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Diversity and distribution of Scleractinian corals in Mayabunder region of North Andaman, India

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Abstract

The coral reef of the Andaman and Nicobar Islands encompass significantly diversified faunal component of the Indo-Pacific Ocean. The present study on corals was designed to assess the status, population diversity and abundance at Mayabunder region. A total of 43 corals belonging to 30 species, 15 genera, 8 families were distributed widely in the study area. More number of species belonged to the Family Acroporidae (11) and Fungiidae (9) and the coral species composition was less in the Families Faviidae (4) and Pocilloporidae (2); and other families *viz.,* Agariciidae, Oculinidae, Siderastreidae and Euphyllidae which were represented with only a single specie. The diversity index (H^1) of corals at Mayabunder ranged from 2.32 to 4.52. Mean density and relative abundance of corals were higher for Acroporidae and Fungiidae when compared to other families. The maximum number of coral species was present in Avis Island (48) followed by Sound Island (30), Curlew Island (9), Karmatang beach (7) and Rail Island (5).

Keywords: Andaman Nicobar, coral diversity, coral abundance, Mayabunder Island, Scleratinian corals

INTRODUCTION

Coral reefs of the world cover an estimated area of 600,000 Km^2 (Smith, 1978; Kleypas, 1977). 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). All the major reef types are represented in India as the fringing and barrier reefs are found in Andaman and Nicobar Islands, fringing reefs alone in Gulf of Mannar and Palk Bay, Atoll reefs in Lakshadweep Island, platform reefs along the Gulf of Katchchh and Patchy reefs near Ratnagiri and Malvan coasts (Venkataraman, 2003). In India, the reefs are distributed along the east and west coasts at restricted places along a stretch of approximately 5,790 Km^2 and are distributed in major ecozones. The islands of Andaman and Nicobar have biodiversity comparable to those of the famous Galapagos Islands in Pacific Ocean. The Andaman and Nicobar group of islands are surrounded by fringing reef on their eastern side and barrier reefs on their western side. They have unique coral diversity which are very important zoogeographically. The total area of coral reefs in India is estimated as 2000 Sq. Km., *i.e.,* 6% of the total continental shelf of Andaman and Nicobar Islands. The first quantitive survey of the corals on a fringing reef in India was carried out by Pillai (1969). A total number 199 hermatypes (Under 50 genera) and 44 Ahermatypes (Under 21 genera) have been recorded earlier from the Indian reefs (Pillai 1983, Wafer, 1986). Among the twenty five to two hundred species of stony corals distributed worldwide, about 135 species belonging to 59 genera were reported from Andaman and Nicobar Islands by Pillai (1985). Turner *et al.* (2001), in their pioneer work reported 181 species and Venkataraman *et al.* (2003), reported 208 species of scleractinian corals. *Dendrophyllia minuscule* was identified by Sundrsan and Mukhopadhyay (1967). The reef ecology and structure in Tsunami affected Katchal and Teressa islands of Andaman and Nicobar Archipelago islands have been studied by Raghunathan *et al.,* (2009) and coral diversity status of Pongibalu from South Andaman were studied in detail by Raguraman *et al.,* (2010).

In all probability, the number of species from all groups and all habitats of seas could be of the order of several million but we know only a fraction of that for certain (Venkataraman and Wafar, 2005). The most vulnerable species were the branching corals such as *Acropora* and *Pocillopora* spp. *Montipora* is also reported to have been adversely affected. Only about 25% of live corals remain in Gulf of Mannar. Overall, the bleaching event increased dead coral cover by about 60 – 80% in India (Venkataraman, 2000). Collection of coral reef associates such as *Trochus* and other shells as well as other reef resources are also causing damage. Invasion of crown

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of thorn starfish (*Acanthaster planchi*) and White Band Disease were reported in many reefs in Andaman and Nicobar Islands (Pillai, 1971, 1986). The major impacts on the coral reef ecosystem comes from the industrial development, including cutting of mangroves, development of ports and offshore moorings and pollution from large cities. Anthropogenic impacts due to human activities have degraded the coral reefs habitats and reduced the coral cover by more than 50% on most reefs (Wafar *et al*. 2000). In a recent communication it has been shown that coral growth in the intertidal region can occur fairly high upon the shore in sheltered areas and that the limiting factor for coral growth is the period of desiccation during the low water and not the rain water or sedimentation to which they get frequently exposed (Ditlev, 1978). The coral colonies have experienced wide changes in the environmental conditions periodically from their evolution. Corals requires uniform conditions even though they can survive short spells of adverse changes in the environment. The aim of the present study is an attempt to provide information on the abundance and population diversity on corals and the impacts of environmental factors on them.

