

ECHINODERMS OF CHRISTMAS ISLAND

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The first echinoderms collected from Christmas Island were eight specimens of four species taken by H.M.S. 'Flying Fish' in 1887. These were briefly recorded by Bell (1887) but the identity of several of the species listed is questionable; a crinoid from this collection was later described, with type locality Christmas Island, by A.H. Clark (1911). Andrews (1900) added six species, identified by Bell, to the previous list but again several identifications are questionable.

No further collections were made until the 1930s when Tweedie collected about 30 specimens of 13 species from Flying Fish Cove and the reef at Little Ann Beach. The collection, deposited in the Raffles Museum, Singapore, was identified by Mortensen (Echinoidea and Ophiuroidea) and Fisher (Asteroidea and Crinoidea) but the only directly resulting publication was that of Fisher (1934). Gibson-Hill, while medical officer on the island (1938-1940), made additional collections of echinoderms but added only one species to Tweedie's unpublished list. The combined collections were reported on by Gibson-Hill (1947), publication having been delayed by World War II. Gibson-Hill (1947) listed 12 species, excluding holothurians, of which he estimated that about four species were present.

The published records are indicated in Table 7 by the author's initial, and localities, if given, are converted to the Western Australian Museum 1987 station numbers.

In September 1969 a Western Australian Museum Expedition to Christmas Island (S. Slack-Smith and A. Paterson) made extensive invertebrate collections, including echinoderms, from the intertidal and shallow sub-tidal areas. Additional species of Asteroidea were collected by G.R. Allen in 1978 from the deeper reef slopes. These records are included in Table 7 with localities converted to the Western Australian Museum 1987 station numbers.

Crinoidea

The crinoid fauna of the island is very depauperate both in numbers of individuals and of species (6) compared with 26 at Ashmore Reef (Marsh *et al.*, 1993), 16 at Scott Reef and 10 at the Rowley Shoals off north-western Australia (Marsh, 1986).

Four species are new records for the island. The large comasterid *Oxycomanthus bennetti*, which clings to the top of pinnacles where there is a good flow of water, is the only conspicuous crinoid at Christmas Island. The other species tend to be cryptic during the day.

Crinoids have a short larval life (Mortensen, 1938) and relatively few coral reef associated species are widely distributed in the Pacific and Indian Oceans. The isolation of Christmas Island, its small size and limited coral reef habitat, including lack of a lagoon, combined with the short larval life of crinoids would be sufficient to explain the limited number of species found.

Asteroidea

The asteroid fauna of 14 species is also very impoverished, even more so if one discounts several species of very sporadic occurrence (eg. *Culcita novaeguineae*, *Asteropsis carinifera*, *Mithrodia clavigera* and the usually abundant *Linckia laevigata*) which do not appear to have established breeding populations on the island. One species recorded from the literature is not included in the tally since it probably represents a species already listed. Seven species are new records for the island. For comparison 22 species are recorded from Ashmore Reef (Marsh *et al.*, 1993), 21 at Scott Reef and 17 at the Rowley Shoals (Marsh, 1986).

The most common species is *Linckia multifora*, a small starfish which reproduces asexually by autotomy. The only other species found at many collecting sites is *Gomophia watsoni*, usually found buried deep in coral rubble; because of its cryptic habit it may be much more common than the records suggest. Like its congener (*Gomophia egyptiaca*) it probably has an abbreviated larval stage with lecithotrophic development (Yamaguchi, 1974) so that once having colonised an isolated island the larvae are less likely to be lost from the island than those of species with planktotrophic larvae. *G. watsoni* was reported from Christmas Island by A.M. Clark (1967) as *G. egyptiaca egyptiaca*.

During the 1987 survey the Crown-of-thorns Starfish, *Acanthaster planci*, was only seen at one locality, where two specimens were recorded.

Ophiuroidea

Twenty nine species of brittle stars are now recorded from Christmas Island; of these 21 species are new records while a further two species are of uncertain identity. Most of the new records are of small and/or cryptic species obtained from the interstices of coral, sponges and algae.

In contrast to the asteroids and crinoids, the brittle star fauna is moderately rich when compared with 31 species from Ashmore Reef (Marsh *et al.*, 1993), 36 from Scott Reef and 28 from the Rowley Shoals (Marsh, 1986), obtained by similar collecting effort.

As on most coral reefs the large *Ophiocoma* species are the most conspicuous brittlestars: *O. scolopendrina* inhabiting crevices of intertidal platforms and *O. erinaceus* among living and dead coral and under boulders. An interesting record is that of *Ophiocoma anaglyptica*, recorded from north-western Australia, Cocos (Keeling) Islands, Christmas Island and Indonesia by Marsh (1986). This species was previously thought to be confined to the Pacific (Clark and Rowe, 1971).

