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COMMUNITY STRUCTURE OF SCLERACTINIAN CORALS IN NANCOWRY GROUP OF NICOBAR ISLANDS, INDIA

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ABSTRACT
Diversity and distribution of scleractinia corals of Nancowry group of Nicobar Islands were investigated during February, 2011- December, 2011using Line Intercept Transect method. The study was carried out five different islands named as Kardwip, Munak, Champion Island, Tapong and Western Island. We undertook a systematic assessment of coral reef areas to study the biodiversity of coral species including bleaching status of coral species, diversity index, and relative abundance. A total of 103 coral species belonging to 11 families and 41 genera were recorded from this Island. The percentage of live coral cover was higher in Kardwip Island (64.9%) whereas it is lower in Munak (28.7%). Due to higher thermal stress reef condition of Munak (20.7) and Tapong (17.1) becomes degraded. The species diversity was highest at Kardwip (H'=2.73) and Pieoul's evenness index (P= 0.91) was highest in Western Entrance. The coral family Faviidae (34.95%) shows dominance of species composition than other reported families of corals from Nancowry group of Nicobar Island. The present paper investigates the quantitative assessment of hard coral species along with the health condition of reef ecosystem in Nancowry group of Nicobar Islands.

KEY WORDS: Scleractinia species, Relative abundance, species diversity, Acroporidae, Faviidae.

INTRODUCTION

Coral reefs are highly productive marine ecosystem in the world with annual gross production rates in the range of 2000-5000g Cm^2 through efficient retention and recycling of nutrients [Mann, 1982]. The Andaman and Nicobar Islands are a low mountainous chain of islands, which rise from a submerged north-south trending ridge separating the Andaman Sea from the Bay of Bengal between 6°-14°N and 92°-94°E. The islands occupy an area of 8,293 Km^2 with a coastline of 1962 Km and account for 30% of the Indian Exclusive economic zone [Jeybaskaran, 1999]. Rink (1847) first time studied the taxonomy of Indian Coral Reef in Nicobar Islands. Alcock (1893) conducted the earliest recorded survey of the islands, and the general topography was described by Kloss (1902). The diversity of marine flora and fauna around Andaman and Nicobar Islands has received attention: Matthai [1924] studies on coral species based on collection in the Indian Museum in Kolkata; 135 coral species were also reported (Pillai, 1983a) from the region, and found that the Andaman Island were less diverse (31 genera with 82 species) than the Nicobar Island (43 Genera and 103 species). Wilkinson (2001) reported 203 hard corals species occur in Andaman and Nicobar Islands. Recent studies on Scleractinian coral diversity revealed out 197 species belonging to 59 genera from Andaman Islands [Turner, *et.al.,* 2001]. The percentage cover of live corals has been estimated for the islands of Mahatma Gandhi Marine National Park [Dorairaj and Sundararajan,1997; Arthur, 1996; Kulakrni *et al.,*2001] and North Reef, Cinque, Twin, West Rutland, Tarmughli, Flat, South Button, Outram, Henry Lawrence, Minerva ledges and Neil Island [Turner *et al.,* 2001]. In Nancowry group of Nicobar Island, diversity and percentage of live coral covers remains unstudied. No such reports were given from this area. Present study reports 103 scleractinian coral species with percentage of abundance, species diversity and occurrence of similarities at different islands of Nancowry.

MATERIALS AND METHODS

Study Area

Nancowry refers both to a single island and to the group of adjoining islands that make the central part of the Nicobar Islands chain, located in the Northeast Indian Ocean between Andaman Sea and Bay of Bengal. The island is located in between 07°59.21'N and 93°32.86'E, approximately 160km south-southeast of Car Nicobar. The coordinates of the study sites (Fig. 1) are as follows: Champion Island (Lat: N 08˚01.379'and Long: E 93˚33.850'), Tapong (Lat: N 07˚59.147'and Long: E 93˚35.073'), Western Entrance (Lat: N 08˚01.380'and Long: E 93˚33.851'), Munak (Lat: N 08˚00.331'and Long: E 93˚31.679') and Kardwip (Lat: N08˚01.706' and Long: E93˚32.602').

