Part 6

Echinoderms of Ashmore Reef and Cartier Island

L.M. Marsh*, L.L. Vail†, A.K. Hoggett† and F.W.E. Rowe‡

Abstract

A total of 178 species of echinoderms is recorded from Ashmore and Cartier Reefs compared with 119 from Scott and Seringapatam Reefs and 90 from the Rowley Shoals.

Background and discussion

There are no published data on the echinoderm fauna of Ashmore and Cartier Reefs but an unpublished report on collections made by the USSR R.V. Bogorov expedition (17-20 October 1978) lists 59 species of Asteroidea, Ophiuroidea, Echinoidea and Holothurioidea, of which voucher specimens were deposited in the Western Australian Museum and identified by the first author and Dr F.W.E. Rowe (Holothurioidea).

The R.V. Bogorov occupied 14 stations at Ashmore Reef, eight in the lagoon, three on the outer reef slope and three intertidal and reef flat stations of which the most productive was the north side of middle reef. The Western Australian Museum (WAM) collections from Ashmore and Cartier Reefs were made from 5 reef flat and 2 sand flat sites, 6 lagoon sites and 11 outer reef slope sites, sampled over 11 days (described in Part 1, Table 1 and Figures 2 and 3). The Northern Territory Museum (NTM) collections were made from 8 reef flat and intertidal rock sites, 2 sand flat sites, 2 lagoon sites and 8 outer reef slope sites, (described in Part 1, Table 2). Some sites were visited on a number of occasions in July 1986, April and September 1987; sampling took place on 37 days in all. Thus the sampling effort at Ashmore Reef by both museum parties totals 48 days compared with 9 days at Scott Reef and 9 days at the Rowley Shoals. It is not surprising therefore that the total number of species recorded is much greater at Ashmore Reef.

A total of 178 species of echinoderms is recorded from Ashmore and Cartier Reefs compared with 119 from Scott and Seringapatam Reefs and 90 from the Rowley Shoals (Marsh 1986).

A numerical comparison of all the species recorded (Table 1) shows that 51% of the species are in common between Ashmore Reef and Scott Reef while 43% are in common between Ashmore Reef and the Rowley Shoals. If species records from single sites are eliminated (Table 2) 61% of species are in common between Ashmore and Scott Reefs and 47% between Ashmore Reef and the Rowley Shoals.

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Table 1. A comparison of the total number of echinoderm species found on three reef groups and the proportion of species in common. Scott/ Seringapatam and Rowley Shoals data from Marsh (1986) and notes in text.

<table>
<thead>
<tr>
<th>Echinoderm</th>
<th>Ashmore Cartier</th>
<th>Scott Seringapatam</th>
<th>Rowley Shoals</th>
<th>In common Ashmore/ Scott</th>
<th>In common Ashmore/ Rowley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crinoidea</td>
<td>38</td>
<td>16</td>
<td>10</td>
<td>13 = 34.2%</td>
<td>8 = 21.1%</td>
</tr>
<tr>
<td>Asteroidea</td>
<td>28</td>
<td>21</td>
<td>17</td>
<td>16 = 57.1%</td>
<td>14 = 50.0%</td>
</tr>
<tr>
<td>Ophiuroidea</td>
<td>42</td>
<td>38</td>
<td>28</td>
<td>26 = 61.9%</td>
<td>22 = 52.4%</td>
</tr>
<tr>
<td>Echinoidea</td>
<td>23</td>
<td>19</td>
<td>14</td>
<td>14 = 60.9%</td>
<td>13 = 56.5%</td>
</tr>
<tr>
<td>Holothurioidea</td>
<td>47</td>
<td>25</td>
<td>21</td>
<td>21 = 44.7%</td>
<td>20 = 42.5%</td>
</tr>
<tr>
<td>Total echinoderms</td>
<td>178</td>
<td>119</td>
<td>90</td>
<td>90 = 50.6%</td>
<td>77 = 43.3%</td>
</tr>
</tbody>
</table>

Table 2. A comparison of echinoderm species between the three reef groups excluding records from single stations.

