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DIVERSITY AND ABUNDANCE OF SCLERACTINIA CORALS IN CAR NICOBAR ISLAND, INDIA.

Koushik Sadhukhan and C. Raghunathan

Zoological survey of India, Andaman and Nicobar Regional Centre, National Coral Reef Research Institute, Port Blair- 744 102, Andaman and Nicobar Islands.

ABSTRACT : Scleractinia species survey were conducted at four sites of Car Nicobar Island between April' 2010 to February' 2011. Coral reefs, the most diverse and complex of all ecosystems, which are also among the most economically valuable to humankind are being heavily exploited. We undertook a systematic assessment of coral reef areas to study the biodiversity of coral species including bleaching status of coral species, mortality index, and relative abundance. A total of 48 coral species belonging to 10 families and 25 genera were recorded from this Island. The average percentage of live coral, dead coral and bleached coral cover is 27.3%, 26.5% and 46.3% respectively. Percentage of species composition was higher in Faviidae (27.1%) and Acroporidae (22.9%) family of hard corals. The species diversity was highest at stn-2 (2.51) and Pieoul's evenness index (0.91) was highest in Stn-1. The coral family Faviidae and Acroporidae shows higher percentage of species composition than other reported families of corals from Car Nicobar Island. Due to massive bleaching and less percentage of live coral cover the reef becomes inaudibly sick but this island has a very good species diversity that can support a rich diversity of marine animals in this Island.

Key Words: Scleractinia species, Relative abundance, species diversity, mortality index, 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 [1]. The Andaman and Nicobar Islands is located in the southeast of Bay of Bengal, between 6^0-14^0N latitude and 91^0-94^0 E longitude. The Andaman and Nicobar comprised of 572 islands in the chain, some of which are volcanic. 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 [2]. The diversity of marine flora and fauna around Andaman and Nicobar Islands has received attention: Matthai [3] listed coral species from Andaman based on collection in the Indian Museum in Kolkata; and Pillai [4] listed 135 coral species 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 [5] 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 [6]. The percentage cover of live corals has been estimated for the islands of Mahatma Gandhi Marine National Park [7, 8, 9] and North Reef, Cinque, Twin, West Rutland, Tarmughli, Flat, South Button, Outram, Henry Lawrence, Minerva ledges and Neil Island [10]. Kulkarni *et al.,* [9] also addressed several ecological parameters in their study, which includes sedimentation, terrestrial zone influence and other anthropogenic factors. In Car Nicobar Island, diversity and percentage of live coral covers remains unstudied. No such reports were given from this area. Present study reports 48 scleractinian coral species with percentage of live corals, dead corals and bleached corals from this Island.

MATERIALS AND METHODS

Study Area: Car Nicobar Island is a part of fringing reefs extends from 09°08'-09°15' N Lat; 93˚43'-93°50' E Long. This island located between Little Andaman and Nancowrie Island is a flat fertile island covered with cluster of coconut palms and beaches. Sites were defined by the scope of survey expeditions, but were generally consistent as being reef systems of some 300-400m extent in a consistent geo morphological unit. The coordinates of the study sites (Fig. 1) are as follows: Kimos (Stn 1- Lat: N 09˚07.587' and Long: E 92˚46.316'), Malacca (Stn 2- Lat: N 09˚09.701' and Long: E 92˚50.128'), Lapathi (Stn 3- Lat: N 09˚13.978' and Long: E 92˚48.002') and Tamaloo (Stn 4- Lat: N 09˚11.350' and Long: E 092˚49.498').

Species Identifiction: 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 [11]. 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 was collected by adapting Line Intercept Transect method [12] at four stations in Car Nicobar Island. 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 [13]. The relative abundance (RA) of each species was calculated according to the contribution to living cover [14]

$RA = P_i / P \times 100$ (Where, P_i = Total living coverage of one species from all transects taken at a given site; P = Total living coverage of all species in all transects at a given site.)

The diversity of corals was calculated following the Shannon-Wiener index (H') [15]. Species richness was calculated following the Simpson's index (d) and the evenness (J') was computed using the formula of Pielou.

