CONDITION AND SPATIAL DISTRIBUTION OF STONY CORAL IN BUNGURAN, SOUTHWEST NATUNA ISLANDS, INDONESIA

M. I. Yosephine Tuti H.

Research Centre for Oceanography–Indonesian Institute of Sciences
Jln. Pasir Putih 1 Ancol Timur, Jakarta 14430, Indonesia
E-mail: yostuti@yahoo.co.id

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ABSTRACT

Bunguran waters is part of Natuna waters consisting of several small islands located in the southern part of South China Sea, between Sumatera and Kalimantan Island. This paper reported results of a study on spatial distribution and condition of coral reefs and other biota in Bunguran waters,i.e. percentage cover and diversity of coral species. The observation was conducted using line intercept transect (LIT) on eight stations distributed in Salor Island, Sedanau Island, Komang Island, Kumbik Island, Depeh Strait, Sabangmawang Island, Pulau Tiga Village and Tekolampak Cape. The results showed that the reef type of Bunguran were mostly fringing reef dominated by *Porites cylindrica*, P. lutea and P. rus. *Porites spp*. were evenly distributed in all location observed. A total of 115 coral species belonging to 16 genera were found and the percentage of living coral cover ranged from 43.20 to 63.53 %. Coral cover reached their maximum at 10–15 meter depth and decreased rapidly coincident with the increasing depth. In general, the condition of coral cover was in "good" category with the average percentage living cover of coral was estimated 51.38%.

Keywords: Coral reefs, condition, distribution, diversity, South West Natuna.

INTRODUCTION

Coral reef ecosystem is a unique environment with a high diversity of biota (Hoeksema and Putra, 2000; Wallace et al., 2000). In Indonesia, the role of these ecosystems is very important as renewable resources that they are strongly support the local economic development. Exploitation on this ecosystem will give impacts on both the natural environment and in socio-economic systems (Walker et al., 2006). Coral reefs are among the most threatened global ecosystems, and among the most vitals compared to other ecosystem, such as estuarine, mangrove and sea grass (Wilkinson, 2000). Especially in developing countries such as Indonesia, reefs are important to human survival because they provide subsistence food for a substantial portion of the population. Supporting by Wells *et al.* (2001), and Salm *et al.* (2001), coral reef ecosystem serves as the principle coastal protection structures for most tropical islands, as well as contributes major income including from tourism aspects. Bunguran, which is part of Natuna Islands, waters located in the southern part of South China Sea, which consists of several small islands. The area has a variety of ecosystems such as mangrove, sea-grasses and coral reefs, and deposits. The communities in Bunguran Island are mostly fishermen and solely dependent on the marine fisheries.

Natuna Islands are one group of islands located in the southern part of South China Sea. The Natuna Islands district is administratively under Riau Islands Province. From the natural resources perspectives of the waters, the Natuna Islands has a high potential of fisheries resources. These waters have a variety of ecosystems such as mangroves, sea-grasses and coral reef ecosystems which are places to live and spawn for a variety of biota. The communities in Bunguran are mostly

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fishermen and are solely dependent on fisheries, whilst Natuna as a whole is known as a growing oil industrial area, from which oil pollution is a potential threat. Furthermore, rapid development and unfriendly fishing technique has given more serious pressures on the surrounding environment, especially at West Bunguran (Cappenberg and Djuwariah, 2008). Monitoring is necessary to provide knowledge on the impact of human activities on coral reef ecosystems, which has been stated by Hodgson (1999). Knowledge of which is not well understood. Moreover, mapping on coastal habitats is an essential requirement for developing coastal management plans (Cendrero, 1989). Accordingly, research must be done to determine the condition and distribution of coral reefs.

The purpose of this paper is to show the spatial distribution and the condition of coral reefs and other biota in Bunguran, south west of Natuna Islands, in terms of percentage cover and diversity of coral species.

MATERIAL AND METHODS

The study was conducted in Bunguran subdistric located in the south western part of Natuna Islands. The sampling sites are covered eight islands i.e. Salor, Sedanau, Komang, Kumbik, Depeh Strait, Sabangmawang, Pulau Tiga Village and Tekolampak Cape (Fig. 1). The condition of coral reefs was observed using Line Intercept Transect adopted from English *et al.* (1997), on eight sites. The 10 meters measuring tape was used as transect and placed on 5 and 10 meters depth. At each depth, a set of three replicate transects was laid down parallel to the shoreline. All biota and substrate found below the transect line was recorded with accuracy up to centimeters.

