

Echinodermata (Asteroidea, Echinoidea and Holothuroidea) of Mermaid (Rowley Shoals), Scott and Seringapatam Reefs, Western Australia.

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Abstract – A survey documenting the diversity and indicative abundance of targeted echinoderms (asteroids, echinoids and holothurians) at Mermaid, Scott and Seringapatam Reefs was conducted in September 2006. Due to logistical constraints species were counted along a single transect furnishing limited scope for statistical analysis. Echinoderms (including some ophiuroids) were collected opportunistically at each station. Fourteen species of echinoderm were collected from the NW atolls for the first time (five species of Asteroidea including a possible new species, six Ophiuroidea and three Echinoidea). Voucher specimens of all but the commonest species have been lodged with the Western Australian Museum. The echinoderm fauna of Scott Reef, particularly North Scott Reef, has declined in abundance and species richness since the surveys of the 1980s. This may have been influenced by a significant coral bleaching event in 1998 and subsequent scouring by cyclonic activity. Fishing pressure at South and North Scott Reefs (but not Mermaid Reef) by Indonesian fishers has also had a drastic effect on holothurian populations to the point where oligospermy will be a serious factor.

INTRODUCTION:

In 1986, the Western Australian Museum (WA Museum) published the results of its surveys of the Rowley Shoals, Scott and Seringapatam Reefs (Berry, 1986). Included were the results of the first survey of the echinoderms (Marsh, 1986). There have been no formal biodiversity surveys since that time. Several agencies, including the Australian Institute of Marine Science (AIMS) (Rees *et al.*, 2003) and the Commonwealth Scientific and Industrial Organisation (CSIRO) (Skewes *et al.*, 1999) have undertaken marine resource evaluations, including holothurians (Smith *et al.*, 2005). The WA Museum also undertook a contract rapid assessment survey of the marine resources (including holothurians) of Scott Reef and Seringapatam Reefs and Browse Island in February 2006 (Bryce, 2006). All of these surveys were related to fishing pressure and general stock assessments and did not investigate other echinoderm groups.

Here we report in detail the echinoderms recorded during the 2006 WA Museum survey of Mermaid (Rowley Shoals), Scott and Seringapatam Reefs off the north coast of Western Australia. The information in this paper supersedes that provided in the 2006 unpublished preliminary report (Bryce and Marsh, 2006) of the same survey.

METHODOLOGY

(see Station and Transect Data in this volume)

The echinoderm species were recorded, individuals counted and representatives collected from a single transect, which was one of the two mollusc transects at each station. Additional species were also collected generally from the station area. Due to logistical constraints and lack of time in the field the Ophiuroidea were only collected opportunistically and crinoids were omitted from the survey.

The methodology adopted recorded echinoderm diversity with an indication of abundance. The method (described in detail below) varied dependent on whether the station was located on the outer reef slope, in the lagoon or on the reef platform.

A single transect was swum at all stations, except for reef platform stations and the channel drifts. Extra echinoderm records were made throughout the transect swim to increase the biodiversity list; this was accomplished by opportunistic investigations of the areas adjacent to the transect. The diver would periodically mark his current transect position and then explore habitats and features adjacent to the transect. Further investigations were undertaken by a general swim around the station once the transect had been completed. This ensured all depths and

Table 1 Number of stations sampled for Echinoderms - 1986 and 2006

	Clerke	Mermaid	Sth Scott	Nth Scott	Seringapatam
1986 Report	20	2	12	11	2
2006 Report		16	14	10	5

habitats were represented in the biodiversity list while maximising dive time and completing the transect. The time at each station was limited to approximately one hour of effort, which varied depending on the complexity of the topography, transect length and habitat types encountered.

Outer slope stations:

A single transect, one metre wide, was swum up-slope from a depth of 20 m to reef crest at 3 to 4 m. The transect was determined at the surface by lining up the 20 m station buoy with the two shallower buoys marking the replicated transects of the coral, sponge and crustacean researchers. A transect bearing using an underwater compass was used to keep the diver on course.

As many echinoderms are cryptic, rocks and coral slabs, when abundant, were turned at 20, 15, 10 and 5 m depth increments along the transect. Where rocks and slabs were few all encountered were turned and investigated. Small sand patches occurring intermittently were raked for echinoid species; larger sand plains were sub-sampled

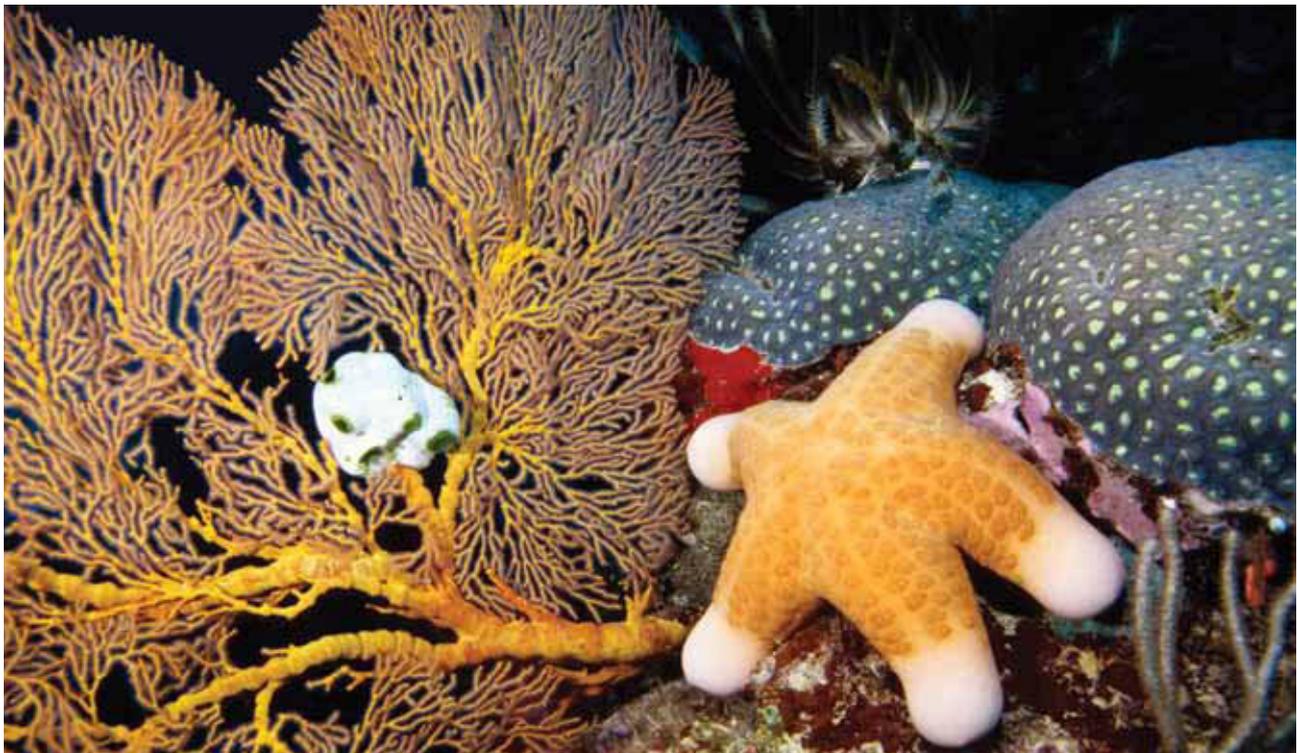
by raking a series of one metre squares at every alternate meter along the transect line. Small hand rakes were used for this purpose.