FIGURE 1. Study Area

Species Identification

Species inventories during individual dives were made, generally lasting 30-60 minutes and extending over the full range of depths at a site from deep to shallow. Identification of species was done in situ assisted by digital UW photography, collecting a full inventory focusing on unusual or difficult species for photographs [Sheppard and Obura, 1998]. In cases of uncertainty collected skeletons were further examined after the dives. The principal resources used in identification were Veron 2000, 2002 and Wallace 2000.

Data Analysis

Data collection was done by using Line Intercept Transect method [English *et al.,* 1994] at five regions of Nancowry group of Nicobar Islands. Though all conspicuous benthic life forms underlying the transect lines were monitored, since cover by organisms other than corals (i.e., macroalgae, soft corals, coralline algae and sponges) constituted only less than 1% of total cover, reference is made only to reef building corals in this paper. A total of 10 transects of 20m each were placed at four study sites around the island. All hard corals intercepted by the transect were recorded and their maximal projected length were measured. An individual colony of a hard coral was defined as any colony growing independently of its neighbours [Loya, 1972].

The diversity of corals was calculated following the Shannon-Wiener index (H') [Clarke and Barwick, 1991]. Species richness was calculated following the Simpson's index (d) and the evenness (J') was computed using the formula of Pielou.

Jaccard's Similaity Index was also calculated to determine the occurrence of similar species between different islands of Nancowry.

$S = (2C/a+b) \times 100$ (C= Number of species common at any two stations, a= Number of species at one station and b= number of species at other station).

RESULTS AND DISCUSSION

A total of 103 species belonging to 11 families and 41 genera were reported on the transect area (Table 1).The reefs of Kardwip Island showed a maximum living coral coverage of 64.9% around the Nancowry group of Nicobar Islands. The maximum bleached coral cover of 17.1% and dead coral cover of 47.5% were recorded from the reefs of Tapong and Munak respectively (Fig.4). Unlike Munak site, no reef build up exists at Tapong sites (Dead coral 43.7%), but rather there is a community of separate colonies spread throughout the area. The species diversity index of Nancowry group of Nicobar Islands varied from H'- 1.12-2.73 (Fig.5). The relative abundance of scleractinia corals was higher in Kardwip (25%) and Champion Island (23%) (Fig.2). The hard coral family Faviidae (34.5%) and Acroporidae (14.5) represent higher percentage of species composition than other families (Table.3). In Southeast Asia, reefs are evaluated according to a linear scale cover [Gomez and Yap, 1988], such that only those reef with >75% corals are considered to be excellent condition. Reefs with 50-75% live coral cover are considered to be in "good" condition ; with 25 – 50% live coral cover in "fair" condition; and those with <25% live coral cover, in "poor". According to this classification this reef area falls under category of good condition. Live coral coverage (LCC) is a critical component of a coral reef. The percentage of LCC is used as a health indicator of coral reefs (Brown, 1988). The Andaman Sea recently experienced 3 bleaching events in 1998, 2002, 2010 (NOAA coral reef watch). In Andaman and Nicobar Islands, the scleractinian family Acroporidae represents 74 species which is the maximum species diversity among other coral families (Turner *et al.,* 2001). But due to affect of coral bleaching in Munak (20.7%) and Tapong (17.1%) most of the corals particularly *Acropora* sp were severely damaged and degraded. Massive coral Faviidae were more in number in this reef with 34.95% species abundance and solitary coral Fungiidae with 9.71% (Fig.3).

