zooids in colonies of increasing complexity that result from rapid
replication interrupting the growth of individuals while increasing their number and
the growth rate of the colony (Berrill, 1955). Selection for these adaptations has
occurred in parallel in all genera in the family and convergence tends to further
obscure the resolution of phylogenetic relationships and species parameters.
Generally, the large or small, highly organized, two- or three-dimensional colonies,
with small, simplified zooids, do not display many distinguishing characters at
either species or genus level; and the same range in cloacal systems and colony
shape and size, and in the size and form of the calcareous spicules (produced by the
thoracic ectoderm) occurs in all known genera. Characters such as loss of atrial
siphons, reduction in the length of the vas deferens and its change to straight from a
cooled condition, subdivision of the testis into two or more follicles, differences in
the larvae (formation of blastozooids before metamorphosis, increase in the number
of lateral ampullae, shifts in the position of the larval oozooid toward the anterior
end of the trunk and the isolation of the sensory vesicle from the larval thorax) are
significant at genus level. However, other morphological trends, such as reduction
in the size of zooids and development of more complex colonies and cloacal systems
are indicative of parallel evolution and are not unique to any one genus, although
they often comprise useful distinguishing characters for species. Understanding of
the phylogenetic significance of some of the characters observed in this family has
made it possible to pursue studies of their taxonomy on a more rational basis than
has been possible previously. This, to some extent, has removed what is a ‘tyranny
of similarity’ that beset former studies of the group and resulted in misinterpreta-
tion of the significance of many of the observed characters.

Nevertheless, owing to the lack of characters, difficulties in interpreting some
(e.g. the numbers of spicule rays) and the condition (maturity, contraction, fixation,
mutilation) of some of the material that tends to obscure many of these characters
(e.g. numbers of stigmata and vas deferens coils), species descriptions often are
unsatisfactory and require confirmation and revision as further material becomes
available. In the present work scanning electron micrographs accompany species
descriptions whenever possible to confirm the intraspecific stability of these
calcareous products of the zooids, and as aids to species identification.

As a result of recent studies incorporating a more informed approach to
the taxonomy of the Didemnidae than previously has been possible, their remarkable diversity in tropical and temperate waters of the Indo-West Pacific oceans has been recognized. These new studies have confirmed the continuity of the Indonesian and West Pacific fauna into northern Australian waters; and new records reinforce the view that there are separate temperate and tropical faunas around the Australian coast, few tropical species having a continuous range south of Moreton Bay on the eastern coast, and south of Houtman’s Abrolhos on the western coast. However, there are exceptions, notably *Trididemnum pseudo-diplosoma* (Kott, 1962), previously known only from southern Australia, now is known to occur off northern Australia and in the Coral Sea. Also, *Didemnum incanum* (Herdman, 1899), formerly known from around the south-eastern corner of Australia between South Australia and Port Jackson, is newly recorded from New Zealand.

Analyses of the species composition and geographic range of the diverse Australian didemnid fauna are set out below (tables 1 and 2, respectively). The number of species in each genus is shown in table 1; and table 2 shows the geographic range for each species recorded. Only *Diplosoma listerianum* (Milne Edwards, 1841) and *Didemnum psammatode* (Sluiter, 1895) are not included in these tables, their occurrence in Australian waters apparently being part of wide cosmopolitan ranges that include locations around the Australian coast.

*Didemnum* is shown to be the most diverse genus, being represented by 79 species. *Polysyncraton, Leptoclinides, Lissoclinum* and *Trididemnum* are relatively well represented and *Diplosoma, Atriolum* and *Clitella* are less often encountered. With the exception of South Australian waters, the number of species recorded from temperate locations is relatively low for all genera; and although the number of records have not been analysed, it appears that sampling off mid-western Australia, south-western Australia, Tasmania, Victoria and New South Wales has not been as intense as in tropical locations. A total of 91 species has been recorded from these temperate locations, about a third (29) only from South Australian waters. Six species are known only from Tasmania, five from Victoria and 10 from New South Wales, while 37 have a range that extends over two or more of the areas, occasionally to New South Wales, but seldom into south-western Australian waters. A relatively few species (eight) of *Diplosoma, Lissoclinum* and *Didemnum* appear to have extended down the New South Wales coast at the southern end of their tropical range, but generally tropical species do not extend into Australian temperate waters. One hundred and fifty-one species recorded from north-western Australia, and/or the Northern Territory and Queensland have not been recorded south of Houtman’s Abrolhos or Moreton Bay and should be considered tropical species. Of these, 51 are known from two or more of these tropical Australian locations, and 73 known from one or more Australian locations are known also from the tropical western Pacific and/or (less often) from the western Indian Ocean.

*Didemnum* is the most conspicuous genus at most locations, 44 species being recorded from Queensland alone, of which 34 also occur in the western Pacific. However, *Didemnum* is also common in temperate waters, 16 species being known from South Australia.
Table 1. Total number of species in the family Didemnidae recorded from Australian waters.

| Reference     | Atriolum | Leptoclinides | Polysyncraton | Didemnum | Tridemnum | Lissoclinum | Clitella | Diplosoma | Total |
|---------------|----------|---------------|---------------|----------|-----------|-------------|----------|-----------|-------|
| Kott, 2001    | 6        | 34            | 36            | 71       | 22        | 24          | 1        | 5         | 199   |
| Kott, 2002c   | 1        | 1             | 2             | 2        | 0         | 0           | 0        | 0         | 6     |
| Kott, 2004    | 3        | 4             | 6             | 2        | 2         | 1           | 1        | 0         | 17    |
| This work     | 1        | 2             | 9             | 2        | 4         | 1           | 1        | 0         | 19    |
| Total         | 7        | 40            | 50            | 81       | 26        | 30          | 1        | 6         | 241   |
Table 2. Geographic range of the known Australian Didemnidae.

| Genus       | South Australia | Tasmania | Victoria | New South Wales | Queensland | Northern Territory | Northwestern Australia | Midwestern Australia | Southwestern Australia |
|-------------|-----------------|----------|----------|----------------|------------|-------------------|------------------------|----------------------|------------------------|
| Atriolium   |                 |          |          |                |            |                   |                        |                      |                        |
|             | lillium         |          |          |                |            |                   |                        |                      |                        |
| Leptoclinides |     |          |          |                |            |                   |                        |                      |                        |
|             | compactus       | magnistellus | prunus | longicollis    | placidas   | albamaculatus     | complexus | echinus            |                        |                      |
|             | decoratus       | cucarbitus |         |                |            | cardaus           |          |                   |                        |                      |
|             | exigus          |           |          |                |            | lissus            |          |                   |                        |                      |
|             | fungiformis     |           |          |                |            | umbrosus          |          |                   |                        |                      |
|             | imperfectus     |           |          |                |            | rufus             |          |                   |                        |                      |
|             | variecatus      |           |          |                |            | brandi            |          |                   |                        |                      |
|             | volvus          |           |          |                |            | cavernosus        |          |                   |                        |                      |
|             | comitus         |           |          |                |            | erinaceus         |          |                   |                        |                      |
|             | confirmatus     |           |          |                |            | kingi             |          |                   |                        |                      |
|             | maculatus       |           |          |                |            | rigidas           |          |                   |                        |                      |
|             | multilobatus    |           |          |                |            | levitatus          |          |                   |                        |                      |
|             | seminudus       |           |          |                |            | aciculus          |          |                   |                        |                      |
|             |                 |           |          |                |            | constellatus      |          |                   |                        |                      |
|             |                 |           |          |                |            | setulosus         |          |                   |                        |                      |
| Polysyncratont |    | infundibulum | linere | (sulawesi)      |              |                  |            |                   |                        |                      |
|             | longitubis      | papyrus   | luteum   | circulum       |            |                  |            |                   |                        |                      |
|             | montanum        |           |          | flammeum       |            |                  |            |                   |                        |                      |
|             | reticulum       | tasmanense|          | jugosum        |            |                  |            |                   |                        |                      |
|             | rubitapum       |           |          | regulum        |            |                  |            |                   |                        |                      |
|             | scorteum        |           |          | scobinum       |            |                  |            |                   |                        |                      |
|             |                 |           |          |                |            |                  |            |                   |                        |                      |
|             |                 |           |          |                |            |                  |            |                   |                        |                      |

New species of Didemnidae

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| Genus       | South Australia | Tasmania | Victoria | New South Wales | Queensland | Northern Territory | Northwestern Australia | Midwestern Australia | Southwestern Australia |
|-------------|-----------------|----------|----------|-----------------|------------|-------------------|-----------------------|----------------------|------------------------|
| tegetum     |                 |          |          |                 |            |                   |                       |                      |                        |
| galaxum     |                 |          |          |                 |            |                   |                       |                      |                        |
| pontoninae  |                 |          |          |                 |            |                   |                       |                      |                        |
| rugosum     |                 |          |          |                 |            |                   |                       |                      |                        |
| purou      |                 |          |          |                 |            |                   |                       |                      |                        |
| arafuresis  |                 |          |          |                 |            |                   |                       |                      |                        |
| cuculliferum|                 |          |          |                 |            |                   |                       |                      |                        |
| pseudorugosum|               |          |          |                 |            |                   |                       |                      |                        |
| millepore   |                 |          |          |                 |            |                   |                       |                      |                        |
| orbiculum   |                 |          |          |                 |            |                   |                       |                      |                        |
| discoides   |                 |          |          |                 |            |                   |                       |                      |                        |
| Didemnum    |                 |          |          |                 |            |                   |                       |                      |                        |
| bicolor     |                 |          |          |                 |            |                   |                       |                      |                        |
| delectum    |                 |          |          |                 |            |                   |                       |                      |                        |
| microthoracium|              |          |          |                 |            |                   |                       |                      |                        |
| minusculum  |                 |          |          |                 |            |                   |                       |                      |                        |
| monile      |                 |          |          |                 |            |                   |                       |                      |                        |
| pellucidum  |                 |          |          |                 |            |                   |                       |                      |                        |
| effusum     |                 |          |          |                 |            |                   |                       |                      |                        |
| macrospionicum|              |          |          |                 |            |                   |                       |                      |                        |
| mantile     |                 |          |          |                 |            |                   |                       |                      |                        |
| ternerratum |                 |          |          |                 |            |                   |                       |                      |                        |
| lissoclinum |                 |          |          |                 |            |                   |                       |                      |                        |
| pecten      |                 |          |          |                 |            |                   |                       |                      |                        |
| crescente   |                 |          |          |                 |            |                   |                       |                      |                        |
| incanum     |                 |          |          |                 |            |                   |                       |                      |                        |
| fragum      |                 |          |          |                 |            |                   |                       |                      |                        |
| judundum    |                 |          |          |                 |            |                   |                       |                      |                        |
| complexum   |                 |          |          |                 |            |                   |                       |                      |                        |
| chartaceum  |                 |          |          |                 |            |                   |                       |                      |                        |

Table 2. (Continued).
Table 2. (Continued).

| Genus         | South Australia | Tasmania | Victoria | New South Wales | Queensland | Northern Territory | North-western Australia | Mid-western Australia | South-western Australia |
|---------------|-----------------|----------|----------|----------------|------------|--------------------|------------------------|------------------------|------------------------|
| *patulum*     |                 |          |          |                |            |                    |                        |                        |                        |
|               |                 |          |          |                |            | *caesium*          |                        |                        |                        |
|               |                 |          |          |                |            | *elongatum*        |                        |                        |                        |
|               |                 |          |          |                |            | *grande*          |                        |                        |                        |
|               |                 |          |          |                |            | *jedanense*        |                        |                        |                        |
|               |                 |          |          |                |            | *moseleyi*         |                        |                        |                        |
|               |                 |          |          |                |            | *multispire*       |                        |                        |                        |
|               |                 |          |          |                |            | *nekozita*         |                        |                        |                        |
|               |                 |          |          |                |            | *perplexum*        |                        |                        |                        |
|               |                 |          |          |                |            | *precocinum*       |                        |                        |                        |
|               |                 |          |          |                |            | *stragulum*        |                        |                        |                        |
|               |                 |          |          |                |            | *vahatuio*         |                        |                        |                        |
|               |                 |          |          |                |            | *candidum*         |                        |                        |                        |
|               |                 |          |          |                |            | *astrum*           |                        |                        |                        |
|               |                 |          |          |                |            | *albopunctatum*    |                        |                        |                        |
|               |                 |          |          |                |            | *clavum*           |                        |                        |                        |
|               |                 |          |          |                |            | *fragile*          |                        |                        |                        |
|               |                 |          |          |                |            | *fucatum*          |                        |                        |                        |
|               |                 |          |          |                |            | *fuscum*           |                        |                        |                        |
|               |                 |          |          |                |            | (membranaceum)     |                        |                        |                        |
|               |                 |          |          |                |            | membranaceum−      |                        |                        |                        |
|               |                 |          |          |                |            | molle†             |                        |                        |                        |
|               |                 |          |          |                |            | viride†            |                        |                        |                        |
|               |                 |          |          |                |            | roberti            |                        |                        |                        |
|               |                 |          |          |                |            | sordidum†          |                        |                        |                        |
|               |                 |          |          |                |            | scopi               |                        |                        |                        |
| *Trididemnum* |                 |          |          |                |            | *reticulatum*      |                        |                        |                        |
|               |                 |          |          |                |            | *crystallinum*     |                        |                        |                        |
|               |                 |          |          |                |            | *lapidosum*        |                        |                        |                        |
|               |                 |          |          |                |            | *areolatum*        |                        |                        |                        |
|               |                 |          |          |                |            | *marmoratum*†      |                        |                        |                        |
|               |                 |          |          |                |            | *pusillum*         |                        |                        |                        |
|               |                 |          |          |                |            | *clinides*†        |                        |                        |                        |
|               |                 |          |          |                |            | *planum†*          |                        |                        |                        |
|               |                 |          |          |                |            | *miniaturum†       |                        |                        |                        |
|               |                 |          |          |                |            | *multifidum††*     |                        |                        |                        |

New species of Didemnidae

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| Genus                  | South Australia | Tasmania | Victoria | New South Wales | Queensland | Northern Territory | North-western Australia | Mid-western Australia | South-western Australia |
|-----------------------|-----------------|----------|----------|----------------|------------|-------------------|------------------------|-----------------------|------------------------|
| Lissoclinum           |                 |          |          |                |            |                   |                        |                       |                        |
| concavum              |                 |          |          |                |            |                   |                        |                       |                        |
| laneum                |                 |          |          |                |            |                   |                        |                       |                        |
| levitum               |                 |          |          |                |            |                   |                        |                       |                        |
| (discrepans)          |                 |          |          |                |            |                   |                        |                       |                        |
| sibogae               |                 |          |          |                |            |                   |                        |                       |                        |
| pseudodiplosoma       |                 |          |          |                |            |                   |                        |                       |                        |
| (discrepans)          |                 |          |          |                |            |                   |                        |                       |                        |
| nubilum               |                 |          |          |                |            |                   |                        |                       |                        |
| tomarah               |                 |          |          |                |            |                   |                        |                       |                        |
| dispersum             |                 |          |          |                |            |                   |                        |                       |                        |
| pigmentatum           |                 |          |          |                |            |                   |                        |                       |                        |
| savignii              |                 |          |          |                |            |                   |                        |                       |                        |
| cyclops               |                 |          |          |                |            |                   |                        |                       |                        |
| discrepans            |                 |          |          |                |            |                   |                        |                       |                        |
| sibogae               |                 |          |          |                |            |                   |                        |                       |                        |
| pseudodiplosoma       |                 |          |          |                |            |                   |                        |                       |                        |
| paracyclops            |                 |          |          |                |            |                   |                        |                       |                        |
| caliginosum            |                 |          |          |                |            |                   |                        |                       |                        |
| maculatum              |                 |          |          |                |            |                   |                        |                       |                        |
| variabile              |                 |          |          |                |            |                   |                        |                       |                        |
| calysis                |                 |          |          |                |            |                   |                        |                       |                        |
| pacificense            |                 |          |          |                |            |                   |                        |                       |                        |
| punctatum              |                 |          |          |                |            |                   |                        |                       |                        |
| taratara               |                 |          |          |                |            |                   |                        |                       |                        |
| triangulum             |                 |          |          |                |            |                   |                        |                       |                        |
| nebulosum              |                 |          |          |                |            |                   |                        |                       |                        |
| timorensae            |                 |          |          |                |            |                   |                        |                       |                        |
| linosum                |                 |          |          |                |            |                   |                        |                       |                        |
| roseum                 |                 |          |          |                |            |                   |                        |                       |                        |
| badium                 |                 |          |          |                |            |                   |                        |                       |                        |
| regium                 |                 |          |          |                |            |                   |                        |                       |                        |
| patella                |                 |          |          |                |            |                   |                        |                       |                        |
| ostrearia              |                 |          |          |                |            |                   |                        |                       |                        |
| tasmanense            |                 |          |          |                |            |                   |                        |                       |                        |
| durabile               |                 |          |          |                |            |                   |                        |                       |                        |
| (tasmanense)           |                 |          |          |                |            |                   |                        |                       |                        |
| (ostrearia)            |                 |          |          |                |            |                   |                        |                       |                        |
| (sente)               |                 |          |          |                |            |                   |                        |                       |                        |

Table 2. (Continued).
Table 2.  

| Genus   | South Australia | Tasmania | Victoria | New South Wales | Queensland | Northern Territory | Northwestern Australia | Midwestern Australia | Southwestern Australia |
|---------|-----------------|----------|----------|-----------------|------------|-------------------|------------------------|-----------------------|------------------------|
| Clitella| nutricola       |          |          |                 |            |                   |                        |                       |                        |
| Diplosoma| fecundum       |          |          |                 |            |                   |                        |                       |                        |
|         | velatum         |          |          |                 |            |                   |                        |                       |                        |
|         |                 |          |          |                 |            |                   |                        |                       |                        |
|         |                 |          |          |                 |            |                   |                        |                       |                        |

*Range includes the western Pacific;

†Range includes the western Indian Ocean;

→Limit of known range;

—Occurrence recorded;

---Not yet recorded, though occurrence likely.