Lagoon Stations:

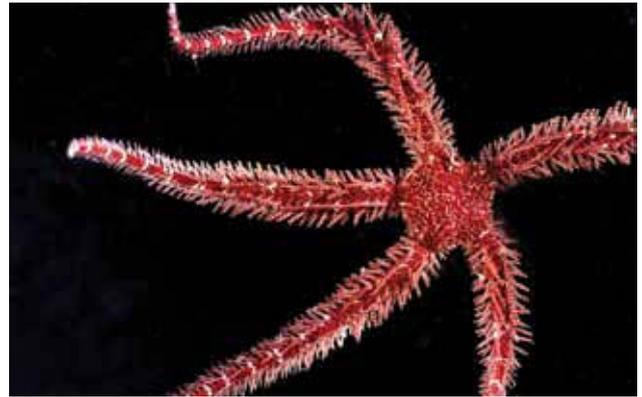
All lagoon stations were centred on coral outcrops or reef edges to maximise habitat diversity. The methodology for these stations differed little from the outer slope stations, except for instances where the required 20 m starting depth was unobtainable. In these instances, the transect was defined by the distance between the buoys marking the shallow and deep transect series of the coral, sponge and crustacean divers. In this way, the transect ran from deepest to shallowest point and perpendicular to the other transects.

Platform Stations:

Platform habitats have several zones – outer edge, platform centre and lagoonal edge – and these can be more than a kilometre apart. As such, this macro-habitat was treated as a biodiversity site with no attempt to quantify the echinoderms found.



Above: *Choriaster granulatus* Lütken, 1869 (Photo: Clay Bryce)



Left: *Echinaster luzonicus* (Gray, 1840); **Right:** *Ophiomastix annulosa* (Lamarck, 1816) (Photos: Clay Bryce)

Channel Drifts:

The channel drifts, like the platform stations were qualitative only.

Voucher specimens of unknown and noteworthy species were collected, identified at the WA Museum, registered and retained for the collections of the WA Museum.

RESULTS

Results are presented in such a way as to enable comparison with the earlier WA Museum survey (Berry, 1986; Marsh, 1986). However, a direct comparison in a quantitative sense is problematical as the methodology and effort between the surveys differ.

52 echinoderm species from the classes Asterozoa, Echinozoa and Holothurozoa were recorded during the present survey (2006), which is 71% of the species from the same classes recorded by Marsh (1986). Table 1 highlights the differences in the number of stations surveyed between the 2006 report and corresponding reefs from the 1986 publication data. The difference in effort and collection opportunity portrayed in Table 1 is reflected by the variability within and between the reefs for the two survey periods.

However, combining the number of stations for each reef system (Figure 1) a clearer indication of collecting effort can be determined. For example, 20 sampling stations were recorded in the data published in 1986 for Clerke Reef (Rowley Shoals). When this is added to the two stations at Mermaid

