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Degraded coral reefs of gulf of kachchh marine national park in India

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Abstract

Coral reefs of the Gulf of Kachchh are in a highly degraded condition, when compared with other threemajor coral reef regions of India. In correlation with geographical and oceanographical changes, its arid climate and the semi-diurnal tidal amplitudes fluctuations hamper the recovery of the reef. Soft corals may play the alternative key role in maintaining the ecological role in the degraded reef ecosystem in the absence of hard corals. Re-colonization of soft corals on the degraded reefs is among the first steps to make them to recover gradually. Present Line Intercept Transect survey (LIT) conducted in a reef of the Gulf inferred the possibility to recovery of the reefs due to the colonization of soft corals on the bare coral boulders.

Keywords:*1.Chandri reef, 2.degraded reef, 3.Gulf of Kachchh, 4.LIT, recovery,5.Sinularia poly dactyl, 6.soft coral.*

Introduction

Nearly 92% of the world's coral reefs are located between latitudes 30° N and 30° S in the Indo-Pacific region (Spalding *et al*, 2001). The Gulf of Kachchh is an inlet of the Arabian Sea along the north-west coast of India. It occupies an area of7350 sq.km., which comprises 42 islands with a diverse group of fauna and flora (Nair, 2002). This region is considered to be the northern most limit of coral distribution in the Indian Ocean (Hoon, 1997). Coral reefs of this region are in a degraded condition, when compared with other three major coral reef regions of India *ie*. Gulf of Mannar, Andaman & Nicobar and Lakshadweep. The degradation is explained due to transgression of the sea levels of the Late Pleistocene-Holocene period and up-liftment of tectonic plates of the Gulf (Srivastava, 1965). In correlation with this, its arid climate and the semi-diurnal tidal amplitudes fluctuations imply flux in water quality and heavy sediment depositions on coral reefs are hamper their recovery to a healthy state (Michael *et al,* 2009). Residual coral species living today are quite distinctive in terms of their isolation and their adaptation to survive in such extreme oceanographic and climatic conditions (Dixit *et al,* 2010). The reef flats and inter-tidal pools of most of the islands of the Gulf are covered with dead coral boulders. Like other many benthic marine ecosystems, in the inter-tidal regions also sessile organisms compete for limited substrata for settlement and growth (Dayton, 1971; Paine, 1974). In the Gulf of Kachchh, every available space for new recruitment is colonized by a variety of benthic macro algae and zoanthids and makes the reef flats as competitivedynamics. Successfully settling less coral juveniles also can't survive due to the prolonged exposure to the temperature during the low-tides and sedimentation during high-

tides. Hence, the reefs are still in unrecovered state. Soft corals are conspicuous component in the coral reef ecosystems. They co-exist with the hard corals along the tropical reefs. They were once considered a mere veneer of reef construction but, detailed studies revealed their role in cementing the coral lime stones together in building the reefs (Jeng *et al,* 2011). In the areas where stony corals have been devastated, recolonization of soft corals are among the first steps to make the degraded reef to recover gradually by letting the other organisms including hard corals to recolonize (Nishihira &Yamazato, 1974). It is noteworthy to bring up such a situation of soft coral abundance on a reef in the Gulf of Kachchh observed during a study, which may improve the resilience of the reef and enhance its fast recovery in the coming decades.

Materials and method

The Gulf of Kachchh is an east-west oriented indentation lying between the Kachchh mainland and the Saurashtra Peninsula along the North West coast of India. The southern shore has more than 42 Islands and inlets generally which harbour vast areas of mangroves and coral reefs. 'Chandri', the westernmost reef of the Gulf (22° 30.4' - 22° 31.8'N and 69°07.0'E - 69°08.4'), covering an area of 266 sq.km. is situated 10 kms. away from the coast (Fig. 1). This island remains submerged during high tide. Because of its location in the open sea, and without mudflats and mangroves, it is subjected to heavy currents. Sandy beach is found on the southern side of the island (Satyanarayana & Ramakrishna, 2009). The North and Eastern side of the reef flat are mostly covered with dead coral boulders, which get exposed only during the minus tides. Percentage cover of the biotic and abiotic components of the reef flat was quantified by laying quadrat transects randomly in 5 stations following the methodology of English *et al,* (1997). Based on the steepness of the slope, five different stations were selected on the reef flat. Station-1 was the deeper most station, which had about 15cm of water level during the survey (minus tide) and stations-4 and 5 were fully exposed at that time. In each station, quadrates were laid in triplicate. Preliminary survey was carried out during April 2014 and follow-up survey was done in March 2015.