<table>
<thead>
<tr>
<th>Echinoderm</th>
<th>Ashmore Cartier</th>
<th>Scott Seringapatam</th>
<th>Rowley Shoals</th>
<th>In common Ashmore/ Scott</th>
<th>In common Ashmore/ Rowley</th>
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</thead>
<tbody>
<tr>
<td>Crinoidea</td>
<td>21</td>
<td>11</td>
<td>6</td>
<td>10 = 47.6%</td>
<td>4 = 19.0%</td>
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<td>Asteroidea</td>
<td>17</td>
<td>16</td>
<td>12</td>
<td>14 = 82.4%</td>
<td>11 = 64.7%</td>
</tr>
<tr>
<td>Ophiuroidea</td>
<td>29</td>
<td>26</td>
<td>19</td>
<td>22 = 75.9%</td>
<td>18 = 62.1%</td>
</tr>
<tr>
<td>Echinoidea</td>
<td>16</td>
<td>16</td>
<td>11</td>
<td>13 = 81.3%</td>
<td>10 = 62.5%</td>
</tr>
<tr>
<td>Holothurioidea</td>
<td>33</td>
<td>12</td>
<td>12</td>
<td>12 = 36.4%</td>
<td>12 = 36.4%</td>
</tr>
<tr>
<td>Total echinoderms</td>
<td>116</td>
<td>81</td>
<td>60</td>
<td>71 = 61.2%</td>
<td>55 = 47.4%</td>
</tr>
</tbody>
</table>

The richer echinoderm fauna at Ashmore Reef than at the other offshore atolls can be attributed to three probable factors, apart from the greater sampling effort: firstly, the large areas of sand and seagrass-flats at Ashmore Reef which provide a habitat not found at either Scott Reef or the Rowley Shoals, secondly, the position of Ashmore Reef on the edge of the Sahul Shelf with shallow water connections to the north coast of Australia, the Aru Islands and Papua New Guinea which may provide a route for colonisation by species with demersal larvae. Lastly, the greater proximity of Ashmore Reef to the Indonesian Archipelago must increase the chances of colonisation by species with short pelagic larval stages. Rowe (1985) supports the recognition of two faunal suites in northern Australia, a “reef” suite and a “mainland” suite (Endean 1957) but as Marsh and Marshall (1983) showed the two suites are separated ecologically but often not geographically in north-western Australia. Ashmore Reef is a good example of a reef where “mainland” or continental species occur on the same reef as “reef” species but in separate habitats while Scott Reef and Rowley Shoals have a fauna of "reef" or widely distributed species. Yamaguchi (1977) has shown, for four species studied of Asteroidea, that the continental species have a slightly shorter pelagic larval life although all four species have small eggs and planktotrophic larvae. The main difference is in larval behaviour: the continental species have semi-demersal larvae while the widely distributed
species have surface swimming larvae giving them more chance of wide distribution by ocean currents. However some widely distributed coral reef species such as *Ophidiaster granifer* and *Fromia indica* have lecithotrophic, demersal larvae with abbreviated development (Yamaguchi and Lucas 1984, Marsh 1988, respectively). *O. granifer* is found from Madagascar (WAM specimen) to Samoa and *F. indica* from the Maldive Is to Fiji (Clark and Rowe 1971). No explanation is offered for these anomalies although Yamaguchi and Lucas (1984) showed that larval life of *O. granifer* can be prolonged to 7-10 weeks.

The echinoderm fauna of Ashmore and Cartier Reefs has strong affinities with that of Indonesia and consists of a mixture of continental species with a limited distribution and coral reef species with a wide distribution in the tropical Indo-West Pacific.

**Crinoidea**

The crinoid fauna of Ashmore Reef, with 38 species recorded, is considerably more diverse than that of either Scott Reef (16 species) or the Rowley Shoals (10 species) (Marsh 1986).