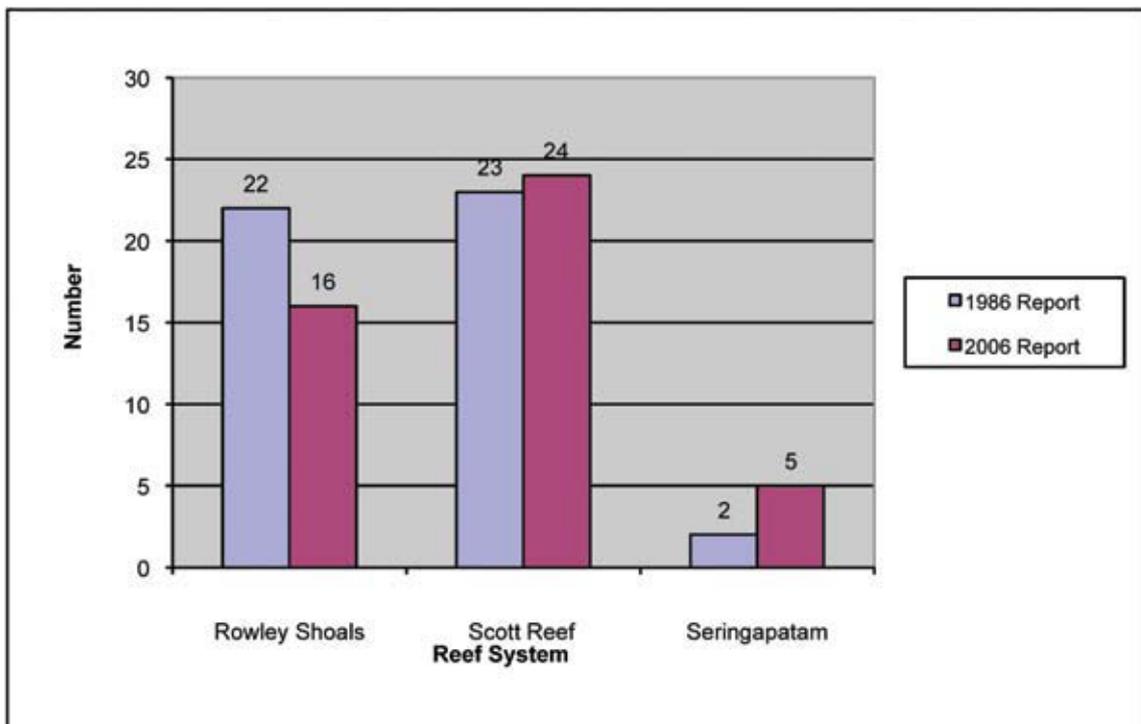
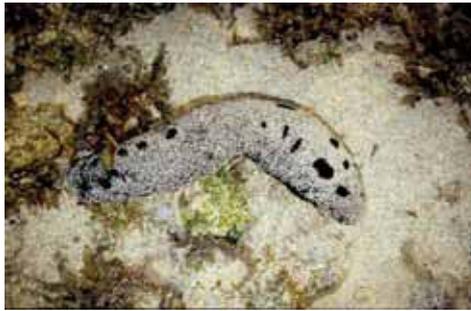


Figure 1 Station comparison between systems for 1986 and 2006 reports



Clockwise From Top Left: *Holothuria atra* Jaeger, 1833; *Holothuria edulis* lesson, 1830; *Holothuria whitmaei* (Selenka, 1867); *Holothuria fuscogilva* Chertonnier, 1980. (Photos: Clay Bryce)

Reef (Rowley Shoals), the only other reef sampled, and then compared to the 16 Mermaid Reef stations from the 2006 survey a more meaningful coverage of collecting opportunity is observed. A station breakdown of the various reefs visited for the report of 2006 and 1986 publication is provided in Table 1 and relates directly to Figure 1.

A complete list of species' occurrence at each atoll is shown in Table 2, which also lists previous records. A limited list of Ophiuroidea (20 species) is also provided within this table. A breakdown by atoll of the 52 species is presented in Figure 2.

From Figure 2 it can be seen that Mermaid Reef and South Scott Reef have a significantly higher number of total recorded species and correspondingly similar unique species component to the other two atolls. However, Mermaid Reef has a similar geographical shape and habitat diversity to that of North Scott Reef and Seringapatam, while South Scott Reef is large with a greater range of habitats.

Asteroidea

In Marsh (1986), 17 species of seastars were found at Mermaid and Clerke Reefs (Rowley Shoals). Of these 10 were found in 2006 plus four additional species. In the 1986 publication, 19 species were recorded from Scott (north and south atolls) and Seringapatam Reefs, of these 11 were found in 2006 plus two new records including a possible undescribed species. The newly recorded species are *Cistina columbiae* Gray, 1840, *Aquilonastra anomala* (H.L. Clark, 1921), *Indianastra sarasini* (de Loriol,

1897) and *Echinaster callosus* Marenzeller, 1895 from Mermaid Reef and *Celerina* sp. and *Cistina columbiae* from South Scott Reef. *Echinaster callosus* is a new record for Western Australia. From North Scott Reef seven species were found in 2006 with no new records. Eight species were found at Seringapatam Reef in 2006, with no new records.

Echinoidea

In the 1986 publication, 14 species of echinoids were recorded from Rowley Shoals; of these six were recorded at Mermaid Reef in 2006 plus one new record, *Nacospatangus (Pseudomaretia) alta* (A. Agassiz, 1863), which is known from Indonesia. From Scott and Seringapatam Reefs 19 species of echinoid were recorded in the 1986 publication, of these only seven species were found in 2006 at the same reefs. From North Scott there was one new record, *Temnotrema elegans* Mortensen, 1918 and a possible new species, cf. *Cyrtechinus* sp.

Figures 3 and 4 demonstrate similar trends for the Asteroidea and Echinoidea in that Mermaid and South Scott Reefs are similar in having high species abundance but show a reduction for North Scott and Seringapatam Reefs. The species diversity is consistent across the reefs except for Seringapatam Reef. This low count is due to limited collecting.

Holothuroidea

In the 1986 publication, 23 species of holothurians were recorded from the Rowley Shoals of which 12 were found at Mermaid Reef in 2006. From Scott and Seringapatam Reefs 26 species were cited in

