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STUDY ON CORAL BLEACHING (2010) IN MIDDLE ANDAMAN, ANDAMAN AND NICOBAR ISLANDS

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INTRODUCTION

Coral reefs are the most diverse marine habitat, and support an estimated 0.5 million species globally (Splading *et al.* 2001). They are among the most sensitive of all ecosystems to temperature changes, exhibiting bleaching when stressed by higher than normal sea temperatures (Jokiel *et al.* 1977). The dinoflagellets algae called Zooxanthellate lives in the endodermal cells of the Corals. The zooxanthellae provide the coral with large quantities of organic materials, especially high calorific value lipids and carbohydrates which are believed to provide most of the energy for maintenance, tissue and skeletal growth, and possibly reproduction (Veron, 1986; Brown and Ogden, 1993; Meehan and Ostrander, 1997). Coral bleaching refers to the loss of the zooxanthellae by the host (i.e. the coral), or the loss of photosynthetic pigments within the alga itself, which makes the coral transparent. Consequently, coral colony appears white due to the underlying skeleton. The phenomenon of coral bleaching affecting extensive reef areas across the Pacific was first described by Glynn in 1984. A coral bleaching event may be evoked by various environmental factors, such as higher than normal sea temperatures (Glynn *et al.*, 1988; Glynn, 1993; Goreau and Hayes, 1994; Winters *et al.*, 1998), higher levels of ultraviolet radiation (Gleason and Wellington, 1993), fluctuations in salinity (Holthus *et al.*, 1989; Glynn, 1993), increased sedimentation (Stafford-Smith, 1993; Riegel and Bloomer, 1995), bacterial infection (Kushmaro *et al.*, 1996), and various anthropogenic toxicants (Kendall *et al.*, 1983). Corals usually recover from bleaching, but they die in extreme cases (McClanahan, 2004). Increased frequency of bleaching events will reduce corals' capacity to recover (Lough, 2000). In 2002, coral bleaching was observed in the different coastal areas of India (Palk Bay and Andaman), Australia (Great Barrier Reef Marine Park), Sri Lanka and Venezuela during the period of April to June (Kumaraguru, 2002). One such bleaching event has occurred recently around the Andaman and Nicobar Islands during the period of April - June, 2010. The middle Andaman region comprises wide range of coral reefs around the Aves, Sound, Rail, Karlo and Interview Island. Hence the present study was conducted to estimate the extent of coral bleaching in this area.

STUDY AREA

During survey we selected five areas in Middle Andaman region named as Aves Island (Stn. 1), Karlo Island (Stn. 2), Sound Island (Stn. 3), Rail Island (Stn. 4) and Interview Island (Stn5). The brief description of the study areas are as follows:

a. Aves Island (Stn. 1): Elv: 10ft. Lat: N 12°54.917′ and Long: E 92°55.954′. This area has limited sandy beach otherwise covered with mangrove vegetation. Live coral cover present at a depth range between 2-12m. In the eastern side shallow intertidal extended with rocky areas upto a length of 200m.

b. Karlo Island (Stn. 2): Elv: 19ft. Lat: N12°56.282′ and Long: E 92°53.541′. Shore area is muddy and mostly brackish water around the

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island. Island is meandrous, swampy and densely lined with mangrove vegetation. Live coral patches are found at shallow water depth upto 7m. Reef slope are started more than 100m away from shore area.

c. Sound Island (Stn. 3) : Elv: 142ft. Lat: N 12°56.156′ and Long: E 92°58.123′. Island is extended about 10 sq km. Coast is much intended. Live corals abound. Reefs start from shore and extend to 10m depth. The area near to shore itself is deep.

d. Rail Island (Stn. 4) : Elv: 78ft. Lat: N 1256.860 and Long: E 9254.620. Mangrove thick, narrow sandy beach with occasional coral stones. Intertidal areas restricted to few places getting exposed in patches only during neap low tides. In Northern side of the island dead coral stones are found at 1-2m depths and live coral occurs at a depth range of 2-6m depth.

e. Interview Island (Stn. 5): Elv: 146ft. Lat: N 12°59.304′ and Long: E 92°43.245′. In northern tip of island live coral cover extends upto 200m areas. Shore side mangroves covered. Thin strip of sandy beach in places devoid of rocks and dead coral boulders. During low tide, exposed area extends upto a length of 300m. Live corals are found depth upto 10m.