Species names in parenthesis indicates anomalous records outside usual range. Reference to accounts of all species are in Kott (2001, 2002c, 2004, and/or below).
Species list

1. *Atriolum glauerti* (Michaelsen, 1930)
2. *Leptoclinides aciculus* Kott, 2001
3. *Leptoclinides brandi* Kott, 2001
4. *Leptoclinides cavernosus* Kott, 2001
5. *Leptoclinides comitus* Kott, 2001
6. *Leptoclinides constellatus* Kott, 2001
7. *Leptoclinides decoratus* sp. nov.
8. *Leptoclinides exiguus* Kott, 2001
9. *Leptoclinides levitatus* Kott, 2001
10. *Leptoclinides maculatus* Kott, 2001
11. *Leptoclinides placidus* Kott, 2001
12. *Leptoclinides prunus* sp. nov.
13. *Leptoclinide rigidus* Kott, 2001
14. *Leptoclinides sulawesi* Monniot and Monniot, 1996
15. *Leptoclinides variegatus* Kott, 2001
16. *Polysyncraton catillum* sp. nov.
17. *Polysyncraton cuculliferum* (Sluiter, 1909)
18. *Polysyncraton dromide* Kott, 2001
19. *Polysyncraton galaxum* sp. nov.
20. *Polysyncraton longitubis* sp. nov.
21. *Polysyncraton montanum* sp. nov.
22. *Polysyncraton pedunculatum* Kott, 2001
23. *Polysyncraton peristroma* sp. nov.
24. *Polysyncraton pseudomagnetae* sp. nov.
25. *Polysyncraton pseudorugosum* Monniot, 1993
26. *Polysyncraton reticulum* sp. nov.
27. *Polysyncraton rica* Kott, 2001
28. *Polysyncraton rostrum* sp. nov.
29. *Polysyncraton tegetum* Kott, 2001
30. *Polysyncraton textus* sp. nov.
31. *Didemnum albopunctatum* Sluiter, 1909
32. *Didemnum candidum* Savigny, 1816
33. *Didemnum congregatum* sp. nov.
34. *Didemnum coralliforme* Kott, 2004
35. *Didemnum crescente* Kott, 2001
36. *Didemnum delectum* Kott, 2001
37. *Didemnum grande* (Herdman, 1886)
38. *Didemnum granulatum* Tokioka, 1954
39. *Didemnum incanum* (Herdman, 1899)
40. *Didemnum jucundum* Kott, 2001
41. *Didemnum lissoclinum* Kott, 2001
42. *Didemnum madeleinae* Monniot and Monniot, 2001
43. *Didemnum membranaceum* Sluiter, 1909
44. *Didemnum pecten* Kott, 2001
45. *Didemnum poecilomorpha* Monniot and Monniot, 1996
46. *Didemnum scopi* Kott, 2001
47. *Didemnum sordidum* Kott, 2001
(48) Didemnum spumante sp. nov.
(49) Didemnum tabulatum Sluiter, 1909
(50) Didemnum ternerratum Kott, 2001
(51) Didemnum vahatuio Monniot and Monniot, 1987
(52) Trididemnum paracyclops Kott, 1980
(53) Trididemnum pigmentatum Kott, 2001
(54) Trididemnum pseudodiplosoma (Kott, 1962)
(55) Trididemnum savignii (Herdman, 1886)
(56) Trididemnum sibogae (Hartmeter, 1910)
(57) Lissoclinum coactum sp. nov.
(58) Lissoclinum conchylium Kott, 2001
(59) Lissoclinum diversum sp. nov.
(60) Lissoclinum durabile Kott, 2001
(61) Lissoclinum laneum sp. nov.
(62) Lissoclinum levitum Kott, 2001
(63) Lissoclinum limosum Kott, 2001
(64) Lissoclinum multifidum (Sluiter, 1909)
(65) Lissoclinum ostrearium (Michaelsen, 1930)
(66) Lissoclinum roseum Kott, 2001
(67) Lissoclinum reginum Kott, 2001
(68) Lissoclinum stellatum sp. nov.
(69) Diplosoma fecundum sp. nov.
(70) Diplosoma ferrugeum Kott, 2001
(71) Diplosoma translucidum (Hartmeyer, 1909)

Taxonomy

*Atriolum glauerti* (Michaelsen, 1930)
(figures 1A–D, 15A)

*Leptoclinides glauerti* Michaelsen, 1930: 511.

*Distribution.* Previously recorded (see Michaelsen, 1930): Western Australia (Shark Bay). New record: Western Australia (24 km N of Dongara, 15 m, WAM 141.93).

*Description.* Colonies are small cup-shaped to flattened oval or irregular plates or lobes about 3–5 mm thick, joined to one another or to the substratum by short, narrow commissures or stalks, or with a series of short prop-like or tapered roots from the under-surface or around the margins of the colony. Concavities, when present, are shallow, and are on upper surfaces. The newly recorded colonies are growing amongst the branches of a bryozoan colony. The lower (under) surfaces of the flattened plate-like colonies are lifted off the substratum by the prop-like supports, and the five-lobed atrial apertures, either outlined in spicules or with a plug of spicules in the siphon lining, are evenly distributed on the under surfaces, or on the outer (convex) surfaces of the cup or saucer-like colony lobes. Evenly spaced but not crowded branchial openings, each with a conspicuous plug of spicules, are withdrawn into the upper, sometimes concave, surfaces. The excurrent streams of water from the atrial apertures would, very likely, complement the actions of the prop-like supports in elevating
the colony off the substratum, and would also tend to irrigate the algal or bryozoan mat forming the substratum for these colonies.

Spicules are evenly distributed throughout, but are not particularly crowded. They are small, the larger ones stellate, to 0.03 mm diameter, with 11–15 conical rays in optical transverse section; and the smaller ones globular, to 0.0175 mm diameter, with varying numbers of crowded, flat-tipped rays.

Zooids are large, about 3 mm between the branchial and atrial openings, each at the extremity of long cylindrical siphons that, with the dorsal border of the thorax, form a straight vertical line between the upper and lower surfaces of the colony. Six small, pointed tooth-like lobes are on the rim of the branchial apertures. Five-rayed stellate atrial apertures sometimes are outlined with spicules, but sometimes are obscured by contraction, a plug of spicules being drawn into the aperture. Four rows of long, rectangular stigmata are in the large thorax, with about 14 in the anterior row. Fine longitudinal muscles are on the thorax and circular muscles extend along the length of each of the siphons. The small abdomen is bent up beside the thorax. Gonads were not detected in the newly recorded colonies.

**Remarks.** The atrial siphon shown by Michaelsen (1930: figure 4) is shorter than the characteristically long siphon found in the present specimens, leading

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**Fig. 1.** *Atriolum glauerti* (WAM 141.93). (A) Flat colony from the upper surface; (B) vertical section through cup-shaped colony (semi-diagrammatic); (C) thorax; (D) abdomen. Scale bars: 1.0 mm (A, B); 0.1 mm (C, D).
Kott (2001) to assume (erroneously) that the species belonged to the genus *Leptoclinides*. Other characters reported by Michaelsen (1930) that differ from the newly recorded specimens are the bladder cell layers, which were not detected (although the surface test is soft and the branchial apertures are withdrawn into it); and the spicules, which were reported to be 0.045 mm diameter (slightly larger than the maximum diameter of spicules in the present colonies). Nevertheless, the colonies and zooids (with nine or 10 stigmata per row) otherwise resemble those described by Michaelsen (1930) and the specimens appear to be conspecific. Gonads have not been detected in any of the known specimens.

*Atriolum eversum* Kott, 2001 has the atrial apertures on the outside of the cup-shaped colony and branchial apertures opening from the inside of the cup, a condition in which, like the present species, the concavity is not homologous with the common cloacal cavity. The species differs from the present one in its larger colony (to 2 cm diameter), more stigmata per half row and large stellate spicules (to 0.1 mm diameter).

Spicules of two types, globular and stellate, with relatively numerous rays are known in other genera (*e.g.* *Polysyncraton dentatum* Kott, 2001, *Didemnum chartaceum* Sluiter, 1909 and *Didemnum multispirale* Kott, 2001) but have not been recorded previously for *Atriolum*, in which the other known species have larger and invariably stellate spicules.

*Leptoclinides aciculus* Kott, 2001

*(figure 15B)*

*Leptoclinides aciculus* Kott, 2001: 37; 2002c: 29 and synonymy.

*Distribution.* Previously recorded (see Kott, 2001, 2002c): Western Australia (Port Hedland), Queensland (Whitsunday Is), Northern Territory (Darwin), Papua New Guinea, Palau Is, Philippines. New record: Northern Territory (Darwin, QM G308615).

*Description.* The colony is robust, with large terminal common cloacal apertures on the lobes and rounded ridges on the surface. Zooids are along each side of deep primary common cloacal canals that surround zooid-free patches of test that create a mosaic of oval elevated areas on the surface of the preserved colony. Spicules are not in a thin surface layer of test, nor in the roof of the circular common cloacals. They are crowded in the surface of the elevated stands of test, becoming sparse or absent toward the base. The spicules are stellate, to 0.06 mm diameter, with 11–13 chisel-tipped rays in optical transverse section. The circular common cloacal canals are the whole depth of the zooids. Zooids have the usual posteriorly orientated atrial siphons opening directly into the common cloacal canals. There are seven coils of the vas deferens around four or five testis follicles. Embryos are developing in the basal test.

*Remarks.* Although the spicules of this species resemble those of *L. cavernosus*, they are smaller and have fewer rays. Also, the form of the common cloacal canals in these two species is different, the circular canals and solid pillars of zooid-free test in the present species more closely resembling *L. rigidus* Kott, 2001, which has similar spicules but with fewer rays and only five coils of the vas deferens. Spicules of the maximum size reported (0.096 mm) were not detected.
**Leptoclinides brandi** Kott, 2001

*(figure 15C)*

**Leptoclinides brandi** Kott, 2001: 40 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Queensland (Capricorn Group). New records: Northern Territory (Stevens Rock, QM G308597, G308645; Channel I., QM G308633).

**Description.** Newly recorded colonies are sheet-like, sometimes with some ridges on the surface, which is finely crinkled when the colony is removed from the substratum. Branchial apertures are evenly spaced over the surface. Spicules are in an even layer in the surface test and a sparse layer on the base, but they are absent from the remainder of the colony. They are large, stellate, to 0.1 mm or more in diameter, with 11–13 acutely pointed rays in optical transverse section. Zooids are large with smooth-rimmed apertures, about 10 long stigmata in the anterior row. The vas deferens coils five times around the testis follicles.

**Remarks.** The colonies and zooids are as previously described, especially the distribution of the characteristic spicules and the crinkled colony surface contributing to the species determination. The newly recorded specimens are the first reported from other than the southern end of the Great Barrier Reef.

**Leptoclinides cavernosus** Kott, 2001

*(figure 15D)*

**Leptoclinides cavernosus** Kott, 2001: 44 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Exmouth Gulf), Queensland (Heron I.), Coral Sea (Marion Reef, Switzer Reef). New record: Western Australia (off Shoalwater Bay Cockburn Sound, WAM 308.89).

**Description.** The preserved colony is hard, with large (to 0.1 mm diameter) spicules crowded throughout, making the upper surface raspy to the touch. The spicules have 13–16 and sometimes 11 rays in optical transverse section and all the spicule rays have chisel-shaped tips. Zooids are brown, firmly embedded in the test and impossible to remove. This colony appears to have dried out at some stage, and the superficial bladder cell layer previously reported for the species was not detected.

**Remarks.** Other *Leptoclinides* species with similar spicules with chisel-shaped tips and relatively numerous rays are *L. cuspidatus* (Sluiter, 1909) with larger spicules and *L. albamaculatus* Kott, 2001 with smaller spicules. In addition to the spicule size differences, in neither of these species do all the spicules have chisel-shaped tips as in the present species.

**Leptoclinides comitus** Kott, 2001

*(figure 15E)*

**Leptoclinides comitus** Kott, 2001: 48.

**Distribution.** Previously recorded (see Kott, 2001): Tasmania (Port Davey). New records: South Australia (Kangaroo I., SAM E3223).

**Description.** The newly recorded colony has a large circular common cloacal aperture with a transparent rim protruding from the surface on a short cylindrical siphon on the top of a conical elevation at each end of a robust slab about
2 cm long. The colony is tough, but neither hard nor brittle. The rims of the cloacal apertures are orange and slightly everted in life. The margins of the stellate branchial apertures are outlined in a thick band of spicules that project down into the siphon lining. Spicules are small, evenly spaced in a layer around the outer surface of the colony that is particularly thin on the base of the colonies. Spicules are absent from the remainder of the colony, which is soft and transparent. They are up to 0.02 mm diameter, globular or burr-shaped with flat-tipped, rod-like or club-shaped rays. The spicules are interrupted in the surface by minute vesicles that make the colony look spotted. Zooids are large. Gonads are not present in the newly recorded material. 

Remarks. Kott (2001) drew attention to the fact that the globular spicules characteristic of this species are unusual in this genus. Although smaller ones are said to predominate (Kott, 2001), spicules previously have been reported up to 0.07 mm diameter. Nevertheless, this is the only difference detected between the newly recorded colony and the types and, until further material is available that would suggest otherwise, the specimens are thought to be conspecific. 

**Leptoclinides constellatus** Kott, 2001
(figure 15F)

*Leptoclinides constellatus* Kott, 2001: 51.

**Distribution.** Previously recorded (see Kott, 2001): Queensland (Whitsunday Is). New records: Northern Territory (Channel I., QM G308611).

**Description.** Tough, slab-like colony whitish grey and leathery in preservative, but blue-grey when living, with blue round the large, terminal common cloacal apertures on surface elevations. The colour is the result of black pigment particles mixed with spicules in the test of the upper half of the colony (around the zooids). Both pigment and spicules are sparser in the base of the colony, which is separated from the surface (zooid) layer by a large posterior abdominal common cloacal cavity. Sand and other debris are embedded in the basal test. Secondary common cloacal cavities penetrate amongst the zooids. Spicules are stellate, to 0.0625 mm diameter, with 9–11 sturdy, usually conical, pointed rays in optical transverse section. Chisel-shaped ray tips were not detected and truncated spicule rays are rare.

**Remarks.** Despite Kott’s (2001) statement that spicules with chisel-shaped rays are found in this species, this was not confirmed in any of the previously recorded material. The species slightly resembles *L. sulawesi* Monniot and Monniot, 1996 (see Kott, 2001) although the latter species has larger spicules, most with conspicuously chisel-shaped ray tips.

**Leptoclinides decoratus** sp. nov.
(figures 2, 15G)

*Leptoclinides decoratus* sp. nov.
(figures 2, 15G)

**Distribution.** Type locality: South Australia (Kangaroo I., The Arch between Snug Cave and Western River Cave on rock wall, coll. K. Gowlett Holmes, 8 March 2002, holotype SAM E3212; rock E of Snug Cave, coll. K. Gowlett Holmes, 10 March 2002, paratype SAM E3214).

**Description.** In life the colonies look glassy with randomly distributed,
embedded blue-black spots of pigment and, mixed with them and in the same size range, spherical white clumps of tightly crowded spicules. In preservative, the black and white spots persist in reddish brown colonies, which have a fleshy appearance. However, these colonies are especially tough, the translucent test is difficult to cut and the zooids are impossible to remove. The surface of the holotype colony is elevated into a broad rounded ridge with a large circular, elevated common cloacal aperture at one end of the ridge. The superficial layer of test contains pale brown-orange pigment mixed with an even, but relatively sparse, thin layer of spicules. Spicules are even sparser in a layer lining the very extensive posterior abdominal common cloacal cavity and another thin, sparse layer of spicules is on the base of the colonies. Spicules are absent from other parts of the colony. The surface ridges are the result of thickening of the basal test.

Clean scanning electron micrographs of the spicules were not obtained, and a considerable amount of amorphous material obscures them, despite efforts to free them by the usual method of incinerating strips of spicule-containing test. The spicules are small, stellate, to 0.04 mm diameter, with five to seven and sometimes nine conical, pointed rays in optical transverse section.

Zooids are relatively large. Branchial siphons are robust cylinders without branchial lobes around the apertures. Posteriorly orientated atrial siphons have a

**Fig. 2.** *Leptoclinides decoratus* (SAM E3214). (A) Thorax; (B) abdomen. Scale bars: 0.1 mm.
small lip on the posterior rim of the aperture. There appear to be about 10 stig mata per row, but these could not be counted accurately. Gonads were not detected in these specimens.

**Remarks.** *Leptoclinides maculatus* Kott, 2001 has similar black spots in the test, although its posterior abdominal common cloacal cavities are never so extensive and the spicules are larger with more spicule rays. Larger spicules with more rays are also in *L. variegatus* Kott, 2001. *Leptoclinides compactus* Kott, 2001 has similar tough colonies, with surface swellings and terminal common cloacal apertures, but it has a superficial layer of bladder cells, which is lacking in the present species and although its spicules have a similar number of rays, larger spicules (to 0.06 mm diameter) occur in *L. compactus* and the ray tips often are chisel-shaped or truncated.

*Leptoclinides exigus* Kott, 2001

*Leptoclinides exigus* Kott, 2001: 62 and synonymy; *not* Kott, 2004 (*= L. maculatus, see below).

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Gulf St Vincent, Spencer Gulf, Kangaroo I.); Victoria (Port Phillip Bay, Western Port, Gabo I.). New records: Victoria (Western Port, QM G398569).

**Description.** In preservative, the newly recorded colony has blue-black piebald markings resulting from fine pigment cells beneath a thin, superficial layer of bladder cells. Spicules are present throughout the test but they are never crowded and they become sparser toward the base of the colony. Zooids have a number of male follicles surrounded by five coils of the vas deferens.

**Remarks.** Although *Leptoclinides exigus*: Kott, 2001 (part, specimen QM G301615) is a figured specimen, it is not the holotype of *L. exigus* Kott, 2001 as Kott (2004) erroneously stated. This specimen and others from South Australia (SAM E2096-7) with similar colonies, spicules and zooids with eight coils of the vas deferens (*L. exigus*: Kott, 2004) appear to be specimens of *L. maculatus* Kott, 2001 incorrectly assigned to the present species.

*Leptoclinides levitatus* Kott, 2001

*Leptoclinides levitatus* Kott, 2001: 69.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Warnbro Sound), Queensland (Little Black Reef, Penrith I.). New records: Northern Territory (Darwin Harbour, QM G308603, G308624).

**Description.** The surfaces of the newly recorded slab-like colonies (up to 6 cm long and 3 cm thick) are raised into long, sinuous rounded ridges. One colony (QM G308603) has large common cloacal apertures with frilled margins, along one side of the colony, at the outer extremity of each curve, suggesting that the slab may have been on a vertical surface, the margin with the common cloacal cavities being along the upper edge. Colonies are soft and gelatinous but quite turgid. Spicules are in a single layer in the surface, and in a sparse layer lining the vast central common cloacal cavity which has large vertical canals penetrating the surface layer of test around the zooids. The surface layer of spicules penetrates into the test that forms the rim around the common cloacal apertures
but they are sparse in the remainder of the colony. One of the photographed colonies appears to have been black, although it is recorded in the collector’s note as brown (QM G308603). The other newly recorded colony appears to have been reddish orange. Both are colourless in preservative. The spicules are relatively small (to 0.04 mm diameter) with attenuated tips on the pointed conical rays, which are variable in length and number up to 15 in optical transverse section.

Zooids are large, with false siphons formed by the velum in the base of the branchial siphon, short atrial siphons, fine longitudinal muscles in the parietal body wall, and especially fine and few muscles in the transverse sinuses between the rows of stigmata. The paired dorsal pharyngeal muscles, which generally are inconspicuous in this genus, were not detected at all in this species. About 16 stigmata are in the anterior row of the branchial sac but the number reduces to about 12 in the posterior row. The gut forms a double loop and the vas deferens makes a sinuous curve across the outside of the testis follicles.

Remarks. The colonies resemble those previously described for this species, including the variations in colour, previously recorded and photographed specimens having been pink or bright orange-red or black in life and colourless in preservative. The spicules are, as in other species of the *dubius* group (see Kott, 2001), in a thin layer in the surface of the colony. Also, the zooids have the characters previously identified as characteristic of this group of species, having a branchial velum at the base of the branchial siphon, numerous stigmata, a double curved gut loop and an S-shaped curve of the vas deferens over the outside of the testis follicles. The only departure from previously recorded specimens is the absence of the smaller almost globular spicules that Kott (2001) reported, although the attenuated points on the conical spicule rays are exactly like those previously described.