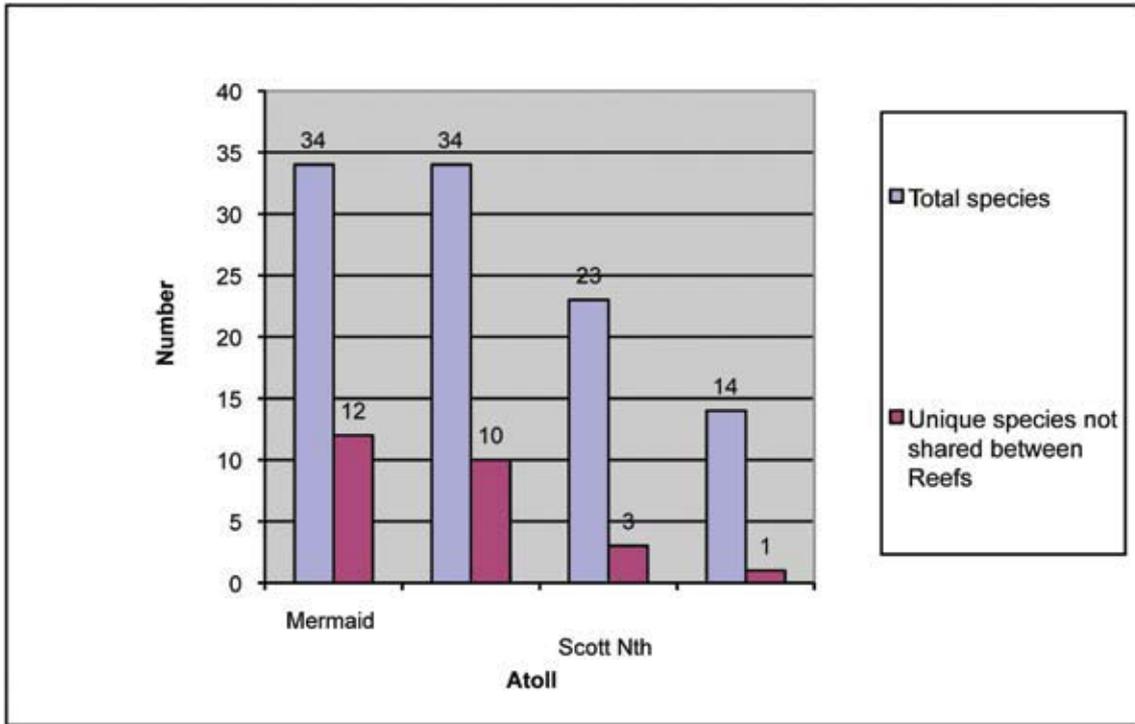


Figure 2 Comparison of the total and unique species of targeted echinoderms from each atoll (2006 Survey)

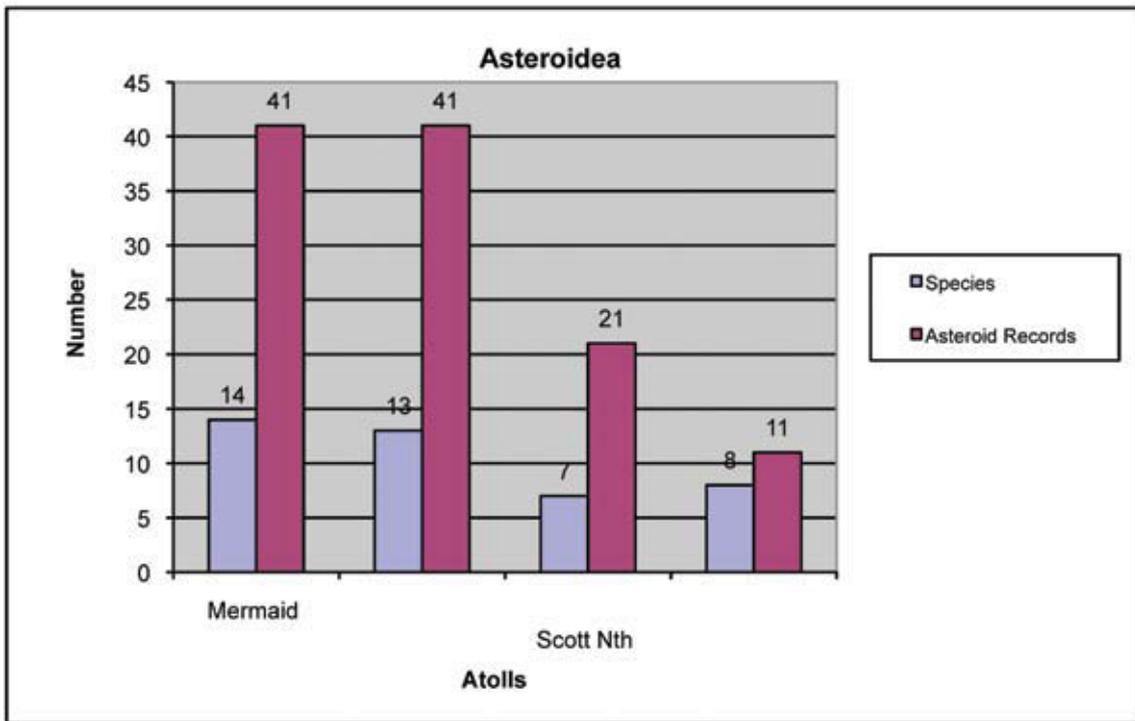


Figure 3 Number of Asterozoidea species recorded by Atoll (2006 Survey)

Table 2 Recorded echinoderm species from numbered stations at Mermaid Reef (Rowley Shoals), South Scott Reef, North Scott, and Seringapatam reefs, September 2006, with comparative records published in 1986. (Key: # = new record (2006), M= Mermaid Reef, S= Scott Reef (both North and South combined) and Se= Seringapatam Reef).