The progression of an increasing number of species from the Rowley Shoals to Ashmore Reef is consistent with the opinion expressed by Marsh (1986) that proximity to the rich fauna of the Indonesian archipelago is responsible for the richer crinoid fauna found at Scott Reef than at the Rowley Shoals. Mortensen (1938) has shown that at least some coral reef crinoids have a short larval stage with lecithotrophic demersal larvae which would tend to restrict their distribution to reefs on the continental shelf and make it difficult for them to colonise isolated reefs, rising from relatively deep water, such as Scott Reef and the Rowley Shoals.

A comparison of the crinoid fauna of Ashmore Reef with that of Scott Reef and the Rowley Shoals (Tables 1 and 3), while of limited value because of the short collecting period spent at each reef, nevertheless gives some indication of the fauna in common. Twenty-five of the 38 species found at Ashmore Reef were not found at either Scott Reef or the Rowley Shoals and only 13 and 8 respectively were in common. Only three species (*Comanthus briareus* (Bell, 1882), *Oxycomanthus comanthipinna* (Gislén, 1922) and *Decametra parva* (A.H. Clark, 1912) found at Scott Reef or the Rowley Shoals, were not found at Ashmore or Cartier Reefs.

Habitat differences may account for some variation in species composition as Ashmore Reef lacks the coral rich back reef areas which make up a large part of the lagoon edge reef habitat at Scott Reef and the Rowley Shoals and are the preferred habitat of some species. Most of the Ashmore Reef crinoids were found on the outer slopes with the majority on the protected northern side of the reef (sites 5, 8, 11 and 13), a habitat more similar to that of many Indonesian reefs than the more exposed outer slopes of Scott Reef and the Rowley Shoals.

**Asteroidea**

Twenty-eight species of Asteroidea are recorded from Ashmore and Cartier Reefs, compared with 21 from Scott Reef and 17 from the Rowley Shoals (Marsh 1986).

Sixteen species are in common between Ashmore and Scott Reefs and 14 between Ashmore Reef and the Rowley Shoals (Tables 1 and 3). While some of the differences are probably due to collecting effort most of them appear to reflect differences in habitat and in the geographical position of the reefs.

Five species were found at Scott Reef or the Rowley Shoals but not at Ashmore Reef. Three of these (*Celerina heffernani* (Livingstone, 1931), *Fromia eusticha* Fisher, 1913 and *Euretaster insignis* (Sladen, 1882)) were single specimens and therefore probably chance collections but two (*Ophidiaster cribrialius* Lütken, 1872, and *Disasterina abnormalis* Perrier, 1875) were collected at four sites on Scott Reef and one at the Rowley Shoals. No reason can be suggested for their apparent absence from Ashmore Reef.
The presence at Ashmore Reef of four species of large oreasterids, *Pentaceraster multispinus*, *P. regulus*, *Protoreaster lincki* and *P. nodosus* (found on sand and seagrass flats) reflects both habitat differences and the position of Ashmore Reef on the edge of the Sahul Shelf with a continuous shelf connection to the north coast of Australia and the Aru Islands of Indonesia. *Pentaceraster regulus* and *Protoreaster lincki* have been found on shelf and reef areas (respectively) to the south in Western Australia but *Protoreaster nodosus* is replaced on the north-west coast by *P. nodulosus*, an endemic Western Australian species (Marsh 1976, Marsh and Marshall 1983). Yamaguchi (1977) found that *P. nodosus* has a demersal lecithotrophic larva and is therefore unlikely to be able to colonise isolated reefs separated by deep water.

The occurrence at Ashmore and Cartier Reefs of *Bunaster ritteri* and *Cistina columbiae* are new records for Australia while *Neoferdina cumingi* is a new record for the western half of Australia. *B. ritteri* was previously known only from the Philippines, as *B. lithodes* (Marsh 1991) and Indonesia while *N. cumingi* occurs from Christmas Island in the Indian Ocean to the central Pacific. *C. columbiae* is a very rare but widespread Indo-West Pacific species. *Archaster typicus* is newly recorded for the western half of Australia, it is replaced by *A. angulatus* elsewhere in Western Australia.