**Leptoclinides maculatus** Kott, 2001

(figure 16A)

*Leptoclinides maculatus* Kott, 2001: 72.

*Leptoclinides exiguus*: Kott, 2001: 62 (part, specimen QM G301615); 2004.

**Distribution.** Previously recorded (see Kott, 2001, 2004): South Australia (Yorke Peninsula to Investigator Strait); Western Port (Victoria). New records: South Australia (Kangaroo I., SAM E2916); Victoria (Western Port, QM G308556, G308563-4).

**Description.** Colonies are encrusting sheets varying in colour from white with black spots or with patches of grey to an even black. In preservative colours are similar, though lighter, and black spots are in the grey areas. Sometimes the pigment is more concentrated in the surface grooves over the primary common cloacal canals that surround grey surface elevations over the solid stands of test (where the pigment layer is diluted by the depth of the white spicules in the upper part of the colony). The black pigment is in branching bodies in a layer beneath the surface, where it is mixed with spicules. Randomly distributed common cloacal apertures with frilled rims are at the junctions of the primary common cloacal canals. Spicules are crowded in a layer in the upper, zooid-bearing half of the colony, but are only very sparse in, or absent from, the lower half of the colony where the test is translucent. They are to 0.065 mm in diameter, and have 9–11 rays with pointed or chisel-shaped tips in optical transverse section.
Zooids have four rows of oval stigmata, a long oesophageal neck, eight coils of the vas deferens around a circle of four or five testis follicles.

**Remarks.** The sympatric *L. exiguus* Kott, 2001 has been confused with the present species (see *L. exiguus*, above), having similar colonies and spicules. It has more intense pigmentation, with, in life, a vivid yellow/black pattern and only five coils of the vas deferens. The tropical *L. aciculus* is distinguished by its fewer (seven) coils of the vas deferens, larger spicules (some with bifid rays) and the lack of the quilted pattern on the surface of the colony.

*Leptoclinides placidus* Kott, 2001

*Leptoclinides placidus* Kott, 2001: 75.

**Distribution.** Previously recorded (see Kott, 2001): New South Wales (Solitary Is) to Queensland (Hervey Bay). New records: New South Wales (Byron Bay, QM G308514-5).

**Description.** As previously described, the stellate spicules, to 0.06 mm in diameter, have 9–11 rays with chisel-shaped tips in optical transverse section and are crowded throughout the tough, hard colonies. The common cloacal cavities are oesophageal; the vas deferens coils seven times around the circle of four or five long, club-shaped male follicles.

*Leptoclinides prunus* sp. nov. (figures 3, 16B)

**Distribution.** Type locality: Victoria (Portsea Pier on piles 4–5 m, coll. K. Gowlett Holmes, 26 June 1999, holotype SAM E2915).

**Description.** The holotype is an encrusting sheet with a quilted surface, formed by depressions in the surface test over the primary common cloacal canals that surround the circular stands of solid test protruding slightly from the surface. A thin superficial layer of bladder cells contains stellate grey-black pigment bodies mixed with evenly, but sparsely, distributed spicules. Some relatively large spots created by patches of crowded spicules are scattered in the bladder cell layer on some parts of the surface. Branchial apertures are depressed into the surface along each side of the primary common cloacal canals, but they are inconspicuous, without a marginal row of spicules. Large common cloacal apertures are on slight prominences at some of the junctions of primary common cloacal canals. The common cloacal apertures are scattered over the surface of the colony rather than around its margins. Deep posterior-abdominal common cloacal cavities are found beneath common cloacal apertures, but these become oesophageal canals toward the outer margins of the colony.

Spicules are present only in the zooid layer and lining the common cloacal canals. In the lower half of the colony the test is firm and translucent. Spicules are stellate, to 0.063 mm diameter, with seven to nine rays in optical transverse section, the rays with relatively short, round, pointed, chisel-shaped or truncated tips.

**Remarks.** Of the *Leptoclinides* spp. with similar common cloacal systems and spicules absent from the lower half of the colony, the tropical *L. constellatus* Kott, 2001 lacks the pigment cells and has larger zooids and spicules; while *L. rigidus* Kott, 2001 has only five coils of the vas deferens and larger spicules than the present
species. The temperate *L. seminudus* Kott, 2001 has larger spicules and more (eight) vas deferens coils, and *L. exigus* Kott, 2001 has fewer (five) vas deferens coils and different pigmentation. All of these species have more (9–11) spicule rays than the present species. Other temperate species, such as *L. compactus* Kott, 2001 with spicules missing from the lower half of the colony, have different common cloacal systems with a terminal common cloacal aperture on conspicuous lobes projecting from the surface of the colony, rather than the quilted surface of the present species.

*Leptoclinides rigidus* Kott, 2001

*Leptoclinides rigidus* Kott, 2001: 77 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Montebello Is), Queensland (Whitsunday Is, Deloraine I., Hawksbury I.), Northern Territory (Wessel I.); ?Papua New Guinea. New records: Western Australia (Ashmore Reef, WAM 1035.88), Northern Territory (Darwin Harbour, QM G308614).

**Description.** The surface of the firm, gelatinous colony has a mosaic of oval to irregular elevated areas separated by circular depressions over the primary common cloacal canals. These deep canals expand into extensive posterior abdominal common cloacal cavities that separate the lower basal test from the
upper zooid-bearing layer. In the zooid-bearing layer of test there is black pigment mixed with the spicules, which are sparse elsewhere. Spicules are to 0.082 mm diameter and have 9–11 pointed or chisel-tipped rays in optical transverse section. Atrial apertures are on long posteriorly orientated siphons opening into the posterior abdominal common cloacal cavities. The abdomina are bent up ventral to the thoraces or are vertical loops in teardrop-shaped abdomina. Six coils of the vas deferens surround seven or eight testis follicles.

**Remarks.** Although the colony has the same mosaic of elevated areas on the surface as in *L. aciculus*, it is distinguished by its spicules, which have fewer rays. The spicules have more rays and are larger than *L. sulawesi*.

*Leptoclinides sulawesi* Monniot and Monniot, 1996

(figure 16D)

*Leptoclinides sulawesi* Monniot and Monniot, 1996: 180; Kott, 2001: 83.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Dongara), New South Wales (Twofold Bay), Indonesia, Palau Is. New records: NW Australia (Ashmore Reef, WAM 996.88).

**Description.** Small oval cushions about 1 cm long, with about three randomly distributed common cloacal openings on slight prominences on the upper surface. A crowded layer of spicules is on the upper surface and another is on the lower surface, and these form a capsule that surrounds the whole colony. Spicules are not present in the remainder of the colony. Spicules are stellate, to 0.075 mm diameter, with seven to nine chisel-tipped rays in optical transverse section. Black pigment, mixed with spicules around each common cloacal aperture in the surface test and in the zooid layer in the upper half of the colony, fades out toward the base. A large common cloacal cavity is posterior to the zooids in the centre of the lower part of the colony and abdomina are around the periphery.

Zooids are relatively small, with about 12 stigmata in the anterior row, a posteriorly orientated atrial aperture, a gut loop bent at right angles to the antero-posterior axis of the body, five testis follicles surrounded by seven coils of the vas deferens.

**Remarks.** The newly recorded specimens are as previously described except for the small cushion-shaped colonies. Only further material can resolve the true identity of these newly recorded colonies, which could be found not to be conspecific with *L. sulawesi*.

*Leptoclinides variegatus* Kott, 2001

(figure 16E)

*Leptoclinides variegatus* Kott, 2001: 86 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Great Australian Bight, Spencer Gulf, Gulf St Vincent, Investigator Strait). New records: South Australia (Gulf St Vincent, SAM E3206; Kangaroo I., SAM E3221).

**Description.** The tough, robust, sheet-like colonies have patches of black grey pigment in a white background, crossed by veins of orange pigment mixed with the spicules in the superficial test. The spicules are relatively small (to 0.09 mm diameter) and have 11–13 rays in optical transverse section, usually with chisel-shaped or truncated tips. They are not crowded and the colony is slightly translucent. Spicules become sparser toward the base of the colony and often are missing altogether from
the basal test. Large sessile common cloacal apertures are randomly distributed over
the otherwise smooth or slightly quilted surface. Gonads were not detected.

**Remarks.** Apart from the distinctive marbled colour pattern, the firm con-
sistency of the colony without conspicuous surface depressions over the common
cloacal canals, the relatively small zooids, the conspicuous chisel-shaped tips of
the relatively large spicules, and their distribution, together distinguish the species.

**Polysyncraton catillum** sp. nov.

(figure 16F)

*Distribution.* Type locality: Western Australia (northern side of Ashmore
Reef, 6–16 m, coll. L. Marsh, 16 September 1986, holotype WAM 1046.88).

*Description.* Colonies are almost circular, thin, brittle, plates with conspicuous
stellate branchial apertures along each side of the deep primary common cloacal
cavities that surround solid stands of test in which the ventrum of each thorax is
embedded. Conspicuous stellate branchial apertures are outlined in spicules. Spicules
are in a single layer in the paper-thin surface test, are crowded in the solid stands of
test in which the ventrum of each thorax is embedded and also are crowded in a layer
on the base of the colony. Spicules are not present in a layer of test in the floor of the
common cloacal canals and are sparse around the abdomina, which are
embedded in the basal test. Spicules are small, to 0.04 mm diameter. They have
9–11 long, thick and almost rod-like rays in optical transverse section.

Zooids have relatively large but delicate thoraces. The oesophageal neck is
relatively short and a short, thin retractor muscle projects from it. Stigmata are
long and fusiform, nine are in each of the first two rows, eight in the third and
seven in the last row. A huge atrial aperture exposes much of the branchial sac
directly to the common cloacal cavity and has a bifid atrial tongue of varying
size. The long gut loop is typical of *Polysyncraton* with a long rectum. Four coils
of the vas deferens surround about eight male follicles.

**Remarks.** Apart from the small, thin, plate-like colonies, this species is distin-
guished from others by its spicules, which are relatively small and have long,
almost cylindrical rays. The spicules of *P. cuculliferum* are larger and although
they have the same number of rays, they are shorter and more pointed than
those of the present species. The conspicuous circular common cloacal cavities
around the solid stands of test also distinguish the species from *P. cuculliferum. 
Polysyncraton scobinum* Kott, 2001 has similar but larger spicules with more rays
than the present species and although *P. pseudorugosum* has similar common
cloacal systems, its spicules are larger than the present species with more con-
spicuously conical pointed rays.

**Polysyncraton cuculliferum** (Sluiter, 1909)

(figure 16G)

*Diplosomoides cuculliferum* Sluiter, 1909: 90.

*Polysyncraton cuculliferum*: Kott, 2002c: 30 and synonymy.

Not *Didemnum cuculliferum*: Kott: 2001: 167 (<*Didemnum nekozita* Tokioka, 1967).

*Distribution.* Previously recorded (see Kott, 2002): Northern Territory
(Darwin), Queensland (Heron I. to Lizard I.), Indonesia. New records: Northern
Territory (South Shell I., QM G308604; Angler Reef, QM G308616).
Description. The in situ photographs of newly recorded colonies from Darwin Harbour resemble those from Queensland (see Kott, 2001: pl.5B, C). They are large, encrusting and surrounding debris, with the surface raised into lobes. The common cloacal canals are thoracic but roomy, the surface layer of test in the roof of the canal being very thin and brittle. Spicules are in a single layer in the surface test and are in a crowded layer on the base of the colony. They are not in the test in the floor of the common cloacal canals and are sparse in the basal test where the abdomina are embedded. They are to 0.057 mm diameter with 9–11 strong, sharply pointed conical rays in optical transverse section. Some of the spicules have rays of variable size. Branchial apertures are conspicuous on the surface of the colony with six petal-like lobes crowded with spicules. Internally the test is translucent and cloudy, with the zooids in clumps surrounded by deep primary common cloacal canals that extend the full length of the zooids and occasionally become posterior abdominal.

Larvae are in one of the colonies (QM G308608) collected in May. They have a conspicuous horizontal ampulla on the right side of the trunk which projects posteriorly.

Remarks. The newly recorded specimens lack the large papilla often associated with each branchial aperture in this species. However, all other characters conform with previous descriptions of the species, especially the large thorax, roomy common cloacal canals and relatively small spicules with sharply pointed rays. Although Kott (2002c) reported that the external larval ampulla on the right side of the trunk was vertical, it projects horizontally in the newly recorded specimens. Polysyncraton pseudorugosum has similar spicules with the same number of pointed conical rays, but they are larger than the spicules of the present species and are present throughout the colony. The spicules of P. catillum and P. peristroma have longer almost cylindrical or rod-shaped rays that distinguish them from the present species.

Polysyncraton dromide Kott, 2001
(figure 16H)

Polysyncraton dromide Kott, 2001: 99; 2002c: 32.

Distribution. Previously recorded (see Kott, 2001, 2002c): Northern Australia (Darwin, Torres Strait), Western Australia (Cockburn Sound). New records: Northern Territory (Darwin, QM G308596, G308670).

Description. In preservative the colonies are firm and gelatinous, but thin, beige and translucent lamellae or sheets, with the surface divided into a mosaic of elevated blister-like oval zooid-free areas surrounded by circular depressions over the narrow circular primary common cloacal canals that are lined on each side by the zooids. One (QM G308670) of the newly recorded colonies is aspiculate. Parts of the other are aspiculate, but other parts have a superficial aspiculate layer containing brown pigment cells over a thin layer of evenly spaced spicules. Spicules are absent from the remainder of the colony. The spicules (to 0.04 mm diameter) are almost burr-like, with 15–17 rays in optical section. The ray tips are sometimes rounded and the spicules almost globular but other spicules have short pointed rays.

Thoraces are large with a long, tulip-shaped branchial siphon, a bifid atrial lip, a long retractor muscle from the top of the oesophagus, four coils of the
vas deferens and eight or nine testis follicles. Larvae, present in the basal test of specimens collected in August have 12 lateral ampullae on each side of the three antero-median adhesive organs and larval blastozoooids.

**Remarks.** The large thoraces of the newly recorded colonies with their bifid atrial tongues are exactly like those of the type material as are the colonies, the spicules and the larvae with bladder cells packed in their test. Although Kott (2001) reported only three coils of the vas deferens for this species, four have been found on re-examination of the type material (see also Kott, 2002c). The newly recorded colonies differ from the type material only in their fewer testis follicles, 20 having been reported previously (see Kott, 2001). In life this species has a dramatic appearance, the blister-like elevations of the surface test being opaque, and sometimes quite metallic in appearance.

*Polysyncraton galaxum* sp. nov.  
(figures 4, 17A)

**Distribution.** Type localities: South Australia (Kangaroo I. W of Western River Cave, Pissy Boy Rock, The Amphitheatre on rock wall 14–17 m, coll. K. Gowlett Holmes, 28 November 2001, holotype SAM E3200), Tasmania (Tasman Peninsula, Fortescue Bay, Cape Havy, 18–20 m, coll. K. Gowlett Holmes, 2 July 1998, paratype SAM E2927).

**Description.** Both colonies are firm, flat, encrusting sheets, white with a tinge of pinkish orange in preservative. Small common cloacal apertures in the centre of zooid-free areas about 1 cm apart have frilled margins or are contracted into a cross. Each opening is surrounded by thick spicule-filled radial ribs in the roof of the common cloacal cavity beneath it. Orange pigment particles, especially crowded, mixed with the spicules around each common cloacal aperture in the holotype colony, fade to pale pinkish orange further away from the openings. On the remainder of the upper surface, away from the common cloacal apertures, are evenly spaced branchial apertures with their margins outlined with spicules. The surface layer of test is relatively thick with the anterior end of each zooid in a concavity in its under surface. The common cloacal cavity is a shallow, horizontal space at thoracic level, its shallowness contributing to the firmness of the colony. A short test strip is associated with the ventrum of each thorax as it crosses the common cloacal cavity. Abdomina are embedded in the basal test. Spicules are stellate, with five to seven conical pointed rays in optical transverse section and are crowded throughout. They are of two sizes, the larger ones to 0.06 mm diameter and the smaller and more numerous ones only to about 0.02 mm.

Zooids are relatively small. An atrial lip from the anterior rim of the opening is especially long on those zooids in the vicinity of the common cloacal apertures. Large, circular saucer-shaped lateral organs are on each side of the thorax. Eight stigmata are in the anterior row in the branchial sac, reducing to six in the posterior row. Five coils of the vas deferens surround four or five testis follicles in the holotype colony, although gonads are not present in the Tasmanian specimen. Also, robust larvae are in the basal test of the holotype. The larval trunk is 0.9 mm long, the tail is wound almost the whole way around it, 12 lateral ampullae are along each side of the three antero-median adhesive organs and a large, thick, external horizontal ampulla is on the left side of the trunk.
Remarks. The species has spicules with fewer rays than any of the few species in this genus (e.g. *P. tenuicutis* Kott, 2001 and *P. rubitapum* Kott, 2001) that have stellate spicules in two conspicuously different size ranges. Also, it is distinguished from *P. rubitapum* by its more numerous larval lateral ampullae. *Polyyncraton tasmanense* Kott, 2001 has similar but larger spicules (to 0.114 mm diameter) with more rays. *Didemnum microthoracicum* has large and small spicules, but although they have the same number of rays as the present species, they reach nearly twice the size (the larger ones to 0.09 mm diameter).

The common cloacal apertures in the present species are surrounded by zoooids, and do not occur at the junctions of circular canals, as they do in so many species in the Didemnidae. *Polyyncraton glaucum* Kott, 2001, *P. multiforme* Kott, 2001, *P. pavimentum* Monniot, 1993 and the New Zealand species *P. lithostrotum* Brewin, 1956 have similar common cloacal systems, however, all of these species have more spicule rays than the present one.

**Fig. 4.** *Polyyncraton galaxum* [(A) SAM E3200; (B–D) SAM E2927]. (A, B) Thoraces; (C) abdomen; (D) larva. Scale bars: 0.1 mm (A–C); 0.5 mm (D).
**Polysyncraton longitubis** sp. nov.
(figures 5A, 17B)

**Distribution.** Type locality: South Australia (Kangaroo I., between Western River Cave and Snug Cove, The Arch on rock wall, 10–14 m, coll. K. Gowlett Holmes, 28 November 2001, holotype SAM E2929).

**Description.** The colony is a hard, black plate with a rounded margin, more or less circular and about 8 cm diameter. The black pigment is in spindly stellate bodies that may be chromatophores. These form a black layer on the surface where they are mixed with spicules. The pigmented bodies continue down into the siphon lining and also form a layer on the base of the colony. Pigment

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**Fig. 5.** (A–C) *Polysyncraton longitubis* (SAM E2929). (A) Surface of colony; (B) thorax; (C) abdomen. (D, E) *Polysyncraton montanum* (SAM E3224). (D) Thorax; (E) abdomen. Scale bars: 5.0 mm (A, C); 0.1 mm (B, D, E).
bodies are also scattered in the remainder of the colony which is white and opaque with crowded spicules. Zooids open along each side of the surface depressions over the deep primary common cloacal canals that surround the solid pillars of test in which the ventrum of each zooid is embedded, and that form rounded swellings of the colony surface. A few spicules are in the branchial siphonal linings but do not outline the apertures. Common cloacal apertures are randomly spaced on the surface. Spicules are small, to 0.04 mm diameter, and of two types: some stellate with 9–11 conical rays in optical transverse section and others with a similar number of truncated flat-tipped rays that form almost globular spicules.