Selected Taxa	1986 Records	STATIONS - 2006			
		Mermaid Reef (M)	Scott South (S)	Scott North	Seringapatam (Se)
# = New Record (2006)					
Asteroidea					
OREASTERIDAE					
<i>Choriaster granulatus</i> Lütken, 1869	M, S, Se	11,14	23,29	34,38	43
<i>Culcita novaeguineae</i> Müller and Troschel, 1842	M, S, Se	1,3,8,9,11,12	23,27,29,30	32,33,35,38	43
ASTEROPSEIDAE					
<i>Asteropsis carinifera</i> (Lamarck, 1816)	M, S, Se				
OPHIDIASTERIDAE					
<i>Celerina heffermani</i> (Livingstone, 1931)	Se				
<i>Celerina</i> sp. #		10	17		
<i>Cistina columbiae</i> Gray, 1840 #	M		17		
<i>Dactylosaster cylindricus</i> (Lamarck, 1816)	M				
<i>Fromia eusticha</i> Fisher, 1913	S, Se		25,26,30		45
<i>Fromia indica</i> (Perrier, 1869)	S, Se				
<i>Fromia milleporella</i> (Lamarck, 1816)	S, Se	6,9,11			
<i>Fromia monilis</i> Perrier, 1875	M, S, Se	1,2,4,5,12,13,15	19,23,25,27,29,30	31,38,40	43,45
<i>Linckia guildingi</i> Gray, 1840	M, S, Se	10		40	
<i>Linckia laevigata</i> (Linnaeus, 1758)	M, S, Se	1,3,7,8,12	24,25,26,27,30	31,32,33,35,40	44
<i>Linckia multifora</i> (Lamarck, 1816)	M, S, Se	2,4,5,7,8, 9,10,11	17,18,22,23,24,26,27,28,29	31,34,38,40	45
<i>Nardoa tuberculata</i> Gray, 1840	M, S, Se		30		43
<i>Neoferdina cumingi</i> (Gray, 1840)		15	22		
<i>Ophidiaster cribrarius</i> Lütken, 1872	M, S, Se				
<i>Ophidiaster granifer</i> (Lütken, 1872)	M, S, Se		20		
<i>Ophidiaster hemprichi</i> Müller and Troschel, 1842	M, S, Se				
MITHRODIDAE					
<i>Mithrodia clavigera</i> (Lamarck, 1816)	M, S, Se				
ASTERINIDAE					
<i>Aquilonastra anomala</i> (H.L Clark, 1921) #		14			
<i>Aquilonastra cepheus</i> (Müller & Troschel, 1842)	S, Se	9			
<i>Disasterina abnormalis</i> Perrier, 1875	M, S, Se		24,28		
<i>Indianastra sarasini</i> (de Lortol, 1897) #		10			
ACANTHASTERIDAE					
<i>Acanthaster planci</i> (Linnaeus, 1758)	M, S, Se				

PTERASTERIDAE							
<i>Euretaster insignis</i> (Sladen, 1882)	S, Se						
ECHINASTERIDAE							
<i>Echinaster luzonicus</i> (Gray, 1840)	M, S, Se	11,12,14	23,24,28,29,30		33,35,		43,44,45
<i>Echinaster callosus</i> Marenzeller, 1895 #		4					
Ophiuroidea							
OPHIACANTHIDAE							
<i>Ophiacantha</i> sp. #		8					
OPHACTIDAE							
<i>Ophiactis savignyi</i> (Müller & Troschel, 1842)	M, S, Se	12			32		43
OPHIOTRICHIDAE							
<i>Ophiogymna</i> cf. <i>pellicula</i> (Duncan, 1887) #	M, S, Se	2,13	22		40		41
<i>Ophiotrix purpurea</i> von Martins, 1867	S, Se	3,12	29		40		
<i>Ophiotrix armata</i> Koehler, 1905					34		
<i>Ophiotrix exigua</i> Lyman, 1874 #	S, Se				40		
<i>Ophiotrix nereidina</i> (Lamarck, 1816)					32		
<i>Dougaloplus</i> sp. #							41
<i>Macrophiothrix demessa</i> (Lyman, 1861)	M, S, Se				31		
OPHIOCOMIDAE							
<i>Ophiarthrum pictum</i> Müller & Troschel, 1842	M, S, Se	8				35	
<i>Ophiocoma dentata</i> Müller & Troschel, 1842	S, Se	1,14	24				
<i>Ophiocoma doederleini</i> de Loriol, 1899	S, Se		17				
<i>Ophiocoma erinaceus</i> Müller & Troschel, 1842	M, S, Se	16					
<i>Ophiocoma</i> cf. <i>pusilla</i> (Brock, 1888)	M, S, Se	16	29				41
<i>Ophiocoma schoenleinii</i> (Müller & Troschel, 1842) #	M, S, Se	14	30				
<i>Ophiomastix annulosa</i> (Lamarck, 1816)	M, S, Se		24				
<i>Ophiomastix variabilis</i> Koehler, 1905	M, S, Se	12					
OPHIODERMATIDAE							
<i>Ophiarachnella septemspinosa</i> (Müller & Troschel, 1842)	M, S, Se	12	20				
<i>Ophiarachna incrassata</i> (Lamarck, 1816)	S, Se		24				
OPHIONEREIDIDAE							
<i>Ophionereis dubia</i> (Müller & Troschel, 1842) #		9					
Echinoidea							
CIDARIDAE							
<i>Euclidaris metularia</i> (Lamarck, 1816)	M, S, Se		17,20,22,23,29		31,32,34		41,43
DIADEMATIDAE							

Selected Taxa	STATIONS - 2006				
	1986 Records	Mermaid Reef (M)	Scott South (S)	Scott North	Serlingapatam (Se)
# = New Record (2006)					
<i>Diadema savignyi</i> Michelin, 1845	M, S, Se		19,21	35,39	
<i>Diadema setosum</i> (Leske, 1778)	S, Se				
<i>Echinothrix calamaris</i> (Pallas, 1774)	M, S, Se		23,24,27	33,35,39	44
<i>Echinothrix diadema</i> (Linnaeus, 1758)	M, S, Se	5,6,7	21,22,23,24,25		
TEMNOPLURIDAE					
<i>Mespilia globulus</i> (Linnaeus, 1758)	S, Se				
<i>Tennotrema elegans</i> Mortensen, 1918 #				32,39	
TOXOPNEUSTIDAE					
<i>Toxopneustes pileolus</i> (Lamarck, 1816)	S, Se				
<i>Triplonastes gratilla</i> (Linnaeus, 1758)	M, S, Se			40	
cf. <i>Cyrtechinus</i> sp. #					
PARASALENIIDAE					
<i>Parasalenia gratiosa</i> A. Agassiz, 1863	S, Se	1,2,5,8, 10,11,12,13,14,15	30	32	
<i>Parasalenia poehli</i> Pfeffer, 1887	S, Se	4			
ECHINOMETRIDAE					
<i>Echinometra mathaei</i> (de Blainville, 1825)	M, S, Se	1,2,4,5,10,11,13,15	19,20,22,23,24,25,26,28,29,30	32,33,34,35,40	43,44,45
<i>Echinostrephus molaris</i> (de Blainville, 1825)	M, S, Se	2,3,5,15	17,18,19,20,22,24,28,29,30	31,34,40	45
<i>Heterocentrotus mammillatus</i> (Linnaeus, 1758)	M	1,2,3,4,5,13,14	17,18,20,22	31	
ECHINONEIDAE					
<i>Echinoneus cyclostomus</i> Leske, 1778	M, S, Se				
CLYPEASTERIDAE					
<i>Clypeaster reticulatus</i> (Linnaeus, 1758)	M, S, Se				
LAGANIDAE					
<i>Peronella orbicularis</i> (Leske, 1778)	M				
FIBULARIIDAE					
<i>Fibularia ovulum</i> Lamarck, 1816	S, Se				
<i>Fibularia volva</i> L. Agassiz, 1846	S, Se				
SPATANGIDAE					
<i>Nacospatangus alta</i> (A. Agassiz, 1863) #		11			
SCHIZASTERIDAE					
<i>Schizaster</i> sp.	S, Se				
BRISSIDAE					
<i>Brissus latecarinatus</i> (Leske, 1778)	M, S, Se				
<i>Metalia dicrana</i> H.L. Clark, 1917	M				