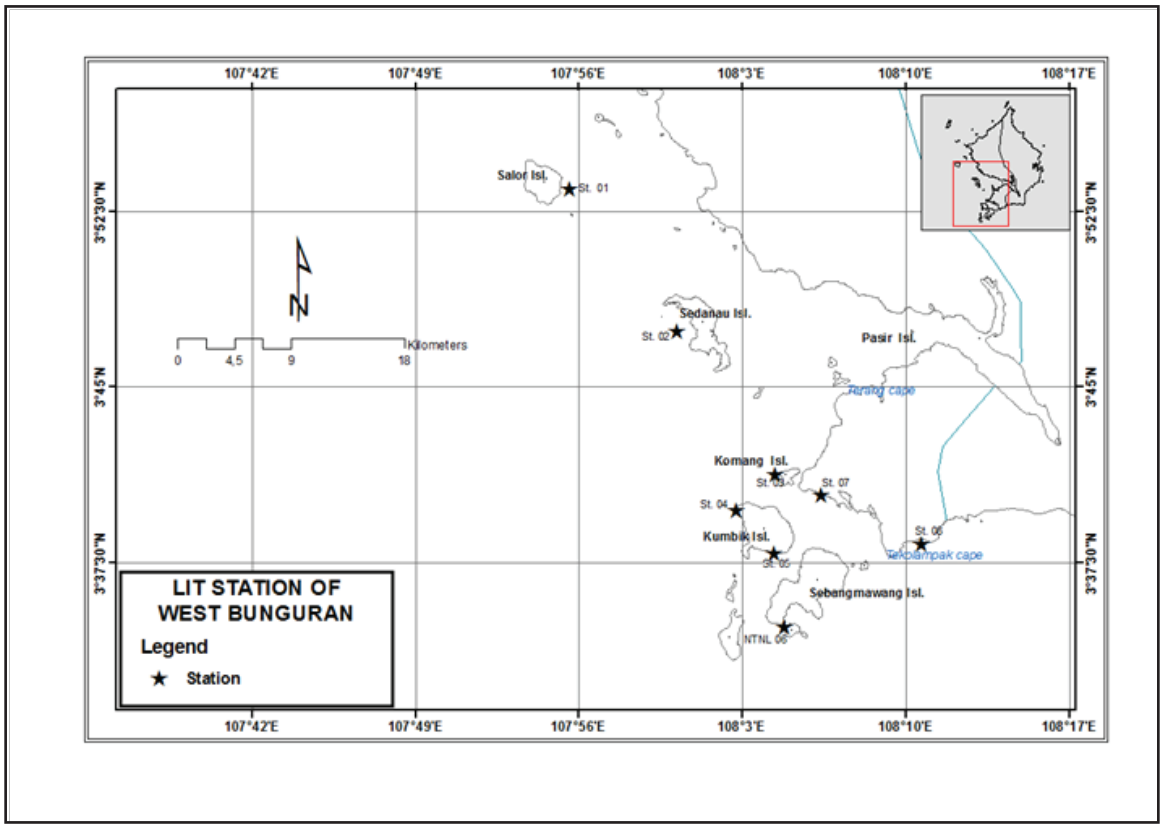


Figure 1. Sampling stations on reef of West Bunguran, South West Natuna

Based on transect data obtained, the length of each category of biota/substrate under the transect line was calculated. Percentage cover was calculated based on the ratio between the length area of each category of biota or substrate with the length of transect line. This technique was also used to calculate the occurrence frequency of hard coral along the transect line. Both calculations were used to estimate the index values i.e. species richness index (d), evenness (J ‘) and diversity (H’ (ln)) following Zar (1996) and Warwick and Clarke (2001). Cluster analysis was done based on the frequency of occurrence, living coral cover and substrate type by applying Multi-dimensional Method PRIMER program version 5.2 referring to Warwick and Clarke (2001).

RESULTS AND DISCUSSION

Coral reefs were found in good condition in four observed sites, with coral cover range that the percentage coral cover at four sites ranged 52.73–63.53%. The other four sites were categorized as fair condition with coral cover ranged from 43.20 to 49.57%. Those reefs may represent coral condition in the south western part of Natuna, in which the average of living coral cover reached 51.38% and were categorized in good condition were still in good condition (Fig. 2). The highest living coral cover was found in Site 2 and the lowest was in Site 4. The coral communities in all sites were dominated by *Poriteslutea*, *Poritescylindrica* and *Porites lobata*.

