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Corals of the north west of Western Australia: biogeography and considerations for dredging-related research

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WAMSI Dredging Science Node

Report

Theme 4 | Project 4.5

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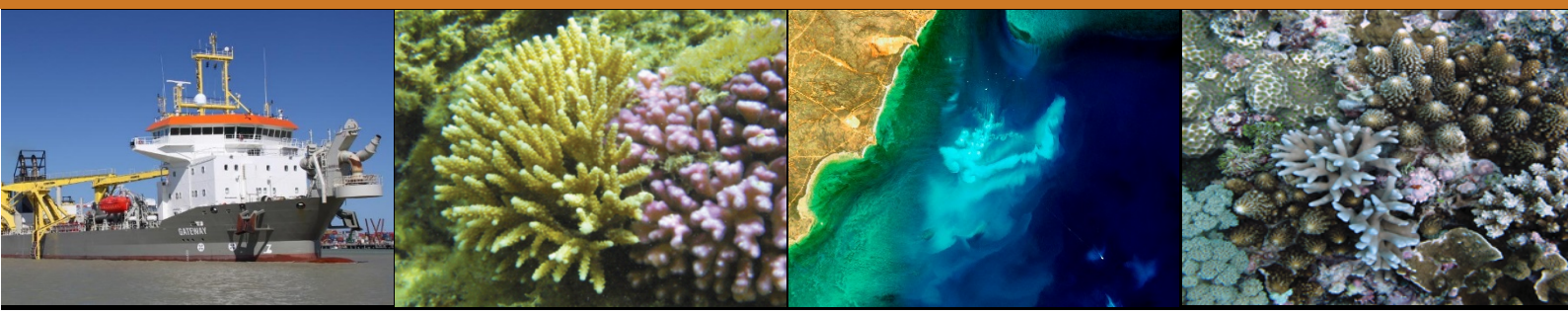

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WAMSI Dredging Science Node

The WAMSI Dredging Science Node is a strategic research initiative that evolved in response to uncertainties in the environmental impact assessment and management of large-scale dredging operations and coastal infrastructure developments. Its goal is to enhance capacity within government and the private sector to predict and manage the environmental impacts of dredging in Western Australia, delivered through a combination of reviews, field studies, laboratory experimentation, relationship testing and development of standardised protocols and guidance for impact prediction, monitoring and management.

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Funding Sources

The $20million Dredging Science Node is delivering one of the largest single issue environmental research programs in Australia. This applied research is funded by **Woodside Energy, Chevron Australia, BHP Billiton and the WAMSI Partners** and designed to provide a significant and meaningful improvement in the certainty around the effects, and management, of dredging operations in Western Australia. Although focussed on port and coastal development in Western Australia, the outputs will also be broadly applicable across Australia and globally.

This remarkable **collaboration between industry, government and research** extends beyond the classical funder-provider model. End-users of science in regulator and conservation agencies, and consultant and industry groups are actively involved in the governance of the node, to ensure ongoing focus on applicable science and converting the outputs into fit-for-purpose and usable products. The governance structure includes clear delineation between end-user focussed scoping and the arms-length research activity to ensure it is independent, unbiased and defensible.

And critically, the trusted across-sector collaboration developed through the WAMSI model has allowed the sharing of hundreds of millions of dollars worth of environmental monitoring data, much of it collected by environmental consultants on behalf of industry. By providing access to this usually **confidential data,** the **Industry Partners** are substantially enhancing WAMSI researchers' ability to determine the real-world impacts of dredging projects, and how they can best be managed. Rio Tinto's voluntary data contribution is particularly noteworthy, as it is not one of the funding contributors to the Node.

Funding and critical data **Critical data**

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Front cover images (L-R)

Image 1: Trailing Suction Hopper Dredge *Gateway* in operation during the Fremantle Port Inner Harbour and Channel Deepening Project. (Source: OEPA)

Image 2: A branching Acropora species, *Acropora yongei*, (Veron & Wallace 1984), beside a pink colour morph of *Pocillopora damicornis* (Linnaeus, 1758) at Salmon Bay, Rottnest Island. (Photo: Ross Jones taken January 2002).

Image 3: Dredge Plume at Barrow Island. Image produced with data from the Japan Aerospace Exploration Agency (JAXA) Advanced Land Observing Satellite (ALOS) taken on 29/08/2010.

Image 4: Close up image of the reef flat at Scott Reef. (Source: AIMS)

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Executive Summary and Considerations for predicting and managing the impacts of dredging

To guide the choice of coral species for the laboratory experiments on the effects of dredging activities on adult and juvenile corals, the biogeographic distribution of hard corals in Western Australia (WA) was examined over a ~2,500 km latitudinal gradient from Ashmore Reef (12°S) in the Timor Sea to the Recherche Archipelago near Esperance (34°S).

Since the laboratory studies are based in Townsville (central Great Barrier Reef (GBR)) using locally collected corals, the WA coral distributions were also compared with the species list from the inner and mid-shelf reefs of the central GBR.

Using data from multiple sources, but principally studies conducted in association with the Western Australia Museum (WAM), all available data was manually transcribed from the printed, hard copy reports into a spreadsheet database together with digital records from the east coast held by the Museum of Tropical Queensland (MTQ).

The resulting list of ~3,500 records was grouped to 19 locations and then sorted according to family, genus and species. Each entry was validated against the World Register of Marine Species (WORMS) database to account for synonymized species, and also for several recent major taxonomic changes which would otherwise confound attempts to relate the results from older to the newer studies.

Of the WA records, the total hard coral species count was 361 species from 17 Families and 83 genera. The highest species count (253 species) was recorded at Scott Reef (North and South Scott Reef and Seringapatam).

The Family Acroporidae was the most speciose, followed by the Merulindae, Fungiidae and Poritidae. The genus Acropora was the most speciose. Species number decreased with increasing latitude to <10 species on the south west coast, and this attenuation of species, as opposed to species replacement, is a feature of scleractinian biogeography.

Cluster analysis of a matrix based on the Sørensen similarity index for all sites shows a distinct division between the more tropical, reefal areas and more sub-tropical and temperate non-reef areas. This clustering pattern is well known (see Veron and Marsh (1988) and Veron (1995)).

The central GBR corals clustered closely with the tropical groups from WA and of the ~240 species of hard corals found in the inshore/offshore Pilbara region, ~65% are found in the central GBR giving a large pool (154 coral species) to select for the laboratory studies.

Multiple different criteria were used to select the test species, including that they (1) are present on both the east and west coasts, (2) have a wide distribution, (3) are from different families, (4) have different morphologies (including branching, foliose and massive macroskeletal growth form), (4) can be easily identified and collected, (5) are amenable to laboratory culture, and (6) that they have different reproductive strategies (including broadcast spawning and brooding modes of reproduction). Nine coral species were selected for laboratory study: two species from each of the family Acroporiidae (*Acropora millepora*, *A. tenuis* and *Montipora aequituberculata*, *M. capricornis*), Poritidae (*Porites lutea* and *P. lobata*) and Dendrophylliidae (*Turbinaria mesenterina* and *T. reniformis*) and one each from the Family Pocilloporidae (*Pocillopora damicornis*) and Merulinidae (*Goniastrea retiformis*).

1. Introduction

The objective of this study is to examine the biogeographic range of hard corals in Western Australia (WA) to guide the choice of organisms for the laboratory experiments of effects of sediments from dredging and dredging activities (such as dredge material placement) on adult and juvenile corals. In WA, the majority of major dredging programs have occurred on the Pilbara coast (EPA 2013). These programs have been associated with the current resources boom and the need for coastal infrastructure associated with LNG processing plants and mineral port expansions (Minifie 2013, Wood et al. 2013). With the exception of the LNG processing plant at Barrow Island, these projects have occurred on the coastal mainland near the towns of Onslow, Port Hedland and Dampier (Hanley 2011). Dredging in these instances is mostly in the coastal environment associated with shore side facilities but dredging also occurs far offshore and in deeper water associated with gas trunk line installation and entrance channels.

Since the manipulative studies of the effects of sediments on corals will be based in Townsville (central Great Barrier Reef (GBR)), the WA coral distributions were also compared with the species list from the inner and mid-shelf reefs of the central GBR which are the most likely collection locations for the experimental studies. The biogeographic distribution of hermatypic corals in WA was first described by Veron and Marsh (1988) based on studies of hard coral skeletons held at the Western Australian Museum (WAM). This collection was compiled over the last 60 years from a variety of sources including opportunistic sampling by interested scientists to dedicated, multi-year faunal sampling expeditions conducted by WAM, state government departments and Commonwealth research institutes such as AIMS and CSIRO.

Since the analysis of the WAM hard coral collection, there have been several further taxonomic studies, including surveys at Ashmore Reef (Griffith 1987), the Montebello Islands (Marsh 2000), the Dampier Archipelago (Marsh 1993, Griffith 2004) and Barrow Island and the southern Montebello Islands (Richards & Rosser 2012). Blakeway and Radford (2004) also described the coral assemblages of Dampier Port and inner Mermaid Sound and correlated coral species to prevailing water quality, wave energy and tidal strength. Most recently, Richards et al. (2014) have summarized the hard coral distribution of the offshore and inshore Kimberley region. Each of these studies have typically only recorded hard coral species as presence/absence data, although some abundance data is available in Richards and Rosser (2012).