The most abundant species, as on most Indo-West Pacific coral reefs, was *Linckia laevigata*. *L. guildingi* was moderately common but *L. multifora* was rare in comparison with Scott Reef and the Rowley Shoals. *Nardoa tuberculata* was much less common than at Scott Reef although represented at a similar number of reef flat sites. *Fromia indica*, *F. milleporella* and *F. monilis* were found at a similar number of sites and appeared to have a similar frequency of occurrence to that at Scott Reef.

**Ophiuroidea**

Forty-two species were collected at Ashmore Reef, compared with 38 from Scott and 28 from the Rowley Shoals (Marsh 1986 and note below). Twenty-six of the species at Ashmore Reef are in common with Scott Reef and 22 with the Rowley Shoals (Tables 1 and 3). As at Scott Reef the most abundant reef flat species were *Ophiomastix annulosa* and *Ophiocoma erinaceus*.

Nine ophiuroid species and two of uncertain identification were found at Scott Reef and/or the Rowley Shoals but not at Ashmore Reef. These are *Astroboa nuda* (Lyman, 1874), *Amphiholis squamata* (Delle Chiaje, 1829), *Macrophiorthrix demessa* (Lyman, 1861), *Ophiorthix (Acanthophiothrix) armata* Koehler, 1905, *Ophiocoma doederleini* de Lorient, 1899, *Ophiomastix variabilis* Koehler, 1905) with the probable synonym *O. palaeoensis* Murakami, 1943, *Ophionereis porrecta* Lyman, 1880, *Ophiarachnella affinis* Lütkem, 1869, *Ophiarachnella snellius* (A.H. Clark, 1964) and *Ophiactis* sp. cf. *maculosa* von Martens, 1870 and *Ophiorthix* sp. cf. *savignyi* (Müller and “Troschel, 1842). It is likely that further collecting will reveal these species at Ashmore Reef as most of them were from single localities. Hoggett (1991) has found specimens of *Macrophiorthrix lorioli* and *M. koehleri* among collections of *M. longipeda* from Scott Reef and the Rowley Shoals. Two new species, *Macrophiorthrix leucosticha* (with type locality Ashmore Reef) and *M. paucispina* were described by Hoggett (1991). *Ophioconis cupida* (recorded by Marsh 1986) is regarded as a junior synonym of *O. cincta* by Rowe, Vail and Hoggett (in prep.).

Habitat differences probably account for some variations in the ophiuroid faunas. For instance *Macrophiorthrix paucispina*, *Ophiarachnella gorgonia*, *Cryptopelta granulifera*, *Ophiolepis superba* and *Ophioplocus imbricatus* probably owe their occurrence at Ashmore Reef to the extensive sandy areas on the reef flats.
Echinoidea

Twenty-three species of Echinoidea were recorded from Ashmore Reef, compared with 19 from Scott Reef and 14 from the Rowley Shoals (Marsh 1986). Of these 14 species were in common between Ashmore Reef and Scott Reef and 13 between Ashmore Reef and the Rowley Shoals (Tables 1 and 3).

The following five species of echinoid were recorded from Scott Reef but not from Ashmore Reef or the Rowley Shoals: *Diadema setosum* (Leske, 1778), *Parasalenia gratiosa* A. Agassiz, 1863, *Fibularia ovulum* Lamarck, 1816, *F. volva* L. Agassiz, 1846 and *Schizaster* sp.; *Peronella orbicularis* (Leske, 1778) was recorded from the Rowley Shoals but not from Ashmore or Scott Reefs. Further collecting at Ashmore Reef may yet reveal these species.

As would be expected from the extensive areas of sand habitat at Ashmore Reef heart urchins are abundant around the sand cays and islets. The most common were *Breynia australasiae*, *Echinolampas ovata* and *Metalia spatagus*, less common were *Brissus latecarinatus* and *Metalia dicrana* while *M. sternalis* and *Rhynobrissus tumulus* were rare.