The high percentage of coral rubble in this area might be due to coral bombing, coral bleaching or destructive fishing technique. The coral rubbles were mostly covered by filamentous or turf algae.

Cluster analysis based on the percentage of living coral and substrate type showed that there were three different groups of coral communities (Fig. 4) with Site 6 was separated from other sites. This might be generated by low percentage of *Acropora spp.* The cluster configuration of living coral and coral rubble showed the same pattern while the proportion of living coral cover was always coupled with the coral rubble.

This study uncovered 115 species of stony corals which belonged to 16 genus . The highest number of coral species was found in Site 7 which consisted of 43 species and the lowest was on Site 4 with 22 species (Fig. 5; Appendix 1).

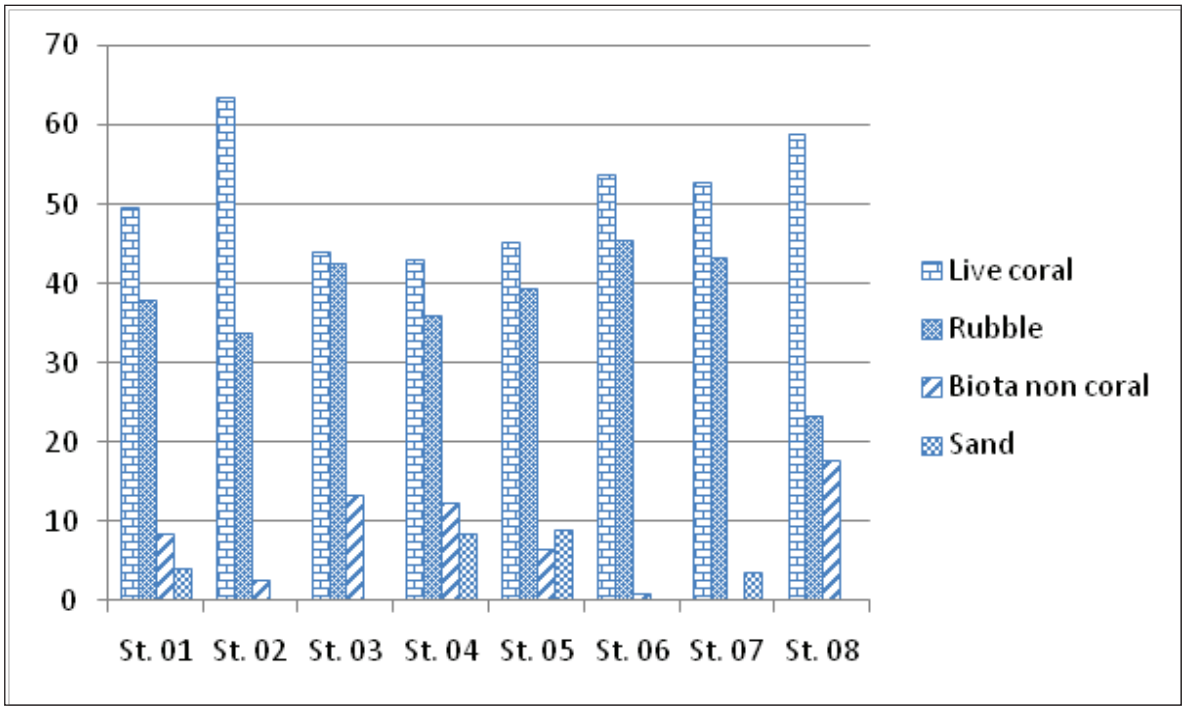


Figure 2. The percentage cover of living coral, biota non-coral, rubble and sand at West Bunguran, Natuna.

The highest percentage of *Acropora* cover was found on Site 3 and the lowest was recorded on Site 7 (Fig. 6). The coral genus *Acropora* can be used as an indicator for high diversity of marine biota, as it contains the greatest number of species of any extent coral genus and it occurs in all tropical reef habitats (Wallace, 1999).