MATERIALS AND METHODS

The study was conducted in 5 regions of Mayabunder Islands (Lat. 12°55′ 113′ N – Long. 9253′ 518′ E), *viz* Karmatang beach (Lat. 12°50′ 827′ N – Long. 92°56′ 326′ E), Aves Island (Lat. 12°55′ 073′ N – Long. 92°55′ 885′ E), Sound Island (Lat. 12°53′ 092′ N – Long. 92°56′ 834′ E), Rail Island (Lat. 12°56′ 860′ N – Long. 92°54′ 620′ E), Curlew Islands (Lat. 12°56′ 210′ N – Long. 92°53′ 378′ E), during July 2009. Coordinates of the sampling site were collected using Global Positioning System (GPS), model GARMIN. After confirmation of the reef areas by using Manta tows UNEP (1993), surveys were undertaken by SCUBA diving in all major islands of Mayabunder. The Line Intercept Transect laid parallel to the reefs was used for assessing the coral communities (English *et al*., 1997). Transects of 20 m in length were laid by using a flexible fiberglass measuring tape. Depending on the size of the reefs 6 to10 transects were laid on each of the islands at the depths ranging between 3m to 15m. Eighty Five samples were collected and examined. All the samples were identified according to the manuala of Jen Veron, (2000), and Venkataraman *et al.* 2003). Shannon diversity index was calculated (Magurran, 1988) to assess the species diversity.

$$H' = -\sum p_i \ln(p_i)$$

Shannon-Weiner diversity Index

H' = Shannon-Weaver Diversity Index

p_i = Relative abundance of each group of organisms

RESULTS AND DISCUSSION

A total of 30 species belonging to 8 families of corals *viz.*, Acroporidae, Fungiidae, Faviidae, Pocilloporidae, Agariciidae, Oculinidae and Euphyllidae were recorded during the present study period at Mayabunder Islands (Table 1). A total number of 7 species belonging to 4 families were observed in Karmatang Beach. In the Avis Island there were a total number of 48 species belonging

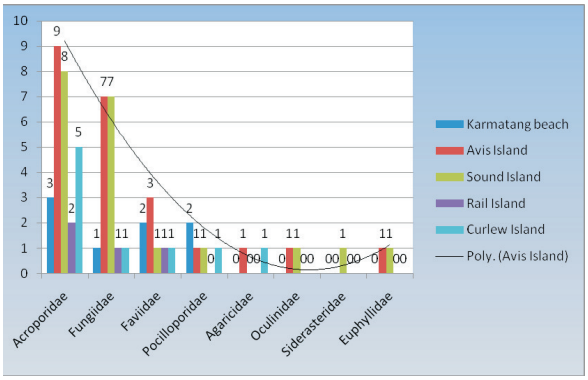

Figure 1. Relative frequency of coral species in different coral families at Mayabunder Islands

to 7 families. In the Sound Island there were 30 species of 7 families, in the Curlew Island there were 9 species belonging to 4 families, and in the case of Rail Island there were 5 species of 3 families. Relative frequency of corals and among the five islands had been shown in Figure 1. Coral Distribution was maximum in Avis and Sound Islands, followed by Curlew Island, Karmatang Beach and Rail Island. High densities and diversity values were noted in the Families Acroporidae and Fungiidae among the islands. Population density and Shannon-weiner diversity index were found to be higher at Avis (4.52) and Sound Island (4.40), moderate at Curlew Island (3.66) and the very least diversity was noted at Rail Island (2.32) and Karmatang Beach (2.72) (Table 2). By comparison, Avis Island and Sound Island had higher diversity when compared to the adjacent Islands such as Curlew Island, Rail Island and Karmatang beach where the diversity was moderate. Among the genera *Acropora* was dominant as it withstands the environmental conditions in all the regions. Out of 30 scleractinian corals, 4 species were new records from Andaman and Nicobar Islands. The less diversity of the coral population in these islands may be attributed to the anthropogenic activities in the nearby islands of Mayabunder.