<i>Metalia spatagus</i> (Linnaeus, 1758)	M, S, Se	11			
Holothurioidea					
CUCUMARIIDAE					
<i>Colochirus robustus</i> Östergren, 1898 cf. <i>Plesiocholochirus dispar</i> (Lampert, 1889) #	S, Se				34
PHYLLOPHORIDAE					
<i>Cladolabes acicula</i> (Semper, 1868)	S, Se				
HOLOTHURIIDAE					
<i>Actinopyga mauritiana</i> (Quoy and Gaimard, 1833)	M, S, Se	1	21		33
<i>Actinopyga miliaris</i> (Quoy and Gaimard, 1833)	S	4,8,11,12			
<i>Bohadschia argus</i> Jaeger, 1833	M, S, Se	1,4,6,7,8,9,10,11,12,14,15	21,29		31,34,38
<i>Bohadschia marmorata</i> Jaeger, 1833	M, S, Se	6,7,11	20,21,27		
<i>Pearsonothuria graeffei</i> (Semper, 1868)	M, S, Se	2,4,6,7,8,9,10,11,12,14,15	17,18,26,28		32
<i>Labidodemas pertinax</i> (Ludwig, 1875)	S, Se				
<i>Labidodemas semperianum</i> Selenka, 1867	M, S, Se		17		
<i>Holothuria inhabilis</i> Selenka, 1867	M				
<i>Holothuria atra</i> Jaeger, 1833	M, S, Se	1,4,7,8,9,10,11,12,14	18,21,25,29		39
<i>Holothuria edulis</i> Lesson, 1830	M, S, Se	1,2,4,6,7,8,9,12,13,14	18,20,21,24,25,26,29,30		32,34,38
<i>Holothuria pardalis</i> Selenka, 1867	M, S, Se	6			
<i>Holothuria leucopilota</i> (Brandt, 1835)	M, S, Se		25,27		
<i>Holothuria perricax</i> Selenka, 1867	M, S, Se				
<i>Holothuria hilla</i> Lesson, 1830	M, S, Se		27		
<i>Holothuria whitmaei</i> (Selenka, 1867)	M, S, Se	1,2,6,7,9			
<i>Holothuria fuscogilva</i> Chéronnier, 1980	M, S, Se H. nobilis		24		
<i>Holothuria difficilis</i> Semper, 1868	M, S, Se H. nobilis				
<i>Holothuria olivacea</i> Ludwig, 1888	M, S, Se				
<i>Holothuria impatiens</i> (Forskål, 1775)	S, Se				
<i>Holothuria remollescens</i> Lampert, 1885	M, S, Se				44
<i>Holothuria remollescens</i> Lampert, 1885	M				
STICHOPODIDAE					
<i>Stichopus chloronotus</i> Brandt, 1835	M, S, Se				
<i>Stichopus horrens</i> Selenka, 1867	M, S, Se		24,27		
<i>Stichopus herrmanni</i> Semper, 1868	M, S, Se	7			
<i>Thelenota ananas</i> (Jaeger, 1833)	M, S, Se	2,4,7,8,10,11,14			
<i>Thelenota anax</i> H.L. Clark, 1921	M	11			40
SYNAPTIDAE					
<i>Euapta godeffroyi</i> (Semper, 1868)	S, Se		27		
<i>Synapta maculata</i> (Chamisso and Eysenhardt, 1821)	M, S, Se		21,24,27		