Acropora spp was found at all sites with percentage cover ranging from 2. 17 to 30.97% (12.99% in average). This genus was relatively of higher coverage in Sites 3, 5, 7, 8. These sites were located in relatively semi enclosed location (Fig. 6). Compared to adjacent waters i.e. Batam, Anambas and Bangka Belitung, the percentage cover of *Acropora spp* in Bunguran was relatively low. Community structure and reefs distribution are resulted from the response of coral to the biotic and abiotic factors such as current pattern, substrate type and local hydrodynamic (Harriot et al. 1994). Corals condition was determined by specific biotic factor such as predatory by *Acantasther planci,* competition and bleaching event. Abiotic factors such as current pattern during monsoon changed the coral condition in Bunguran Islands. Natuna area in which the observed sites were located, lays on the main axis of current flow which runs along Riau to the South China Sea. The current runs six months northward and six months southward.

Natuna Islands are regularly reported being hit by abnormal temperature and it results the bleaching event. The last bleaching event occurred in 2010 (Hendri, pers.comm.). Branching *Acroporidae* and *Pocilloporidae* are most susceptible to bleaching event, in contrast with Poritidae which is least susceptible to bleaching corals. The difference in susceptibilities of the different coral species results in changing of their relative abundance following a mass mortality and growth of less sensitive coral species, soft corals or turf and filamentous algae (McClanahan et al., 2007, Hughes et al., 2007, Baker et al., 2008).

There were 25 species of *Acropora* in West Bunguran waters. The species number did not reflect the real number of *Acropora* species in the Natuna Island due to limited intensity and covered area. Wallace (1999) found that the west coast of Sumatera deposits as many as 40 *Acropora* species. However, the greatest number was found in Tomini Bay, Central Sulawesi with 78 species out of 119 coral species recorded in Indonesia (Wallace et al.,

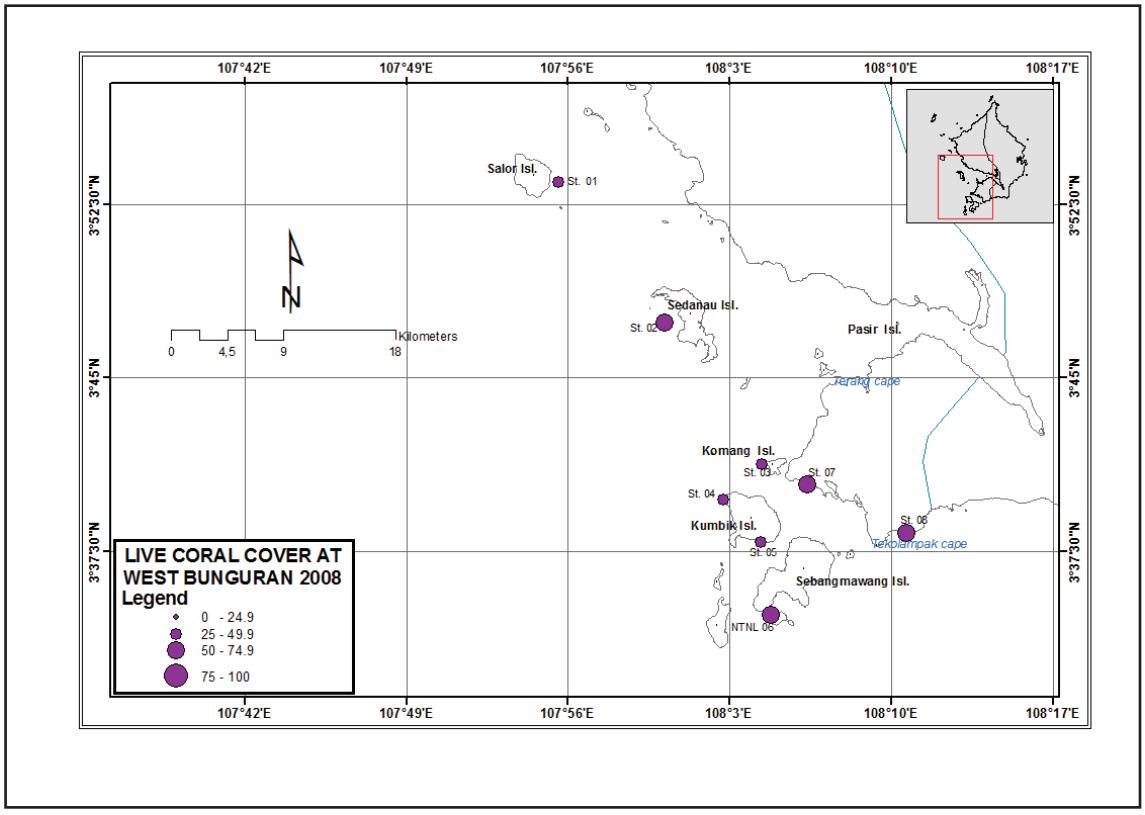
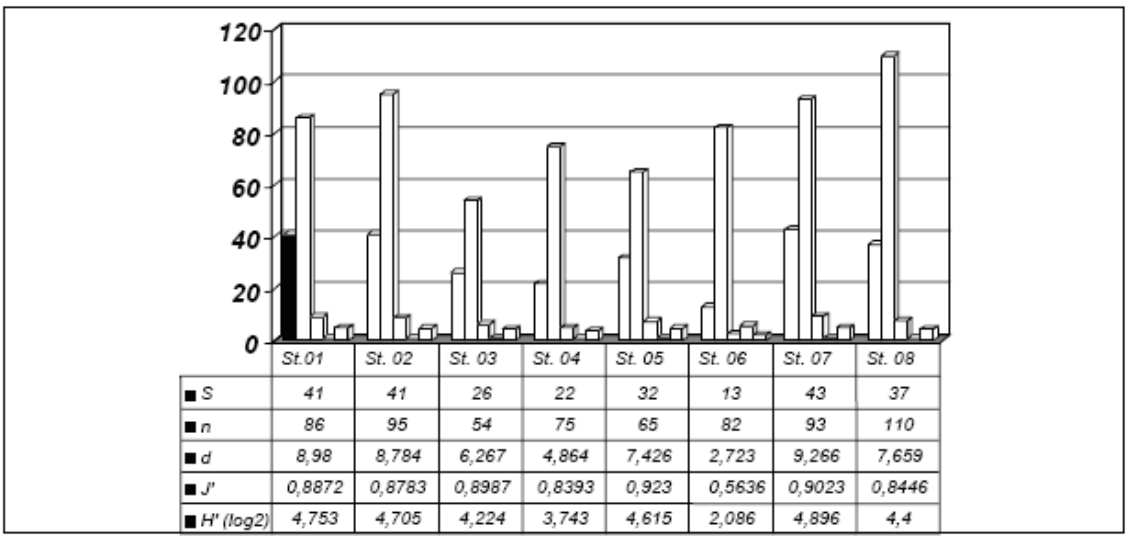