TABLE1: Distribution of Hard Coral species along the different sites of Nicobar Islands

Sl No	Scleractinian Species	NANCOWRY GROUP OF NICOBAR ISLANDS				
		Champion Island	Tapong	Western Entrance	Munak	Kardwip
	Family: Acroporidae					
1	*Acropora aspera* (Dana, 1846)		+			+
2	*Acropora cytherea* (Dana, 1846)	+				
3	*Acropora mirabilis* (Quelch, 1886)		+		+	
4	*Acropora vaughani* (Wells, 1954)			+		
5	*Acropora robusta* (Dana, 1846)			+		+
6	*Acropora donei* (Veron and Wallace, 1984)	+				
7	*Acropora nasuta* (Dana, 1846)		+			+
8	*Acropora nobilis* (Dana, 1846)				+	
9	*Acropora chesterfieldensis* (Veron and Wallace, 1984)	+	+			
10	*Acropora lovelli* (Veron and Wallace, 1984)				+	
11	*Acropora microphthalma* (Verrill, 1859)		+	+		
12	*Montipora digitata* (Dana, 1846)	+				+
13	*Montipora foliosa* (Pallas, 1767)				+	
14	*Montipora aequituberculata* (Bernard, 1897)					+
15	*Montipora danae* (Milne Edwards and Haime, 1860)					+
	Family: Pocilloporidae					
16	*Pocillopora damicornis* (Linneaus, 1758)	+		+		+
17	*Pocillopora verrucosa* (Ellis and Solander, 1786)	+				+
18	*Pocillopora elegans* (Dana, 1846)		+			
19	*Pocillopora ligulata* (Dana, 1846)				+	
20	*Stylophora pistillata* (Esper, 1797)	+	+	+		
21	*Seriatopora hystrix* (Dana, 1846)			+		+
	Family: Faviidae					
22	*Goniastrea edwardsi* (Chevalier, 1971)	+		+		
23	*Goniastrea minuta*(Veron, 2000)		+	+		
24	*Goniastrea retiformes* (Lamrck, 1816)				+	
25	*Goniastrea pectinata* (Ehrenberg, 1834)	+				+
26	*Platygyra sinensis* (Milne Edwards and Haime, 1849)		+			
27	*Platygyra crosslandi* (Matthai, 1928)			+		
28	*Platygyra pini (Chevalier, 1975)*					+
29	*Platygyra lamellina* (Ehrenberg, 1834)				+	+
30	*Diploastrea heliopora* (Lamarck, 1816)	+		+	+	+
31	*Favites complanata* (Ehrenberg, 1834)		+			
32	*Favites pentagona* (Esper, 1794)	+		+		
33	*Favites halicora* (Ehrenberg, 1834)				+	
34	Favites spinosa (Klunzinger,1879)		+			+
35	*Favia veroni* (Moll & Borell- Best,1984	+				+
36	*Favia stelligera* (Dana, 1846)			+		
37	*Favia favus* (Forskal, 1775)		+	+		+
38	*Favia matthaii* (Vaughan, 1918)			+		
39	*Favia speciosa* (Dana, 1846)	+			+	+
40	*Favia lizardensis*(Veron and Pichon, 1977)		+			
41	*Echinopora lamellosa* (Esper, 1794)	+				+
42	*Echinopora gemmacea* (Lamarck, 1816)			+		
43	*Echinopora forskaliana* (Milne Edwards and Haime, 1860)*		+			
44	*Cyphastrea serailia* (Forskal, 1775)				+	
45	*Cyphastrea microphthalma* (Lamarck, 1816)	+				+
46	Cyphastrea chalcidium(Forskal,1775)			+		
47	*Cyphastrea agassizi* (Vaughan, 1907)		+	+		
48	*Montastrea curta* (Dana, 1846)	+				