Zooids have a large tulip-shaped branchial siphon, a large sessile atrial opening with an anterior tongue (small and simple to larger, flattened with a concave tip), a large branchial sac with nine stigmata in the anterior row, eight in each of the next two rows and seven in the last row, a strong retractor muscle projecting from half-way down the oesophageal neck, a double gut loop, and 10 vas deferens coils around four or five testis follicles. In some of the zooids from the holotype colony, the coils of the vas deferens appear to have slipped back from the testis to enclose part of the gut loop in the spiral. This is probably an artefact.

**Remarks.** The colony form and pigmentation closely resemble the tropical species *P. millepore* Vasseur, 1969 (see Kott, 2001), which has similar spicules, some almost globular with truncated rays and others stellate with conical rays. The present species has fewer rays and 10 (rather than five) coils of the vas deferens. The large number of vas deferens coils is an unusual character in zooids of this genus.

**Polysyncraton montanum** sp. nov. (figures 5B, 17C)

**Distribution.** Type locality: South Australia (Kangaroo I., Pissy Boy Rock between Snug Cove and Western River Cave on rock wall, 8–10 m, coll. K. Gowlett Holmes, holotype SAM E3224).

**Description.** In life the colony looks like a *Leptoclinides*, being a deep, slightly asymmetrical, mottled pink and white cone with a large terminal common cloacal aperture. The preserved colony is pinkish orange and the label is stained the same colour. The colony is smooth on the surface. Internally, bright orange zooids line the deep primary common cloacal canals surrounding test connectives to which the zooids are firmly attached, appearing to be in tight clumps. A thin superficial bladder cell layer is aspiculate but beneath that the spicules are crowded throughout. They are stellate, up to 0.08 mm diameter, with 9–11 conical pointed rays in optical transverse section.

Zooids have large thoraces with a broad flat-tipped atrial lip. A long tapering retractor muscle projects from the oesophageal neck. Gonads were not detected in the newly recorded specimens, and the number of stigmata could not be counted.

**Remarks.** The tropical *P. pseudorugosum* Monniot, 1993 (see Kott, 2001 and below) is not readily distinguished from the present species, having similar systems and spicules. However, it has a sheet-like colony with many common cloacal apertures rather than terminal ones like the present species. Other species of *Polysyncraton* with similar common cloacal systems and stellate spicules with 9–11 pointed conical rays are *P. cuculliferum* with smaller spicules (to 0.06 mm
diameter) and *P. sideris* Kott, 2001 (with larger spicules to 0.14 mm diameter). The broad atrial lip resembles that of *P. tegetum*, but the spicule rays are never chisel-shaped. The colony is a similar colour to colonies of *Didemnum fragum* Kott, 2001 and has a similar terminal common cloacal aperture, but *D. fragum* has smaller zooids, lacks an atrial lip and has shorter spicule rays. The present species appears to be previously undescribed.

**Polysyncraton pedunculatum** Kott, 2001

*Polysyncraton pedunculatum* Kott, 2001: 121 (part, not specimen QM GH2387, Flinders I., pl. 6D = *P. rica*) and synonymy; 2004.

*Distribution.* Previously recorded (see Kott, 2001, 2004): South Australia (Great Australian Bight, Nuyts Archipelago, Yorke Peninsula, Investigator Strait). New record: South Australia (Kangaroo I., SAM E3230).

*Description.* The living colony is reddish tan, slightly translucent, biramous vertically ridged with a short, relatively narrow, basal stalk. Zooids are confined to the surface of the completely aspiculate colony. They are in irregular longish oval groups with primary common cloacal canals around each group. The test is soft and translucent.

Zooids have the usual long, fine retractor muscle projecting from about halfway down the oesophageal neck. Three coils of the vas deferens surround a number of testis follicles.

*Remarks.* Kott (2001) confused specimens of *P. rica* (which is only partially aspiculate with a smooth surface) with the present completely aspiculate, irregularly ridged species, which looks very different.

The report of four coils of the vas deferens (Kott, 2001) is incorrect. Re-examination of the material has shown that there are three coils in all specimens.

**Polysyncraton peristroma** sp. nov.

*(figure 17D)*

*Distribution.* Type locality: Northern Territory (Darwin, Angler Reef, 10–12 m, coll. B. Glasby and party, 31 August 2002, holotype QM G308608).

*Description.* In life the surface of the encrusting colony has a conspicuous black network resulting from pigment in the surface test over the common cloacal canals which surround cream/yellow flat-topped stands of solid test, their smooth flat tops looking like scales on the surface of the colony. The common cloacal canals are lined on each side by the zooids, which have their ventral surfaces embedded in the test and their abdomina curved dorsally in the test lining the bottom of the cloacal canals. The layer of test lining the common cloacal canals where zooids are embedded is spicule-free but the remainder of the test is packed hard with spicules. Spicules are stellate, to 0.06 mm diameter with seven to nine long, conical, but often almost rod-like, rays in optical transverse section.

Zooids have a short branchial siphon. The atrial aperture is wide, its anterior rim projecting from the zooid in a wide arc, but an atrial lip is not formed. The thorax is long, comma-shaped, the oesophageal neck is long with a retractor muscle projecting from near its base and the remainder of the abdomen also is long. Five or six coils of sperm-filled vas deferens surround six or seven male
follies and there is a large yellow egg. The sperm-filled coils of the vas deferens often persist as a seminal vesicle after degeneration of the testis follicles.

Remarks. Many species of this genus have similar common cloacal canals lined on each side with zooids and surrounding zooid-free stands of test. Only *P. catillum* has similar spicules with long, almost rod-like spicule rays, although they are smaller, and the rays are more numerous than in the present species.

*Polysyncraton pseudomagnetae* sp. nov.

(figure 17E)

*Distribution.* Type locality: Northern Territory (Darwin, Angler Reef, 10–12 m, coll. B. Glasby and party, 31 August 2002, holotype QM G308612).

*Description.* The colony is a hard sheet mottled white and grey. Spicules are in the surface sometimes, especially over the common cloacal canals, mixed with black pigment particles. Also, there are aggregations of black pigment in the base of the colony. Zooids are along each side of the common cloacal canals that surround white zooid-free areas. White spicules are crowded throughout the colony and can be seen through the open common cloacal apertures, which expose the base of common cloacal cavity. In some parts of the colony the common cloacal canals expand into horizontal spaces, penetrating in amongst the thoraces, isolating them from one another, each with a ventral strip of test. Spicules are to 0.06 mm diameter and are of two types, some with pointed and others with flat-tipped rays. Spicules have 15–17 rays in optical transverse section.

Zooids have a long thorax with eight stigmata in the anterior row, a short retractor muscle from the top of the oesophageal neck, a short, bifid atrial tongue and five coils of the vas deferens around four or five testis follicles.

Remarks. This species has the same range of spicules as *P. magnetae* Hastings, 1931 and similar systems. However, the spicules are larger, the retractor muscle projects from the top of the oesophageal neck rather than from some way down it, and the present species has more coils of the vas deferens, *P. magnetae* having only three coils. *Polysyncraton longitubis* from South Australia has similar but smaller spicules with fewer rays and more coils of the vas deferens; and *P. millepore* Vasseur, 1968 has slightly smaller spicules, also with fewer rays.

*Polysyncraton pseudorugosum* Monniot, 1993

(figure 17F)

*Polysyncraton pseudorugosum* Monniot, 1993: 10; Kott, 2001: 123; 2002c: 33.

*Distribution.* Previously recorded (see Kott, 2001, 2002c): Queensland (Hervey Bay); Northern Territory (Darwin, Bathurst I.); Coral Sea. New records: Northern Territory (Darwin, Angler Reef, QM G308598, Stevens Rock, QM G308600).

*Description.* Both newly recorded colonies are flat lamellae, orange in life, with rounded margins produced out into short, rounded to cylindrical lobes. The colonies are hard and greenish yellow in preservative and the preservative is the same colour. Firm pillars of solid test extend through the depth of the colony, and are surrounded by circular common cloacal canals lined on each side by zooids, the ventral surfaces of the thoraces embedded in the pillars of solid test and the abdomina bent around into the layer of spicule-free test that
lines the base of the common cloacal canals. The surface of the colony is depressed over the common cloacal canals. Spicules are large, to 0.09 mm diameter, stellate, with 9–11 conical, pointed rays and they are present throughout the colony except for the thin aspiculate layer of test lining the common cloacal canals.

Zooids have a wide atrial aperture exposing most of the branchial sac directly to the common cloacal cavity and reducing the parietal body wall to a narrow strip along each side of the endostyle. Seven stigmata are in the anterior row. The vas deferens coils four times. Larvae are present in the basal test. The trunk is deep, 0.7 mm long with up to 12 lateral ampullae on each side of the antero-median adhesive organs. There is at least one blastozooid.

Remarks. The newly recorded colonies of this well-characterized species are as previously described. The common cloacal canals, and the thin layer of aspiculate test lining them occur also in Polysyncraton peristroma, but the species have different spicules and are a different colour. The spicules resemble those of P. cuculliferum but are larger and they do not become sparser toward the base of the colony as they do in P. cuculliferum. The spicules that most closely resemble those of the present species are those of P. montanum, which is distinguished from the present species principally by the upright conical colony, as opposed to the hard, flattened lamellae of the present species.

**Polysyncraton reticulum** sp. nov.
(figures 6A, 17G)

**Distribution.** Type locality: South Australia (Kangaroo I. between Snug Cove and Western River, The Cave on rock wall, 10–12 m, coll. K. Gowlett Holmes, 12 December 1999, holotype SAM E2917).

**Description.** The holotype is a soft, thin encrusting sheet. The thin superficial layer of test has a few sparse spicules scattered in it and a few spicules are in the branchial siphon linings, but they do not outline the apertures. Beneath the superficial layer of test the spicules are crowded around, but not over, the pink zooids so that, when seen from the surface, the colony appears to have a white net or a pinkish white cloth over the surface, enclosing pink spots in its meshes. In life the spots where the zooids open are dark pink. Numerous randomly distributed sessile common cloacal openings are each surrounded by a circle of spicle-free test through which the spicules can be seen, crowded in the floor of the shallow common cloacal cavity. Spicules are burr-like with 13–15 club- to rod-shaped rays in optical section and are to 0.06 mm in diameter. Zooids are evenly distributed, the thoraces crossing the common cloacal cavity with a short ventral strip of spicule-filled test. Deeper primary canals were not detected. Abdomina are embedded in the relatively thick basal test.

Zooids have the tips of the branchial lobes and anterior part of the thorax covered with conspicuous projecting columnar epithelial cells. A long retractor muscle projects from about halfway down a relatively short oesophageal neck and a bifid, forked atrial tongue projects from the upper rim of the opening. Three coils of the vas deferens surround five to seven testis follicles.

Remarks. The spicules of the present species resemble those of the majority of Polysyncraton species. In particular, they are like the temperate species *P. discoides* Kott, 1962, having about the same number of similar spicule rays and the
same number of male follicles and vas deferens coils. However, the spicules of *P. discoides* are smaller than those of the present species, they line the margins of the branchial apertures and, unlike the present species, deep primary common cloacal canals extend the full depth of the zoooids and interrupt the even horizontal common cloacal chambers and the even distribution of the zoooids.

**Polysyncraton rica** Kott, 2001

*Polysyncraton rica* Kott, 2001: 130; 2004 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001, 2004): South Australia (Great Australian Bight; Spencer Gulf, Gulf St Vincent, Kangaroo I.). New records: South Australia (Kangaroo I., SAM E3216; Flinders I., QM G2387).
Description. In preservative, colonies are pinkish cream slabs up to 1.0 cm deep in the centre where the basal layer of test is particularly thick. Branchial apertures are depressed into the surface, sometimes visible along each side of deep (but not posterior abdominal) primary common cloacal canals around circular to longish oval stands of test. Zooids are orange. A conspicuous superficial, aspiculate, bladder cell layer is on the surface of the colony. Spicules are stellate but some are irregular or bilaterally symmetrical. They have 11–13 strongly conical pointed rays in optical transverse section. Some are large, to 0.075 mm diameter, but other small stellate spicules are mixed with them. They are slightly more crowded in the surface and basal layers of test are elsewhere. A few, large common cloacal apertures with aspiculate rims are near the outer margins of the colony and are protected by the bladder cell layer when the colony is contracted. Zooids are almost vertical in the colony. They have moderately long cylindrical branchial siphons and atrial lips and a long retractor muscle. Large larvae are in the basal test of specimens collected in March (SAM E3216).

Remarks. The spicules resemble those of *P. galaxum*, being a mixture of large and very small ones. Generally, they are larger than those of *P. galaxum* and have more rays. Spicules of *P. pseudorugosum* are a similar size but have fewer rays.

*Polysyncraton rostrum* sp. nov.

(figures 18A)

Distribution. Type locality: Northern Territory (South Shell I., 7–11 m, coll. B. Glasby and party, holotype QM G308631; paratype QM G308628).

Description. The colonies are encrusting sheets, the holotype pinkish white with some orange flecks in life and the paratype is more yellowish beige overall with extensive orange patches. Both are white in preservative. Opaque white circles are around the common cloacal apertures. The lobes of the evenly distributed branchial apertures protrude from the surface like small daisies. A pointed, spicule-filled papillum projects from the surface at the base of each of the branchial lobes in the paratype, although actual papillae are not present in the holotype. The surface of the colony is raspy and hard with crowded spicules. Generally, the spicules are crowded throughout, although sometimes they are less crowded in the middle of the basal layer of test. Spicules are large (to 0.1 mm diameter) and stellate with seven to nine sharply pointed conical rays in optical transverse section. The common cloacal cavity is thoracic and abdomina are crowded in the upper part of the basal layer of test. Terminal ampullae of the stolonic vessels are conspicuous in the basal layer of test.

Zooids have a bifid atrial tongue and a retractor muscle projects from the top of the oesophageal neck. Three coils of the vas deferens surround about eight testis follicles.

Remarks. The size of the relatively large spicules with relatively few and sharply pointed rays are characteristic of this species. The spicules of *Polysyncraton sideris* Kott, 2001 are similar but have a greater maximum diameter, and more coils of the vas deferens than the present species; and the spicules of *P. cuculliferum* are significantly smaller with more rays.
Polysyncraton tegetum Kott, 2001
(figures 6B, 18B)

Polysyncraton tegetum Kott, 2001: 137 and synonymy.

Distribution. Previously recorded (see Kott, 2001): South Australia (Great Australian Bight). New record: South Australia (Kangaroo I., SAM E3213).

Description. The newly recorded colony is sheet-like with a smooth surface, slightly blotchy reddish tan in life and orange in preservative. Zooids are orange. Spicules are not particularly crowded. They are scattered in the superficial layer of test where they are mixed with pigment cells. They are present also through the zooid layer but are absent from the basal quarter of the colony, where the test is transparent. The colony is very tough and the zooids are impossible to remove from it. Neither common cloacal apertures nor common cloacal cavity were detected in the newly recorded specimen. The spicules (to 0.075 mm diameter) are stellate, with chisel-tipped or conical pointed rays. Some of the smaller spicules have as few as seven rays in optical transverse section but some of the larger ones have as many as 13, often chisel-tipped rays.

Zooids have a moderately long, cylindrical branchial siphon. The atrial aperture is a wide opening with a broad flat-tipped anterior lip. A fine retractor muscle projects from halfway down the oesophageal neck. About eight stigmata are in the anterior row but these could not be counted accurately. The gut forms a simple vertical loop, the pole of the loop flexed ventrally only when gonads mature. Buds are attached to the oesophageal neck by relatively long stolons. Mature testis follicles (about five) with seven coils of the vas deferens were detected in only one of the zooids examined. A large egg often is present at the posterior end of the abdomen of the newly recorded specimen, some embryos are being incubated in the basal test, and a few larvae are being liberated through the colony surface. Larvae are robust, almost spherical with the tail wound the whole way around the 0.5 mm-long trunk. Four lateral ampullae are along each side of the three antero-median adhesive organs and an external ampulla projects almost vertically from the neck behind the adhesive array on the left side. Four rows of stigmata are in the larval pharynx.

Remarks. The large zooids of the newly recorded colony with their broad flat-tipped atrial tongues are identical with those figured by Kott (2001: figure 68B, C) for this species. The chisel-shaped tips of the spicule rays resemble those found in many species of Leptoclinides but are not known in other species of Polysyncraton, although the large zooids, vertical gut loops and four rows of stigmata in the larval pharynx are characteristic of the genus.

As with some other specimens from Kangaroo I. in this collection (Leptoclinides comitus, L. variegatus), the maximum-sized spicule is only half the diameter of that previously recorded for the species.

Polysyncraton textus sp. nov.
(figure 18C)

Distribution. Type locality: Western Australia (8.5 n. mls NW of Port Hedland, 18 m, coll. J. Fromont on RV Soela, 5 August 1982, holotype WAM 556.88).

Description. The colony is an extensive white sheet overgrowing worm tubes. It is white in preservative. Stellate branchial apertures with a margin of spicules
are arranged around small intensely white unperforated areas of the surface. Deep primary common cloacal canals extend the full length of the zooids and surround circles of zooids with their ventral surfaces embedded in ligaments of test between the surface and base of the colony. Small spicule-filled papillae are crowded on the surface between the branchial apertures. An even layer of relatively crowded spicules is in the surface test and another less crowded layer is on the base of the colony. Spicules are sparse elsewhere. The spicules are small, stellate, to 0.037 mm diameter, with 15–17 relatively short and irregular, sometimes subdivided conical rays in optical transverse section. The ray length/spicule diameter ratio is about 0.2.

Zooids have a tulip-shaped branchial siphon and a large bifid atrial tongue. The branchial sac is large, but the stigmata could not be counted. Three coils of the vas deferens surround four or five testis follicles, the outside coil encircling the base of a large egg. Larvae being incubated in the basal test have a trunk 0.85 mm long with the tail wound about three-quarters of the way around it. A corona of about 16 round-tipped lateral ampullae surround the three antero-median ampullae at the anterior end of the trunk. The larval pharynx does not appear to be perforated, although the gut is differentiated and the otolith and ocellus are present. Blastozoozoids were not detected.

Remarks. Relatively few species in this genus have stellate spicules similar to the present ones. Polysyncraton arafurensis Tokioka, 1952 and P. multiforme Kott, 2001 do have similar spicules although they are larger than those of the present species and are crowded throughout the colony. Other characters, such as the large bifid atrial tongue, the large larvae with relatively rudimentary larval organs but large number of lateral ampullae and the loose and relatively few coils of the vas deferens are characteristic of many Polysyncraton spp.

Didemnum albopunctatum Sluiter, 1909

Didemnum albopunctatum Sluiter, 1909: 58; Kott, 2001: 148 and synonymy; 2004.

Distribution. Previously recorded (see Kott, 2001, 2004): Western Australia (Rowley Shoals), Queensland (Capricorn Group, Swain Reefs, Whitsunday Is), Indonesia, New Caledonia, Palau Is, Fiji. New record: Northern Territory (Dudley Bommies, QM G308627).