Echinoidea

Eighteen species of sea urchins are here recorded from Christmas Island including 11 new records and two additional species of uncertain identity. This compares with 22 species from Ashmore Reef (Marsh *et al.*, 1993), 19 from Scott Reef and 14 from the Rowley Shoals (Marsh, 1986).

Lagoonal sand-dwelling sand dollars are absent and heart urchins are represented by a single spatangoid, due to the lack of suitable habitats.

In addition to the usual coral reef diadematids two specimens of a very rare small species, *Lissodiadema lorioli*, were found. This species was previously recorded from a single specimen collected in the Moluccas (Mortensen, 1940) but is also known to occur in Hawaii (Marsh, unpubl. data).

On the exposed shorelines particularly on the east and west coast of the island, two Indo-Pacific species characteristic of the surf zone occur: these are the limpet-like urchin *Colobocentrotus atratus* and the long-spined *Heterocentrotus trigonarius*. Neither of these species has been recorded from north-western Australian reefs.

As on the offshore reefs in northwestern Australia, the usually common species *Tripneustes gratilla* was rarely found while *Diadema setosum*, uncommon on offshore reefs in Western Australia, was not found at Christmas Island.

Echinometra mathaei, as on most coral reefs, is the most common species while *Diadema savignyi*, *Echinothrix* spp. and the small burrowing urchin *Echinostrephus molaris* are also common.

Holothuroidea

Holothurians are represented at Christmas Island by 20 species, of which 15 were found during the 1987 survey. In contrast Ashmore Reef has a rich holothurian fauna with 34 species (Marsh *et al.*, 1993), while 25 were recorded at Scott Reef and 21 at the Rowley Shoals (Marsh, 1986).

The fauna includes only three species (*Actinopyga miliaris*, *A. mauritiana* and *Thelenota ananas*) fished in other areas for Trepanng (Bêche-de-Mer). Two of these species were uncommon while the third was not found, possibly due to human predation.

Most of the holothurian species collected were small and cryptic in habitat.

Conclusion

Overall the echinoderm fauna of Christmas Island consists of widespread Indo-West Pacific and some more restricted Indo-Malayan coral reef species with many interesting new records but no endemic species. A total of 67 species of echinoderms are now known from the island compared with 135 from Ashmore Reef (Marsh *et al.*, 1993), 117 from Scott Reef and 90 from the Rowley Shoals (Marsh, 1986).

The limited fauna can be attributed to the small size of the island, its isolation from sources of planktonic larvae, and lack of habitat diversity. Species with pelagic larvae would have difficulty in maintaining populations as the larvae would be likely to be swept away from the island by ocean currents. Hence, species with the ability to reproduce asexually (e.g. *Linckia multifora*) or with demersal larvae (e.g. *Gomophia watsoni*) would have an advantage once they became established.

While the present list of echinoderms is probably not complete it undoubtedly includes the majority of species that occur on Christmas Island.

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Table 7 List of Echinoderms

Key to Symbols

Numbers = sampling stations (see Part I, Fig. 1 and Table 2)

- o = New record for Christmas Island A = Andrews 1900
 V = Visual record B = Bell 1887
 i = intertidal C = A.H. Clark 1911
 s = shallow (0-9 m) F = Fisher 1934
 d = deep (10-40 m) G = Gibson-Hill 1947

Previous Western Australian Museum (WAM) collections were made by Car 1961, Slack-Smith 1969 and Allen 1978.