Recent molecular phylogenetic studies have challenged the validity of most families and genera as traditionally described based on skeleton macromorphology (Fukami et al. 2004, Fukami 2008, Stat et al. 2012). In a comprehensive analysis by Fukami et al. (2008), Scleractinia was found to be monophyletic but most taxa (11 of 16 conventional family groups) were found to be polyphyletic. The predominantly Indo-families Faviidae, Mussidae, Pectiniidae, Merulinidae, Trachyphylliidae, Meandrinidae, and Ocullinidae were found not to be monophyletic and especially confusing, epitomized by use of the term the 'Bigmessidae' (Knowlton et al. 2008). There have been a number of significant taxonomic revisions of hard corals for example (Hoeksema 1989, Wallace 1999, Benzoni et al. 2007, Wallace et al. 2012, Arrigoni et al. 2014, Kitano et al. 2014) including recent attempts to untangle the intractable Bigmessidae (Huang et al. 2011, Huang et al. 2014). Budd et al. (2012) group all families into the Merulinidae and even more recent changes (see Huang et al. (2014)) have resulted in further taxonomic amendments with many species and even genera synonymized and some genera re-classified. Some of the these taxonomic changes have been incorporated into a database of hard corals species on the East coast of Australia (held at the Museum of Tropical Queensland (MTQ)) and in order to compare the species distribution between coasts, the older WA taxonomic surveys (available as hard copies) needed to be updated and then individually checked and verified. This report describes the cataloguing and updating/validating process, analysis of the WA distributions, and then the comparison to the east coast species (from the central GBR). The report concludes with a list of species suitable for the laboratory experiments.

2. Materials and methods

The distribution of hard coral species (Phylum: Cnidaria, Class: Anthozoa, Subclass: Hexacorallia: Order: Scleractinian) was determined using presence/abundance data obtained from the sources listed in Table 1. It includes coral species collected on the west coast of Australia ranging over a ~2500 km latitudinal gradient from Ashmore Reef (12°S) to the south west coast area near Albany (35°S), to the east coast of Australia focusing on 3 reefs (Orpheus Island, Magnetic Island and Davies Reef) close to the Australian Institute of Marine Science (AIMS) near Townsville in far North Queensland (see Figure 1).

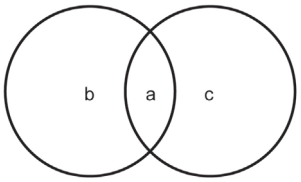
The hard coral species lists were manually transcribed from the printed reports in Table 1 into an Excel database and were sorted according to family, genus and species. All species were then validated against the World Register of Marine Species (WoRMS Editorial Board 2014) and recent taxonomic revisions (Hoeksema 1989, Wallace 1999, Benzoni et al. 2007, Wallace et al. 2012). For example, all references to *Acropora formosa* in any of the reports of Table 1 were entered into the database as *Acropora muricata* (Linnaeus 1758).

Table 1. Data sources (species lists) used to compare the biogeographic distribution of hard corals in Western Australia and central Great Barrier Reef

Location	Survey
Ashmore	Griffith (1987)
Multiple locations in WA	Veron and Marsh (1988)
Rottnest Island	Marsh (1993)
Montebellos	Marsh (2000)
Mermaid Sound and Dampier Port	Blakeway and Radford (2004)
Dampier	Griffith (2004)
Rowley Shoals, Scott Reef and Seringapatam	McKinney (2006)
Montebello and Barrow Island	Richards and Rosser (2012)
Inshore Kimberley	Richards et al. (2014)
Central GBR	MTQ database

Relationships between presence/absence data at each location was examined via a similarity matrix constructed using Sørensen's Similarity Index (= Dice index = Czekanowski's binary index, Equation 1). The resulting similarity matrices were analysed by cluster analysis (group averaging method) and non-metric multi-dimensional scaling (nMDS) using the Primer routine (Clarke 1993, Clarke & Gorley 2006).

Sørensen's Similarity Index = $100 \times \frac{2a}{(2a+b+c)}$ Equation 1



Where:
a = N of species present in both sites
b = N of species present in site 1 but absent from site 2
c = N of species present in site 2 but absent from site 1

3. Results and Discussion

3.1 Species distribution in Western Australia

Of the ~3500 individual records, the total hard coral species count for WA was 361 species from 17 Families and 83 genera (Table 2). The highest species count (253 species) was at Scott Reef (which includes all records collected at North and South Scott Reef and Seringapatam). The Family Acroporidae was the most speciose with 128 species, followed by the Merulindae (82 species) and Poritidae (35 species). The genus Acropora was the most speciose (68 species) followed by Montipora, Favia and Goniopora (Table 3). Species number decreased with increasing latitude to <10 species on the south west coast and Recherche Archipelago (Figure 1).

Cluster analysis of a matrix based on the Sørensen similarity index for all sites shows a distinct division between the more tropical, reefal areas and more sub-tropical and temperate non-reef areas (Figures 1 and 2). Although beyond the scope of this project, this clustering pattern is well known, and was first reported by Veron and Marsh (1988) and again in (Veron 1995). The attenuation of species with increasing latitude, as opposed to species replacement, is also found with two other similar latitudinal gradients, the Papua New Guinea/East Australia gradient and the Philippines-to-Japan island arc (Veron 1995).

Major groupings in the tropical/reef building cluster include the offshore, outer shelf edge reefs (Ashmore and Cartier, Scott and Seringapatam and the Rowley shoals) and the more southern and more nearshore reefs (Barrow Island and the Montbellos Islands, Dampier Archipelago and Ningaloo Reef). Despite their more northerly locations, the assemblages in the inshore Kimberley region are more similar to the nearshore than shelf edge reefs. The more sub-tropical reefs and offshore reefs of the Houtman/Abrolhos (28.7°S) sit within the tropical cluster (Figure 1 and 2).

The second temperate/non-reefal cluster includes the nearshore species assemblages off Geraldton and all sites further south, including Rottnest Island and further southwards and eastwards to the Recherche Archipelago (Figure 1 and 2).

Figure 2 shows a non-metric multidimensional scaling (nMDS) analysis also including the east coast reefs (Figure 1), and using bubble plots where the size is proportional to the number of hard coral species per location. The data shows the higher species number in the upper, reefal cluster as compared with the temperate cluster. The GBR reef sites (Magnetic Island, Davies Reef and Orpheus Island) are found associated with the upper cluster.

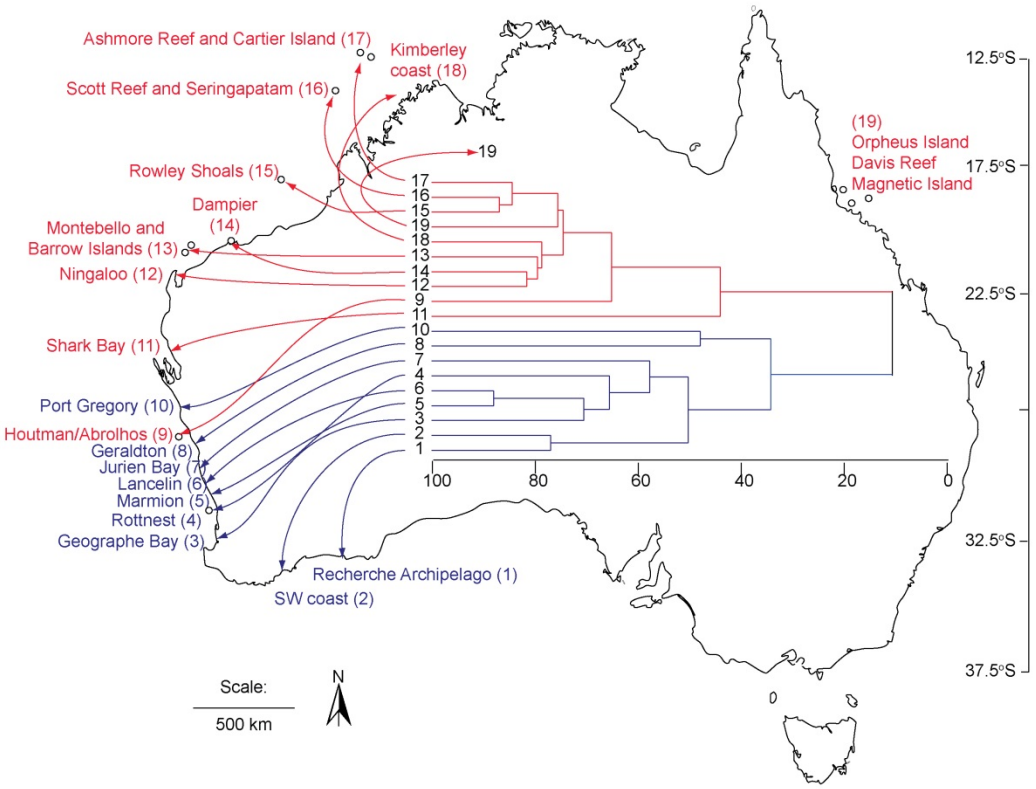


Figure 1. Location map showing the hard corals sampling sites in Table 1. The inner dendrogram depicts the sampling sites grouped according to similarity (based on presence/absence data) using a similarity matrix constructed from Sørensen's Similarity Index. Red locations are generally tropical reefal areas, while blue locations are more sub-tropical and temperate non-reef areas.