Description. The newly recorded colony is soft and flexible, possibly due to the small spicules and the deep common cloacal cavity. They are whitish black in life with white rims around the common cloacal apertures. In preservative the colony is brownish grey on the surface, with white points where the spicule-filled lobes of the evenly spaced, stellate branchial apertures open to the surface. Linings of the branchial apertures are black owing to the pigment in the superficial layer of test that turns in to line the siphons. The pigment in the superficial layer of test is mixed with the small spicules and overlies a non-pigmented layer of test. Zooids cross the deep horizontal common cloacal cavities singly or in clumps with dark pigment and sparse spicules mixed in the test connectives that surround them. The abdomina especially are encapsulated in black pigment cells in the test. Common cloacal cavities do not penetrate the test posterior to the zooids, and the basal test is opaque and white with crowded spicules. Spicules are small (to 0.035 mm diameter) and globular with numerous flat-tipped, rod-like rays.
Zooids have eight stigmata in the anterior row and six in the posterior row and a large open atrial aperture without an anterior lip.

**Remarks.** This specimen has the usual small globular spicules and the black pigment of formerly described specimens, although the black squamous epithelium of the Swain Reefs specimen (see Kott, 2001) has not been detected.

*Didemnum candidum* Savigny, 1816

*(figure 18E)*

*Didemnum candidum* Savigny, 1816: 194; Kott, 2001: 157 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Queensland (Low Is), Western Pacific, West Indian Ocean (Tanzania, Mauritius, Malagasy), Gulf of Suez, Gulf of Arabia. New record: Western Australia (Houtman’s Abrolhos, WAM 557.88).

**Description.** The newly recorded colony is about 5 mm thick with rounded margins and is smooth on the upper surface. The surface layer of test is thin. The common cloacal cavity is a horizontal space with thoraces crossing it in their own ventral strip of test. Abdomina are embedded in the relatively thick basal layer of test. A single sessile common cloacal aperture is on the surface. Spicules are crowded throughout the colony. They are relatively uniform with five to seven, and occasionally nine short, rod-like rays in optical transverse section. Zooids have a small thorax with a sessile atrial aperture without an atrial lip and a relatively large abdomen containing a long, curved gut loop. A long, tapering retractor muscle projects from about halfway down the oesophageal neck. The undivided testis is surrounded by seven coils of the vas deferens.

**Remarks.** The specimen is as previously described for this species and the spicules are the usual stellate form with relatively few, short rod-like rays, differing from those previously described only in the maximum spicule size (0.07 mm diameter), which is more than previously reported for this species.

Although previously known from the western Indian Ocean, the Arabian Gulf and its type locality in the Red Sea, this is the first record from the eastern Indian Ocean.

*Didemnum congregatum* sp. nov.

*(figure 18F)*

**Distribution.** Type locality: Papua New Guinea (Madang, Stn 9 outer side of barrier reef off N end Milibag I., coll. S. Slacksmith, 17 August 1982, syntypes WAM192.90).

**Description.** The syntypes are small, fragile, paper-thin, colonies attached to weed fronds. A small spicule-filled papilla is associated with each branchial aperture, but these appear to be rubbed off in older specimens. Spicules are crowded throughout. The surface test is thin and thoraces of the small zooids cross the horizontal atrial cavity with their own independent ventral strip of test, which has a large vertical oval clump of spicules from the lateral organ along each edge. Abdomina are embedded in the basal test, although the zooids are disintegrated in these very thin colonies and details of their structure were not determined. The spicules are stellate, generally to 0.06 mm with 11–13 strong conical rays in optical transverse section. Scattered amongst these spicules are giant (to 0.1 mm between ray tips) spicules with up to six long, narrow spiky rays.

**Remarks.** Although the details of the zooids are not available and the general
colony form does not differ in any way from many other small, thin, didemnids, the spicules of these colonies differ in the relatively numerous rays of the majority of the spicules. Didemnum membranaceum has both large and small spicules that most closely resemble those of the present species, but the smaller spicules have fewer rays. These small colonies, from Madang, with pointed papillae associated with each branchial aperture, resemble some specimens of D. nekozita Tokioka, 1967. However, the spicules of the latter species have fewer and rod-like rays rather than the conical ones of the present species.

**Didemnum coralliforme** Kott, 2004  
(figure 18G)

*Didemnum coralliforme* Kott, 2004.

**Distribution.** Previously recorded (see Kott, 2004): Western Australia (W of Port Hedland). New records: Northern Territory (Angler Reef, QM G308610; Meigs Reef, QM G308629).

**Description.** In life, one (QM G308610) of the newly recorded colonies is pinkish red while the other is orange-red. Both are fleshy slabs with rounded swellings and some short lobes with white-rimmed terminal cloacal apertures. In preservative both colonies are creamish orange to white flexible sheets and the preservative is a pinkish orange colour. In both colonies orange vesicles interrupt the spicules in the superficial layer of test. In the orange-red colony these vesicles are arranged in a circle around each branchial aperture, and in the other the vesicles are separated from one another by a thin network of spicules. Spicules also line the margins of the evenly spaced branchial apertures but they are only moderately crowded throughout the remainder of the colony, except for a more crowded layer on the base. Spicules are relatively small (to 0.05 mm diameter) with five to seven and occasionally nine long, almost rod-like rays in optical transverse section. The common cloacal cavity is thoracic, the thoraces crossing it in independent test sheaths. Abdomina are embedded in the basal test.

Zooids have large, orange thoraces with huge atrial apertures. An atrial lip is not present. Eight stigmata are in the anterior row. A long oesophageal neck has a fine retractor muscle projecting from about halfway down it. The gut loop is long and flexed ventrally. Seven coils of the vas deferens surround the undivided testis in one (QM G308610) colony but gonads were not detected in the other. Long-stemmed thoracic buds are attached to the oesophageal neck of the former specimen.

**Remarks.** The relatively small spicules with their few and long, straight rays are the principal diagnostic character of this species. Didemnum madeleinae Monniot and Monniot, 2001 has similar spicules but they have shorter and more conical rays. Also, the presence of vesicles in the surface test appears to be characteristic of the present species, although the number of these vesicles and their arrangement are variable, being arranged in a circle around the branchial apertures in the type material and one of the newly recorded colonies, but forming more of a mosaic in the surface in the other newly recorded colony. These vesicles resemble those described in Didemnum sordidum Kott, 2001 and in some Polysyncraton spp. (see Kott, 2001). The newly recorded colonies do not have
the cylindrical thin colony branches and three-dimensional form of the type material of the present species although it occurs in other species in the present collection, namely *D. grande* (Herdman, 1886) and *D. granulatum* Tokioka, 1954. The colony form does not appear to be a characteristic of the species, possibly being affected by the habitat.

**Didemnum crescente** Kott, 2001

*(figures 7A, B, 18H)*

*Didemnum crescente* Kott, 2001: 166.
*Trididemnum spiculatum*: Kott, 1972: 178.

**Distribution.** Previously recorded (see Kott, 2001): Tasmania (Triabunna), Victoria (Mallacoota Inlet, Western Port), New South Wales (Eden). New record: South Australia (Waterloo Bay in caves, SAM E3208).

**Description.** Colonies are thin, flat, hard sheets encrusting fronds of kelp. In preservative they are white with crowded spicules. The common cloacal cavity is shallow and at thorax level. The spicules are stellate, moderately large to 0.062 mm diameter with seven to nine and sometimes 11 conical pointed rays in optical transverse section. The ray length/spicule diameter ratio is 0.375. Zooids are small, with a short branchial siphon, contracted thorax with six stigmata in the anterior row reducing to three in the last row and lateral organs projecting from each side of the endostyle at the posterior end of the thorax. The oesophageal neck is relatively short and the abdomen is bent up at right angles to the thorax. Four conspicuous stolonic vessels project forwards from the ventral concavity of the gut loop. Nine coils of the vas deferens surround the undivided testis.

**Remarks.** Although Kott (2001) reported large posterior abdominal cavities

![Fig. 7. *Didemnum crescente* (SAM E3208). (A) Thorax; (B) abdomen. Scale bars: 0.1 mm.](attachment:image.png)
in this species, they were not detected in the re-examined material from the Great Australian Bight, which have been assigned on the basis of the spicules and their distribution, the number of coils of the vas deferens, the small number of stigmata, and the conspicuous projecting thoracic lateral organs. The short fourth row of stigmata in the small contracted thoraces in specimens from Waterloo Bay (SAM E3208) was overlooked by Kott (1972).

The present species is distinguished from the sympatric *D. incanum* by its larger spicules with seven to nine and occasionally 11 rays in optical transverse section (seven to nine and occasionally five in *D. incanum*).

**Didemnum delectum** Kott, 2001

*(figure 19A)*

*Didemnum delectum* Kott, 2001: 171 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Great Australian Bight, Yorke Peninsula, Spencer Gulf, Gulf St Vincent, Investigator Strait). New record: South Australia (Kangaroo I., SAM E3226).

**Description.** The colony is thin, and brittle, slightly pinkish white in preservative with creamish yellow zooids. Common cloacal canals are oesophageal and the apertures are about 1.0 cm apart on slight elevations of the otherwise smooth surface of the colony. Zooid openings are not present immediately around the common cloacal apertures. Branchial openings appear as white points from the surface owing to the small plug of spicules in the siphon lining. Spicules are crowded throughout the test. They are small, 0.035 mm diameter with seven to nine long, rod-like or conical rays in optical transverse section. The ray-length/spicule diameter ratio in spicules with rod-like rays is about 0.4.

Zooids have small orange thoraces, short and cylindrical branchial siphons, wide atrial apertures and a retractor muscle from halfway down the oesophageal neck. Abdomina are white and gonads were not detected in the newly recorded specimen.

**Remarks.** Species with rod-like spicules include *Didemnum candidum* Savigny, 1816 (which has spicules with shorter and fewer rays), *D. fuscum* Sluiter, 1909 (which has larger spicules and dark cells in the test and around the zooids) and *D. mantile* Kott, 2001 (which has larger spicules with fewer rays and a leathery rather than brittle colony).

Although the more conspicuous lobes with terminal common cloacal apertures are nor present in the newly recorded specimen, the spicules and their distribution and the colour of the colonies are as previously described.

**Didemnum grande** (Herdman, 1886)

*Leptoclinum albidum* var. *grande* Herdman, 1886: 291.

*Didemnum grande*: Kott, 2001: 185 and synonymy; 2004.

**Distribution.** Previously recorded (see Kott, 2001, 2004): Western Australia (Port Hedland); Queensland (Hervey Bay, Capricorn Group, Swain Reefs, Whitsunday Is), Indonesia, Philippines. New records: Northern Territory (Angler Reef, QM G308606-7).

**Description.** Both colonies are thin cylindrical anastomosing stalks little more than 1.0 cm in diameter forming an open three-dimensional reticulum. Sometimes a flat web-footed-like expanse of the colony forms in the fork of the branches.
One (QM G308606) specimen is bright red in life and the other is marbled orange-white. Both colonies are white in preservative, although the preservative is orange-red or brown-orange. Spicules are present throughout the colony and they form an especially hard core (like an axial skeleton) in the centre of the cylinder. The spicules are stellate with 9–11 strong conical rays in optical transverse section. Some are up to 0.09 mm diameter, although more often the maximum diameter is 0.06 mm. The common cloacal cavity is thoracic. The abdomina are embedded in the test that surrounds the central axial core of crowded spicules.

Zooids have large, orange thoraces with large sessile atrial apertures and a conspicuous retractor muscle projecting from the top of the oesophageal neck. The vas deferens coils seven times around the undivided, dome-shaped testis follicle.

**Remarks.** In the present collection, colonies of *D. granulatum* and *Polysyncracion peristroma* sp. nov. have a similar form to these newly recorded colonies of the present species. Also, similar colonies have been reported for *D. coralliforme* Kott, 2004, *D. clavum* Kott, 2001 and *D. ossium* Kott, 2001. Although it is a colony form not previously reported for the present species, other characters such as the form and distribution of the spicules, large thoraces, number of vas deferens coils and the intense colour of the preservative are characteristic.

*Didemnum granulatum* Tokioka, 1954

*(figure 19B)*

*Didemnum (Didemnum) moseleyi* f. *granulatum* Tokioka, 1954: 244.

*Didemnum granulatum*: Kott, 2001: 188; 2002c: 35.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Western Australia (Cervantes, Montebello Is); Queensland (Whitsunday Is, Hardy Reef, Bowden Reef) Northern Territory (Darwin, Bathurst I.), Palau Is, French Polynesia, Tokara Is, Fiji; French Polynesia, Hawaii. New records: Northern Territory (Bottlewasher artificial reef, QM G308601; Angler Reef, QM G308602).

**Description.** Each of the newly recorded specimens has flat expanses of colony with narrow cylindrical outgrowths that tend to form an open reticulum. They are white in life as well as in preservative. Spicules are crowded throughout and are especially crowded in the centre of the branching stalks and projecting lobes where they form a hard central axial rod of packed spicules. The spicules are never more than 0.05 mm and have seven to nine long conical to almost rod-like rays, slightly rounded rather than sharply pointed at the tip. The common cloacal cavity is thoracic, sometimes projecting behind the zooids. Six coils of the vas deferens surround the undivided testis.

**Remarks.** This species lacks very distinctive characters and its wide range could be the result of misidentification. The small spicules resemble those of *D. madeleinae* Monniot and Monniot, 2001, although the conical spicule rays of the latter species are more pointed than the present one. However, the spicule rays of the present species are more conical than the long rod-like ones of *Didemnum coralliforme* Kott, 2004. The relatively few vas deferens coils also help to distinguish the species.
**Didemnum incanum** (Herdman, 1899)
(figures 8A, B, 19C)

*Leptoclinum incanum* Herdman, 1899: 90.
*Didemnum incanum*: Kott, 2001: 191 and synonymy; in press.
*?Leptoclinum tuberatum* Nott, 1892: 314.

*Didemnum moseleyi*: Kott, 1972: 179.

**Distribution.** Previously recorded (see Kott, 1972, 2001): South Australia (Waterloo Bay, SAM E3209; Gulf St Vincent; Cape Jervis); Victoria (Gabo I., Lorne); New South Wales (Illawarra, Port Jackson). New records: Tasmania (Triabunna, SAM E2925), New Zealand (Wellington Harbour, QM G308590; Nelson, QM G308591; Picton Ferry Wharf, QM G308938; Pelorus Sound, QM G308592).

![Fig. 8. (A, B) Didemnum incanum [(A) SAM E3209; (B) QM G308592]. (A) Vertical section through colony (semi-diagrammatic); (B) thorax. (C) Didemnum jucundum (SAM E3201), zooid. Scale bars: 1.0 mm (A); 0.1 mm (B, C).](image-url)
Description. The species has small stellate spicules to 0.03 mm diameter with five to nine conical rays in optical transverse section, sometimes crowded throughout, but sometimes less crowded or even sparse in the lower part of the colony. The thoraces of the small evenly spaced zooids, with not more than six stigmata in the anterior row (reducing to three in the last row), cross the shallow horizontal common cloacal cavity with a ventral strip of test. Occasionally a slightly deeper primary common cloacal canal separates groups of zooids from one another. Nine coils of the vas deferens surround the testis. The small larval trunk (to 0.5 mm long) has the tail wound about three-quarters of the way around it, and four lateral ampullae are along each side of the three anteromedian adhesive organs.

Remarks. Although Kott (2001: 191) regarded the colonies as ‘invariably’ thin, encrusting sheets, she assigned some with lobed surfaces to the species. The same variations in colony form occur in the newly recorded specimens, those from similar New Zealand habitats and one from Edithburgh Jetty (Kott, 2001: pl. 10D: QM G302766) having the same lobed surfaces.

The moderate-sized spicules with five to nine conical rays and the simple colony form resemble the tropical species *D. perplexum* Kott, 2001 and *D. granulatum* Tokioka, 1954, however, the nine coils of the vas deferens distinguish the present species.

Aspects of the Guadeloupe *Didemnum perlucidum* Monniot, 1983 are similar to the present species (small stellate spicules with relatively few rays, and nine coils of the vas deferens). However, the spicule rays appear to be shorter and the spicules are sparser than those of the present species (sometimes being absent altogether) and the zooids of the Atlantic species are arranged along each side of conspicuous, deep, circular primary common cloacal canals, rather than being evenly spaced.

Monniot et al. (1985, 1991) and Monniot and Monniot (1987) believe that *D. perlucidum* has been transported to the western Pacific on the hulls of ships. The specimen shown in Monniot et al. (1991: 176) has smaller and more crowded systems than *D. perlucidum* and appears to be a different species altogether. Specimens referred to *D. perlucidum* from French Polynesia (Monniot et al., 1985; Monniot and Monniot, 1987) apparently have evenly spaced zooids like *D. incanum* (see Monniot et al., 1985: pl.1), but specimens from the same location (possibly the same specimens) are said (Monniot and Monniot, 1987) to have conspicuous cloacal canals and an ‘average’ of seven stigmata per row (which is more than is known for the present species). Although their identity is not resolved, these specimens do not seem to be either *D. perlucidum* or *D. incanum*.

Although there are few trans-Tasman species, there are some that may be part of a Gondwana fauna, and the present species may be part of that fauna (see Kott, in press).

**Didemnum jucundum** Kott, 2001
(figures 8C, 19D)

*Didemnum jucundum* Kott, 2001: 197 and synonymy.

Distribution. Previously recorded (see Kott, 2001): Western Australia (Esperance), South Australia (?West I., Kangaroo I.). New record: Tasmania (Forestier Peninsula, SAM E3201).

Description. In life the newly recorded colony is translucent beige with clouds
of black and yellow pigment in the surface, white dots where the branchial apertures open, and a ring of black pigment around each common cloacal aperture. In preservative the colony is white. Spicules are crowded throughout, but do not line the margins of the branchial apertures. They are large, to 0.82 mm diameter, with 13–15 relatively long rays in optical transverse section. The rays are obelisk-shaped with conical tips. The colony is relatively thick and fleshy owing to the thick layer of basal test in which abdomina are embedded. The zooids are along each side of shallow circular common cloacal canals which surround solid stands of test in which the ventral surface of each zooid is embedded. The surface layer of test over the common cloacal canals is thin and breaks up readily.

The most conspicuous aspect of the zooids of this species is the particularly long oesophageal neck, which, though usually contracted anterior to the point where the retractor muscle separates from it (at least two-thirds of its total length), is about three times the length of the contracted thorax. The gut forms a double loop and 12 coils of the vas deferens surround a spherical testis. The larval trunk is 0.9 mm long, the tail is wound two-thirds of the way around it, and four ampullae are along each side of the three antero-median adhesive organs.

Remarks. The specimen accords with previously recorded material, especially in regard to its appearance in life. It appears to have a wide range across the southern coast of Australia.

**Didemnum lissoclinum** Kott, 2001

*Didemnum lissoclinum* Kott, 2001: 202 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Great Australian Bight, Yorke Peninsula, Kangaroo I., Gulf St Vincent), Victoria (Mallacoota Inlet, Deal I.), New South Wales (Jervis Bay, Port Hacking). New record: South Australia (Kangaroo I., SAM E2922).

**Description.** Living colonies are white, with irregular, knobbly surface lobes, each with a terminal common cloacal aperture. Cloacal apertures are numerous and conspicuous, always on elevations of the surface. They have spicule-free test in the rim of the aperture. Beneath a very thin spicule-free superficial layer of test, spicules are moderately crowded throughout the colony. Branchial apertures are sometimes (but not always) lined with spicules. Spicules are small, to 0.07 mm diameter, with seven to nine and sometimes 11 conical rays in optical transverse section. These colonies are complex, the primary common cloacal canals surrounding clumps of zooids are deep and often posterior abdominal, and the surface lobes often overgrow and fuse with other parts of the colony surface.