MATERIALS AND METHODS

Line-intercept transect method (English *et.al*) was employed to monitor the health of coral reefs during the survey period of April'10-July'10. At each site out of five selected areas, the total length of the transect was 50 m on the reef flat and reef slope. Four transects were laid on parallel to the coast at the depths between 2 m – 12 m in each study sites. All the above locations were fixed using GPS (Garmin Model 12XL) and were revisited periodically, at least once a month. Atmospheric temperature and Sea Surface temperature was measured by using a mercury bulb thermometer and refractometer was used to determine the water salinity. Biophysical status of the coral reef ecosystem was assessed based on observations on bleached coral, non bleached coral, partially bleached coral and algal population. Live and dead form of coral reefs has also been assessed separately on the collected data.

Abbreviation Used: AT- Atmospheric temperature; **SST-** Sea Surface Temperature; **SD**: Standard deviation. **Stn**: Study sites.

RESULTS

Coral bleaching occurs along the entire coast of Andaman and Nicobar Islands and it's started from April, 2010. As much as 57%-90% corals was found to have been bleached in the Middle Andaman region during April-July, 2010. The corals species *Acropora, Merulina, Pocillopra, Porites, and Pachyseris* are most badly affected by this bleaching event. However, at the end of July 8%-15% corals are found to have recovered. The mean SST varied from 30.7-32.1°C during the study period, with the maximum observed in May at Stn. 5 (Table 1). The SST continues above 30°C from April through July in all five study sites. The water salinity value ranged from 33.8-34.2 ppt during the study period, with the maximum occurring in April at Stn. 1 and Stn. 5 (Table 1). The salinity values in all the study sites were lower during July compared to those observed in April. The biophysical status of corals and other life forms was observed and reported (Table 2). The distribution of actual coral cover with dead forms was calculated and it was given in Fig 3. The occurrence of bleaching at different stations have been patchy with more severe bleaching recorded in shallow waters than at deeper offshore sites. During April 2010, maximum coral cover was observed in Stn. 5 (56.04%) and most of the dead forms were found in Stn. 2 (64.92%). The live coral cover in the reefs include hard corals, soft corals, sponges, others benthic macro-organisms found in the transect areas and dead forms include dead corals, rocks, rubbles etc. Most healthy reefs found in Sound (Stn. 3) and Interview Island (Stn. 5) with the live coral covers of 56.96% and 53.11% respectively during the last week of July. A maximum of 89.58% coral bleaching was observed in the reef area of Stn4. Aves Island (Stn. 1) and Sound Island (Stn. 3) also recorded considerable level of bleaching, i.e. 57.86% and 48.89% respectively. Due to low temperature was observed in July compared to April, the effect of bleaching also decreased at different study sites (Table 3). Recovery of corals was noticed from the data of June-July'2010. Partially bleached corals at different study sites recovered quickly with percentage of 25%-30% and completely bleached coral recovered in scanty extent (5%-10%).