49	*Montastrea valenciennesi* (Milne Edwards and Haime, 1860)			+		+
50	*Montastrea colemani* (Veron, 2000)*	+	+			
51	*Leptastrea transversa* (Klunzinger, 1879)				+	+
52	*Leptastrea aequalis* (varon, 2000)			+		+
53	*Leptastrea purpurea* (Dana, 1846)	+	+			
54	*Leptoseris scabra* (Vaughan, 1907)*	+				
55	*Barbattoia amicorum* (Milne Edwards and Haime, 1850)			+		
56	*Oulophyllia crispa* (Lamarck, 1816)		+		+	+
57	*Diploria strigosa* (Dana, 1848)*	+		+		
	Family: Mussidae					
58	*Lobophyllia corymbosa* (Forskal, 1775)				+	+
59	*Lobophyllia hemiprichii* (Ehrenberg, 1834)	+				
60	*Symphyllia recta* (Dana, 1846)		+			+
61	*Symphyllia agaricia* (Milne Edwards and Haime, 1849)	+		+		
62	*Symphyllia radians* (Milne Edwards and Haime, 1849)	+			+	+
63	*Symphyllia hassi* (Pillai and Scheer, 1976)			+		
64	*Scolymia vitiensis* (Briggemann, 1877)	+				
65	*Acanthastrea regularis* (Veron, 2000)					+
	Family: Poritidae					
66	*Porites cylindrica* (Dana, 1846)		+			+
67	*Porites lutea* (Milne Edwards and Haime, 1851)	+				
68	*Porites lobata* (Dana, 1846).		+	+		+
69	*Porites solida* (Forskal, 1775)	+			+	
70	*Porites lichen* (Dana, 1846)	+				
71	*Porites rus* (Forskal, 1775)		+		+	
72	*Alveopora marionensis* (Veron & Pichon, 1982)					
	Family: Fungiidae					
73	*Fungia danai* (Milne Edwards & Haime, 1851)	+		+	+	+
74	*Fungia fungites* (Linneaus, 1758)		+	+		
75	*Fungia corona* (Doderlein, 1901)				+	
76	*Fungia horrida* (Dana,1846)		+			+
77	*Fungia rependa* (Dana, 1846)			+		
78	*Fungia scabra* (Doderlein, 1901)	+				
79	*Herpolitha limax* (Eschscholtz, 1825)				+	+
80	*Ctenactis echinata* (Pallas, 1766)		+			
81	*Sandalitha dentata* (Quelch, 1884)			+		+
82	*Podabcia crustacea* (Pallas, 1766)	+			+	
	Family: Merulinidae					
83	*Hydnophora microconos* (Lamarck, 1816)		+			+
84	*Hydnopohora grandis* (Gardiner, 1904)			+		
85	*Merulina ampliata* (Ellis and Solander, 1786)	+				
	Family: Oculinidae					
86	*Galaxea astreata* (Lamarck, 1816)	+		+	+	
87	*Galaxea fascicularis* (Linneaus, 1767)		+			+
	Family: Agariciidae					
88	*Pavona cactus* (Forskal, 1775)	+				
89	*Pavona decussata* (Dana, 1846)			+		+
90	*Pavona minuta (Wells, 1954)*					+
91	*Leptoseris scabra* (Vaughan, 1907)				+	+
92	*Leptoseris incrustans* (Quelch, 1886)				+	
93	*Pachyseris gemmae* (Nemenzo, 1955)		+	+		
94	*Pachyseris speciosa* (Dana, 1846)	+		+		+
	Family: Pectinidae					
95	*Pectinia paeonia* (Dana, 1846)		+		+	
96	*Pectinia africanus (Wells, 1935)*	+				
97	*Pectinia alcicornis* (Saville- Kent, 1871)				+	+

98	*Oxypora crassispinosa* (Nemenzo, 1979)	+				+
99	*Echinophyllia aspera* (Ellis and Solander, 1788)			+		
	Family: Euphyllidae					
100	*Euphyllia glaberescence* (Chamisso and Eysenhardt, 1821)		+	+		
101	*Plerogyra sinuosa* (Dana,1846)			+	+	
102	*Plerogyra discus* (Veron and Fenner, 2000)	+				+
103	*Psammocora haimeana* (Milne Edwards and Haime, 1851)	+	+			+
104	*Psammocora contigua* (Esper, 1797)	+			+	

TABLE 2: Percentage of live, bleached and dead form of corals in different study sites of Nancowry group of Nicobar Islands.