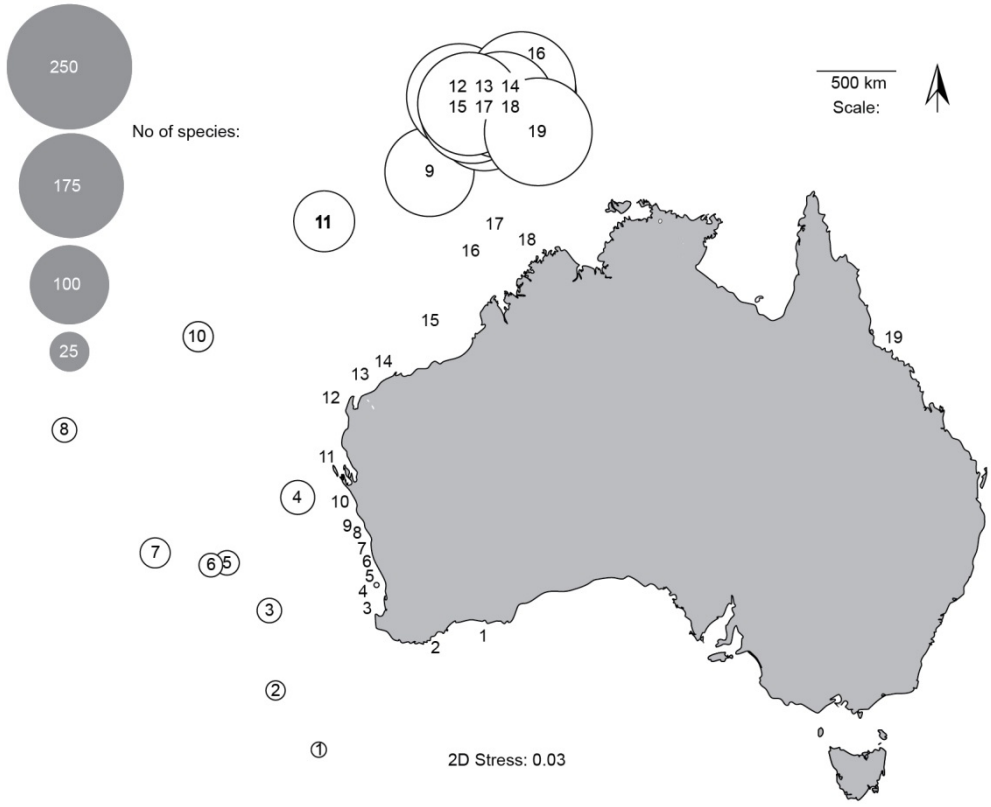


Figure 2. Cluster resulting from the similarity matrix based on the Sørensen Similarity Index for presence/absence data for all hard coral species collected in the studies listed in Table 1. The bubble plots indicate the number of species recorded at each location. The numbers refer to the locations listed in Figure 1.

3.2 Species overlaps between Western Australia and the Great Barrier Reef

Of the ~240 species of hard corals found in the inshore/offshore Pilbara region (Table 2, Table 3) ~65% of the same species are found in the central GBR (Figure 3).

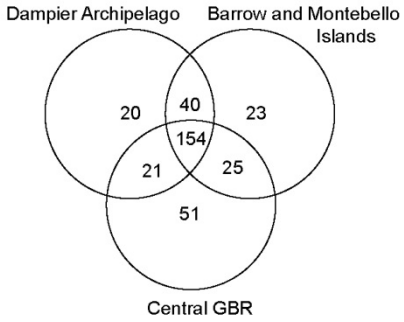


Figure 3. Hard corals species overlap between the Pilbara coast (Barrow and Montebello Islands (site 13 in Figure 1) and the Dampier Archipelago (site 14 in Figure 1) and Central GBR species (Magnetic Island, Orpheus Island and Davies Reef, Site 19 in Figure 1).

3.3 Choice of species for laboratory studies

In addition to the distribution, the important criteria for selection of corals for the laboratory studies are that they are:

1) widely distributed and preferably throughout the Indo-west Pacific;
2) from several species from different families;
3) have different coral morphologies including branching, foliose and massive growth forms;
4) readily identified and easily collected; and
5) species that respond well to experimental conditions.

Table 2. List of number of scleractinian species per Family recorded in WA and reefs of the central Great Barrier (see Table 1 for data sources) updated according to recent taxonomic revisions and verified via the WoRMS database (WoRMS Editorial Board 2014).

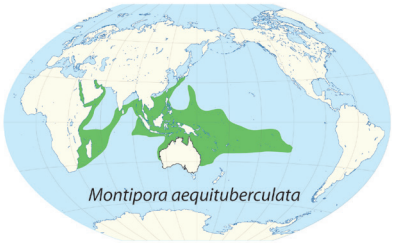
	Recherche Archipelago (1)	South Coast (2)	Geographe Bay (3)	Rottnest Island (4)	Marmion (5)	Lancelin (6)	Jurien Bay (7)	Geraldton (8)	Houtman/Abrolhos (9)	Port Gregory (10)	Shark Bay (11)	Ningaloo (12)	Barrow & Montebello Islands (13)	Dampier Archipelago (4)	Rowley Sho. (15)	N and Scott Reef and Seringapatam	Ashmore and Cartier (17)	Inshore Kimberley (18)	Central GBR (19)
Acroporidae (Verrill, 1902)				3	1	1	3	5	71	13	28	73	83	81	81	87	78	70	90
Agariciidae (Gray, 1847)									12		4	15	13	8	18	20	19	12	15
Astrocoeniidae (Koby, 1890)									2			1		1	2	2	1	1	4
Caryophylliidae (Dana, 1846)																		1	
Coscinaraeidae (Benzoni et al., 2012)	2	2	2	2	1	1	2		3		1	2	1	2	2	2	1	2	2
Dendrophylliidae (Gray, 1847)	2	3	4	4	4	3	1	3	9	4	7	9	9	10	3	4	5	11	9
Diploastreidae (Chevalier & Beauvais, 1987)												1	1	1	1	1	1	1	1
Euphylliidae (Alloiteau, 1952)									3			4	5	7	6	6	6	6	5
Flabellidae (Bourne, 1905)																		1	
Fungiidae (Dana, 1846)									4		2	12	10	15	16	20	21	17	20
Scleractinia incertae sedis	1	1	1	1	1	1	1		5	1	1	7	7	7	7	8	8	6	7
Lobophylliidae (Dai & Horng, 2009)		1	1	1	1	1	1	1	12	1	7	13	21	14	12	13	15	16	14
Merulinidae (Verrill, 1865)			4	10	4	4	2	4	32	11	20	49	63	58	50	61	61	53	58
Mussidae (Ortmann, 1890)		1	1	1									1						
Pocilloporidae (Gray, 1842)				1	1	1	1	1	3	1	4	8	7	7	6	7	8	5	5
Poritidae (Gray, 1842)				2					11	2	5	10	17	18	18	17	17	22	18
Psammocoridae (Chevalier & Beauvais, 1987)									4		2	4	4	5	4	5	4	4	2
Siderastreidae (Vaughan & Wells, 1943)												1		1				1	1
SPECIES	**5**	**8**	**13**	**25**	**13**	**12**	**11**	**13**	**172**	**33**	**80**	**209**	**242**	**235**	**226**	**253**	**245**	**230**	**251**

A further important criterion is that the corals are reasonably abundant, not just for collecting/permitting purposes, but because they are important components of the species assemblages. It was originally intended that abundance data could be examined from the large environmental impact assessments that have been conducted in the Pilbara region in recent years. However, only one study, at the Montebello Islands and Barrow Island, contained taxonomic information more detailed than the genus and family level and with abundance data expressed using a categorical system (rare, infrequent etc, see Richard and Rosser (2012)).

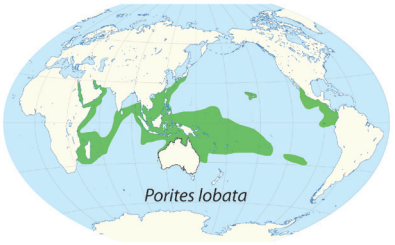
Based on the above criteria, 9 coral species were selected for study (Figure 3). Each of these species is found in the central GBR and at each of the sites from Shark Bay to Ashmore Reef and Cartier Islet (i.e. the tropical/reef building cluster in Figure 1 excluding Port Gregory). The species are described as 'common', 'frequent' and 'dominant' at sites in the Pilbara according to Richards and Rosser (2012).