*Prionocidaris verticillata* and *Metalia sternalis* are new records for the western half of Australia.

On the reef flats, the large diadematid echinoids *Echinothrix calamaris* and *E. diadema* were common but the genus *Diadema* was represented only by *D. savignyi*, most of which were juveniles.

Holothurioidea

Ashmore Reef has an exceptionally diverse holothurian fauna with 47 species recorded compared with 25 for Scott Reef and 21 for the Rowley Shoals (Marsh 1986). Only 21 species are in common with Scott Reef and 20 with the Rowley Shoals (Tables 1 and 3).

The following four species of holothurians were found at Scott Reef but not at the Rowley Shoals or Ashmore Reef: *Pentacta lutea* (Sluiter, 1901), *Cladolabes acicula* (Semper, 1868), *Labidodemas pertinax* (Ludwig, 1875) and *Holothuria (Stauropora) olivacea* (Ludwig, 1888); *Holothuria (Thymiosycia) remollescens* Lampert, 1885 was found at the Rowley Shoals but not at Scott or Ashmore Reefs. All these species were collected from single sites and no significance is attached to their apparent absence from Ashmore Reef. Despite the high diversity of holothurian species many are uncommon and 17 species are recorded only from one station.

The preferred beche-de-mer species i.e. *H. (Microthele)* spp. and *Thelephota ananas* are quite rare, whereas at the Rowley Shoals, where there is no fishing pressure on these species, they are very common in back reef areas.

Acknowledgements

Financial support for the fieldwork from the Australian Museum is gratefully acknowledged.

References


List of Echinoderms

Key to symbols
Numbers = W.A. Museum sampling stations (See Part 1, Figures 2 and 3 and Table 1)
B = R.V. Bogorov collection
C = Cartier I. stations
N = N.T. Museum sampling stations (See Part 1, Table 2)
V = Visual record
+ = Present

<table>
<thead>
<tr>
<th>Ashmore Reef/ Cartier I.</th>
<th>Scott/ Seringapatam</th>
<th>Rowley Shoals</th>
</tr>
</thead>
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<tr>
<td>Crinoidea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMASTERIDAE</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Capilla</em>aster <em>multiradiatus</em> (Linnaeus, 1758)</td>
<td>11,N2</td>
<td>-</td>
</tr>
<tr>
<td><em>C. seniosus</em> (Carpenter, 1888)</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
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</tr>
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<td>+</td>
</tr>
<tr>
<td><em>Oxycomanthus bennetti</em> (Müller, 1841)</td>
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<tr>
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<td>+</td>
</tr>
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<td><em>Comaster multifidus</em> (Müller, 1841)</td>
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58
<table>
<thead>
<tr>
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</tr>
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<td><strong>HIMEROMETRIDA</strong></td>
<td><strong>HIMEROMETRIDA</strong></td>
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<td>-</td>
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<td>-</td>
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</tr>
<tr>
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<td>-</td>
</tr>
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<td>-</td>
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<td><strong>ARCHASTERIDAE</strong></td>
<td><strong>ARCHASTERIDAE</strong></td>
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<td><strong>OREASTERIDAE</strong></td>
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<td><em>P. regulus</em> (Müller and Troschel, 1842)</td>
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<td><em>Protoreaster lincki</em> (de Blainville, 1834)</td>
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<td>Cistina colombiae Gray, 1840</td>
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<td>Dactylosaster cylindricus (Lamarck, 1816)</td>
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<td>F. monilis Perrier, 1875</td>
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<td>Linckia guildingi Gray, 1840</td>
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<td><strong>Ophiocoma anaglyptica</strong> Ely, 1944</td>
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<td><strong>O. pusilla</strong> (Brock, 1888)</td>
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<td><strong>Ophiomastix annulosa</strong> (Lamarck, 1816)</td>
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<td><em>O. delicata</em> (H.L. Clark, 1932)</td>
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<td><em>O. septemspinosa</em> (Müller and Troeschel, 1842)</td>
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<td><em>Ophiocarpa hirsuta</em> Lütken, 1869</td>
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<td><em>Ophioprosa spinosa</em> (Ljungman, 1867)</td>
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<td><em>Ophiocithara cinata</em> Brock, 1888</td>
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<td><em>Cryptopelta granulifera</em> H.L. Clark, 1909</td>
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<td><em>Ophioplocus imbricatus</em> (Müller and Troeschel, 1842)</td>
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<td><em>Temnopleurus alexandri</em> (Bell, 1884)</td>
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<td>B. graeffei</td>
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<td>Labidodemas semperianum</td>
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<td>Holothuria (Acanthotrapeza) coluber</td>
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### Echinoderms