Mayabunder coral community is diminishing drastically due to biotic and abiotic factors. Some of the coral species occur selectively in these islands, which show the sustainability of a particular species in an environment. The selective occurrence of these corals

Table 1. Distribution of Scleractinian Corals at Mayabunder Islands.

S. No	CORAL SPECIES	KB	AI	SI	RI	CI	OS
1	*Acropora aspera* (Dana,1846)		●	●			++
2	*Acropora austera* (Dana,1846)	●	●				+++
3	*Acropora cytherea* (Dana,1846)		●				+++
4	*Acropora microphthalma* (Verrill,1859)		●	●		●	++
5	*Acropora mirabilis* (Quelch,1886)*	●	●	●			+++
6	*Acropora muricata* (Linnaeus,1758)		●		●	●	++
7	*Acropora papillare* (Latypov,1992)	●		●		●	++
8	*Acropora robusta* (Dana, 1846)			●	●	●	++
9	*Acropora valenciennesi* (Milne Edwards & Haime,1860)		●	●			++
10	*Acropora vaughani* (Wells,1954)*		●	●		●	++
11	*Ctenactis echinata* (Pallas,1766)	●		●			++
12	*Cycloseris costulata* (Ortmann,1889)		●	●			+++
13	*Favia complanata* (Ehrenberg,1834)	●	●				+
14	*Favites halicora* (Ehrenberg,1834)	●		●	●		++
15	*Fungia concinna* (Verrill,1864)*		●	●		●	+++
16	*Fungia danai* (Milne Edwards & Haime,1851)		●	●			++
17	*Fungia fungites* (Linnaeus,1758)			●			+
18	*Fungia paumotensis* (Stutchberry,1833)		●	●			+
19	*Fungia taiwanensis* (Hoeksema & Dai,1991)*		●	●			+
20	*Galaxea fascicularis* (Linneaus,1767)		●		●		++
21	*Goniastrea edwardsi* (Linneaus,1767)		●	●			+
22	*Goniastrea aspera* (Verril,1905)		●			●	+
23	*Herpolitha limax* (Esper,1797)		●				+++
24	*Leptoria phrygia* (Ellis & Solander,1786)		●	●			+
25	*Montipora foliosa* (Pallas,1767)		●	●			+++
26	*Pavona cactus* (Forskal,1775)		●			●	+
27	*Plerogyra sinusa* (Dana,1846)		●				+
28	*Pocillopora damicornis* (Linnaeus,1758)	●		●			++
29	*Siderastrea savignayana* (Milne Edwards & Haime,1851)			●			+
30	*Stylophora pistillata* (Esper,1797)		●				+

*KB - Karmatang Beach, AI - Aves Island, SI - Sound Island, RI - Rail Island, CI, Curlew Island, OS - Overall status

Table 2. Density, Abundance and Species Diversity H^1 of coral families recorded at Mayabunder Islands