	Similarity Index (S)			
	Tapong	Western Entrance	Munak	Kardwip
Champion Island	7.04	13.3	10.4	16.6
Tapong		12.1	8.62	14.4
Western Entrance			6.45	15.1
Munak				16.9

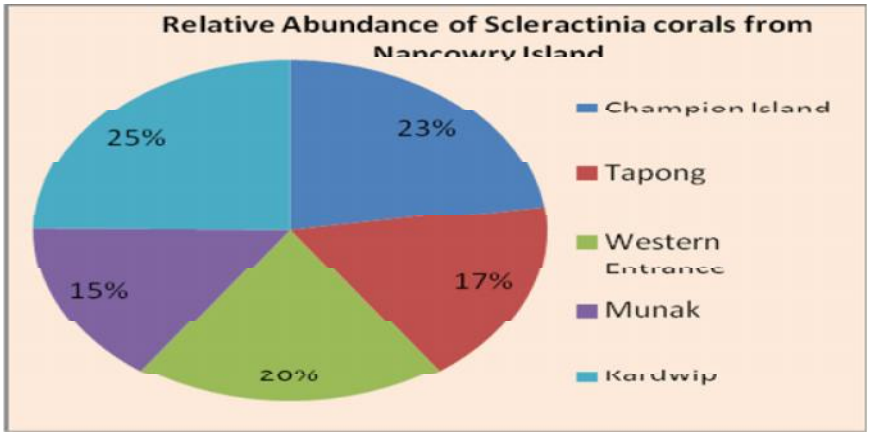

FIGURE 2 Relative abundance of Scleractinia corals from Nancowry Island.

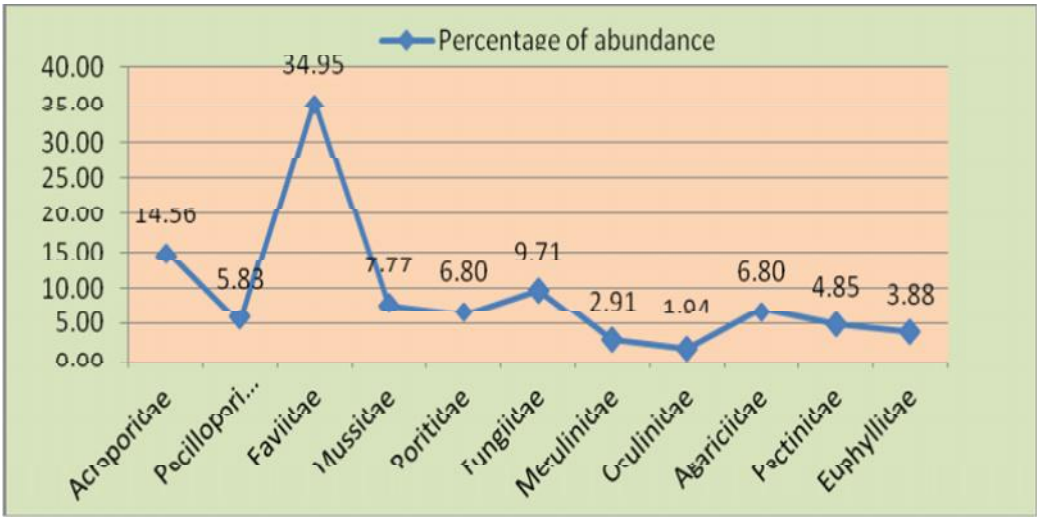

FIGURE 3. Family-wise species abundance of corals

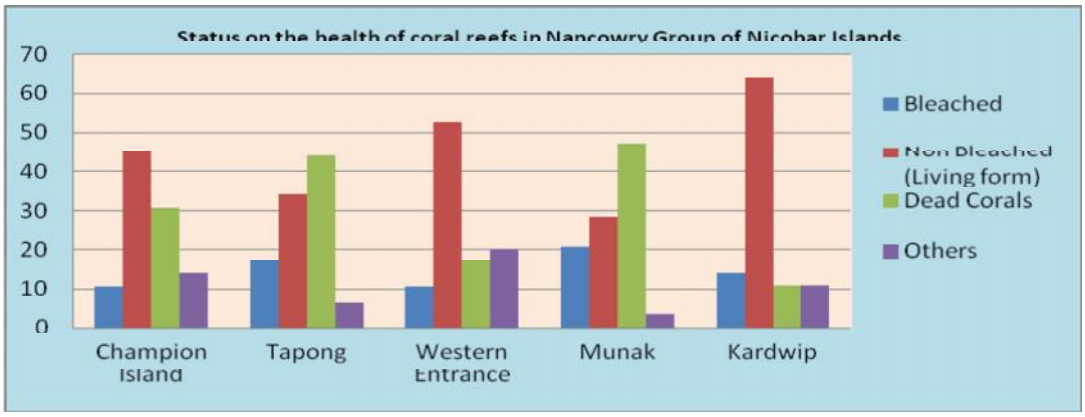

FIGURE 4. Status on the health of coral reefs in Nancowry group of Nicobar Islands.