Coral Mortality Index [16] for each site was calculated as the ratio of standing dead coral cover to total cover of both live and dead corals.

MI = Dead corals / (Live corals + Dead corals),

Where, MI is the mortality index. If MI > 0.33, the mortality index is considered to be high and the reef is classified as sick.

RESULTS AND DISCUSSION

A total of 48 species belonging to 10 families were reported on the transect area (Table 1).The reefs of Car Nicobar Island showed an average live coral cover of 27.3% (Table 3). An average bleached coral cover of 46.3% and dead coral cover of 26.5% were recorded from the reefs (Table 3). The average mortality index for the reef was 0.43. Dominance and abundance of a single species is lacking in the study sites. Shanon diversity index was highest at Stn2 (H'= 2.15) and Pieoul's eveness Index (J') was maximum in Stn1 (Fig 2). The relative abundance is higher for *Porites solida* (6.1) and *Echinopora gemmacea* (5.8). The hard coral family Faviidae (27.1%) and Acroporidae (22.9%) represent higher percentage of species composition than other families (Fig.3).

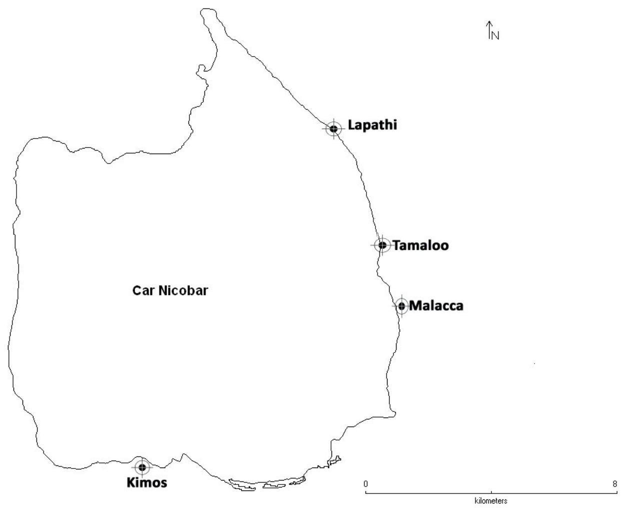

Fig1. Study Area.

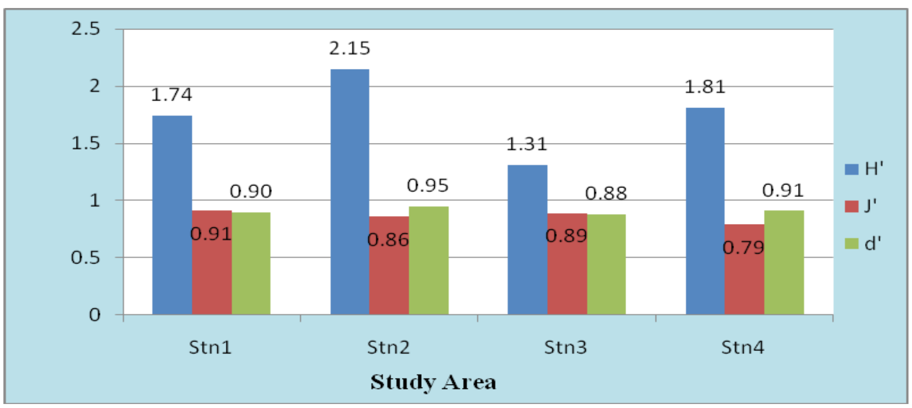

Fig2. Comparison of species diversity in Car Nicobar Island.