Figure 3. Living coral cover at West Bunguran, Natuna.

Figure 4. Multi Dimensional Scaling (MDS) Superimpose based on hard coral occurrence at West Bunguran, South West Natuna.



	St.01	St. 02	St. 03	St. 04	St. 05	St. 06	St. 07	St. 08
S	41	41	26	22	32	13	43	37
n	86	95	54	75	65	82	93	110
d	8,98	8,784	6,267	4,864	7,426	2,723	9,266	7,659
J'	0,8872	0,8783	0,8987	0,8393	0,923	0,5636	0,9023	0,8446
H' (log2)	4,753	4,705	4,224	3,743	4,615	2,086	4,896	4,4

Figure 5. Diversity index at west Bunguran, Natuna

2000). *Acropora* in West Bunguran, especially on site of Komang Island and that of in front of Pulau Tiga Village, was dominated by *Acropora formosa*.

CONCLUSIONS

The coral condition was categorized good although the contribution of *Acropora* coverage relatively low. The coral was composed by 115 species of stony corals belonging to 16 genera. The community was dominated by *Porites cylindrica* and *Porites rus* assemblages, species which were less susceptible to the bleaching event.

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Appendix 1

Coral distribution at western part of Bunguran, Natuna									
Family	**Species**	**St. 01**	**St. 02**	**St. 03**	**St. 04**	**St. 05**	**St. 06**	**St. 07**	**St. 08**
ACROPORIDAE									
	Acropora aculeus						+		+
	Acropora acuminata	+						+	
	Acropora brueggemanni					+		+	
	Acropora cerealis	+	+		+				+
	Acropora divaricata			+					
	Acropora echinata				+				
	Acropora florida			+					+
	Acropora formosa	+	+	+	+		+	+	+
	Acropora grandis	+	+	+				+	+
	Acropora horrida		+						
	Acropora humilis	+		+	+			+	+
	Acropora hyacinctus			+				+	+
	Acropora latistella	+							
	Acropora microphthalma					+			
	Acropora millepora			+					
	Acropora nasuta						+		
	Acropora palifera			+		+		+	
	Acropora paniculata			+					+
	Acropora samoensis					+			
	Acropora sarmentosa			+					
	Acropora sp.	+		+				+	+
	Acropora subglabra	+	+						
	Acropora tenuis			+					+
	Acroporateres					+			
	Acropora yongei					+			
	Astreoporagracilis	+			+	+		+	
	Astreopora sp.							+	
	Montipora foliosa		+						
	Montipora grisea		+	+				+	
	Montipora hoffmeisteri							+	
	Montipora incrassata		+	+				+	+
	Montipora informis	+	+	+	+	+	+	+	
	Montipora monasteriata							+	+
	Montipora sp.		+					+	+
	Montipora squaumosa	+							
	Montipora turgessens		+						
	Montipora venosa	+	+	+		+	+	+	+
AGARICIIDAE									
	Coeloseris mayeri			+	+	+		+	
	Leptastrea purpurea		+						
	Leptastrea transversa					+			
	Pachyseris rugosa	+	+					+	

	Pachyseris speciosa	+	+			+		+		
	Pavona cactus					+				
	Pavona minuta							+		
	Pavona varians	+				+				+
ASTROCOENIIDAE										
	Stylocoeniella armata							+		
DENDROPHYLLIDAE										
	Turbinaria sp.		+							
EUPHYLLIDAE										
	Euphyllia ancora					+				
	Euphyllia glabra		+							
	Euphyllia mammiformis					+				
	Euphyllia sp.		+							
	Physogyra lichtensteini					+				
FAVIIDAE										
	Barabatoia amicorum							+		
	Caulastrea furcata				+					
	Cyphastrea chalcidicum	+		+				+		
	Cyphastrea microphthalma		+					+		
	Cyphastrea serailia	+						+		
	Diploastrea heliopora	+		+	+			+		+
	Echinopora gemmacea									
	Echinopora horrida	+								+
	Echinopora lamellosa									+
	Favia favus	+								
	Favia matthaii	+	+		+					
	Favia pallida			+		+				
	Favia rotundata				+					
	Favia sp.						+			
	Favia speciosa	+	+							
	Favites halicora	+	+							+
	Goniastrea edwardsi	+	+					+		
	Goniastrea favulus				+	+				
	Goniastrea retiformis				+					
	Goniastrea sp.							+		
	Montastrea annularis	+								
	Montastreacurta		+							
	Platygyra daedalea									+
	Platygyra pini							+		
	Platygyra sinensis		+					+		+
	Leptoria phrygia		+							
FUNGIIDAE										
	Ctenactis echinata		+							
	Fungia concinna		+							
	Fungia fungites	+	+							+
	Fungia horrida									+
	Fungia paumotensis	+						+		
	Fungia repanda		+	+	+	+				+

Podabacea crustacea	+							
HELIOPORIDAE								
Heliopora coerulea	+			+				+
MERULINIDAE								
Merulina scabricula	+			+	+			
MILLEPORIDAE								
Millepora platyphylla						+	+	
MUSSIDAE								
Lobophyllia corymbosa		+			+			+
Lobophyllia pachysepta		+					+	
Symphyllia recta				+	+			+
OCULINIDAE								
Galaxea astreata	+							
Galaxea fascicularis				+	+		+	+
Archellia horrescens		+						
PECTINIDAE								
Echinophylliaaspera								+
Mycedium elephantotus							+	
Pectinia lactuca	+				+			
Pectinia paeonia	+	+						
POCILLOPORIDAE								
Pocillopora damicornis	+		+		+		+	+
Pocillopora verrucosa			+			+		+
PORITIDAE								
Goniopora djiboutensis	+				+			
Goniopora minor	+	+						
Goniopora pandoraensis							+	
Goniopora stokesi							+	
Porites cylindrica	+	+	+	+	+	+		+
Porites lichen		+		+	+			+
Porites lobata	+	+	+			+	+	+
Porites lutea	+	+	+	+	+	+	+	+
Porites nigrescens								+
Porites rus	+	+		+	+	+		+
Porites solida					+			
Porites sp.							+	
SIDERASTREIDAE								
Coscinaraea columna		+						
Coscinaraea sp.							+	
Psammocora contigua	+					+		

Legend:

+	Found
	Not Found