Zooids are small with not more than six stigmata per row, a large open atrial aperture, a long, fine retractor muscle from the top of the long oesophageal neck and buds at its base, about three to five stolonal vessels with conspicuous terminal ampullae, and a club-shaped abdomen. Gonads were not detected.

Remarks. The species has been recorded from Kangaroo I. previously and it
appears to be a common component of the southern ascidian fauna. The zooids and larvae are similar to those of *Didemnum incanum*. The spicules also are similar, but are larger and have more rays, the deep three-dimensional cloacal system does not occur in *D. incanum* and the very long oesophageal neck appears to be a unique character of the present species.

**Didemnum madeleinae** Monniot and Monniot, 2001

*Didemnum madeleinae* Monniot and Monniot, 2001: 268; Kott, 2002c: 35.

**Distribution.** Previously recorded (see Kott, 2002c): Northern Territory (Darwin), Papua New Guinea. New record: Northern Territory (Channel I., QM G308630).

**Description.** The colony is an irregular encrusting sheet, red in life. In preservative, it is yellowish and blotchy on the surface and the preservative is stained yellow. The colony is thin, brittle and packed hard with spicules. Spicules are stellate, to 0.05 mm diameter with seven to nine sharply pointed conical rays in optical transverse section. The common cloacal cavity is shallow and thoracic and the abdomina are embedded in the basal test. Zooids are small, with a rounded atrial lip; a circular, concave lateral organ; a thick retractor muscle from halfway down the oesophageal neck; eight coils of the vas deferens and large yellow eggs. The specimen, collected in September, has larvae in the basal test with the tail wound three-quarters of the way around the 0.6 mm-long, cigar-shaped trunk. Four lateral ampullae are along each side of the three antero-median adhesive organs.

**Remarks.** The regular, relatively small stellate spicules with sharply pointed conical rays and the large number of vas deferens coils help to distinguish this species.

**Didemnum membranaceum** Sluiter, 1909

*Didemnum membranaceum* Sluiter, 1909: 58; Kott, 2001: 205 and synonymy; 2002c: 36.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Western Australia (Montebello Is to Dongara); Queensland (Moreton Bay, Heron I., Swain Reefs, Broadhurst Reef, Fantome I., Davies Reef); Northern Territory (Darwin); Timor Sea, Indonesia, Micronesia, French Polynesia, Hong Kong. New records: Western Australia (Passage Is, WAM 531.92; Marmion Lagoon, WAM 54.89); South Australia (Kangaroo I., SAM E3227).

**Description.** One (WAM 531.92) of the Western Australian colonies is an extensive sheet enveloping a branch of a coral skeleton, but the other newly recorded colonies are small and flat. All the colonies have large horizontal common cloacal cavities and spicules crowded throughout. The South Australian colonies have minute spicule-filled papillae crowded on the surface between the branchial apertures and the large colony from Western Australia enveloping the coral has six spicule-filled papillae encircling each branchial aperture. In all the specimens, the spicules are characteristic, giant spicules with up to six long, attenuated, spiky rays being scattered amongst smaller stellate ones with seven to nine conical pointed rays in optical transverse section. The maximum diameter in the South Australian specimens is only 0.056 mm diameter for giant spicules and
0.035 mm diameter for the smaller ones. Other aspects of the zooids are as previously described (see Kott, 2001).

Remarks. The newly recorded specimens have characteristic large horizontal thoracic cloacal cavities and small zooids with comma-shaped thoraces, and they appear to be conspecific, despite the fact that the record from South Australia is the first from temperate waters for this species.

**Didemnum pecten** Kott, 2001

*Didemnum pecten* Kott, 2001: 220.

*Didemnum pellucidum* Kott, 2001: 222 (part, specimens SAM 2606, E2651, E2654-5, E2658).

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Kangaroo I., Point Souttar, Gulf St Vincent), Victoria (Lorne), New South Wales (Jervis Bay). New records: South Australia (Stansbury Jetty, SAM E2856; Kangaroo I., SAM E2858).

**Description.** One colony (SAM E2856) is an upright lobe with a terminal common cloacal aperture. The other specimen (SAM E2585) has slightly translucent vertical lobes each with a terminal common cloacal aperture. Both specimens have large posterior abdominal common cloacal cavities separating the central test core from the outer zooid-bearing layer. Spicules are evenly distributed but not crowded in the surface at branchial siphonal level and a clump is in the siphon lining. They are absent from or sparse in the internal test core. Spicules are stellate, with 7–11 conical rays in optical transverse section and up to 0.08 mm diameter (although smaller ones predominate).

Remarks. The sympatric species *D. pellucidum* has vertical colony lobes with terminal common cloacal apertures projecting from the upper surface, spicules in the surface layer of test but absent from the inner core, stellate spicules with 7–11 rays in optical transverse section, a three-dimensional common cloacal cavity and conspicuous projecting columnar epidermal cells, as in the present species. Both colony and zooids are so alike it would be difficult to separate the species, were it not for the smaller larvae with fewer lateral ampullae and 10 coils of the vas deferens around the beehive or dome-shaped testis in *D. pecten*, while *D. pellucidum* has larger spicules, longer branchial siphons, more (12) larval lateral ampullae, a larger larval trunk and more (11) coils of the vas deferens around a flatter lens-shaped testis.

The newly recorded specimens have neither mature testis nor larvae and have been identified by their spicules, which do not exceed 0.08 mm diameter, and by the relatively short branchial siphons. Conspicuous pointed projecting columnar epithelial cells cover the thorax and branchial siphons.

Spicules are shown in Kott, 2001: figure 170–1 (not figure 170A).

**Didemnum poecilomorpha** Monniot and Monniot, 1996

*Didemnum poecilomorpha* Monniot and Monniot, 1996: 226; Kott, 2001: 226 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Broome), Papua New Guinea, Palau Is, Indonesia. New record: Western Australia (Dongara, WAM142.93).
**Description.** The newly recorded colony is a white, smooth sheet enveloping a kelp stalk. Large, sessile common cloacal apertures are randomly spaced on the surface, amongst the small, evenly spaced (about 7 mm apart) stellate branchial apertures, which are slightly depressed into the surface, the margins of the apertures lined with white spicules. Spicules are packed throughout the test. They are to 0.06 mm diameter, globular to stellate, with 11–13 truncated or conical pointed rays in optical transverse section. The common cloacal cavity is relatively shallow, at thorax level. The surface layer of test is relatively thick, accommodating the long branchial siphons, which are about half the length of the contracted thorax. Otherwise the thoraces are small. The oesophageal neck is longer than the rest of the thorax, and the retractor muscle projects from about three-quarters of the way down it. The vas deferens coils eight times around the undivided testis. Pools of green pigment are in the basal test.

**Remarks.** The quilted surface appearance of previously described specimens was not evident in the newly recorded colony, although other characters, such as the size and form of the spicules, the zooids (including the number of vas deferens coils) are as reported for the type material. *Didemnum diversum* Kott, in press has similar spicules and eight coils of the vas deferens, but is distinguished by its pectinate spicule rays. Of the known species with a similar diversity of spicules, *D. moseleyi* (Herdman, 1886) has a shorter branchial siphon, not more than 11 spicule rays in optical transverse section and nine coils of the vas deferens; *D. bisectatum* Kott, 2001, *D. chartaceum* Sluiter, 1909, *D. multispirale* Kott, 2001 and *D. nambucciensis* Kott, in press have spicules with more rays; *D. bicolor* Kott, 2001, *D. guttatum* Monniot and Monniot, 1996, *D. macrosiphonum* Kott, 2001 and *D. ossium* Kott, 2001 have fewer spicule rays; and *Didemnum elongatum* Sluiter, 1909 has a similar long branchial siphon, similar but larger spicules with fewer rays, and only six coils of the vas deferens.

*Didemnum scopi* Kott, 2001 (figure 20B)

*Didemnum scopi* Kott, 2001: 232.

**Distribution.** Previously recorded (see Kott, 2001): Queensland (Caloundra, Hervey Bay, Capricorn Group, Swain Reefs, Barrow Point). New record: ?Western Australia (Jurien Bay, WAM 203.93).

**Description.** The newly recorded specimen is a small scrap of a colony with brown zooids giving it a pinkish colour when seen through the single, one spicule-thick layer of spicules in the surface. Stellate branchial apertures are packed with spicules around them and also there is a layer on the base of the colony. The spicules have the characteristic 9–11 almost rod-shaped rays in optical transverse section. The common cloacal cavity is thoracic and abdomina are embedded in the basal test.

**Remarks.** Although this species has not previously been recorded from northwestern Australia, its brown zooids and rod-shaped spicule rays are characteristic. The spicules are like those of *Didemnum candidum* Savigny, 1816, but the rays are more numerous.
**Didemnum sordidum** Kott, 2001

(figure 20C)

**Didemnum sordidum** Kott, 2001: 234 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Lord Mayors Shoal, Pilbara); Queensland (Moreton Bay to Noosa, Heron I.); Hong Kong; Philippines; French Polynesia; Christmas I. (Indian Ocean). New record: Western Australia (Rottnest I., WAM 189.93).

The new record is the most southerly one for this widespread and relatively commonly occurring Indo-West Pacific species.

**Remarks.** In the newly recorded colony, characteristic brown spherical cells are free in the test and around the zooids and spicules of characteristic size and form crowd the test and outline the branchial apertures as previously reported for this species (see Kott, 2001).

**Didemnum spumante** sp. nov.

(figures 9A, 20D)

**Distribution.** Type locality: Western Australia (Green Head, near Leeman, in crevice, high tide, coll. M. and D. Griffiths, 4 July 1989, holotype WAM 195.90; paratype WAM 194.90).

**Description.** Colonies are thin white sheets, opaque with crowded spicules and some sandy debris incorporated in the basal test. The small, crowded spicules are interrupted around the branchial apertures by circles of minute spherical vesicles. Similar vesicles are present throughout the test giving it a foamy consistency. Spicules are crowded in the linings of the branchial apertures. The spicules are small, to 0.03 mm diameter, with 9–11 blunt conical to rounded rays in optical transverse section. The spicule rays are relatively short and are made up of not very tightly

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**Fig. 9.** *Didemnum spumante* (WAM 194.90). (A) Thorax; (B) larva. Scale bars: 0.1 mm.
compacted parallel crystals, and some are bipartite with a short conical tip in the centre of a cylindrical basal portion. The common cloacal cavity is shallow and thoracic.

Zooids are very small, but contracted, with a short retractor muscle from the posterior end of the thorax. Seven coils of the vas deferens surround the undivided testis. Small larvae have the tail wound three-quarters of the way around the 0.36 mm-long trunk containing four club-shaped ectodermal ampullae each side of the three antero-median adhesive organs.

Remarks. Although there are no particularly distinctive characters in either colony or zooids of this hard, encrusting species, its spicules provide a compelling difference from other species. They are a similar form to the spicules of *D. elongatum* Sluiter, 1909 and *D. vahatui* Monniot and Monniot, 1987 (which, however, has spicules with more rays), both species having some stellate spicules with terminal cones on cylindrical bases. Nevertheless, both these species have larger spicules than the very small ones of the present species.

*Didemnum tabulatum* Sluiter, 1909

*(figure 20E)*

*Didemnum tabulatum* Sluiter, 1909: 49; Kott, 2001: 241.

**Distribution.** Previously reported (see Kott, 2001): Western Australia (W of Port Hedland), Indonesia. New record: Western Australia (Dongara WAM 143.93).

The newly recorded colony is from 219 m.

**Description.** The colony is sheet-like, about 1.0 mm thick, growing over a sponge. Occasional common cloacal apertures have about seven pointed spicule-filled lobes around the rim that project into the opening. These are the continuations of the radial ribs that surround the aperture in the roof of the common cloacal cavity. Spicules are crowded throughout the colony. Zooids are evenly spaced, the thoraces crossing the common cloacal cavity each with a ventral strip of spicule-filled test. Abdomina are embedded in the basal test. Spicules are to 0.07 mm diameter, stellate, with up to 20 or more conical or fusiform pointed rays. Also there are occasional spicules with flat-tipped or truncated rays, some almost globular. Zooids have short cylindrical branchial siphons, sessile atrial openings, six stigmata in the first two rows and five and four, respectively, in the last two rows. Those in the last two rows are circular perforations. Gonads were not detected.

Remarks. The stellate, many-rayed spicules of this seldom-reported species are distinctive. Although similar to those of *D. multispirale* Kott, 2001, they have longer and more needle-like rays, and most resemble the spicules of the *dubius* group in the genus *Leptoclinides*. Although globular spicules and flat-tipped rays have not previously been reported for this species, they probably have been overlooked, all other characters reported being the same as in the newly recorded colony.

*Didemnum ternerratum* Kott, 2001

*(figures 10, 20F)*

*Didemnum ternerratum* Kott, 2001: 241 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): South Australia (Great Australian Bight, Wright I., Ward I.), Victoria (Western Port). New record: South Australia (Kangaroo I., SAM E2920).
Dome-shaped, brownish colonies have terminal common cloacal apertures on elevations about 5 mm diameter. The surface is quilted, with depressions over the primary common cloacal canals. Dark brown zooids are along each side of the primary common cloacal canals. Small stellate to globular spicules (to 0.046 mm diameter) are crowded in the surface and basal layers of test, but are patchy elsewhere. The spicules have 15–17 rays in optical transverse section. The small zooids have a forked atrial lip on the anterior rim of the wide, sessile atrial opening, a small pointed but strong retractor muscle, eight coils of the vas deferens and a large brown egg.

Remarks. This well-defined species is known only from the south-eastern corner of the continent.

*Didemnum vahatuio* Monniot and Monniot, 1987

Description. Dome-shaped, brownish colonies have terminal common cloacal apertures on elevations about 5 mm diameter. The surface is quilted, with depressions over the primary common cloacal canals. Dark brown zooids are along each side of the primary common cloacal canals. Small stellate to globular spicules (to 0.046 mm diameter) are crowded in the surface and basal layers of test, but are patchy elsewhere. The spicules have 15–17 rays in optical transverse section. The small zooids have a forked atrial lip on the anterior rim of the wide, sessile atrial opening, a small pointed but strong retractor muscle, eight coils of the vas deferens and a large brown egg.

Remarks. This well-defined species is known only from the south-eastern corner of the continent.
conical rays in optical transverse section. They are crowded throughout and the smooth upper surface of the colony is raspy with them. The surface test is thin. Each thorax crosses the common cloacal cavity with an independent ventral strip of test. Abdomina are embedded in the basal test, which is half of the whole thickness of the colony.

Remarks. Kott (2001) reported 13–15 spicule rays in optical transverse section. However, revision of the material on which this count was made has shown this to be incorrect, there being 9–11 rays as in the present material.

Trididemnum paracyclops Kott, 1980

Trididemnum paracyclops Kott, 1980: 12; 2001: 276 and synonymy.

Distribution. Previously recorded (see Kott, 2001): Queensland (Capricorn Group, Lizard I.), Palau Is, New Caledonia, Guam, Philippines, Fiji, French Polynesia. New record: Western Australia (Shoalwater Bay-Cockburn Sound, WAM Z10921).

The record is the most southerly record for this species and the first for the Indian Ocean.

Description. The specimen appears to have been dried out at some stage. It has been identified by the presence of a posterior abdominal common cloacal cavity and by its spicules. The spicules are globular, burr-shaped and stellate, to 0.08 mm diameter and have 13–15 short, blunt rays in optical transverse section.

Remarks. In describing the spicules of the present species, Kott (2001: figure 174A) appears to have overlooked their similarity to those of T. cyclops Michaelsen 1921, which, although smaller, have the same globular, burr-like and stellate shapes, and some stellate spicules with rays of various lengths.

Trididemnum pigmentatum Kott, 2001

Trididemnum pigmentatum Kott, 2001: 278 and synonymy.

Distribution. Previously recorded (see Kott, 2001): Western Australia (Montebello Is, Kimberley), Queensland (Hervey Bay, Capricorn, Sarina, Lizard I.), Indonesia, Fiji. New records: Northern Territory (Angler Reef, QM G308619; Mandorah Jetty, QM G308635).

Description. Colonies are thin, flexible, grey sheets, black in life with a smooth surface. Minute black pigment cells are in the aspiculate superficial layer of test. Beneath this there are moderately crowded spicules in the upper (zooid) layer of the test, but there are no spicules in the lower (posterior abdominal) layer of the colony where some faecal pellets and embryos are embedded. Internally the test is yellowish. The large (to 0.1 mm diameter) stellate spicules have 13–15 long, crowded pointed conical rays in optical transverse section. Sometimes there are lobes and ridges projecting from the surface of the colony.

The zooids are covered in black squamous epithelium which obscures their structure. A long retractor muscle projects from the top of the oesophageal neck. Each of the branchial lobes has a black pigment spot in the tip. There is a posteriorly directed atrial siphon. The pyloric end of the gut loop is bent ventrally at right angles to the longitudinal axis of the zooid.

Remarks. Although the species resembles other Trididemnum spp. in some respects, the large spicules with many pointed rays help to distinguish it. Faecal
pellets are embedded in the basal layer of the colony but they do not form a distinct layer as they do in *T. savignii*. The layer of black squamous epithelium around the zooids has been reported previously for this species, although the black pigment in the superficial layer of test has not.

*Trididemnum pseudodiplosoma* (Kott, 1962)

*Didemnum pseudodiplosoma* Kott, 1962: 321.

*Trididemnum pseudodiplosoma*: Kott, 2001: 279.

*Trididemnum inermum* Monniot and Monniot, 2001: 263.

**Distribution.** Previously recorded (see Kott, 2001; Monniot and Monniot, 2001): South Australia (Gulf St Vincent), Coral Sea. New records: South Australia (Reevesby I., SAM E2912), Northern Territory (South Shell I., QM G308633, G308650; Angler Reef, QM G308649).

**Description.** The colonies from the Northern Territory are soft with outgrowths from the surface forming spongy, complex three-dimensional masses. There is a gradation in the amount of pigment in the three newly recorded colonies, those from South Shell Is sometimes having minute, oval black pigment cells massed together to form irregular black streaks in the surface while the colony from Angler Reef has a smooth black surface. Internally all three specimens are translucent and whitish in preservative. There are no spicules. Common cloacal cavities are oesophageal and posterior abdominal. Also, the overgrowths from the surface of the colony enclose secondary external spaces inside the colony. The test is very soft. The colonies from South Australia are small aspiculate plates, to 1.0 cm diameter with a few, stray, burr-like to stellate, spicules to 0.04 mm diameter and juvenile zooids lacking gonads.

Zooids have an extensive prestigmatal unperforated area in the pharynx, three rows of stigmata with 12 in the anterior row, a posteriorly directed atrial siphon, a delicate retractor muscle projecting from the posterior end of the thorax, an oesophageal sphincter muscle consisting of a few delicate fibres about halfway down the oesophageal neck, and branchial and atrial sphincters. Zooids do not have an endostylar pigment cap. Branchial tentacles are conspicuously long. Gonads were detected in one of the specimens (QM G308633) in which eight coils of the vas deferens surround the undivided spherical testis. Characteristic larvae (see Kott, 2001) are present in the colony from Angler Reef. Both specimens were collected in September.

