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Occurrence of live Corals in Close Vicinity of Nuclear Power Plant site, Tarapur, Maharashtra, India

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Abstract

On the west coast of India live hermatypic and ahermatypic corals were encountered in close vicinity of nuclear power plant site at Tarapur, Maharashtra, which has been working successfully since 1964. The patchy growth of three hermatypic coral genera, viz., Goniastrea, Goniopora and Porites were observed at intertidal area of intake channel of TAPS 3 and 4 (500 m, SE), Varror (8.4 km, NE) and single ahermatypic coral species at Light house (1 km, NE). The corals in these areas were small in size and appeared to be not more than few years old. The water temperature, salinity pH and turbidity were in the range of 27.5^{0}C to 29.9^{0}C, 34.5 ppt to 36 ppt, 7.9 to 8.2 and 10 NTU to 21 NTU respectively. Sediment texture was mainly dominated by sand (81.9 % to 86.6 %) followed by silt (6.75 % to 10.5 %) and clay (5.6 % to 7.7%) and organic carbon was in the range of 0.78 (%) to 1.98 (%). The occurrence of corals indicates that they got adapted to the range of salinity which tends to vary seasonally and turbidity due to strong wave action. It was observed that the corals got affected due to fishing activities rather than discharge from TAPS and therefore efforts are needed to protect them.

Keywords: Coral, West coast of India, Nuclear power plant, Tarapur, Fishing.

Introduction

Corals are very productive and coral reefs are called as "rain forest of the sea", They are supportive in nature as they sustain the biodiversity, which is an indicator of pristine habitat not only for marine vertebrates and invertebrates but also most of the human population adjacent to coastal areas, which are directly or indirectly depend upon coral reef for their livelihood. They are the home (provide shelter and nursery grounds) of 25% of marine fish[1]. It is estimated that about 30 million poor human population is entirely depend on coral reef for their food[2]. Since the beginning of last quarter of 20th century, the environmental problems on coral reef have grown and questions regarding possible causes and solutions have increasingly attracted the attention of researchers. The studies in major reef areas have moved forward but the problems are burgeoning. Global climate change plays major role in coral bleaching, which causes worldwide decline in coral reefs[3,4].

Various factors are responsible for this decline and bleaching, which importantly include fluctuation in sea water temperature[5,6]. Besides, the coral bleaching is often a normal non-lethal response to seasonal variation in water temperature and coral regain photosynthetic algae when conditions reform[7]. Although rise in surface water temperature is primary cause of coral decline and bleaching yet the secondary factors are also equally important such as, reduced salinity, coastal pollution, microbial infections, over exploitation, ecotourism and illegal fishing using dynamite and chemicals. In the present study, three different genera of hermatypic corals and single species of ahermatypic coral were encountered at costal area along the Tarapur Atomic Power Station (TAPS). The various physico-chemical parameters were studied to identify the status of coastal environment.

Materials and Methods

Tarapur Atomic Power Station has two reactors, *i.e.*, TAPS 1 and 2 and TAPS 3 and 4. The live corals were found at intertidal area near to intake channel of TAPS 3 and 4 which fall in restricted zone of TAPS and separated from the discharge channel by an artificially created embankment. Light house, where the discharge water of TAPS 1 and 2 after passing through the channel of ~1.5 km is released at low water level and Varor is situated at a distance of 8.4 km (NE) from TAPS 1 and 2 reactor (Figure-1). The light house and Varor site got impacted by local fishing activity. The Varor area also receives the sewage from surrounding villages. Varor and TAPS 3 and 4, where hermatypic corals were encountered had good growth and diversity of algae.

The coastal survey was conducted during November 2012, along the coastal area of nuclear power plant site, Tarapur. The corals species encountered were identified as per[8] and photographic evidence was collected by using under water digital camera (Model No. OLYMPUS μ Tough, 8010). The air and water temperature (^{0}C) was recorded using digital thermometer (Fisher Scientific, ±0.1^{0}C), Salinity (%o) was measured at site with the help of Refractometer (ATAGO, s/ Mill – E, Salinity 0-100‰). The pH universal indicator was applied to check the pH of seawater in field and got confirmed in laboratory by using digital pH meter (EUTECH pH meter, PC 510) and digital Nephalometer (Equip-tronics, EQ-815) was used to measure turbidity (NTU). Sediment texture (%) analysis was done as explained by Kim[9] and sediment organic carbon (%) was analyzed as per wet combustion method[10].