DISCUSSION

The overall biophysical status of the coral reefs observed during April-July'10 indicated that the bleaching was rapidly affected the reef areas but percentage of recovery is very slow. The species of corals affected were those of the families Acroporidae, Pocilloporidae, Faviidae, Poritidae, Merulinidae, Agariciidae, and Fungiidae. The mortality was severe in the *Acropora aspera, Pachyseris gemmae, Pocillopora damicornis, Merulina ampliata* and *Pectinia* sp. Recovery of corals after the 1998 bleaching phenomenon in the Gulf of Mannar was very slow that took as much as one year to achieve a stable recovery (Kumaraguru, 2002). According to ZSI report, 25% of live cover of coral reefs in 1998 has increased to 45% in 2003, revealing the regeneration of these reefs after 1998 unprecedented coral bleaching in Gulf of Mannar (Venkataraman and Melkani, 2007). During 2002 bleaching event the bleaching was found to be faster than that of 1998 bleaching event (Kumaraguru, 2002). Recovery was slow in the present coral bleaching event, particularly in the branching form of corals like Acroporidae an Pocilloporidae. Members of the families Poritidae and Fungiidae showed better recovery. Post-bleaching surveys conducted in the Middle Andaman region for a short period of time. According to our observation, it will take more than one year to achieve a successful recovery. The coral bleaching event in 2010 has also been reported from the neighboring countries bordering Andaman Sea such as Thailand, Malaysia and Myanmar during May, 2010.

Generally, A variety of stressors have been invoked as being potentially responsible for causing coral bleaching and evidence is steadily accumulating for the role of specific factors both in the field and laboratory. Some of the factors responsible are elevated SST, exposure to excessive irradiance and lowered salinity. Bleaching is a result of expulsion of symbiotic algae, zooxanthellae, from the corals. Mass bleaching of corals had been noticed when SST rose well above the average for summer, causing stress on the corals (Hyne, 1998). Frequently, the hot temperature coincided with more solar radiation, particularly during calm periods (Wilkinson, 1998). A corresponding increase in SST was noticed during April and May, 2010 and the maximum mean SST (32.1°C) was observed during whole study period (Table1). Coral reefs form one of the most dynamic and productive marine ecosystems in the world. Reefs provide the feeding and breeding grounds for thousands of food and ornamental fishes (Birkeland, 1997). There are tens of millions of people in the tropics whose livelihood depends on coral reefs. It has been estimated that a part of the protein consumed in their diet is being obtained from the coral reefs (Salvet, 1992). Although the bleaching occurs in Middle Andaman as well as various part of Andaman Sea, they 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 most noticeable thing is that if we look at the scientific records, this phenomenon of coral bleaching has been taking place periodically all over the world. The process of natural selection is in operation, with the growth of new coral colonies and any disturbance in the system is only temporary. Therefore, in spite of the odds, the corals will resurge under the sea, which we need to protect and conserve for our benefit.

SUMMARY

The Coral bleaching occurred during April- July 2010 was monitored in five sites of the reefs of Middle Andaman. The entire coastal area of Andaman Sea was affected by this bleaching event. 57-90% bleaching was observed on the species of the coral families Acroporidae, Pocilloporidae, Faviidae, Poritidae, Merulinidae, Agariciidae, and Fungiidae. The major causative factors for bleaching might be due to unusual rise in surface sea-water temperature, upto 32.1°C during May, 2010. This unusual thermal stress on the corals leads to expulsion of zooxanthellate from their bodies, causing coral bleaching. The result of this bleaching event might affect the distribution of reef organisms, mainly food fishes which depend on the corals for feeding and breeding. It may also affect the percentage of live coral cover in Middle Andaman region by increasing mortality of corals.

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Table 1. Monthly Variation of biophysical parameters of the study sites

Study Sites	April' 2010		May' 2010		June' 2010		July' 2010	
	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)	SST (°C)	Salinity (ppt)
Aves (Stn1)	31.8	34.2	32.1	34.1	30.8	33.9	30.8	34
karlo (Stn2)	31.8	34.1	32	34	31.1	33.8	30.7	33.8
Sound (stn3)	31.8	34	32	33.9	31.3	33.9	30.7	33.9
Rail (Stn4)	31.9	34.1	32.1	34.1	30.9	34	30.4	33.8
Interview (Stn5)	31.9	34.2	32.2	34.1	31	34	31.1	34
SD ±	**0.05**	**0.08**	**0.08**	**0.09**	**0.19**	**0.08**	**0.25**	**0.10**
Mean	**31.8**	**34.1**	**32.1**	**34.0**	**31.0**	**33.9**	**30.7**	**33.9**