**Remarks.** The species lacks the black squamous epithelium and endostylar pigment cap of *T. discrepans* and has fewer stigmata. *Trididemnum pseudodiplosoma* (Kott, 1962) has a distinctive larva with many blastozooids, and the larvae in the newly recorded colony (QM G308649) are identical to those in previously recorded material (see Kott, 2001). Colonies and zooids of the type material of *T. inermum* are identical with those of the present species.

*Trididemnum savignii* (Herdman, 1886)

*Didemnum savignii* Herdman, 1886: 261.

*Trididemnum savignii*: Kott, 2001: 281; 2002c: 39.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Western Australia (Nares Rock), Queensland (Heron I., Lizard I.), Northern Territory (Darwin),
Indonesia; ?Florida, Bermuda, West Indies. New records: Northern Territory (Plater Rock, QM G308618; Weed Reef II, QM G308626).

Description. Colonies are gelatinous but firm with terminal common cloacal apertures on surface elevations. A conspicuous superficial bladder cell layer overlies a layer of spicules at thorax level but spicules are sparse in the remainder of the test. The common cloacal cavity is posterior abdominal and the basal layer of test beneath it varies in thickness, sometimes being twice the thickness of the zooid layer. A thick layer of faecal pellets is in the base of the colony. Spicules are large, to 0.11 mm diameter, with 11–13 pointed conical rays in optical transverse section. Zooids are relatively small, the atrial aperture on a posteriorly directed siphon, the tapering retractor muscle projecting from the posterior end of the thorax, about 12 stigmata per row and eight coils of the vas deferens around the undivided testis. There is no black squamous epithelium on the zooid.

Remarks. Trididemnum pigmentatum has spicules like those of the present species, with similar strong conical pointed rays. However, in the present species the spicules have a more restricted distribution, the rays are not so crowded and they are less numerous, the superficial bladder cell layer is more conspicuous and there is a distinct layer of faecal pellets in the base of the colony. Although the zooids of this species have previously been reported to have black squamous epithelium, it was not found in the newly reported specimens; nor were there irregularly shaped black pigment cells in the superficial bladder cell layer.

Trididemnum sibogae (Hartmeyer, 1910)

Didemnum sibogae Hartmeyer, 1910: 1489 nom. nov. for Didemnum ramosum Sluiter, 1909: 63.

Trididemnum sibogae: Kott, 2001: 281 and synonymy; 2002c: 39; 2004.

Distribution. Previously recorded (see Kott, 2001, 2002c, 2004): Western Australia (Cape Jaubert), South Australia (Cape Jaffa, Port Turton, Kingston, Flinders and Kangaroo I.), Victoria (Western Port); Tasmania (Swan I., southern Tasmania), New South Wales (Port Hacking, Sydney Harbour, Arrawarra), Queensland (Fraser I., Bargara, Cairns, Princess Charlotte Bay), Northern Territory (Darwin, Gulf of Carpentaria), New Caledonia, Indonesia, India. New record: Northern Territory (Angler Reef, QM G308605).

Description. The newly recorded colony is grey in life, but becomes greenish yellow in preservative. It consists of hard, thin, paper-like lamellae forming a spherical three-dimensional reticulum of coalescing branches. The upper surface of each branch is rounded and even, forming the smooth outer surface of the sphere. Branchial siphons protrude through a thin superficial layer of bladder cells that overlies the crowded spicules in the relatively thin zooid layer of test that surrounds the central common cloacal cavity. Thin spicule-filled supporting rods of test connect the zooid layer of test with a thin layer that lines the internal cavity, i.e. across the posterior abdominal cavity. The central cavity has openings into the posterior abdominal cavity and connects with the thoracic cavities around the zooids. These hard supporting rods of test often project out from the surface in pointed papillae—always crowded with spicules. Spicules are large (to 0.09 mm diameter), stellate, with 11–13 long, narrow, pointed rays in optical transverse section.
Zooids have an endostylar pigment cap, about 12 stigmata per row, and eight coils of the vas deferens around the undivided testis.

Remarks. The colony superficially resembles *Didemnum spongioides* Sluiter, 1909, which also has a complex three-dimensional colony and pointed spicule-filled papillae on the surface. The zooids are characteristic of the genus *Tridemnum* and, with the spicules, conform with previously reported colonies of the present species.

*Lissoclinum coactum* sp. nov.

*(figures 11, 20H)*

Distribution. Type locality: Western Australia (Five Mile Reef, about 10 km E of Hopetoun 33°56′1″S, 120°12′E, 0–3 m, limestone reef, coll. L. Marsh, 13 January 1986, syntypes WAM 1136.89).

Description. Colonies are irregular flattened mats to 3–4 mm in maximum dimension. White-rimmed common cloacal apertures are evenly spaced about 5 mm apart on the upper surface. Between these, the surface is interrupted by evenly spaced stellate branchial apertures surrounded by a spicule-free circle of test depressed into the surface. The rim of the opening has clusters of spicules crowded in each lobe. Brown pigment is mixed with spicules in the surface test, forming a cream, relatively opaque surface layer. Spicules are also present, but not crowded through the remainder of the colony. Spicules, to 0.035 mm in diameter, are globular with 7–9 thick cylindrical flat-tipped rays in optical transverse section. The rays are formed of loosely bound parallel crystals.

Zooids are in clumps of six or seven in the test ligaments between the surface and the basal test. A short connective in which the abdomina are embedded anchors them to the relatively thick basal layer of test, but subdivides to separate the thoraces from one another. Brown stolonic vessels with large terminal vesicles are in the test and the brown pigment in the body wall of the zooids obscures their structure. The testis is divided into two follicles.

Remarks. These colonies are very soft with the consistency of the interior of *Didemnum molle* (Herdman, 1886), a species with similar common cloacal systems, and a similar distribution of small globular spicules. The species are separated by the generic characters, differences in the shape of the colonies and in the presence of *Prochloron* in *D. molle*.

The present species is distinguished from most other *Lissoclinum* spp. by its relatively few and thicker spicule rays. Although there are a number of species in this genus with similar distribution of spicules, similar common cloacal cavities and similar zooids with the branchial apertures depressed into the surface of the colony (namely *L. levitum* Kott, 2001, *L. durabile* Kott, 2001, *L. badium* Kott, 2001 and *L. reginum* Kott, 2001), they all have more spicule rays. Also, *L. levitum* has stellate spicules and the others have burr-like ones rather than globular spicules of the present species. *Lissoclinum durabile* looks most like the present species, having evenly spaced common cloacal apertures on the upper surface and the same geographic range.

*Lissoclinum vareau* Monniot and Monniot, 1987 from French Polynesia appears to have spicules most like the present species although they have more rays, and the common cloacal systems differ, the tropical species having zooids embedded in the surface test rather than in ligaments crossing the common cloacal cavity.
**Lissoclinum conchylium** Kott, 2001

*figure 21A*

*Lissoclinum conchylium* Kott, 2001: 305; 2002c: 40.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Queensland (Heron I., Moreton Bay); Northern Territory (Darwin). New records: Northern Territory (Anglers Rock, QM G308613; South Shell I., QM G308632).

**Description.** Colonies are extensive, thin sheets, hard and brittle with crowded spicules, brownish beige in life and pinkish mauve to reddish brown in preservative. The pigment is confined to the surface layer of test, where reddish pigment
cells are mixed with spicules, absent only from the area around the evenly distributed branchial openings. The common cloacal cavity is shallow and thoracic. Spicules are small, to 0.04 mm diameter, burr-shaped with about 20 rod-like flat-to round-tipped rays in optical transverse section. Common cloacal apertures are evenly distributed over the surface.

Zooids, embedded in the white test, are brown, with minute spherical brown cells in the haemocoel. The abdomen is bent up alongside the thorax. Nine stigmata are in the anterior row in the branchial sac, eight in the second and third rows, and seven in the last row. The testis is divided into two follicles and the proximal end of the vas deferens, between the two follicles, is expanded into a seminal vesicle.

Remarks. The specimens differ from previously recorded material in their restricted common cloacal cavities with the abdomen entirely embedded rather than only partially embedded in the basal test as Kott (2001) reported. However, the spicules are identical to those previously described, as are the brown cells in the haemocoel.

*Lissoclinum diversum* sp. nov.

*(figures 12, 21B)*

Distribution. Type locality: Western Australia (NE end of Kendrew I. Dampier Archipelago, under boulders, reef flat, coll. L. Marsh Crown of Thorns Survey, 10 October 1972, holotype WAM 140.93).

Description. Colonies are hard, encrusting sheets, the stellate branchial apertures depressed into an otherwise smooth, even surface. The common cloacal cavity is thoracic, and the surface test is connected to the thicker basal test by firm cylindrical columns each surrounded by six or seven thoraces with their ventral surfaces embedded in the test of these connectives. These firm columns of test crossing the common cloacal cavity contribute to the firmness of the colony. Abdomina are embedded in the basal test. The relatively small (to 0.0375 diameter) spicules are crowded throughout the test, also contributing to the hardness of the colony. They are globular to burr-like, with 11–17 rod-like to club-shaped rays in optical transverse section, and sometimes flattened to concave tips of the rod-like cylindrical rays appear to have small rounded to conical tips contained in them.

The large thoraces have a large sessile atrial aperture exposing most of the branchial sac directly to the common cloacal cavity. Ten long rectangular stigmata are in the anterior row of the branchial sac, nine in the second, eight in the third and seven in the last row. A retractor muscle was not detected. The proximal end of the vas deferens, where it forms between the two testis follicles, is expanded into a seminal vesicle, narrowing as it extends anteriorly.

Remarks. *Lissoclinum timorense* (Sluiter, 1909) has similar spicules of about the same size, but an undivided testis, a three-dimensional common cloacal cavity and slit-like branchial apertures. Further, the symbiotic green cells of *L. timorense* have not been detected in the present species. *Lissoclinum conchylium* Kott, 2001 has similar zooids with stellate apertures depressed into the
upper surface and two testis follicles like the present species, but its spicules are larger and less diverse with more rays, and clumps of abdomina project up into the floor of the more spacious common cloacal cavity. *Lissoclinum reginum* Kott, 2001 has brown cells in the haemocoel, an atrial lip and more numerous spicule rays which distinguish it from the present species.

**Lissoclinum durabile** Kott, 2001

*Distribution.* Previously recorded (see Kott, 2001, 2002c, 2004): Western Australia (Esperance), South Australia (West I., Wright I.), Victoria (Western Port), New South Wales (Coffs Harbour), Northern Territory (Darwin). New records: South Australia (Kangaroo I., SAM E3217).
The colony is brittle, spicules being crowded throughout and readily falling out of
the test when it is torn. The common cloacal cavity is an extensive horizontal space
at thorax level, thoraces crossing it adhering tightly to separate ventral strips or to
connectives shared by two to four zooids. Abdomina sometimes are embedded in
the relatively thin basal test although in other specimens they project up into the
common cloacal cavity. Spicules are usually burr-shaped, to 0.04 mm diameter, with
relatively thick, almost club-shaped rays, although a few are stellate with about nine
broad rays in optical transverse section.

Zooids are conspicuous in the preserved material, with dark cells in the haemo-
coel. The atrial apertures expose most of the branchial sac to the common cloacal
cavity, the sides of the aperture being drawn ventrally almost to the endostyle.
Thoraces are large with 10 stigmata in the anterior row and a large circular lateral
organ opposite the middle interstigmatal vessel on each side of the endostyle.

Remarks. This is a readily identified species, with characteristic wide-open
common cloacal apertures protruding from the surface and an unusual and con-
spicuous colour pattern that varies only in the intensity of the colour. It has an
extensive range across the southern Australian coast and, although at present it
has not been recorded either from the western Australian coast, or from the
north-eastern coast north of New South Wales, it is recorded from Darwin and
it may be found to be present around the whole of the continent.

Lissoclinum laneum sp. nov.

Distribution. Type locality: South Australia (Port Victoria Jetty, Yorke Penin-
sula, 3–4 m, coll. K. Gowlett Holmes, 3 May 1998, holotype SAM E2923).

Description. The colony is a soft, translucent aspicular sheet, the test with a
cotton-wool consistency. Zooids are seen through the test, embedded along the
sides of the common cloacal canals. Spicules were not detected, although there
are varying-sized spherical clumps of irregular morulae or smooth plate-like to
rounded bodies on each side of the thoraces and in the test around the zooids.
Clumps of similar bodies form a half collar on each side of the duodenum at
the base of the stomach, and they also are found in abundance around the
common cloacal apertures and in the surface test. Zooids are large, with a mod-
erately long branchial siphon and a sessile atrial aperture exposing much of the
large branchial sac to the common cloacal cavity. About 12 stigmata are in the
anterior row. An oesophageal muscle is around the oesophageal neck, but a
retractor muscle was not detected. A small egg is in a sac attached to the abdo-
men by a narrow neck. The testis is spherical and undivided and the proximal
part of the straight vas deferens is expanded into a seminal vesicle.

Remarks. The species has plate-like and morula bodies in the test that resem-
ble those in the larval test of many Lissoclinum spp., as well as in the adult test
of Lissoclinum concavum Kott, 2001 (causing it to be cloudy). The homologue of
the half collar of morula bodies around the duodenum at the base of the
stomach is not known, although the ball of similar bodies on each side of the
thorax appears to be homologous with the lateral organs. Similar clumps of
morula bodies are scattered in the test of Diplosoma fecundum and D. ferrugeum
Kott, 2001, and other Diplosoma species such as D. velatum Kott, 2001 super-
ficially resemble this aspiculate colony. However, Diplosoma spp. usually have
zoooids suspended in the common cloacal cavity in strands of test, rather than being embedded in the test along each side of the common cloacal canals.

*Lissoclinum calysis* Monniot, 1992 has the egg in a sac attached to the body wall as in the present species, lacks a retractor muscle, has an undivided testis and may be related. However, it has distinctive spicules that separate it from the present characteristically aspicular species. *Lissoclinum notti* Brewin, 1958 from New Zealand has a similar undivided testis and the ovary constricted off from the abdomen, but it is also distinguished from the present species by its spicules.

**FIG. 13.** (A) *Lissoclinum laneum* (SAM E2923), zooid with spherical and morula cells in the surrounding test. (B, C) *Lissoclinum stellatum* (SAM E2926). (B) Colony surface showing scattered spherical vesicles; (C) thorax. Scale bars: 0.1 mm (A, C); 2 mm (B).
Lissoclinum levitum Kott, 2001
(figure 21D)

Lissoclinum levitum Kott, 2001: 307; 2004.

**Distribution.** Previously recorded (see Kott, 2001, in press): South Australia (Ward I.). New record: South Australia (Kangaroo I., SAM E3219).

**Description.** The newly recorded colony is mauve, translucent with sparse spicules evenly distributed in a surface and a basal layer. Only occasional spicules are in the remainder of the colony. The surface spicules are slightly more crowded in clumps in each of the branchial lobes than they are in the remainder of the surface, thus creating a daisy-like pattern. Common cloacal openings, on large flaccid cylindrical protrusions here and there on the surface, are also ringed in white. Spicules are less than 0.03 mm diameter, burr-like with numerous pointed or irregular ray tips.

Zooids cross the vast common cloacal cavity in groups of about six, each zooid attached separately at the surface but joined to the basal test by a single common ligament. They have about eight stigmata in the anterior row. A small lateral organ is on each side of the endostyle opposite the middle transverse vessel. Two male follicles are present. The proximal end of the vas deferens is often swollen into a seminal vesicle. Zooids contain the usual dark haemocoel cells.

**Remarks.** The newly recorded specimen differs from the type material in its more extensive common cloacal cavity, the abdomina previously being found embedded in the basal test. Nevertheless, the spicules and their distribution, the colour of the colony and the form of the zooids are identical.

Lissoclinum limosum Kott, 2001
Lissoclinum limosum Kott, 2001: 308; 2002c: 42.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Queensland (Capricorn Group, Swain Reefs), Northern Territory (Darwin). New record: Northern Territory (Weed Reef II, QM G308660).

**Description.** The newly recorded colony is not in good condition. The test is soft and contains dark pigment cells around the zooids encapsulated in white spicules. Spicules, colony and zooids are as previously described.

**Remarks.** These fragile, thin colonies, with the white capsule of spicules around each zooid showing through the black, slightly translucent test, are characteristic of this species.

Lissoclinum multifidum (Sluiter, 1909)
Leptoclinum multifidum Sluiter, 1909: 83.
Lissoclinum multifidum: Kott, 2001: 311 and synonymy; 2002c: 42.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Northern Territory (Darwin, Port Essington), Indonesia, Gulf of Thailand, Mauritius. New record: Northern Territory (Plater Rock, QM G308677).

**Description.** The colony is soft and encrusting, with long rounded branches growing over the coralline rubble substratum. It is orange in life and white in preservative. Rounded prominences with large terminal common cloacal apertures are relatively evenly spaced along the centre of the rounded almost cylindrical
branches. The common cloacal apertures are large with smooth transparent rims. Spherical, white granular bodies to 0.1 mm diameter are in patches in the surface test.

Zooids are in clumps surrounded by deep trench-like common cloacal cavities that here and there are continuous with the vast posterior abdominal common cloacal cavities that interrupt the zooid layer from the basal test. Larvae are being incubated in the zooid layer of test rather than in the basal layer. Zooids are large with 10 stigmata in the anterior row, seven male follicles, a straight vas deferens and a long straight retractor muscle. Larvae have a trunk 0.8 mm long with the tail wound three-quarters of the way around it. Three lateral ampullae are each side of the three antero-median adhesive organs. The blastozooid is separated from the oozooid by a deep anterior groove. The sensory vesicle with ocellus and otolith is also separated from the oozooid by a marked constriction.

Remarks. The specimen conforms with others assigned to this species. Kott’s statement that the abdomina are embedded in the basal test is incorrect; they are in the zooid layer of test, separated from the basal test by the posterior abdominal common cloacal cavity. The aspiculate nature of the colony, the extensive common cloacal cavity, the soft test, numerous testis follicles and the large larva, with deeply separated blastozooid and oozooid at the base of the lateral ampullae, and the sensory vesicle constricted off from the oozooid, is distinctive, resembling a *Diplosoma* larva more closely than most other *Lissoclinum* larvae. In this and other characters it resembles other *Lissoclinum* species in the *aureum* group, which are separated from *Diplosoma* by the presence of spicules and their numerous testis follicles.

*Lissoclinum ostrearium* (Michaelsen, 1930)

*(figure 21E)*

*Diplosomoides ostrearium* Michaelsen, 1930: 526.

*Lissoclinum ostrearium*: Kott, 2001: 314 and synonymy.

**Distribution.** Previously recorded (see Kott, 2001): Western Australia (Cockburn Sound, Albany), South Australia (Great Australian Bight, Gulf St Vincent), Victoria Western Port). New record: South Australia (Kangaroo I., SAM E3215).