Results and Discussion

The various physico-chemical parameters studied are listed in Table-1. The air temperature and water temperature was in the range of 26.1^{0}C to 28.5^{0}C and 28^{0}C to 29.9^{0}C respectively. The survey was conducted in the month of November, which is a winter season on west coast of India when the wind with low temperature blows from sea towards the land and reduces the surface water temperature to some extent. The pH was in the range of 7.9 to 8.2. The salinity was recorded with minimum of 34.5 % at Varor and maximum 36%o at Light house. The possible reason might be the fresh water input at Varor from surrounding villages and higher water temperature at Light house due to discharge from TAPS 1 and 2. Turbidity varied in the range of 10 (NTU) to 21 (NTU). The reason of maximum turbidity at Varor and Light house was the impact of high tidal waves and the bottom sediment used to disturbed due to daily local fishing activity. Whereas, at TAPS 3 and 4, the boulders at low water level help to reduce the impact of tidal waves. The sediment texture was mainly dominated by sand followed by silt and clay except at light house where clay > silt. The organic carbon in sediment was minimum at TAPS 3 and 4 (0.78 %) and maximum at Varor (1.98 %), clearly indicating that the sewage input from surround villages played key role to increase the organic load. At Light house, the organic carbon was found as 1.44 %, possibly due to presence of mangroves at high water level.