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<th>Rowley Shoals</th>
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<td><strong>H. (Cystipus) inhabilis</strong> Selenka, 1867</td>
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<td><strong>H. (Halodeima) atra</strong> Jaeger, 1833</td>
<td>1V,2,3,8,10V, 14V,16V,B,N1, N2,N3,N4V,N7V, N8,N10V,C2</td>
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<td><strong>H. (H.) edulis</strong> Lesson, 1830</td>
<td>6,8,B,N1,N2, N5,N7V,N9V</td>
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<td><strong>H. (Lessonothuria) lineata</strong> Ludwig, 1875</td>
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<td><strong>H. (L.) pardalis</strong> Selenka, 1867</td>
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<td><strong>H. (Mertensiosthuria) leucospilota</strong> (Brandt, 1835)</td>
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<td><strong>H. (M.) fusco-rubra</strong> Theel, 1886</td>
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<td><strong>H. (Metriotyla) scabra</strong> Jaeger, 1833</td>
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<td><strong>H. (M.) acauleata</strong> Semper, 1868</td>
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<td><strong>H. (Platyperona) difficilis</strong> Semper, 1868</td>
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<td><strong>H. (S.) pervicax</strong> Selenka, 1867</td>
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### STICHOPODIDAE

*Stichopus chloronotus* Brandt, 1835 | 3,6,10V,18V,B, N3,N5,N7,N8,C2 | + | + |

*S. horrens* Selenka, 1867 | 16,B | + | + |

*S. hermanni* Semper, 1868 | 3,14,18,N2,N3, N4,N8,C2 | - | - |

*S. monotuberculatus* (Quoy & Gaimard, 1833) | 18,B,N3,N8,C2 | + | + |

*S. naso* Semper, 1868 | N3 | + | + |

*Thelenota ananas* (Jaeger, 1833) | 9V,B,N1V,N2, N7V,N8 | + | + |

*T. anax* H.L. Clark, 1921 | 18,B,N1,N2, N5,N7 | - | + |

### CUCUMARIDAE

*Havelockia versicolor* (Semper, 1868) | + | - | - |

### PHYLLOPHORIDAE

*Afrocucumis africana* (Semper, 1868) | N3 | - | - |

### SYNAPTIDAE

*Euapta godeffroyi* (Semper, 1868) | 1,16,B,N1 | + | - |

*Opheodesoma grisea* (Semper, 1868) | N2,N3,N4 | - | - |
<table>
<thead>
<tr>
<th></th>
<th>Ashmore Reef/ Cartier I.</th>
<th>Scott/ Seringapatam</th>
<th>Rowley Shoals</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>O. lineata</em> Heding, 1928</td>
<td>N3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Polyplectana kefersteini</em> (Selenka, 1867)</td>
<td>N17</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Synapta maculata</em> (Chamisso and Eysenhardt, 1821)</td>
<td>3,B,N1,N2,N3</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Synaptula recta</em> (Semper, 1868)</td>
<td>N3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**CHIRIDOTIDAE**

<table>
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<tr>
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<th>Scott/ Seringapatam</th>
<th>Rowley Shoals</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Chiridota rigida</em> Semper, 1868</td>
<td>N1,N7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>C. stuhlmanni</em> Lampert, 1896</td>
<td>16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><em>Trochodota maculata</em> H.L. Clark, 1921</td>
<td>N1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>