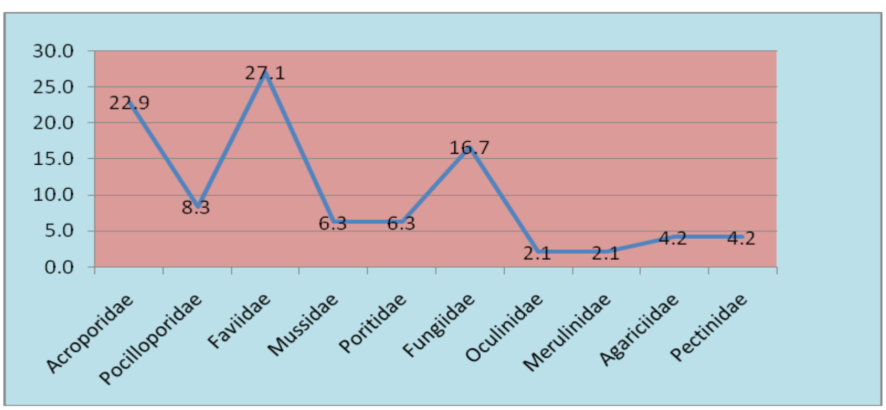

Fig3. Comparison on percentage of species composition in different families of Scleractinia.

Table1: List of Hard coral species with live form categories and Status according to relative abundance.

Species	Relative Abundance	Species Status	Life form Categories
Acropora aspera (Dana, 1846)	2.3	C	Branching
Acropora cytherea (Dana, 1846)	2.9	C	Branching
Acropora mirabilis (Quelch, 1886)	0.6	U	Branching
Acropora vaughani (Wells, 1954)	1.0	C	Branching
Acropora robusta (Dana, 1846)	0.3	U	Branching
Acropora austera (Dana, 1846)	1.0	C	Branching
Acropora granulosa (Milne Edwards and Haime, 1860)	0.3	U	Branching
Acropora subulata (Dana, 1846)	2.6	C	Branching
Acropora donei (Veron and Wallace, 1984)	1.6	C	Branching
Montipora foliosa (Pallas, 1767)	2.3	C	Foliose
Montipora aequituberculata (Bernard, 1897)	0.3	U	Foliose
Pocillopora damicornis (Linneaus, 1758)	3.9	C	Branching
Pocillopora verrucosa (Ellis and Solander, 1786)	1.3	C	Branching
Stylophora pistillata (Esper, 1797)	4.2	C	Digitate
Seriatopora hystrix (Dana, 1846)	2.3	C	Branching
Goniastrea edwardsi (Chevalier, 1971)	2.6	C	Massive
Goniastrea minuta(Veron, 2000)	3.5	C	Massive
Goniastrea retiformes (Lamrck, 1816)	4.2	C	Massive
Platygyra crosslandi (Matthai, 1928)	2.9	C	Massive
Diploastrea heliopora (Lamarck, 1816)	4.5	C	Massive
Favites complanata (Ehrenberg, 1834)	4.5	C	Massive
Favites pentagona (Esper, 1794)	1.6	C	Massive
Favites halicora (Ehrenberg, 1834)	1.0	C	Massive
Favia favus (Forskal, 1775)	0.6	U	Massive
Favia maritime (Nemenzo, 1971)	1.3	C	Massive
Echinopora lamellosa (Esper, 1794)	1.6	C	Encrusting
Echinopora gemmacea (Lamarck, 1816)	5.8	C	Encrusting
Cyphastrea chalcidium(Forskal,1775)	1.0	C	Massive
Lobophyllia corymbosa (Forskal, 1775)	1.6	C	Massive
Lobophyllia hemiprichii (Ehrenberg, 1834)	2.3	C	Massive
Symphyllia recta (Dana, 1846)	1.3	C	Massive
Porites lobata (Dana, 1846).	4.8	C	Massive
Porites solida (Forskal, 1775)	6.1	C	Massive
Porites cylindrica (Dana, 1846)	2.3	C	Massive

Cycloseris costulata (Ortmann, 1889)	1.0	C	Solitary
Fungia danai (Milne Edwards & Haime, 1851)	0.3	U	Solitary
Fungia fungites (Linneaus, 1758)	2.3	C	Solitary
Fungia paumotensis (Stutchberry, 1833)	3.5	C	Solitary
Fungia scabra (Doderlein, 1901)	0.6	U	Solitary
Herpolitha limax (Eschscholtz, 1825)	1.6	C	Solitary
Ctenactis echinata (Pallas, 1766)	1.3	C	Solitary
Ctenactis crassa (Dana, 1846)	0.6	U	Solitary
Galaxea fascicularis (Linneaus, 1767)	1.3	C	Encrusting
Hydnopohora grandis (Gardiner, 1904)	1.0	C	Branching
Pavona cactus (Forskal, 1775)	2.6	C	Digitate
Pachyseris speciosa (Dana, 1846)	1.3	C	Foliose
Pectinia paeonia (Dana, 1846)	0.3	U	Encrusting
Oxypora crassispinosa (Nemenzo, 1979)	1.9	C	Encrusting

Table3: Percentage of Species composition of hard coral families found in Car Nicobar Island.