Family: Acroporidae
Acropora millepora
Author: Ehrenberg 1834
Morphology: Branching
Abundance: Rare to common
Sediment rejection mechanism: 1:

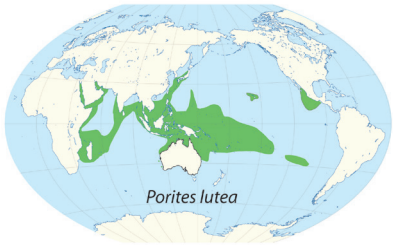
Family: Acroporidae
Montipora capricornis
Author: Veron (1995)
Morphology: Foliose
Abundance: Sometimes common
Sediment rejection mechanism: 1



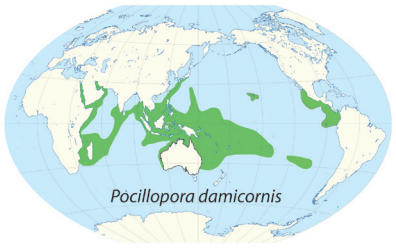
Family: Acroporidae
M. aequituberculata
Author: Bernard 1897
Morphology: Foliose
Abundance: Rare to frequent
Sediment rejection mechanism: 2



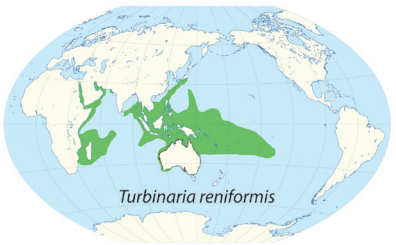
Family: Poritiidae
Porites lobata
Author: Dana 1846
Morphology: Massive
Abundance: Infrequent to dominant
Sediment rejection mechanism: 4



Family: Poritiidae
Porites lutea
Quoy and Gaimard 1833
Morphology: Massive
Abundance: Infrequent to dominant
Sediment rejection mechanism: 4

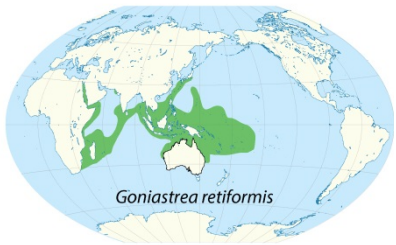


Family: Pocilloporidae
Pocillopora damicornis
Author: Linnaeus 1758
Morphology: Branching
Abundance: Rare to frequent
Sediment rejection mechanism: 2



Family: Dendrophylliidae
Turbinaria reniformis
Author: Bernard 1896
Morphology: Foliose
Abundance: Rare to frequent
Sediment rejection mechanism: 3

Family: Dendrophylliidae
Turbinaria mesenterina
Author: Lamarck 1816
Morphology: Foliose
Abundance Rare to frequent
Sediment rejection mechanism: 3



Family: Merulindae
Goniastrea retiformis
Author: Lamarck 1816
Morphology: Massive
Abundance: Rare to common
Sediment rejection mechanism: 3

Sediment rejection mechanism:
1 = undescribed
2 = passive rejection is predominant to the extent that active rejection is mostly redundant,
3 = easily manipulates silt and fine sand but movement of larger sizes is laboured; usually active immediately,
4 = manipulates silt, movement of fine sand is slow, very little rejection of larger sizes; often inactive for long periods

Figure 4. Biogeographic distribution of the selected species with biogeographical distribution from the Ocean Bioghttp://www.iobis.org/ and Atlas of Living Australia http://www.ala.org.au/ together with abundance information from the Australian Institute of Marine Science Coral Fact Sheets (http://coral.aims.gov.au/info/search.jsp).

The species represent five families including Porites spp. and Acroporidae which are abundant in the Pilbara and commonly used in tagged-coral monitoring program in the Pilbara (Hanley 2011) and in the central GBR (Jones 2008). Three of the species *Acropora millepora*, *Pocillopora damicornis*, and *Turbinaria mesenterina* are commonly used in laboratory experiments and all respond well to collecting and handling. The selected species have a range of morphologies and also exhibit and range of different rejection abilities according to the studies of Stafford-Smith and Ormond (1992). *Acropora millepora* is a broadcast spawning species and *Pocillopora damicornis* is a brooder and will be used in Theme 7. *Acropora tenuis* (a broadcast spawning species) will also be used in experiments in Theme 7 as it spawns just after sunset a few hours earlier than *A. millepora* allowing for more experiments to be performed on the night of spawning. It is a very common species with a similar widespread distribution pattern as *Acropora millepora*.

Table 3. List of Scleractinian Family, genus recorded in WA and on selected reefs of the central Great Barrier (see Table 1 for data sources) updated according to recent taxonomic revisions and verified via the WORMS database (WoRMS Editorial Board 2014). F = Family.

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Genus Name	Species name	Author Year	Site (see Figure 1):	Recherche Archipelago	South Coast	Geographe Bay	Rottnest Island	Marmion	Lancelin	Jurien Bay	Geraldton	Houtman/Abrolhos	Port Gregory	Shark Bay	Ningaloo	Barrow & Montebello Islands	Dampier Archipelago	Rowley Sho.	N and Scott Reef and Seringapatam	Ashmore and Cartier	Inshore Kimberley	Central GBR
ACROPORIDAE	Acropora	*Acropora abrolhosensis*	Veron 1985										1			1	1	1	1	1	1		
		Acropora abrotanoides	Lamarck 1816													1		1	1	1	1		
		Acropora aculeus	Dana 1846										1	1		1	1	1	1			1	1
		Acropora acuminata	Verrill 1864										1				1	1			1		1
		Acropora anthocercis	Brook 1893										1			1	1	1	1	1	1	1	1
		Acropora arafura	Wallace Done and Muir 2012														1						
		Acropora aspera	Dana 1846										1		1	1	1	1			1	1	1
		Acropora austera	Dana 1846													1	1	1	1	1	1	1	1
		Acropora bushyensis	Veron and Wallace 1984												1							1	
		Acropora carduus	Dana 1846																1	1			1
		Acropora caroliniana	Nemenzo 1976																1		1		
		Acropora cerealis	Dana 1846										1			1	1	1	1	1	1	1	1
		Acropora clathrata	Brook 1891													1		1	1	1	1	1	1
		Acropora cytherea	Dana 1846													1	1	1	1	1	1	1	1
		Acropora dendrum	Bassett-Smith 1890										1				1	1				1	
		Acropora digitifera	Dana 1846										1	1	1	1	1	1	1	1	1	1	1
		Acropora divaricata	Dana 1846										1			1	1	1	1	1	1	1	1
		Acropora donei	Veron and Wallace 1984										1				1		1	1	1	1	1
		Acropora echinata	Dana 1846																1	1			
		Acropora elseyi	Brook 1892																1	1	1		1
		Acropora exquisita	Nemenzo 1971																1	1	1		
		Acropora florida	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Acropora gemmifera	Brook 1892														1	1	1	1	1	1	1
		Acropora glauca	Brook 1893									1	1	1			1	1	1		1		1

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Acropora grandis	Brook 1892										1			1	1		1	1	1		1
		Acropora granulosa	Milne Edwards 1860										1			1			1	1	1		1
		Acropora horrida	Dana 1846										1			1	1	1	1	1	1	1	1
		Acropora humilis	Dana 1846														1	1	1	1	1	1	1
		Acropora hyacinthus	Dana 1846								1		1		1	1	1	1	1	1	1	1	1
		Acropora indonesia	Wallace 1997																	1			
		Acropora insignis	Nemenzo 1967														1						
		Acropora intermedia	Brook 1891										1			1	1	1	1	1	1	1	1
		Acropora kirstyae	Veron and Wallace 1984																				1
		Acropora kosurini	Wallace 1994															1					
		Acropora latistella	Brook 1892										1		1	1	1	1	1	1	1	1	1
		Acropora listeri	Brook 1893														1	1	1	1			1
		Acropora loisetteae	Wallace 1994																1	1			
		Acropora longicyathus	Milne Edwards 1860													1			1	1	1		1
		Acropora loripes	Brook 1892													1	1		1	1	1		1
		Acropora loveli	Veron and Wallace 1984										1				1	1					
		Acropora lutkeni	Crossland 1952														1					1	1
		Acropora microclados	Ehrenberg 1834													1	1		1			1	1
		Acropora microphthalma	Verrill 1869										1			1	1	1	1	1	1	1	1
		Acropora millepora	Ehrenberg 1834								1		1		1	1	1	1	1	1	1	1	1
		Acropora monticulosa	Brüggemann 1879																1	1	1		
		Acropora muricata	Linnaeus 1758										1			1	1	1	1	1	1	1	1
		Acropora nana	Studer 1877													1	1	1	1	1	1	1	
		Acropora nasuta	Dana 1846										1			1	1	1	1	1	1		1
		Acropora palmerae	Wells 1954														1						
		Acropora paniculata	Verrill 1902														1				1	1	
		Acropora papillare	Latypov 1992																				1
		Acropora polystoma	Brook 1891														1	1	1				1
		Acropora pulchra	Brook 1891										1		1	1	1	1	1	1	1	1	1
		Acropora robusta	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Acropora samoensis	Brook 1891														1	1	1	1	1	1	1
		Acropora sarmentosa	Brook 1892										1			1	1	1				1	1
		Acropora secale	Studer 1878														1	1		1			1
		Acropora selago	Studer 1878										1	1		1	1	1	1	1	1	1	1
		Acropora solitaryensis	Veron and Wallace 1984									1	1	1	1		1	1	1		1	1	1
		Acropora spathulata	Brook 1891																				1
		Acropora speciosa	Quelch 1886																				1