Table 2. Monthly variation of live form at different study sites

Live and Dead Form	Stn1		Stn2		Stn3		Stn4		Stn5	
	April	July	April	July	April	July	April	July	April	July
Live coral cover (%)	37.28	39.35	25.78	26.15	54.15	53.11	31.5	32.9	56.04	56.96
Dead Coral Cover (%)	54.12	53.45	64.92	64.18	34.65	33.89	60.1	60.7	37.86	37.94
Sand	8.6	7.2	9.3	9.67	11.20	13.00	8.4	6.4	6.1	5.1

Table 3. Monthly variation of coral bleached form at different study sites

Bleached form	Stn1		Stn2		Stn3		Stn4		Stn5	
	April	July	April	July	April	July	April	July	April	July
Bleached coral (%)	57.86	54.91	32.59	30.17	48.89	45.71	89.58	85.12	52.41	47.12
Healthy coral (%)	32.53	38.90	56.15	58.57	32.17	39.52	8.79	12.21	27.18	36.61
Partially bleached (%)	6.92	3.89	5.76	4.19	16.67	12.54	1.32	1.12	15.16	11.10
Algae (%)	2.69	2.30	5.50	5.12	2.27	2.23	0.31	1.55	5.25	5.17

PLATE-I

Fig. 1

Fig. 1A

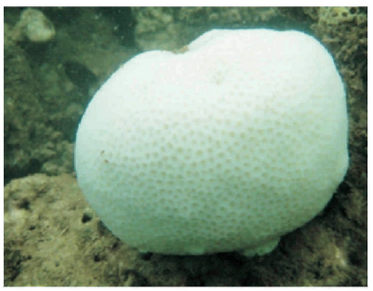


Fig. 1B

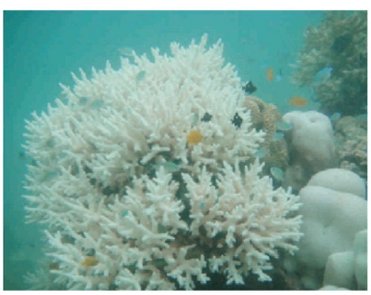


Fig. 1C

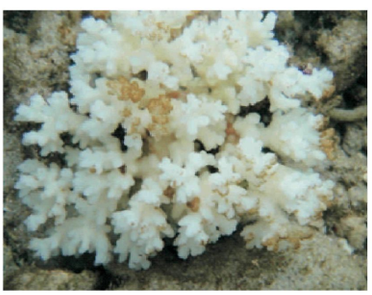


Fig. 1D

Fig. 1E

Fig. 1F

Fig. 1G

Fig 1 : Coral bleaching occurs at different coral colonies.

Fig. 1A, 1B- *Porites* sp, *Goniastrea* sp.

Fig. 1C, 1D, 1E- *Acropora* sp, *Pocillopra* sp, *Fungia* sp.

Fig. 1F, 1G- *Pachyseris* sp, *Pectinia* sp.