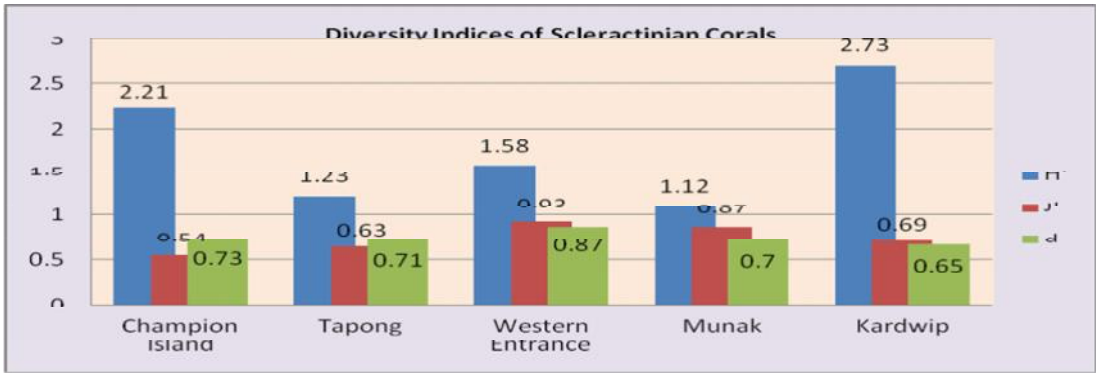

FIGURE 5. Diversity Indices of Scleractinia Corals in Nancowry group of Nicobar Islands

Anthropogenic disturbance, competition and stress are also the primary factors for controlling the growth of coral species [Houston, 1994]. According to Hughes (1985), the genus *Acropora*, *Pocillopora* which usually recruit in larger numbers and are more sensitive to disturbances and so they are better indicators of whole coral community state than corals that are more sustainable, like most of the massive corals such as *Favia, Favites*, *Goniastrea, Diploastrea*. The percentage of finding of similar species was highest between the island of Munak and Kardwip whereas it is only 6.45% in between Munak and West Entrance Island (Table.2). According to Odum [1971] higher diversity means longer food chains and more cases of symbiosis (mutualism, parasitism, and commensalism) and greater possibilities for negative feedback control which reduces oscillations and hence increases stability and species diversity. Kardwip showed a very good species diversity with maximum number of faviids species as this area are continuously monitored by defense ministry and protected from anthropogenic disturbances. Being one of the most species rich habitats of the world, coral reefs are important in maintaining a vast biological diversity and genetic library for future generations (Knight *et.al.,* 1997). Coral reefs are the most productive of all marine ecosystems, with primary production rates ranging generally between 8 and 12 gC m^{-2} d^{-1} (Nair and Pillai, 1978). The study on scleractinia coral diversity in Nancowry group of Nicobar Islands represents a moderate diversity area of coral species. The species richness gives various improving characters to this Island for its various biodiversity aspects.

In conclusion, presence of 103 species of corals from Nancowry group of Nicobar Islands indicates a stable coral reef environment exist here after a massive bleaching events occurred in 2010. Due to thermal stress the current absence of branching corals, as particularly *Acropora* as one of the most vulnerable coral genera, from the Island. The higher species richness in kardwip comprises a moderate occurrence of similar species with other islands. The Coral reef areas of Nancowry group of Nicobar Islands need to be protected because these bleached reefs will slowly recover in time by way of new growth of coral colonies over the old ones. The process of natural selection is on continuous action, with the growth of new coral colonies and any disturbance in the system is temporary. Therefore, inspite of the odds, the corals will resurge under the sea, which we need to protect and conserve for our benefit.

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