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Acropora spicifera	Dana 1846										1		1	1	1	1	1	1		1	
		Acropora striata	Dana 1846																				1
		Acropora subglabra	Brook 1891																1	1	1		
		Acropora subulata	Dana 1846										1	1		1	1	1	1	1	1	1	1
		Acropora tenuis	Dana 1846										1			1	1	1	1	1	1	1	1
		Acropora torihalimeda	Wallace 1994																				1
		Acropora tortuosa	Dana 1846										1					1					1
		Acropora valenciennesi	Milne Edwards 1860										1			1	1	1		1	1		1
		Acropora valida	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Acropora vaughani	Wells 1954										1			1		1	1	1		1	1
		Acropora verweyi	Veron and Wallace 1984										1		1	1	1	1			1	1	1
		Acropora willisae	Veron and Wallace 1984										1			1	1			1			
		Acropora yongei	Veron and Wallace 1984					1					1	1		1	1	1	1	1	1	1	1
		Acropora Total			0	0	0	1	0	0	2	2	38	7	13	39	51	46	50	48	46	39	54
	Alveopora	*Alveopora allingi*	Hoffmeister 1925										1		1	1			1	1		1	1
		Alveopora catalai	Wells 1968																	1	1		1
		Alveopora fenestrata	Lamarck 1816					1				1	1			1	1	1	1	1	1	1	1
		Alveopora gigas	Veron 1985										1										
		Alveopora spongiosa	Dana 1846										1		1	1			1	1	1		1
		Alveopora tizardi	Bassett-Smith 1890										1		1				1				
		Alveopora verrilliana	Dana 1846										1			1	1			1	1		
		Alveopora Total			0	0	0	1	0	0	0	1	6	0	3	4	2	1	4	5	4	2	4
	Anacropora	*Anacropora forbesi*	Ridley 1884																				1
		Anacropora matthai	Pillai 1973																				1
		Anacropora puertogalerae	Nemenzo 1964																	1			1
		Anacropora reticulata	Veron and Wallace 1984																				1
		Anacropora Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4
	Astreopora	*Astreopora cucullata*	Lamberts 1980																1	1			
		Astreopora expansa	Brüggemann 1877										1			1		1	1	1	1		
		Astreopora gracilis	Bernard 1896										1				1	1		1	1	1	1
		Astreopora incrustans	Bernard 1896																1	1			
		Astreopora listeri	Bernard 1896														1			1			1
		Astreopora moretonensis	Veron and Wallace 1984																				1
		Astreopora myriophthalma	Lamarck 1816										1			1	1	1	1	1	1	1	1
		Astreopora ocellata	Bernard 1896										1			1	1	1			1	1	
		Astreopora Total			0	0	0	0	0	0	0	0	4	0	0	3	4	4	4	6	4	3	4
	Isopora	*Isopora brueggemanni*	Brook 1893														1		1	1	1	1	1

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Isopora palifera	Lamarck 1816															1	1	1	1	1	1
		Isopora Total			0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	2	2
	Montipora	*Montipora aequituberculata*	Bernard 1897										1	1	1	1	1	1	1	1	1	1	1
		Montipora angulata	Lamarck 1816										1		1	1	1			1		1	1
		Montipora australiensis	Bernard 1897										1									1	
		Montipora calcarea	Bernard 1897													1		1					
		Montipora caliculata	Dana 1846										1				1	1		1	1	1	
		Montipora capricornis	Veron 1985										1		1	1		1					
		Montipora crassituberculata	Bernard 1897										1			1	1	1		1		1	1
		Montipora danae	Milne Edwards and Haime 1851										1			1	1	1	1	1	1	1	1
		Montipora digitata	Dana 1846										1			1	1	1		1	1	1	1
		Montipora efflorescens	Bernard 1897										1			1	1	1	1	1	1	1	1
		Montipora floweri	Wells 1954													1			1	1	1		1
		Montipora foliosa	Pallas 1766										1			1	1	1	1	1	1		1
		Montipora foveolata	Dana 1846												1	1		1	1	1	1	1	1
		Montipora grisea	Bernard 1897										1	1		1	1	1	1	1	1	1	
		Montipora hispida	Dana 1846										1		1	1	1	1		1	1	1	1
		Montipora hoffmeisteri	Wells 1954										1			1		1	1	1	1		
		Montipora incrassata	Dana 1846										1				1	1	1	1			1
		Montipora informis	Bernard 1897										1			1	1	1	1	1	1	1	1
		Montipora millepora	Crossland 1952													1		1	1		1	1	
		Montipora mollis	Bernard 1897					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Montipora monasteriata	Forskål 1775												1	1	1	1	1	1	1	1	1
		Montipora nodosa	Dana 1846										1				1	1		1		1	
		Montipora peltiformis	Bernard 1897										1	1	1	1	1	1	1	1	1	1	1
		Montipora spongodes	Bernard 1897									1	1	1	1		1	1			1	1	
		Montipora spumosa	Lamarck 1816										1		1	1	1	1	1	1	1	1	1
		Montipora stellata	Bernard 1897										1			1	1	1					
		Montipora tortuosa	Dana 1846																				1
		Montipora tuberculosa	Lamarck 1816												1	1	1	1	1	1		1	1
		Montipora turgescens	Bernard 1897										1	1	1	1	1	1	1	1	1	1	
		Montipora turtlensis	Veron and Wallace 1984										1			1	1	1	1				1
		Montipora undata	Bernard 1897													1	1	1	1	1	1	1	1
		Montipora venosa	Ehrenberg 1834													1	1	1	1	1	1	1	1
		Montipora verrucosa	Lamarck 1816													1	1	1	1	1	1	1	1
		Montipora Total			0	0	0	1	1	1	1	2	23	6	12	27	25	29	21	25	22	24	22
		ACROPORIDAE Total			0	0	0	3	1	1	3	5	71	13	28	73	83	81	81	87	78	70	90

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
AGARICIIDAE	Coeloseris	*Coeloseris mayeri*	Vaughan 1918																1	1	1	1	1
		Coeloseris Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	Gardineroseris	*Gardineroseris planulata*	Dana 1846													1	1	1	1	1	1	1	
		Gardineroseris Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Leptoseris	*Leptoseris explanata*	Yabe and Sugiyama 1941										1			1	1		1	1	1	1	
		Leptoseris foliosa	Dinesen 1980										1			1	1			1	1		1
		Leptoseris hawaiiensis	Vaughan 1907										1			1			1	1	1		1
		Leptoseris incrustans	Quelch 1886																1	1	1		
		Leptoseris mycetoseroides	Wells 1954										1		1	1	1		1	1	1	1	1
		Leptoseris papyracea	Dana 1846																	1			
		Leptoseris scabra	Vaughan 1907										1			1			1	1	1		1
		Leptoseris yabei	Pillai and Scheer 1976										1			1			1	1	1	1	1
		Leptoseris Total			0	0	0	0	0	0	0	0	6	0	1	6	3	0	6	8	7	3	5
	Pachyseris	*Pachyseris rugosa*	Lamarck 1801													1	1	1	1	1	1	1	1
		Pachyseris speciosa	Dana 1846										1			1	1	1	1	1	1	1	1
		Pachyseris Total			0	0	0	0	0	0	0	0	1	0	0	2	2	2	2	2	2	2	2
	Pavona	*Pavona cactus*	Forskål 1775																1	1	1		1
		Pavona clavus	Dana 1846														1	1	1	1	1		
		Pavona decussata	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Pavona duerdeni	Scheer and Pillai 1974										1		1	1	1	1	1	1	1		1
		Pavona explanulata	Lamarck 1816										1		1	1	1	1	1	1	1	1	1
		Pavona maldivensis	Gardiner 1905										1			1	1		1	1	1		1
		Pavona minuta	Wells 1954																			1	
		Pavona varians	Verrill 1864										1			1	1	1	1	1	1	1	1
		Pavona venosa	Ehrenberg 1834													1	1		1	1	1	1	1
		Pavona Total			0	0	0	0	0	0	0	0	5	0	3	6	7	5	8	8	8	5	7
		AGARICIIDAE Total			0	0	0	0	0	0	0	0	12	0	4	15	13	8	18	20	19	12	15
ASTROCOENIIDAE	Madracis	*Madracis kirbyi*	Veron and Pichon 1976																				1
		Madracis Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Palauastrea	*Palauastrea ramosa*	Yabe and Sugiyama 1941										1										1
		Palauastrea Total			0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	Stylocoeniella	*Stylocoeniella armata*	Ehrenberg 1834																1	1			1
		Stylocoeniella guentheri	Bassett-Smith 1890										1			1		1	1	1	1	1	1
		Stylocoeniella Total			0	0	0	0	0	0	0	0	1	0	0	1	0	1	2	2	1	1	2
		ASTROCOENIIDAE Total			0	0	0	0	0	0	0	0	2	0	0	1	0	1	2	2	1	1	4