**Description.** The colony is a flat sheet, orange pink in life. In preservative it is brownish pink in the surface and white in the remainder of the colony. Orange pigment cells are in the surface test. Spicules are crowded throughout the colony, which is hard and brittle. They are up to 0.3 mm diameter, and are burr-like with 15–17 club-shaped rays in optical transverse section. Zooids are yellowish brown, their structure often obscured by brown cells in the haemocoel (especially in the interstigmatal bars and transverse vessels) and in the test. Common cloacal apertures about 0.5–1.0 cm apart are on short chimney-like protrusions filled with spicules. These are closed with their rims gathered in the newly recorded specimen. Branchial apertures are not depressed into the surface. The common cloacal cavity in the newly recorded colony is shallow and thoraces cross it in test connectives. The abdomina, embedded in the relatively thick layer of basal test, are bent up at right angles to the thorax.

**Remarks.** The species is distinguished from *L. durabile* by its smaller and
more crowded spicules, by the branchial apertures not being depressed into the surface of the colony and by the pigmentation of the colonies. Kott (2001) believed that the common cloacal cavity of the present species was more extensive than that of *L. durabile*, but this was not confirmed in the newly recorded specimen. As in *L. durabile* and *L. levitum*, the depth of the common cloacal cavity and the extent to which the abdomina are embedded in the basal test probably are variable. The newly recorded colony also differs from previously described specimens in not having such needle-like spicule rays. Until further material becomes available to test the stability of these characters, the present specimen is assigned to *L. ostrearium*, which has many similar features.

**Lissoclinum reginum** Kott, 2001

(figure 21F)

*Lissoclinum reginum* Kott, 2001: 319 and synonymy; 2004.

*Distribution.* Previously recorded (see Kott, 2001): Queensland (Capricorn Group, Swain Reefs, Lizard I.), Indian Ocean (Cocos Keeling Is). New record: Northern Territory (Plater Rock, QM G308617).

*Description.* The colony is a thin, brittle, fragile sheet, crowded with spicules and brownish white in preservative with spherical brown cells scattered throughout. Spicules are burr-like, to 0.04 mm diameter, with numerous narrow rod-like rays with irregular tips. Zooids cross a vast horizontal common cloacal cavity in separate test sheaths. They have brown spherical cells in the haemocoel. Numerous terminal ampullae of vascular stolons project from the zooids into the basal test.

*Remarks.* The colonies are as previously described, being characteristically thin and fragile and with the usual burr-like spicules and the brown spheres in the haemocoel.

**Lissoclinum roseum** Kott, 2001

(figure 21G)

*Lissoclinum roseum* Kott, 2001: 322.

*Distribution.* Previously recorded (see Kott, 2001): Hervey Bay, Capricorn Group, Swain Reefs (Queensland). New record: Western Australia (Exmouth Gulf, WAM 882.89).

*Description.* The newly recorded colonies are small, soft, pinkish cushions on worm tubes. The spicules, burr-like, to 0.028 mm diameter, encapsulate the zooids.

*Remarks.* Although this is the first record of this species from Western Australia, its characters conform with all those reported from the eastern Australian tropical material (see Kott, 2001).

**Lissoclinum stellatum** sp. nov.

(figures 13B, 21H)

*Distribution.* Type locality: Tasmania (Tasman Peninsula, Waterfall Bay, Dog Leg Cave on rock wall, 10–12 m, coll. K. Gowlett Holmes, 3 July 1998, holotype SAM E2926).
**Description.** The colony is sheet-like with brown pigment in the surface test intense around the large common cloacal canals. Crowded spicules are interrupted by oval vesicles in the basal and surface test. These vesicles appear as brown spots owing to the brown pigment in the test seen through these colourless, transparent vesicles. The ventrum of each thorax is embedded in the stand of solid test, which is surrounded by the deep primary common cloacal canals that extend the whole length of the zooid. The solid stands of test protrude slightly from the upper surface as rounded elevations. Common cloacal apertures are randomly distributed at the junctions of the circular common cloacal canals. The spicules are unique in this genus, usually stellate to 0.06 mm diameter with relatively few (five to seven) rays, often conical and pointed, but many with flat irregular or divided ray tips, and often the spicules are asymmetrical.

Zooids are narrow, with about 10 long, narrow stigmata in the anterior row, a wide open atrial aperture exposing the whole of the branchial sac to the common cloacal cavity, a retractor muscle projecting from halfway down the oesophageal neck, an undivided testis and a straight vas deferens. The thoraces are kept extended in the preserved specimens by the firm stand of solid test in which the ventrum is embedded.

**Remarks.** The common cloacal systems of the present species, like those of *L. laneum* and *L. durabile* Kott, 2001, have zooids partially embedded along each side of primary common cloacal canals that surround solid stands of test, and although these common cloacal canals may be deep (the whole depth of the zooid) they are not posterior abdominal as they are in many species of this genus. Although *L. laneum* has an undivided testis like the present species, it is readily distinguished by the absence of spicules. *Lissoclinum durabile* has two testis follicles and burr-like spicules and also is readily distinguished. The form of the spicules is very unusual for this genus, similar ones being known only in *Didemnum* (e.g. *D. complexum* Kott, 2001), and the form of the common cloacal systems are also more often encountered in other genera such as *Leptoclinides* and *Didemnum*.

**Diplosoma fecundum** sp. nov. (figure 14)

*Distribution.* Type locality: South Australia (Kangaroo I., Kingscote Jetty on piles, 3–4 m, coll. K. Gowlett Holmes, 3 May 1999, holotype SAM E2919).

*Description.* The soft translucent test is easily torn, and the colonies are grey owing to the black squamous epithelium that surrounds each zooid. Rounded ridges and deep furrows are on the surface of the colony, and white corpuscles in the test are gathered into small clumps that look like patches of spicules. The vast common cloacal cavity surrounds clumps of one to five zooids, each clump connected to the basal test by a single short basal connective. The common cloacal cavity penetrates around the zooids in each clump. Both surface and basal layers of test are thin. Zooids are of the usual form for this genus, with short branchial siphons, short retractor muscles and straight vas deferens. The testis is divided into two follicles.

Embryos are in a pouch projecting from the abdomen into the common cloacal cavity and this pouch remains attached to the abdomen as the larva is incubated. The larval trunk is about 1.1 mm long and the tail extends only halfway
around it. Yellowish white corpuscles are in the larval test (as in the colony test) and are especially crowded in the posterior half of the trunk. Six ectodermal ampullae are on each side of the adhesive organs at the anterior end of the larva and these have conspicuous conical terminal caps of modified epithelial cells. Three crowded thoracic buds are on the left and three abdominal buds on the right. Zooids are in an active vegetative condition at the same time as the larvae are being incubated in the abdominal pouches.

Remarks. The species is like *D. velatum* Kott, 2001, which has unbranched and sometimes relatively short test connectives anchoring clumps of zooids to the basal test. Larvae of *D. velatum* have only three pairs of lateral ampullae on each side of the median adhesive organs (see Kott, 2004: figure 22B), in the same work she recorded four pairs of lateral ampullae, but her description is incorrect. The tropical *Diplosoma translucidum* (Hartmeyer, 1909) also has

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**Fig. 14.** *Diplosoma fecundum* (SAM E2919). (A) Colony surface showing ridges; (B) zooid; (C) larva. Scale bars: 1.0 cm (A); 0.1 mm (B); 0.2 mm (C).
Fig. 15. (A) *Atriolum glauerti* (WAM 141.93); (B) *Leptoclinides aciculus* (QM 308615); (C) *Leptoclinides brandi* (QM G308645); (D) *Leptoclinides cavernosus* (WAM 308.89); (E) *Leptoclinides comitus* (SAM E3223); (F) *Leptoclinides constellatus* (QM G308634); (G) *Leptoclinides decoratus* (SAM E3212); (H) *Leptoclinides levitatus* (QM G308603).
Fig. 16. (A) Leptoclinides maculatus (SAM E2916); (B) Leptoclinides prunus (SAM E2915); (C) Leptoclinides rigidus (WAM 1035.88); (D) Leptoclinides sulawesi (WAM 996.98); (E) Leptoclinides variegatus (SAM E3221); (F) Polysyncraton catillum (WAM 1046.88); (G) Polysyncraton cuculliferum (QM G308616); (H) Polysyncraton dromide (QM G308596).
FIG. 17. (A) *Polysyncraton galaxum* (SAM E2927); (B) *Polysyncraton longitubis* (SAM E2929); (C) *Polysyncraton montanum* (SAM E3224); (D) *Polysyncraton peristroma* (QM G308608); (E) *Polysyncraton pseudomagnetae* (QM G308612); (F) *Polysyncraton pseudorugosum* (QM G308600); (G) *Polysyncraton reticulum* (SAM E2917); (H) *Polysyncraton rica* (SAM E3216).
Fig. 18. (A) Polysyncraton rostrum (QM G398628); (B) Polysyncraton tegetum (SAM E3213); (C) Polysyncraton textus (WAM 556.88); (D) Didemnum albopunctatum (QM G308627); (E) Didemnum candidum (WAM 557.88); (F) Didemnum congregatum (WAM 192.90); (G) Didemnum coralliforme (QM G308629); (H) Didemnum crescente (SAM E3208).
FIG. 19.  (A) Didemnum delectum (SAM E3226); (B) Didemnum granulatum (QM G308601); (C) Didemnum incanum (SAM E3209); (D) Didemnum jucundum (SAM E3201); (E) Didemnum lissoclinum (SAM E2922); (F) Didemnum madeleinae (QM G308630); (G) Didemnum membranaceum (WAM 54.89); (H) Didemnum pecten (SAM E2858).
Fig. 20. (A) Didemnum poecilomorpha (WAM 142.93); (B) Didemnum scopi (WAM 203.93); (C) Didemnum sordidum (WAM 189.93); (D) Didemnum spumante (WAM 194.90); (E) Didemnum tabulatum (WAM 143.93); (F) Didemnum ternerratum (SAM E2920); (G) Didemnum vahatuio (WAM 204.93); (H) Lissoclinum coactum (WAM 1136.89).
FIG. 21. (A) Lissoclinum conchylium (QM G308632); (B) Lissoclinum diversum (WAM 140.93); (C) Lissoclinum durabile (SAM E3218); (D) Lissoclinum levitum (SAM E3219); (E) Lissoclinum ostrearium (SAM E3215); (F) Lissoclinum reginum (QM G308617); (G) Lissoclinum roseum (WAM 882.89); (H) Lissoclinum stellatum (SAM E2926).
similar common cloacal systems and two testis follicles like the present species. However, neither *D. translucidum* nor *D. velatum* has the black squamous epithelial tissue surrounding the zooids in the present species. The most conspicuous distinguishing characters are in the larvae, the present species having significantly more numerous blastozoooids and more lateral ampullae.

*Diplosoma ferrugeum* Kott, 2001 has similar corpuscles in the colonial and larval test as in the present species, and the larvae develop in a similar brood pouch attached to the parental abdomen. However, *D. ferrugeum* larvae have fewer blastozoooids and lateral ampullae than the present species. *Diplosoma listerianum* (Milne Edwards, 1841), which also has black squamous epithelium, is distinguished from the present species by its branched basal test connectives and its larvae.

**Diplosoma ferrugeum** Kott, 2001

*Diplosoma ferrugeum* Kott, 2001: 337 and synonymy.

**Distribution.** Previous records (see Kott, 2001): Western Australia (Montebello Is, Houtman’s Abrolhos), New South Wales (Lord Howe I.), Queensland (Capricorn Group, Swain Reefs, Townsville, Lizard I.), Philippines. New record: Northern Territory (Rocky Reef, Darwin, QM G308663).

**Description.** The colony is the usual encrusting sheet with the characteristic brown-orange grey pattern in life. In preservative black pigment cells are in the test interrupted by white opaque strips and flecks of crowded morula cells that also encapsulate the abdomen. Zooids are covered with black squamous epithelium and are contained in branching sheaths of test that cross the vast common cloacal cavity.

**Remarks.** The morula cells that characterize this species do not dissolve in acid and are not spicules. *Lissoclinium laneum* (see above) has similar bodies in the test.

**Diplosoma translucidum** (Hartmeyer, 1909)

*Leptoclinum translucidum* Hartmeyer, 1909: 1490 nom. nov. for *L. perspicuum* Sluiter, 1909.

*Diplosoma translucidum*: Kott, 2001: 343; 2002c: 43.

**Distribution.** Previously recorded (see Kott, 2001, 2002c): Western Australia (Dampier Archipelago, Cape Ruthiers, Cape Jaubert), Queensland (Hervey Bay, Capricorn Group, Lizard I.), Northern Territory (Darwin); Indonesia, New Caledonia. New record: Northern Territory (East Arm, Old Man Rock, Darwin).

**Description.** Sheet-like investing aspiculate colony encrusting bryozoans. Zooids evenly distributed in clumps at the surface, each clump attached to the basal test by a connective that branches at the top to separate the zooids from one another. In life the colony appears to have been bluish beige, the zoid clumps apparent from the surface surrounded by the bluish colour where the deep common cloacal cavity separates them from one another.
Remarks. The differences between the present species and other Diplosoma spp. are discussed above (see D. fecundum).

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References
BERRILL, N. J., 1955, The Origin of Vertebrates (London: Oxford University Press).
BREWIN, B. I., 1956, Ascidians from the Chatham Is and the Chatham Rise, Transactions and Proceedings of the Royal Society of New Zealand, 84(1), 1–37.
HARTMEYER, R., 1909–11, Ascidien (continuation of work by Seeliger), in H. G. Bronn (ed.) Klassen und Ordnungen des Tierreichs, Vol. 3, supplement, Part 89–98 (Leipzig: C. F. Winter), pp. 1281–1772. (Abstract, repeating lists of species by Schepotieff, A., 1911, in Archives für Naturgeschichte, 6, 3–27).
HASTINGS, A. B., 1931, Tunicata, Scientific Reports of the Great Barrier Reef Expedition 1928–1929, 4(3), 69–109.
HERDMAN, W. A., 1886, Report on the Tunicata collected during the voyage of H.M.S. ‘Challenger’ during the years 1873–76. Pt. II, Ascidiae compositae. Report on the Scientific Results of the Exploring Voyage of H.M.S. ‘Challenger’ During the Years 1875–1876. Zoology, 14(38), 1–425.
HERDMAN, W. A., 1899, Descriptive catalogue of the Tunicata in the Australian Museum, Australian Museum, Sydney, Catalogue, 17, 1–139.
KOTT, P., 1962, The ascidians of Australia III. Aplousobranchiata Lahille: Didemnidae Giard., Australian Journal of Marine and Freshwater Research, 13, 265–334.
KOTT, P., 1972, The ascidians of South Australia II. Eastern sector of the Great Australian Bight and Investigator Strait, Transactions of the Royal Society of South Australia, 96(4), 165–196.
KOTT, P., 1980, Algal-bearing didemnid ascidians in the Indo-West Pacific, Memoirs of the Queensland Museum, 20, 1–47.
KOTT, P., 1985, The Australian Ascidiacea Pt 1, Phlebobranchia and Stolidobranchia, Memoirs of the Queensland Museum, 23, 1–440.
KOTT, P., 1990a, The Australian Ascidiacea Pt 2, Aplousobranchia (1), Memoirs of the Queensland Museum, 29, 1–266.
KOTT, P., 1990b, The Australian Ascidiacea, Phlebobranchia and Stolidobranchia, supplement, Memoirs of the Queensland Museum, 29, 267–298.
KOTT, P., 1992a, The Australian Ascidiacea, Pt 3, Aplousobranchia (2), Memoirs of the Queensland Museum, 32, 377–620.
KOTT, P., 1992b, The Australian Ascidiacea, supplement 2, Memoirs of the Queensland Museum, 32, 621–655.
KOTT, P., 2001, The Australian Ascidiacea Pt 4, Aplousobranchia (3) Didemnidae, Memoirs of the Queensland Museum, 47, 1–407.
KOTT, P., 2002a, Culeolus herdmani Sluiter, 1904 (Asciidiacea, Tunicata) from the
north-western Australian continental slope with an overview of the genus, *Records of the Western Australian Museum*, 21, 63–70.

KOTT, P., 2002b, The genus *Herdmania* Lahille, 1888 (Tunicata) in Australian waters, *Zoological Journal of the Linnean Society*, 134, 359–374.

KOTT, P., 2002c, Asciidiacea (Tunicata) from Darwin, Northern Territory, Australia, *The Beagle, Records of the Museums and Art Galleries of the Northern Territory*, 18, 19–55.

KOTT, P., 2003, New syntheses and new species in the Australian Asciidiacea, *Journal of Natural History*, 37, 1611–1653.

KOTT, P., 2004, New and little-known species of Didemnidae (Asciidiacea, Tunicata) from Australia (part 1), *Journal of Natural History*, 38, 731–774.

KOTT, P., Class Asciidiacea, in D. P. Gordon (ed.) *The Tunicata. The New Zealand Inventory of Biodiversity: A Species 2000 Symposium Review* (Christchurch: Canterbury University Press) (in press).

MICHAELSEN, W., 1930, Ascidiae Krikobranchiae, *Fauna Südwest-Australien*, 5(7), 463–558.

MONNIOT, C. and MONNIOT, F., 1987, Les asciidiens de Polynésie française, *Mémoires du Muséum National d’Histoire naturelle, Paris*, 136, 1–155.

MONNIOT, C., MONNIOT, F. and LABOUTE, C., 1985, Asciidiens du port de Papeete (Polynésie française): relations avec le milieu naturel et apports intercontinentaux par la navigation, *Bulletin du Muséum National d’Histoire Naturelle, Paris, série 4*, A7(3), 481–495.

MONNIOT, C., MONNIOT, F. and LABOUTE, P., 1991, *Coral Reef Asciidiens of New Caledonia* (Paris: Editions de l’Orstom).

MONNIOT, F., 1983, Ascidie littorale de Guadeloupe 1, Didemnidae, *Bulletin du Muséum National d’Histoire Naturelle Paris, série 4*, A1(5), 5–49.

MONNIOT, F., 1993, Asciidiens de Nouvelle-Calédonie XIII. Le genre *Polysyncrato* (Didemnidae), *Bulletin Muséum National d’Histoire Naturelle, Paris, série 4*, 15A(1–4), 3–17.

MONNIOT, F. and MONNIOT, C., 1996, New collections of ascidiens from the western Pacific and southeastern Asia, *Micronesica*, 29, 133–279.

MONNIOT, F. and MONNIOT, C., 2001, Asciidiens from the tropical western Pacific, *Zoosystema*, 23, 201–383.

NOTT, J. T., 1892, On the composite ascidiens of the North Shore Reef, *Transactions of the New Zealand Institute*, 14, 305–348.

SAVIGNY, J. C., 1816, *Mémoires sur les Animaux sans Vertébres*, Part 2 (Paris: G. Dufour), 239 pp.

SLUITER, C. P., 1909, Die Tunicaten der Siboga Expedition Pt. 2. Die merosomen Asciidiien, *Siboga Exped. 56B*, 1–112.

TOKIOKA, T., 1952, Asciidiens collected by Messrs Renzi Wada and Seizi Wada from the Pearl Oyster bed in the Arafura Sea in 1940, *Publications of the Seto Marine Biological Laboratory*, 2, 91–142.

TOKIOKA, T., 1954, Contributions to Japanese ascidian fauna VII. Invertebrate fauna of the intertidal zone of the Tokara Islands. VII Ascidiens, *Publications of the Seto Marine Biological Laboratory*, 3, 239–264.

VASSEUR, P., 1969, Deuxième contribution a l’étude des asciidiens de Madagascar région de Tuléar, *Bulletin du Musèum national d’Histoire naturelle, Paris*, 40, 912–933.