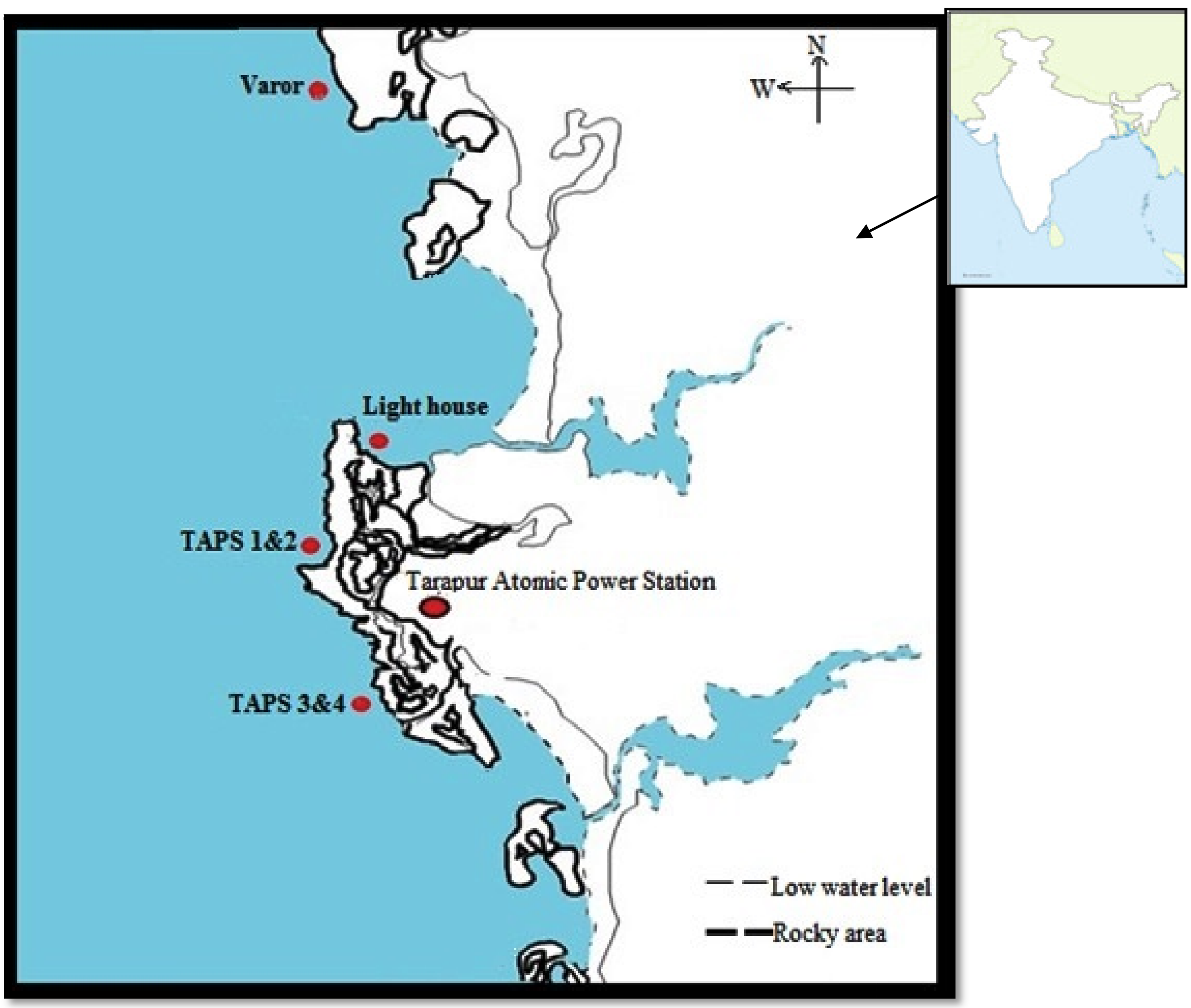

Figure-1
Study area around Tarapur Atomic Power Station

Table-1
Physico-chemical analysis of costal area at different locations around TAPS

Parameter	Varor	Intake channel TAPS 3 and 4	Light house
Air temperature (^oC)	26.1	27.5	28.5
Water temperature (^oC)	28	28.2	29.9
pH	8.2	8	7.9
Salinity ($\%_0$)	34.5	35.5	36
Turbidity (NTU)	21	10	19
Sand (%)	81.98	86.6	85.6
Silt (%)	10.5	7.8	6.75
Clay (%)	7.52	5.6	7.65
Organic carbon (%)	1.98	0.78	1.44
Ammonia NH_4-N^+(mg/l)	0.73	0.93	0.7
Nitrite NO_2-N (mg/l)	0.06	0.07	0.4
Nitrate NO_3-N (mg/l)	0.92	0.7	0.4

There are published literatures for presence of live corals around west coast of India. The coral patches were recorded from intertidal region at Malavan, Ratnagiri and south Mumbai[11-13], the Gaveshani bank, 100 km west of Mangalore[11] from Quilon in Kerala to Enayam in Tamilnadu[14]. Ratnagiri, Malavan and Sindhudurga are the major attractions of tourist to experience this stunning ecosystem. The study of coral pertaining to costal area along Gujarat was mainly restricted to Gulf of Kachchh[15-18]. Recently, Raghunathan *et al.*[19] reported five species of live corals along Sourashtra coast of Gujarat. The present study is the first record of occurrence of live corals around Tarapur Atomic Power Station, Tarapur.

In the present study, the coral encountered during November 2012, along the coastal area of TAPS were, *Goniastrea retiformis, Porites Lutea* and *Goniapora sp.* at Varor and intake channel of TAPS 3 and 4 (Figure-2 A-E). The single ahermatypic coral species was found at Light house (Figure No.2 F). The species for ahermatypic coral could not be identified.

Coral is a kind of marine fauna with its aragonite skeleton exhibiting different growth rates influenced by external factors such as temperature and light[20]. The cooling water from the Nuclear Power Plant site at Tarapur released through two discharge channels, one belongs to TAPS 3 and 4 reactor and second is of TAPS 1 and 2 reactor. When the heated water is released into tidal water, it typically floats on cooler receiving water. Hence, there is often little direct thermal impact on benthic communities[21]. The discharge from TAPS 1 and 2 and TAPS 3 and 4 passes through a channel (~1.5 km) and pond (area of 1ha) respectively, dredged along the discharge point which ultimately reduces the water temperature by dissipative process. The change in water temperature above ambient by heated effluent of TAPS was observed only about 100 to 200 m from the discharge point.

Earlier it was thought that no coral growth is likely to occur at close to shore area along west coast of India, because of heavy monsoon which is associated with high turbidity and decrease in salinity[12]. Therefore, occurrence of live corals around TAPS is interesting as these corals got ecologically adapted to wide variation in salinity, turbidity and temperature. Except global climate change, there are many localized threats to corals including fishing, industrialization along coastal sites, tourism, agricultural and wastewater pollution, dynamite and chemical fishing *etc.* In the present study, except intertidal area around intake channel of TAPS 3 and 4, the other locations, *viz.*, Varor and Light house, where these corals are mainly susceptible to local fishing activity. The TAPS 3 and 4 falls under the restricted zone of TAPS; hence, the fishing activity is banned at this location. The local fishermen use conventional methods for fishing such as, scraping of intertidal area to catch fish, planting of bottom net on coral rock (Figure-2E), stamping on the corals, disturbing the coral rocks for searching of fish and tying of fishing nets.