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
CARYOPHYLLIIDAE	Heterocyathus	*Heterocyathus aequicostatus*	Milne Edwards and Haime 1848																			1	
		Heterocyathus Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		CARYOPHYLLIIDAE Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
COSCINARAEIDAE	Coscinaraea	*Coscinaraea columna*	Dana 1846								1		1		1	1	1	1	1	1	1	1	1
		Coscinaraea exesa	Dana 1846										1			1		1	1	1		1	1
		Coscinaraea marshae	Wells 1962		1	1	1	1					1										
		Coscinaraea mcneilli	Wells 1962		1	1	1	1	1	1	1												
		Coscinaraea Total			2	2	2	2	1	1	2	0	3	0	1	2	1	2	2	2	1	2	2
		COSCINARAEIDAE Total			2	2	2	2	1	1	2	0	3	0	1	2	1	2	2	2	1	2	2
DENDROPHYLLIIDAE	Duncanopsammia	*Duncanopsammia axifuga*	Milne Edwards and Haime 1848												1	1	1	1				1	1
		Duncanopsammia Total			0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1
	Heteropsammia	*Heteropsammia cochlea*	Spengler 1781										1	1		1	1	1					
		Heteropsammia Total			0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0
	Rhizopsammia	*Rhizopsammia verrilli*	Van der Horst 1922																			1	
		Rhizopsammia Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Turbinaria	*Turbinaria bifrons*	Brüggemann 1877										1	1	1	1	1	1				1	1
		Turbinaria conspicua	Bernard 1896									1	1		1	1		1				1	
		Turbinaria frondens	Dana 1846			1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1
		Turbinaria heronensis	Wells 1958																				1
		Turbinaria mesenterina	Lamarck 1816		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1
		Turbinaria patula	Dana 1846														1	1				1	1
		Turbinaria peltata	Esper 1794				1	1	1				1		1	1	1	1		1	1	1	1
		Turbinaria radicalis	Bernard 1896										1										
		Turbinaria reniformis	Bernard 1896		1	1	1	1	1	1			1		1	1	1	1		1	1	1	1
		Turbinaria stellulata	Lamarck 1816										1			1	1	1	1	1	1	1	1
		Turbinaria Total			2	3	4	4	4	3	1	3	8	3	6	7	7	8	3	4	5	8	8
	Tubastraea	*Tubastraea coccinea*	Lesson 1829																			1	
		Tubastraea Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		DENDROPHYLLIIDAE Total			2	3	4	4	4	3	1	3	9	4	7	9	9	10	3	4	5	11	9

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
DIPLOASTREIDAE	Diploastrea	*Diploastrea helioporo*	Lamarck 1816													1	1	1	1	1	1	1	1
		Diploastrea Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
		DIPLOASTREIDAE Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
EUPHYLLIIDAE	Catalaphyllia	*Catalaphyllia jardinei*	Saville-Kent 1893														1	1			1	1	1
		Catalaphyllia Total			0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1
	Euphyllia	*Euphyllia ancora*	Veron and Pichon 1980													1	1	1	1	1	1	1	
		Euphyllia cristata	Chevalier 1971															1	1				1
		Euphyllia divisa	Veron and Pichon 1980										1					1					
		Euphyllia glabrescens	Chamisso and Eysenhardt 1821										1			1	1	1	1	1	1	1	1
		Euphyllia Total			0	0	0	0	0	0	0	0	2	0	0	2	2	4	3	2	2	2	2
	Galaxea	*Galaxea astreata*	Lamarck 1816													1	1	1	1	1	1	1	1
		Galaxea fascicularis	Linnaeus 1767										1			1	1	1	1	1	1	1	1
		Galaxea horrescens	Dana 1846																1	1	1		
		Galaxea longisepta	Fenner and Veron 2000																	1			
		Galaxea Total			0	0	0	0	0	0	0	0	1	0	0	2	2	2	3	4	3	2	2
	Montigyra	*Montigyra kenti*	Matthai 1928																			1	
		Montigyra Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		EUPHYLLIIDAE Total			0	0	0	0	0	0	0	0	3	0	0	4	5	7	6	6	6	6	5
FLABELLIDAE	Truncatoflabellum	*Truncatoflabellum aculeatum*	Milne Edwards and Haime 1848																			1	
		Truncatoflabellum Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		FLABELLIDAE Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
FUNGIIDAE	Cantharellus	*Cantharellus noumeae*	Hoeksema and Best 1984																1				
		Cantharellus Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Ctenactis	*Ctenactis crassa*	Dana 1846													1		1	1	1	1	1	1
		Ctenactis echinata	Pallas 1766													1	1		1	1	1	1	1
		Ctenactis Total			0	0	0	0	0	0	0	0	0	0	0	2	1	1	2	2	2	2	2
	Cycloseris	*Cycloseris costulata*	Ortmann 1889																1	1	1		1
		Cycloseris cyclolites	Lamarck 1815												1		1	1			1	1	
		Cycloseris distorta	Michelin 1842										1										
		Cycloseris explanulata	Van der Horst 1922										1			1		1			1	1	1
		Cycloseris fragilis	Alcock 1893										1		1			1					
		Cycloseris mokai	Hoeksema 1989													1		1		1	1		1
		Cycloseris sinensis	Milne Edwards and Haime 1851																		1		

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Cycloseris tenuis	Dana 1846																			1	
		Cycloseris vaughani	Boschma 1923																1	1	1		
		Cycloseris wellsi	Veron and Pichon 1980																	1			
		Cycloseris Total			0	0	0	0	0	0	0	0	3	0	2	2	1	4	2	4	6	3	3
	Danafungia	*Danafungia horrida*	Dana 1846																1	1	1	1	1
		Danafungia scruposa	Klunzinger 1879														1	1		1	1	1	1
		Danafungia Total			0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	2
	Fungia	*Fungia fungites*	Linnaeus 1758													1	1	1	1	1	1	1	1
		Fungia Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Halomitra	*Halomitra pileus*	Linnaeus 1758														1						1
		Halomitra Total			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	Heliofungia	*Heliofungia actiniformis*	Quoy and Gaimard 1833																	1	1	1	1
		Heliofungia Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	Herpolitha	*Herpolitha limax*	Esper 1797													1	1	1	1	1	1	1	1
		Herpolitha Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Lithophyllon	*Lithophyllon concinna*	Verrill 1864													1		1	1	1	1	1	1
		Lithophyllon repanda	Dana 1846										1			1	1	1	1	1	1	1	1
		Lithophyllon undulatum	Rehberg 1892														1	1		1		1	
		Lithophyllon Total			0	0	0	0	0	0	0	0	1	0	0	2	2	3	2	3	2	3	2
	Lobactis	*Lobactis scutaria*	Lamarck 1801													1		1	1	1	1	1	1
		Lobactis Total			0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	Pleuractis	*Pleuractis granulosa*	Klunzinger 1879																1	1	1		1
		Pleuractis moluccensis	Van der Horst 1919																				1
		Pleuractis paumotensis	Stutchbury 1833															1	1	1	1		1
		Pleuractis Total			0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	0	3
	Podabacia	*Podabacia crustacea*	Pallas 1766													1	1	1	1	1	1	1	1
		Podabacia Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Polyphyllia	*Polyphyllia talpina*	Lamarck 1801													1	1	1	1	1	1	1	1
		Polyphyllia Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Sandalolitha	*Sandalolitha robusta*	Quelch 1886													1			1	1	1	1	1
		Sandalolitha Total			0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1
		FUNGIIDAE Total			0	0	0	0	0	0	0	0	4	0	2	12	10	15	16	20	21	17	20
INCERTAE SEDIS	Blastomussa	*Blastomussa merleti*	Wells 1961										1				1	1					
		Blastomussa wellsi	Wijsman-Best 1973										1										
		Blastomussa Total			0	0	0	0	0	0	0	0	2	0	0	0	1	1	0	0	0	0	0
	Leptastrea	*Leptastrea aequalis*	Veron 2000																	1			
		Leptastrea bottae	Milne Edwards and Haime 1849													1					1		