	Published records	Previous WAM collections	WAM 1987
Crinoidea			
COMASTERIDAE			
o <i>Oxycomanthus bennetti</i> (Müller, 1841)	-	-	1,2s,11d
<i>Alloeocomatella pectinifera</i> (A.H. Clark, 1911)	C1	-	-
<i>Alloeocomatella</i> (juv.)	-	-	9
MARIAMETRIDAE			
<i>Lamprometra palmata</i> (Müller, 1841)	G1	-	1d,12,14s
o <i>Stephanometra indica</i> (Smith, 1876)	-	-	1s,d,9d
o <i>S. oxyacantha</i> (Hartlaub, 1890)	-	-	12
ANTEDONIDAE			
o <i>Antedon</i> sp.	-	-	5s,9,12,15d
Asteroidea			
OREASTERIDAE			
o <i>Culcita novaeguineae</i> Müller and Troschel, 1842	-	-	1s
ASTEROPSEIDAE			
o <i>Asteropsis carinifera</i> (Lamarck, 1816)	-	1s	-
OPHIDIASTERIDAE			
o <i>Celerina heffernani</i> (Livingstone, 1931)	-	1d,13d	1s,2d,5s,15d
<i>Gomophia watsoni</i> (Livingstone, 1936)	-	1s,6s,11s	2d,5s,d,9dv,10s,12d,15d
o <i>G. egeriae</i> A.M. Clark, 1967	-	1d	-
<i>Linckia guildingi</i> Gray, 1840	A1,B	-	-
<i>L. laevigata</i> (Linnaeus, 1758)	A1	1s	-
<i>L. multifora</i> (Lamarck, 1816)	G1,3	1s,11s,14s	1s,d,2d,3s,5d,9,11s,d,12v
<i>Nardoa tuberculata</i> Gray, 1840	A1	-	-
<i>Neoferdina cumingi</i> (Gray, 1840)	F1s, G1	-	2d,5s,15d
<i>Ophiaster hemprichi</i> Müller and Troschel, 1842	G1	1s,11s,14s,15s	-
<i>Ophiaster</i> sp.	A	-	-
MITHRODIIDAE			
o <i>Mithrodia clavigera</i> (Lamarck, 1816)	-	-	5s

Table 7 (cont.)

	Published records	Previous WAM collections	WAM 1987
ASTERINIDAE			
o <i>Asterina anomala</i> H.L. Clark, 1921	-	1,10i	3i,4,9d
ACANTHASTERIDAE			
o <i>Acanthaster planci</i> (Linnaeus, 1758)	-	-	2v
Ophiuroidea			
OPHIOMYXIDAE			
o <i>Ophiomyxa australis</i> Lütken, 1869	-	-	14s
AMPHIURIDAE			
o <i>Amphipholis squamata</i> (Delle Chiaje, 1828)	-	-	12,13s
OPHIACTIDAE			
o <i>Ophiactis hexacantha</i> H.L. Clark 1939	-	-	2d,5d,12s,15d
o <i>O. savignyi</i> (Müller and Troschel, 1842)	-	-	1s,2d,5s,9,10,11, 12s,d,14S,15d
o <i>Ophiactis hemiteles</i> H.L. Clark, 1915	-	-	12d,15d
o <i>Ophiactis</i> sp.	-	-	1s,2,12s,14s
OPHIOTRICHIDAE			
o <i>Macrophiothrix longipeda</i> (Lamarck, 1816)	-	1s	1s,5s,d,9d,11sv,12v,14s,15d
o <i>M. propinqua</i> (Lyman, 1861)	-	-	1,2,5d,9d,11,12,15d
o <i>Ophiiothrix (Acanthophiothrix) purpurea</i> von Martens, 1867	-	-	2d,11
o <i>Ophiopteron elegans</i> Ludwig, 1888	-	-	5s
o <i>Ophiiothela danae</i> Verrill 1869	-	-	12s
OPHIOCOMIDAE			
o <i>Ophiarthrum elegans</i> Peters, 1851	-	-	15s,12d
o <i>Ophiocoma anaglyptica</i> Ely, 1944	-	1s,4i,15i	-
o <i>O. brevipes</i> Peters, 1851	-	-	15d
o <i>O. dentata</i> Müller & Troschel, 1842	-	1s,3i,5i	3s,5s,9d
o <i>O. erinaceus</i> Müller & Troschel, 1842	G	1s	1s,2d,3sv,9d,11,12d,14
o <i>O. pica</i> Müller & Troschel, 1842	-	-	5d,9d
o <i>O. pusilla</i> (Brock, 1888)	-	-	2d,5s,11,12s,13s,15d
o <i>Ophiocoma</i> sp.	B,A	-	-
o <i>O. scolopendrina</i> (Lamarck, 1816)	B,A,G	1s,4i,10i,14i	3i,13iv
o <i>Ophiocomella sexradia</i> (Duncan, 1887)	-	-	1s,2d,15d
o <i>Ophiomastix annulosa</i> (Lamarck, 1816)	G1	1s	1v,3sv,5s,11
o <i>Ophiomastix</i> sp. cf. <i>variabilis</i> Koehler, 1905 (juv.)	-	-	12s
OPHIONEREIDIDAE			
o <i>Ophionereis porrecta</i> Lyman, 1860	-	-	1s,9,11d,12d
OPHIODERMATIDAE			
o <i>Ophiarachna affinis</i> Lütken, 1869	-	-	9s,12d
o <i>Ophiarachnella paucigranula</i> H.L. Clark, 1938	-	11s	1s,11,12d
o <i>O. septemspinosa</i> (Müller and Troschel, 1842)	-	-	3s,15d
o <i>Ophiopeza</i> sp. (juv.)	-	-	12s
o <i>Ophioconis cincta</i> Brock, 1888	-	-	2d,15d
o <i>Ophiochaeta hirsuta</i> Lütken, 1869	-	-	1s,5s,15d
OPHIURIDAE			
o <i>Ophioplocus imbricatus</i> (Müller & Troschel, 1842)	G1,3	1s,5s	-
Echinoidea			
CIDARIDAE			
o <i>Eucidaris metularia</i> (Lamarck, 1816)	-	-	1,2d,4,9d,11d
o <i>Prionocidaris baculosa</i> (Lamarck, 1816)	-	4i	-
DIADEMATIDAE			
o <i>Diadema savignyi</i> (Michelin, 1845)	A?	1s,4i	1s,4v
o <i>Echinothrix calamaris</i> (Pallas, 1774)	-	1s	1,4v
o <i>E. diadema</i> (Linnaeus, 1758)	G1,4	1s,4i	1v,5s
o <i>Lissodiadema lorioli</i> Mortensen, 1903	-	-	1s,9d