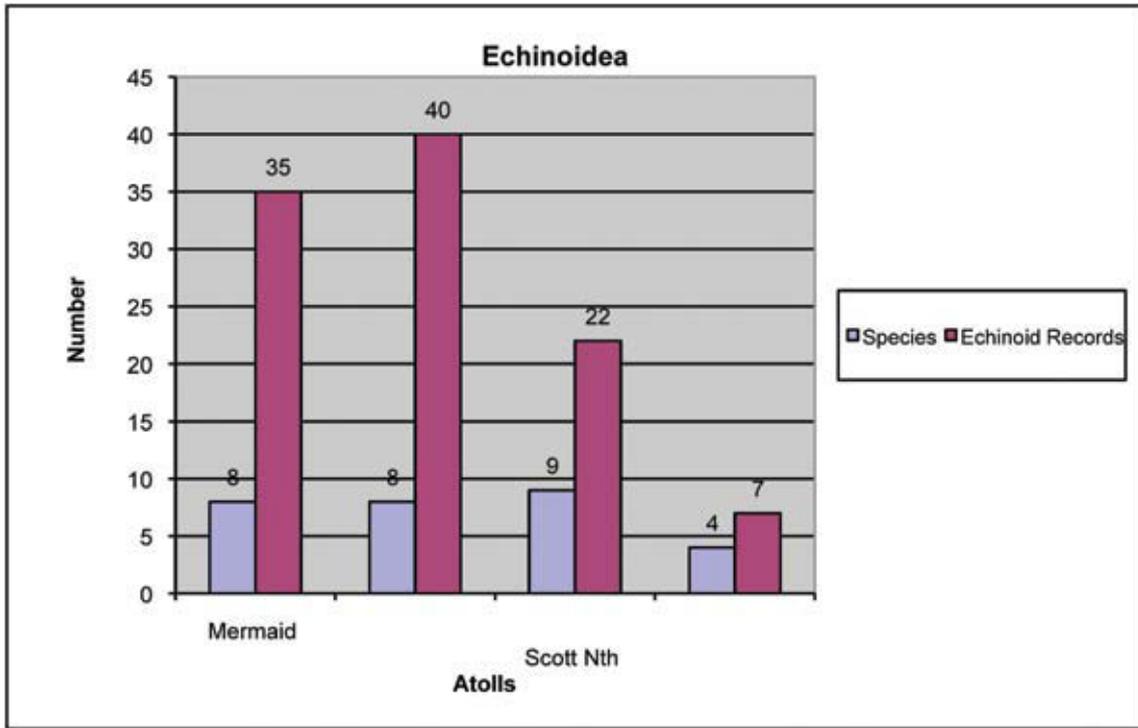


Figure 4 Number of Echinoidea species recorded by Atoll (2006 Survey)

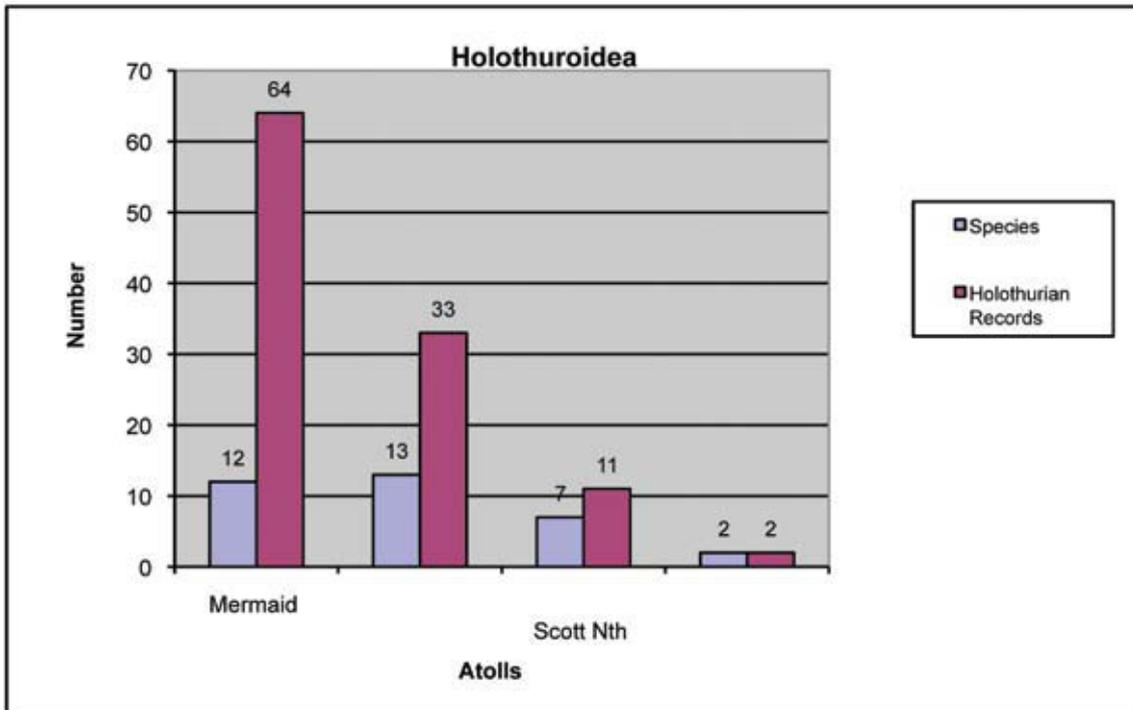
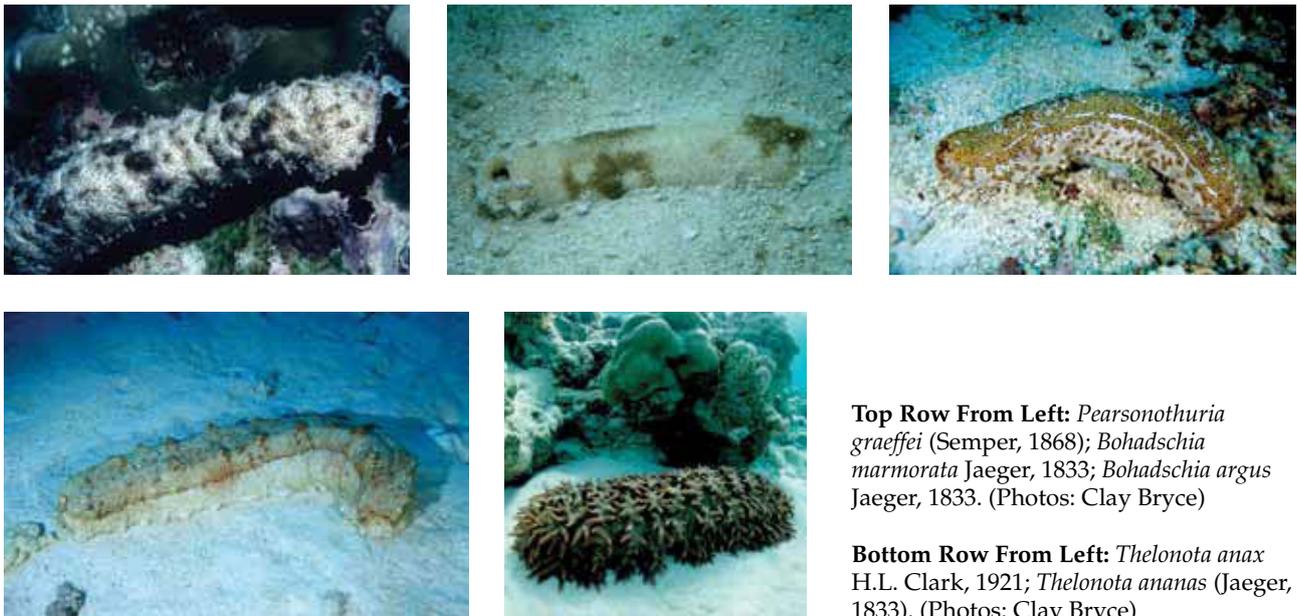