PLATE-II

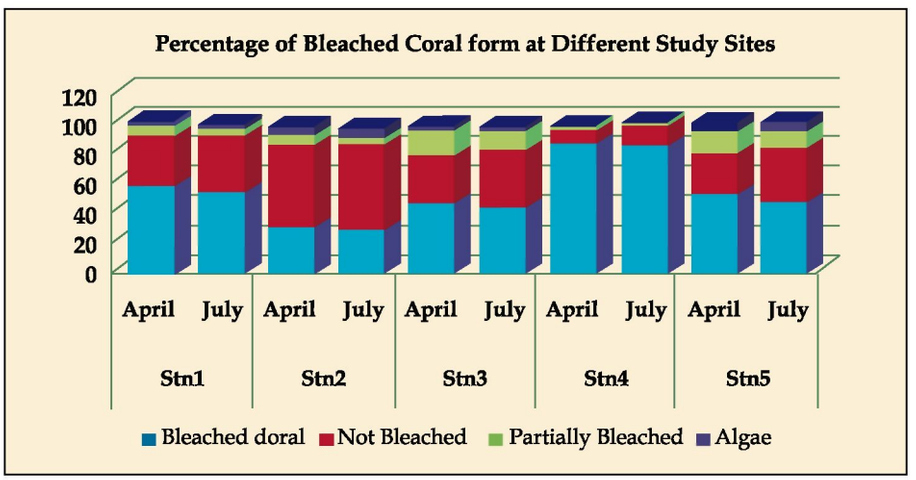


Figure 2. Percentage of coral bleaching in Middle Andaman Region.

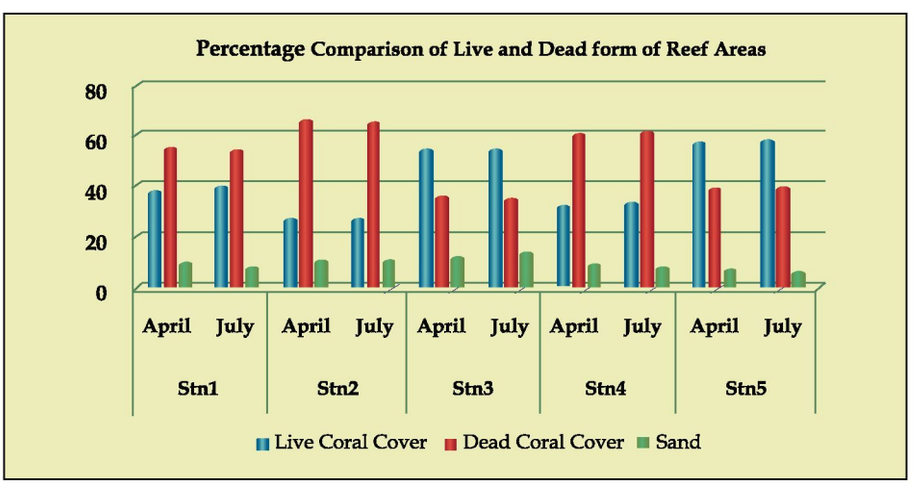
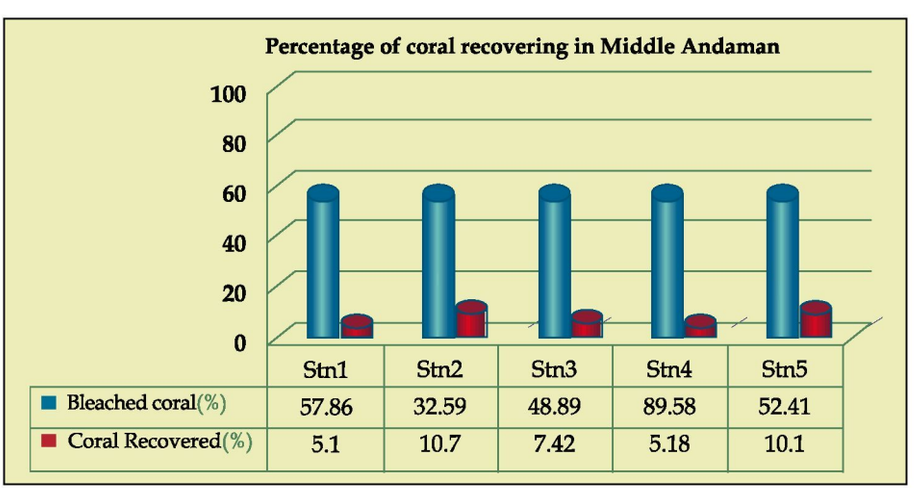


Figure 3. Comparison of Live and Dead forms at Different Study Sites.



	Stn1	Stn2	Stn3	Stn4	Stn5
Bleached coral(%)	57.86	32.59	48.89	89.58	52.41
Coral Recovered(%)	5.1	10.7	7.42	5.18	10.1

Figure 4. Percentage of recovery from bleaching in Middle Andaman.

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