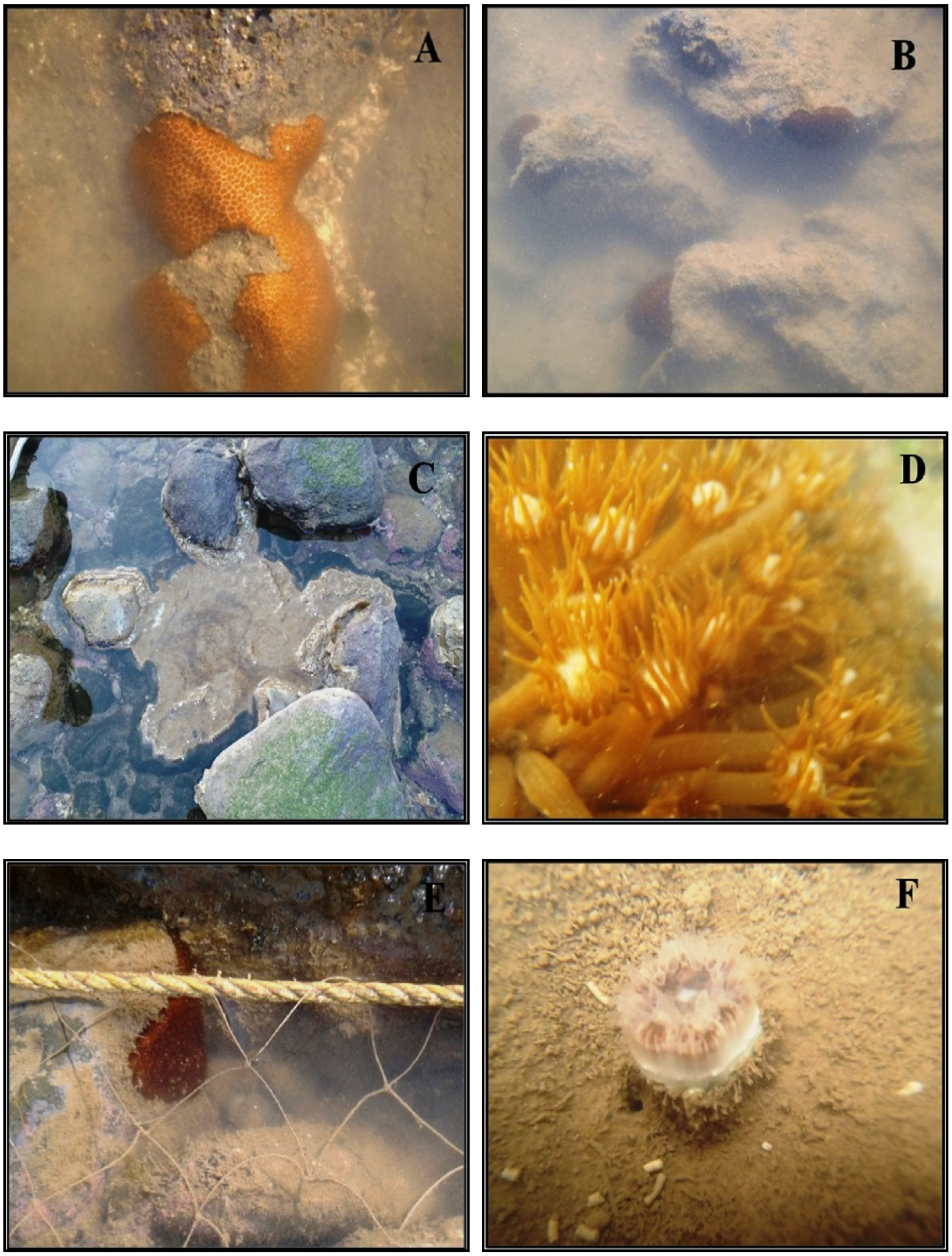

Figure-2
Live corals around TAPS; A-massive growth of *Goniatrea retiformis*, B- patches of *Goniatrea retiformis*, C- *Porites lutea,* D- *Goniopora sp.*, E- bottom fishing net on *Goniatrea retiformis* at Varor, F- ahermatypic coral species at Light house

Conclusion

The live corals encountered in this area are more susceptible to anthropogenic and local fishing activities rather than heated effluent released from TAPS. Hence, the efforts have to be made to protect this highly important marine biota. The awareness about the ecological importance of coastal biodiversity should be made available among the fishermen and fishing techniques should be banned. The other point of interest is, there may be presence of coral colonies in nearby subtidal area from where the planulae larvae floats and settled on the intertidal area. Therefore, an extensive survey must be conducted around TAPS to explore the biodiversity.

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