Figure 5 Number of Holothuroidea species recorded by Atoll (2006 Survey)



Top Row From Left: *Pearsonothuria graeffei* (Semper, 1868); *Bohadschia marmorata* Jaeger, 1833; *Bohadschia argus* Jaeger, 1833. (Photos: Clay Bryce)

Bottom Row From Left: *Thelonota anax* H.L. Clark, 1921; *Thelonota ananas* (Jaeger, 1833). (Photos: Clay Bryce)

the 1986 publication, of these 13 were found at South Scott Reef, seven at North Scott Reef and two at Seringapatam Reef. A single new record, cf. *Plesiocolochirus dispar* (Lampert, 1889) from North Scott Reef was collected.

Figure 5 illustrates that the number of individual holothurians from Mermaid Reef to be the highest (64), but South Scott (33), North Scott (11) and Seringapatam Reefs (2) are extremely reduced in numbers.

Ophiuroidea

Brittle stars were not targeted during the 2006 survey but were collected opportunistically and so are not graphed. No meaningful comparisons can be made with the 1986 publication results of the survey. However, ophiuroids are the most speciose group found on coral reefs. In Marsh (1986) 28 species were collected from the Rowley Shoals (all three atolls) and 38 from Scott and Seringapatam Reefs. In 2006 twelve species were collected at Mermaid Reef, nine at South Scott, eight at North Scott and four at Seringapatam. In total 20 species were collected during the 2006 survey. Of note are six species, *Ophiacantha* sp., *Ophiocoma schoenleini* (Müller and Troschel, 1842), *Ophionereis dubia* (Müller and Troschel, 1842), *Ophiothrix exigua* Lyman, 1874, *Dougaloplus* sp. and *Ophiogymna pellicular* (Duncan, 1887) recorded for the first time from the northwest atolls (Table 2).

DISCUSSION

The reduction in echinoderm records (Figure 3, 4 and 5) in North Scott and Seringapatam Reefs when compared to Mermaid Reef, a similar sized atoll, and South Scott Reef, a close neighbour, is noteworthy. The reduction could be due to a

number of factors. Seringapatam and North Scott Reefs were heavily damaged by two bleaching events in 1998 and 2003 (Rees, 2003) and by the subsequent erosive cyclonic damage of Cyclone Fay during the 2003 /2004 cyclone season. Mermaid Reef, being of a comparable size to North Scott and Seringapatam Reefs but 400 km south, only suffered minimal damage. South Scott Reef also suffered the same damage as North Scott and Seringapatam, but covers a larger area, has deeper lagoonal waters with better flushing due to its open north end and a more diverse range of habitats.

The bleaching and cyclonic events may also explain the numbers of seastars and echinoids. Under-sampling for Seringapatam Reef would also have been a cause in the low numbers recorded there. Seringapatam Reef has always had the least sampling devoted to it by all expeditions to the region.

Mermaid Reef has the highest numbers of holothurians but stocks at South Scott, North Scott and Seringapatam have declined significantly. This reflects the added factor of fishing pressure by Indonesian fishers under the Australian–Indonesian government’s Memorandum of Understanding (MOU74). This MOU allows traditional fishers to utilise the waters of Scott and Seringapatam Reefs, but not Mermaid Reef. As can be seen, the bêche-de-mer (commercial holothurian) stocks of South Scott, North Scott and Seringapatam Reefs have declined significantly to an extremely low level (Berry, 1986; Skewes, 1999; Bryce, 2006) where oligospermy may become a serious factor in slowing population regrowth.

Only seven holothurians, representing three commercial species were found over 21 transects on Scott (North and South) and Seringapatam

Reefs. In contrast, Mermaid Reef had 49 individual holothurians representing 9 species over 16 transects.

The highly sought after *Holothuria whitmaei* (Selenka, 1867) (black teat fish) and *H. fuscogilva* Cherbonnier, 1980 (white teat fish) were notably absent in over 21 transects at Scott and Seringapatam Reefs. There was only one sighting for these two species off the transects and this was a juvenile *H. fuscogilva* at platform station 24. Both these species have a high commercial value but have late sexual maturity and low to medium fecundity resulting in rapid depletion of stocks and slow replenishment after overfishing (Uthicke *et al.*, 2004, 2004a). South Scott and North Scott Reefs exhibit the diversity but not the numbers of this most necessary reef inhabitant. The figures point to near total population collapses at all reefs, other than Mermaid Reef, for this group of echinoderms. In contrast, the holothurian stocks at Mermaid Reef are very much greater with good populations of the above two species.

CONCLUSION

The results of this survey show considerable difference in the echinoderm populations between the reefs. The Mermaid Reef far to the south has escaped much of the recent influences of fishing, bleaching events and cyclonic activity (Rees, 2003). Allowing for the differences in methodology and effort between the WA Museum's published report of 1986 (Berry, 1986) and this survey, the echinoderm diversity and numbers for Mermaid Reef appear to be very similar. The same cannot be said, however, for Scott and Seringapatam Reefs. These once pristine oceanic atolls, which form part of a unique habitat off Western Australia's coast (Berry, 1986) appear to be in a state of decline. The collapse of the holothurian populations may have a detrimental effect on reef nutrient loads and general lagoonal turbidity.

The possibly undescribed species of seastar at South Scott Reef is of significance. It has been placed in the genus *Celerina* with further work needed to clarify its species status.

As with much of the Western Australian coastline, new species are still being found and with developments in marine exploration technology improving more will undoubtedly be found. It is, therefore, imperative that the reefs and their inhabitants, which are Australian assets, should be managed with due diligence.

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