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Leptastrea inaequalis	Klunzinger 1879																1	1	1		1
		Leptastrea pruinosa	Crossland 1952										1			1	1	1	1	1	1	1	1
		Leptastrea purpurea	Dana 1846										1			1	1	1	1	1	1	1	1
		Leptastrea transversa	Klunzinger 1879													1	1	1	1	1	1	1	1
		Leptastrea Total			0	0	0	0	0	0	0	0	2	0	0	4	3	3	4	5	5	3	4
	Oulastrea	*Oulastrea crispata*	Lamarck 1816																			1	
		Oulastrea Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Physogyra	*Physogyra lichtensteini*	Milne Edwards and Haime 1851													1	1	1	1	1	1		1
		Physogyra Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Plerogyra	*Plerogyra sinuosa*	Dana 1846													1	1	1	1	1	1	1	1
		Plerogyra Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Plesiastrea	*Plesiastrea versipora*	Lamarck 1816		1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
		Plesiastrea Total			1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
		INCERTAE SEDIS Total			1	1	1	1	1	1	1	0	5	1	1	7	7	7	7	8	8	6	7
LOBOPHYLLIIDAE	Acanthastrea	*Acanthastrea bowerbanki*	Milne Edwards 1857																		1		
		Acanthastrea brevis	Milne Edwards and Haime 1849																	1			
		Acanthastrea echinata	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Acanthastrea hemprichi	Ehrenberg 1834														1						
		Acanthastrea hillae	Wells 1955										1		1	1	1	1				1	
		Acanthastrea lordhowensis	Veron and Pichon 1982															1				1	
		Acanthastrea subechinata	Veron 2000														1						
		Acanthastrea Total			0	0	0	0	0	0	0	0	2	0	2	2	4	3	1	2	2	3	1
	Cynarina	*Cynarina lacrymalis*	Milne Edwards and Haime 1849														1					1	1
		Cynarina Total			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
	Echinophyllia	*Echinophyllia aspera*	Ellis and Solander 1786										1		1	1	1	1	1	1	1	1	1
		Echinophyllia echinata	Saville-Kent 1871														1			1	1		
		Echinophyllia echinoporoides	Veron and Pichon 1980																			1	1
		Echinophyllia orpheensis	Veron and Pichon 1980										1		1	1	1	1	1	1	1	1	1
		Echinophyllia Total			0	0	0	0	0	0	0	0	2	0	2	2	3	2	2	3	3	3	3
	Lobophyllia	*Lobophyllia corymbosa*	Forskål 1775										1			1	1	1			1	1	1
		Lobophyllia diminuta	Veron 1985													1	1						
		Lobophyllia flabelliformis	Veron 2000														1						
		Lobophyllia hataii	Yabe and Sugiyama 1936										1			1	1	1	1	1	1		1
		Lobophyllia hemprichii	Ehrenberg 1834										1			1	1	1	1	1	1	1	1
		Lobophyllia pachysepta	Chevalier 1975																				1
		Lobophyllia robusta	Yabe Sugiyama and Eguchi 1936														1						
		Lobophyllia Total			0	0	0	0	0	0	0	0	3	0	0	4	6	3	2	2	3	2	4

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Moseleya	*Moseleya latistellata*	Quelch 1884										1		1	1	1	1				1	1
		Moseleya Total			0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	1	1
	Oxypora	*Oxypora glabra*	Nemenzo 1959										1			1	1		1	1	1	1	
		Oxypora lacera	Verrill 1864										1		1	1	1	1	1	1	1	1	1
		Oxypora Total			0	0	0	0	0	0	0	0	2	0	1	2	2	1	2	2	2	2	1
	Parascolymia	*Parascolymia rowleyensis*	Veron 1985										1				1	1	1	1	1	1	
		Parascolymia vitiensis	Brüggemann 1877														1					1	1
		Parascolymia Total			0	0	0	0	0	0	0	0	1	0	0	0	2	1	1	1	1	2	1
	Symphyllia	*Symphyllia agaricia*	Milne Edwards and Haime 1849													1		1	1	1	1		
		Symphyllia radians	Milne Edwards and Haime 1849													1	1		1		1	1	1
		Symphyllia recta	Dana 1846														1	1	1	1	1	1	1
		Symphyllia valenciennesii	Milne Edwards and Haime 1849															1	1	1	1		
		Symphyllia wilsoni	Veron 1985			1	1	1	1	1	1	1	1	1	1								
		Symphyllia Total			0	1	1	1	1	1	1	1	1	1	1	2	2	3	4	3	4	2	2
		LOBOPHYLLIIDAE Total			0	1	1	1	1	1	1	1	12	1	7	13	21	14	12	13	15	16	14
MERULINIDAE	Astrea	*Astrea annuligera*	Milne Edwards and Haime 1849																1	1	1		
		Astrea curta	Dana 1846										1	1	1	1	1	1	1	1	1	1	1
		Astrea Total			0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	1	1
	Australogyra	*Australogyra zelli*	Veron Pichon and Best 1977																				1
		Australogyra Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Caulastraea	*Caulastraea curvata*	Wijsman-Best 1972														1					1	
		Caulastraea furcata	Dana 1846																	1	1	1	1
		Caulastraea tumida	Matthai 1928														1	1				1	
		Caulastraea Total			0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	1	1	3	1
	Coelastrea	*Coelastrea aspera*	Verrill 1866				1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
		Coelastrea palauensis	Yabe and Sugiyama 1936					1					1			1		1		1	1	1	1
		Coelastrea Total			0	0	1	2	1	1	1	0	2	1	1	2	1	2	1	2	2	2	2
	Cyphastrea	*Cyphastrea agassizi*	Vaughan 1907																1				
		Cyphastrea chalcidicum	Forskål 1775													1	1	1	1	1	1	1	1
		Cyphastrea japonica	Yabe and Sugiyama 1932																				1
		Cyphastrea microphthalma	Lamarck 1816													1	1	1	1	1	1	1	1
		Cyphastrea serailia	Forskål 1775					1	1	1			1	1	1	1	1	1	1	1	1	1	1
		Cyphastrea Total			0	0	0	1	1	1	0	0	1	1	1	3	3	3	4	3	3	3	4
	Dipsastraea	*Dipsastraea amicorum*	Milne Edwards and Haime 1849					1					1			1	1	1			1	1	
		Dipsastraea danai	Milne Edwards 1857																	1			1
		Dipsastraea favus	Forskål 1775					1					1		1	1	1	1	1	1	1	1	1
		Dipsastraea helianthoides	Wells 1954													1	1		1	1	1		1

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Dipsastraea laxa	Klunzinger 1879										1				1		1	1	1		1
		Dipsastraea lizardensis	Veron, Pichon and Wijsman-Best 1977										1					1	1	1	1		1
		Dipsastraea maritima	Nemenzo 1971														1					1	1
		Dipsastraea marshae	Veron 2000															1					
		Dipsastraea matthaii	Vaughan 1918										1			1	1	1	1	1	1	1	1
		Dipsastraea maxima	Veron Pichon and Wijsman-Best 1977										1			1	1	1	1	1	1	1	1
		Dipsastraea pallida	Dana 1846										1			1	1	1	1	1	1	1	1
		Dipsastraea rosaria	Veron 2002																				1
		Dipsastraea rotumana	Gardiner 1899														1	1	1	1	1		1
		Dipsastraea speciosa	Dana 1846													1	1	1	1	1	1	1	1
		Dipsastraea truncata	Veron 2000																1	1			1
		Dipsastraea veroni	Moll and Best 1984										1				1	1			1	1	1
		Dipsastraea Total			0	0	0	2	0	0	0	0	8	0	1	7	11	10	10	11	11	8	14
	Echinopora	*Echinopora ashmorensis*	Veron 1990														1		1				
		Echinopora gemmacea	Lamarck 1816															1			1		1
		Echinopora hirsutissima	Milne Edwards and Haime 1849															1		1	1	1	
		Echinopora horrida	Dana 1846													1		1	1	1	1	1	1
		Echinopora lamellosa	Esper 1795													1	1	1	1	1	1	1	1
		Echinopora mammiformis	Nemenzo 1959																	1	1		1
		Echinopora Total			0	0	0	0	0	0	0	0	0	0	0	2	2	4	3	4	5	3	4
	Favites	*Favites abdita*	Ellis and Solander 1786				1	1				1	1	1	1	1	1	1	1	1	1	1	1
		Favites acuticollis	Ortmann 1889														1						1
		Favites chinensis	Verrill 1866										1		1	1	1	1		1	1	1	1
		Favites complanata	Ehrenberg 1834				1	1	1				1			1	1	1	1	1	1	1	1
		Favites flexuosa	Dana 1846					1					1	1		1	1	1		1	1	1	1
		Favites halicora	Ehrenberg 1834										1			1	1	1	1	1	1	1	1
		Favites magnistellata	Chevalier 1971										1		1	1	1	1	1	1	1	1	1
		Favites paraflexuosus	Veron 2000														1						
		Favites pentagona	Esper 1794							1			1	1	1	1	1	1	1	1	1	1	1
		Favites rotundata	Veron Pichon and Wijsman-Best 1977										1			1	1	1		1	1	1	
		Favites stylifera	Yabe and Sugiyama 1937														1		1	1			
		Favites valenciennesi	Milne Edwards and Haime 1849										1		1	1	1	1	1	1	1	1	1
		Favites Total			0	0	2	3	1	1	0	1	9	3	5	9	12	9	7	10	9	9	9
	Goniastrea	*Goniastrea edwardsi*	Chevalier 1971										1		1	1	1	1	1	1	1	1	1
		Goniastrea favulus	Dana 1846										1		1	1	1	1		1	1	1	1
		Goniastrea pectinata	Ehrenberg 1834										1		1	1	1	1	1	1	1	1	1
		Goniastrea retiformis	Lamarck 1816											1		1	1	1	1	1	1	1	1