Table 7 (cont.)

	Published records	Previous WAM collections	WAM 1987
STOMOPNEUSTIDAE			
o <i>Stomopneustes variolaris</i> (Lamarck, 1816)	-	3i,4i,10i,15i	4iv
TEMNOPLEURIDAE			
o <i>Mespilia globulus</i> (Linnaeus, 1758)	-	-	1s
o <i>Temnotrema</i> sp.	-	-	2d
TOXOPNEUSTIDAE			
o <i>Tripneustes gratilla</i> (Linnaeus, 1758)	-	1s	1s
PARASALENIIDAE			
o <i>Parasalenia gratiosa</i> A. Agassiz, 1863	-	+	-
ECHINOMETRIDAE			
<i>Echinometra mathaei</i> (de Blainville, 1825)	A,G	1s,3i,4i,10i,15i	1,3,4
<i>Colobocentrotus atratus</i> (Linnaeus, 1758)	A,G	3i,4i,10i,15i	4iv,10iv
o <i>Echinostrephus molaris</i> (de Blainville, 1825)	-	-	1s,5sv,11sv,12s
<i>Heterocentrotus mammillatus</i> (Linnaeus, 1758)	G	-	-
o <i>H. trigonarius</i> (Lamarck, 1816)	-	4i,10i,15i	1s
ECHINONEIDAE			
o <i>Echinoneus cyclostomus</i> Leske, 1778	-	-	3s,4,9d,11
BRISSIDAE			
o <i>Metalia</i> sp. cf. <i>spatagus</i> (Linnaeus, 1758)	-	-	1s,5s
Holothuroidea			
HOLOTHURIIDAE			
<i>Actinopyga mauritiana</i> (Quoy and Gaimard, 1833)	-	1s,5s,6s	1v,3s,4v,6,13s
<i>A. miliaris</i> (Quoy and Gaimard, 1833)	B,A	-	-
<i>Pearsonothuria graeffei</i> (Semper, 1868)	-	-	2s,d,13s
<i>Holothuria</i> (<i>Halodeima</i>) <i>atra</i> Jaeger, 1833	-	15	1s,4s
<i>H. (Mertensiothuria) leucospilota</i> (Brandt, 1835)	-	+	-
<i>H. (Platyperona) difficilis</i> Semper, 1868	-	-	4s
cf. <i>H. (Stauropora) pervicax</i> Selenka, 1867	-	-	6
<i>H. (Stauropora)</i> sp.	-	-	9,15d
<i>H. (Semperothuria) cinerascens</i> (Brandt, 1835)	-	5	-
<i>H. (Thymiosycia) hilla</i> Lesson, 1830	-	-	6,15
<i>H. (Thymiosycia) impatiens</i> (Forskål, 1775)	-	-	1d,15d
<i>H. (Thymiosycia)</i> sp.	-	-	12d
<i>H. (Theelothuria)</i> sp. 1	-	-	9
<i>H. (Theelothuria)</i> sp. 2	-	-	6
<i>Labidodemas semperianum</i> Selenka, 1867	-	-	5s,11s
<i>Bohadschia argus</i> (Jaeger, 1833)	-	+	-
STICHOPODIDAE			
<i>Thelenota ananas</i> (Jaeger, 1833)	-	1	1d,9d
SYNAPTIDAE			
<i>Euapta godeffroyi</i> (Semper, 1868)	-	-	3s,13s
<i>Synapta maculata</i> (Chamisso and Eysenhardt, 1821)	-	-	1d
CHIRIDOTIDAE			
<i>Polycheira rufescens</i> (Brandt, 1835)	-	1	-