Sampling Site	Karmatang Beach				Aves Island				Sound Island				Rail Island				Curlew Island			
Families	Density (Mean ± SD)	RA	RG	ER	Density (Mean ± SD)	RA	RG	ER	Density (Mean ± SD)	RA	RG	ER	Density (Mean ± SD)	RA	RG	ER	Density (Mean ± SD)	RA	RG	ER
Acroporidae	1.50 ± 16.90	0.37	0 -24	12.00	18.00 ± 12.70	0.39	0 -18	9.00	17.5 ± 13.4	0.40	0 -19	9.50	14.5 ± 17.6	0.05	0 -25	12.50	16.00 ± 15.55	0.55	0 -22	11.00
Fungiidae	9.00 ± 11.30	0.12	0 -16	8.00	12.00 ± 7.07	0.30	0 -10	5.00	12.0 ± 7.07	0.35	0 -10	5.00	9.00 ± 11.31	0.25	0 -16	8.00	9.00 ± 11.31	0.11	0 -16	8.00
Faviidae	5.00 ± 4.24	0.25	0 - 6	3.00	5.50 ± 3.53	0.13	0 - 5	2.50	4.50 ± 4.94	0.05	0 - 7	3.50	4.50 ± 4.94	0.25	0 - 7	3.50	4.50 ± 4.94	0.11	0 - 7	3.50
Pocilloporidae	3.50 ± 2.12	0.25	0 - 3	1.50	3.00 ± 2.82	0.04	0 - 4	2.00	3.00 ± 2.82	0.05	0 - 4	2.00	2.50 ± 3.53	0.00	0 - 5	2.50	3.00 ± 2.82	0.11	0 - 4	2.00
Agariciidae	1.60 ± 1.41	0.00	0 - 2	1.00	1.50 ± 0.70	0.04	0 - 1	0.50	1.00 ± 1.41	0.00	0 - 2	1.00	1.00 ± 1.41	0.00	0 - 2	1.00	1.50 ± 0.70	0.11	0 - 1	0.50
Oculinidae	1.00 ± 1.41	0.00	0 - 2	1.00	1.50 ± 0.70	0.04	0 - 1	0.50	1.50 ± 0.70	0.05	0 - 1	0.50	1.00 ± 1.41	0.00	0 - 2	1.00	1.00 ± 1.41	0.00	0 - 2	1.00
Siderastreidae	0.50 ± 0.70	0.00	0 - 1	0.50	0.50 ± 0.70	0.00	0 - 1	0.50	1.00 ± 0.00	0.05	0 - 0	0 - 0	0.50 ± 0.70	0.00	0 - 1	0.50	0.50 ± 0.70	0.00	0 - 1	0.50
Euphyllidae	1.00 ± 1.41	0.00	0 - 2	1.00	1.50 ± 0.70	0.04	0 - 1	0.50	1.50 ± 0.70	0.05	0 - 1	0.50	1.00 ± 1.41	0.00	0 - 2	1.00	1.00 ± 1.41	0.00	0 - 2	1.00
H' - Diversity	2.726435497				4.520707053				4.405646901				2.323172699				3.669338176			

*RA – Relative Abundance; RG – Range; ER – Error; H' - (Shannon-Weaver diversity index)

seems to be controlled by several environmental factors or competition. Corals have certain ranges of tolerance to water temperature, salinity, UV radiation, opacity and nutrient quantities. The coexistence of hard and soft coral leads to the utilization of resources in many reef communities. However, it has also few found that mechanism of aggression or defense by hard corals seems to be ineffective against neighboring soft coral (Sheppard, 1979).

Corals have been recorded earlier from muddy sand and with some adaptations they can live in turbid waters (Goreau and Young, 1968). They had also been reported from the water where the temperature is as low as 10^0C (Macintyre and Pilkey, 1969).Seawater quality and human impacts are particularly critical to coral reefs when they are exposed to other stressors or when they are recovering from storms of bleaching events (Burke *et al*. 2002; Wilkinson, 2002; Brown *et al*. 2006).

Interaction with other organisms also plays an important role in determining the coral types and distribution in the environments. The coexistence of hard and soft coral leads to the competition in many reef communities in the utilization of resources. However, it has also been found that mechanism of aggression or defense by hard corals seems to be ineffective against neighboring soft corals (Sheppard, 1979) especial in si as where. The ability of hard corals to reestablish successfully before an increase in soft coral abundance in a stressful ecosystem.

The local fisher-folk of this region have traditionally had a close relationship with the sea resulting in strong cultural and economic links with maritime activities such as fishing, pearl and chank diving. The over-exploitation of seaweeds, sacred chank, pearl oysters, dugong, sea cucumber and seahorses by the locals has made even their mere existence under threat (Patterson, 2002).

When compared to other islands of Andaman and Nicobar region, the coral diversity seems to be less in the Mayabunder islands. This showed that the coral patches in the regions of Mayabunder are extremely susceptible to human influence, and unless special efforts are made to protect coral community, they may not last long.

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