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Goniastrea stelligera	Dana 1846													1	1	1	1	1	1	1	1
		Goniastrea Total			0	0	0	0	0	0	0	0	3	1	3	5	5	5	4	5	5	5	5
	Hydnophora	*Hydnophora exesa*	Pallas 1766										1		1	1	1	1	1	1	1	1	1
		Hydnophora grandis	Gardiner 1904														1						
		Hydnophora microconos	Lamarck 1816													1	1	1			1	1	
		Hydnophora pilosa	Veron 1985										1		1	1	1	1		1	1	1	
		Hydnophora rigida	Dana 1846													1	1	1	1	1	1	1	1
		Hydnophora Total			0	0	0	0	0	0	0	0	2	0	2	4	5	4	2	3	4	4	2
	Leptoria	*Leptoria phrygia*	Ellis and Solander 1786													1	1	1	1	1	1	1	1
		Leptoria Total			0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Merulina	*Merulina ampliata*	Ellis and Solander 1786										1			1	1	1	1	1	1	1	1
		Merulina scabricula	Dana 1846													1	1	1	1	1	1		
		Merulina triangularis	Veron and Pichon 1980																				1
		Merulina Total			0	0	0	0	0	0	0	0	1	0	0	2	2	2	2	2	2	1	2
	Mycedium	*Mycedium elephantotus*	Pallas 1766										1			1	1	1	1	1	1	1	1
		Mycedium mancaoi	Nemenzo 1979																	1			
		Mycedium robokaki	Moll and Best 1984														1			1	1		
		Mycedium Total			0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	3	2	1	1
	Oulophyllia	*Oulophyllia bennettae*	Veron Pichon and Best 1977														1	1	1	1	1	1	1
		Oulophyllia crispa	Lamarck 1816													1	1	1	1	1	1	1	1
		Oulophyllia Total			0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	2	2	2	2
	Paragoniastrea	*Paragoniastrea australensis*	Milne Edwards 1857				1	1	1	1	1	1	1	1	1	1	1	1				1	1
		Paragoniastrea russelli	Wells 1954					1					1	1	1	1	1	1	1	1	1		1
		Paragoniastrea Total			0	0	1	2	1	1	1	1	2	2	2	2	2	2	1	1	1	1	2
	Pectinia	*Pectinia alcicornis*	Saville-Kent 1871																1	1	1	1	1
		Pectinia lactuca	Pallas 1766													1	1	1	1	1	1	1	1
		Pectinia paeonia	Dana 1846													1	1	1	1	1	1	1	1
		Pectinia teres	Nemenzo and Montecillo 1981																1	1	1		
		Pectinia Total			0	0	0	0	0	0	0	0	0	0	0	2	2	2	4	4	4	3	3
	Platygyra	*Platygyra acuta*	Veron 2000														1	1					
		Platygyra daedalea	Ellis and Solander 1786										1		1	1	1	1	1	1	1	1	1
		Platygyra lamellina	Ehrenberg 1834									1	1	1	1	1	1	1		1	1	1	1
		Platygyra pini	Chevalier 1975												1	1	1	1	1	1	1	1	1
		Platygyra ryukyuensis	Yabe and Sugiyama 1935													1	1	1	1	1	1		
		Platygyra sinensis	Milne Edwards and Haime 1849											1		1	1	1	1	1	1	1	1
		Platygyra verweyi	Wijsman-Best 1976													1	1	1	1	1	1	1	
		Platygyra yaeyamaensis	Eguchi and Shirai 1977														1						

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Platygyra Total			0	0	0	0	0	0	0	1	2	2	3	6	8	7	5	6	6	5	4
	Scapophyllia	*Scapophyllia cylindrica*	Milne Edwards and Haime 1849										1			1	1	1	1	1	1	1	
					0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0	0
	Trachyphyllia	*Trachyphyllia geoffroyi*	Audouin 1826														1	1				1	
		Trachyphyllia Total			0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
		MERULINIDAE Total			0	0	4	10	4	4	2	4	32	11	20	49	63	58	50	61	61	53	58
MUSSIDAE	Mussidae	*Homophyllia australis*	Milne Edwards and Haime 1849			1	1	1									1						
		Homophyllia Total			0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
		MUSSIDAE Total			0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
POCILLOPORIDAE	Pocillopora	*Pocillopora damicornis*	Linnaeus 1758					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Pocillopora grandis	Milne Edwards and Haime 1860												1	1	1	1	1	1	1		
		Pocillopora meandrina	Dana 1846										1			1	1	1	1	1	1		
		Pocillopora verrucosa	Ellis and Solander 1786										1		1	1	1	1	1	1	1	1	
		Pocillopora woodjonesi	Vaughan 1918													1		1		1	1		1
		Pocillopora Total			0	0	0	1	1	1	1	1	3	1	3	5	4	5	4	5	5	2	2
	Seriatopora	*Seriatopora caliendrum*	Ehrenberg 1834													1	1	1			1	1	1
		Seriatopora hystrix	Dana 1846													1	1		1	1	1	1	1
		Seriatopora Total			0	0	0	0	0	0	0	0	0	0	0	2	2	1	1	1	2	2	2
	Stylophora	*Stylophora pistillata*	Esper 1797												1	1	1	1	1	1	1	1	1
		Stylophora Total			0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
		POCILLOPORIDAE Total			0	0	0	1	1	1	1	1	3	1	4	8	7	7	6	7	8	5	5
PORITIDAE	Bernardopora	*Bernardopora stutchburyi*	Wells 1955										1		1		1	1	1		1	1	1
		Bernardopora Total			0	0	0	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	1
	Goniopora	*Goniopora burgosi*	Nemenzo 1955														1		1	1			
		Goniopora columna	Dana 1846										1			1	1	1		1	1	1	
		Goniopora djiboutiensis	Vaughan 1907										1				1	1	1	1		1	1
		Goniopora eclipsensis	Veron and Pichon 1982																			1	
		Goniopora fruticosa	Saville-Kent 1891																				1
		Goniopora lobata	Milne Edwards and Haime 1860												1	1	1	1		1	1	1	1
		Goniopora norfolkensis	Veron and Pichon 1982																			1	1
		Goniopora palmensis	Veron and Pichon 1982														1	1	1			1	1
		Goniopora pandoraensis	Veron and Pichon 1982															1			1	1	
		Goniopora pedunculata	Quoy and Gaimard 1833													1		1	1	1	1	1	1
		Goniopora pendulus	Veron 1985					1					1					1	1		1	1	
		Goniopora somaliensis	Vaughan 1907																		1	1	1
		Goniopora stokesi	Milne Edwards and Haime 1851										1	1			1	1			1	1	

F	Genus Name	Species name	Author Year	Site (see Figure 1):	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		Goniopora tenuidens	Quelch 1886										1	1	1	1	1	1	1	1	1	1	
		Goniopora Total			0	0	0	1	0	0	0	0	5	2	2	4	7	9	6	6	8	12	7
	Porites	*Porites annae*	Crossland 1952														1		1	1			1
		Porites australiensis	Vaughan 1918														1						1
		Porites cylindrica	Dana 1846													1	1	1	1	1	1	1	1
		Porites heronensis	Veron 1985										1					1					
		Porites lichen	Dana 1846										1			1	1	1	1	1	1	1	1
		Porites lobata	Dana 1846										1		1	1	1	1	1	1	1	1	1
		Porites lutea	Quoy and Gaimard 1833					1					1		1	1	1	1	1	1	1	1	1
		Porites monticulosa	Dana 1846																1	1			
		Porites murrayensis	Vaughan 1918															1	1	1			
		Porites nigrescens	Dana 1848													1	1		1	1	1	1	1
		Porites rus	Forskål 1775														1	1	1	1	1	1	1
		Porites solida	Forskål 1775										1			1	1	1	1	1			1
		Porites stephensoni	Crossland 1952																		1	1	
		Porites vaughani	Crossland 1952																1	1	1	1	1
		Porites Total			0	0	0	1	0	0	0	0	5	0	2	6	9	8	11	11	8	8	10
		PORITIDAE Total			0	0	0	2	0	0	0	0	11	2	5	10	17	18	18	17	17	22	18
PSAMMOCORIDAE	Psammocora	*Psammocora contigua*	Esper 1794										1		1	1	1	1	1	1	1	1	1
		Psammocora digitata	Milne Edwards and Haime 1851										1			1	1	1	1	1	1	1	1
		Psammocora haimiana	Milne Edwards and Haime 1851										1			1		1	1	1		1	
		Psammocora profundacella	Gardiner 1898										1		1	1	1	1	1	1	1	1	
		Psammocora verrilli	Vaughan 1907														1	1		1	1		
		Psammocora Total			0	0	0	0	0	0	0	0	4	0	2	4	4	5	4	5	4	4	2
		PSAMMOCORIDAE Total			0	0	0	0	0	0	0	0	4	0	2	4	4	5	4	5	4	4	2
SIDERASTREIDAE	Pseudosiderastrea	*Pseudosiderastrea tayamai*	Yabe and Sugiyama 1935													1		1				1	1
		Pseudosiderastrea Total			0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1
		SIDERASTREIDAE Total			0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1
GRAND TOTAL					**5**	**8**	**13**	**25**	**13**	**12**	**11**	**14**	**171**	**33**	**81**	**209**	**242**	**235**	**226**	**253**	**245**	**229**	**251**

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