Family	Genus	Species	Percentage
Acroporidae	2	11	22.9
Pocilloporidae	3	4	8.3
Faviidae	7	13	27.1
Mussidae	2	3	6.3
Poritidae	1	3	6.3
Fungiidae	4	8	16.7
Oculinidae	1	1	2.1
Merulinidae	1	1	2.1
Agariciidae	2	2	4.2
Pectinidae	2	2	4.2

In the present investigation the reef of Car Nicobar Island is inaudibly sick (MI>0.33) as because most of the corals are bleached and percentage of live coral coverage become less. In Southeast Asia, reefs are evaluated according to a linear scale cover [17], 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 fair condition. The primary factors for controlling diversity and abundance of plants and animals in natural communities are disturbance, competition and stress [18]. Edinger and Risk [19] defined massive and submassive corals are stress tolerance where as *Acropora* corals as disturbance adapted ruderals due to their rapid growth and mechanical fragility. In the present study, all corals belong to common and uncommon species status. Massive coral Faviidae were more in number in this reef with 13 species and branching coral Acroporidae

According to Hughes [20], branching corals are type 2 corals 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 which are type 1. There is evidence that for a given number of species, perturbed communities usually comprise a more limited taxonomic spread, whereas under less disturbed conditions the species present belong to a wider range of higher taxa which can be attributed to the species richness of this reef.

Table2: Percentage of live, bleached and dead form of corals in different study sites of Car Nicobar Island.

Status of Corals	Stn1	Stn2	Stn3	Stn4	Mean%
Bleached coral	43.9	39.9	45.1	56.1	46.3
Not Bleached (Living form)	31.5	27.8	32.5	17.3	27.3
Dead Corals	24.6	32.3	22.4	26.6	26.5

In the present study Shannon diversity, Simpson diversity and species evenness are moderately high at all the study sites of Car Nicobar Island. According to Odum [21] 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. The indices of reef health considered in the present study i.e., the live coral cover (low live coral cover), reef condition (domination by massive corals), and mortality index substantiate the deprived condition of this reef. Arthur [22] reported a bleached coral cover of 89% in the Gulf of Mannar reefs with a bleaching related mortality of 23% due to the 1997 – 1998 El~Nino Southern Oscillation event, which elevated sea surface temperatures (SST's) of tropical oceans by more than 30˚C. But in the present study, general observation on coral bleaching percentage (46.3%) has been discussed, no comparisons could be made and conclusions drawn due to paucity of island wise data. Coral reef ecosystems are very sensitive to external impacts both natural and manmade, which violate their homeostasis [23]. The majority of damage to coral reefs around the world has been through direct anthropogenic stress [24]. 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 [25]. According to Bryant *et al.* [26], 57% of the world's coral reefs are potentially threatened by human activity such as coastal development, destructive fishing, overexploitation, marine pollution, runoff from deforestation and toxic discharge from industrial and agricultural chemicals. As global pressures on coral reefs and other ecosystems grow with increasing coastal populations, the need for careful monitoring, planning and management become essential [27]. The study on scleractinia coral diversity in Car Nicobar Island represents a rich diversity area of coral species. Though the other sources of degradation such as the practice of shell collection and tourism have been cited to have caused damages at local scales [28], most of the reef area in this island is still healthy, with moderately good coral cover. The species richness gives various improving characters to this Island for its various biodiversity aspects. The species of Acroporidae and Faviidae family shows maximum abundance of coral species in this Island. We see a role for detailed study of particular taxa in accelerating knowledge on the diversity and abundance of coral species within this Island and for planning for future monitoring and management. The relatively unaffected reefs of Car Nicobar Island may also get deteriorated if appropriate measures are not taken up at the right time.

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