Results and discussion

The life form cover of the Chandri Island's reef flat is given in Table.1 and 2. During the present study, a single species of soft coral was found colonizing very densely on the reef flats. Colonies looked brown in colour and with sparse, thick long fleshy fingerlike lobes. The tip of the lobes are usually dichotomously branched or bifurcated. The tips of few lobes are branched into three. The colonies have cylindrical stalk. The maximum height of the colony measured is 154mm, lobe length is from 8 to 62mm, lobe and lobule diameter is up to 16mm. All the morphological and sclerite taxonomic characters identify this soft coral as *Sinulariapolydactyla* Ehrenberg 1834 (Fig. 2).

During the preliminary survey, most of the dead coral boulders of the reef flat were occupied by this soft coral colony at station 1 and 2. There was very less cover of macro algae and other space competitors like zoanthids noticed. The percentage abundance of soft corals showed descending towards station 4 and 5 and replaced by sea weeds sea anemone species (Fig.3). Soft coral olonies are found inflated with sea water and a less cover of hard corals was also noticed, most of them are juvenile massive types. The hard coral coverage is also increasing towards station 5 to station 1 (Table.1). Whereas, in addition to the zoanthids and sea anemones, dead coral algae (DCA) and algal assemblage (AA) covers were reducing towards station 5 to station 1 (Fig. 3).
It was interested to note that the hard coral cover was increased especially at the stations 1 and 2 during the follow-up survey (Table. 2) after about one year (March 2015). Total coral cover of the reef flat was increased from 0.368% to 0.958 % after one year. But the soft coral cover was decreased from 24.81% to 15.02% (Fig. 3).

In many benthic marine systems, sessile organisms compete for limited substrata for settlement and growth in the coastal inter- tidal regions (Dayton, 1971; Paine, 1974). They are acted upon by variety of environmental factors like temperature, desiccation stress, change in salinity, predation etc. Moreover, the daily tidal fluctuations imply flux in water quality and sediment depositions (Johannesson *et al,* 2000). Cumulative impact of these stressors has undermined the natural resiliency of the coral reef ecosystems such as Gulf of Kachchh. If this situation persists, the coral boulders covered theGulf's Islands may disintegrate in to coral sand and erode due to the wave action and loss of land mass consequently.

Reef health can be explained in terms of ecological resilience – i.e. its ability to resist threats and to recover to a healthy state when an impact does occur. Source of new coral recruits, suitable substrate for the settlement and survival of larval corals and abundant and diverse communities of herbivorous fishes are the key aspects of ecosystem quality that facilitate recovery (McCook, 1999; Mc Clanahan *et al,* 2002). Though, reef flats of the Gulf are suitable place of planulae settlement and juvenile corals, they will not grow up to a massive structures due to the long exposure during low tides.

Soft corals may play the alternative key role in maintaining the ecological role in the degraded reef ecosystem in the absence of hard corals. During the present study soft coral colonies found inflated with sea water. This is an adaptation to overcome desiccation stress during the low tide exposure.

Present study also reported this species of soft coral, *Sinulariapolydactyla*as new distribution record to the Gulf. Jeng *et al,* (2011) inferred that once a soft coral colony disintegrates,the sclerites, each less than 1 millimeter in size, were thought to scatter and simply accumulate on the sea bed along with shells, sea urchin spines, and other smaller materials. Thus they can construct reef in the degraded coral reefs.
Fish herbivores and other functional groups of invertebrates can be rehabilitated when the soft corals re-colonize the degraded reefs. Such rehabilitated sites may become highly valuable for supplying new coral larvae recruitment also. In some localities, particularly in the areas where the stony corals had been devastated, soft corals are even more abundant than stony corals (Nishihira &Yamazato, 1974). Same pattern of soft coral abundance was also reported by Padmakumar and Chandran (in press) along the reef slopes of Gulf of Mannar Marine Biosphere Reserve Islands, India. Soft corals are widespread, throughout the Indo-Pacific reefs and are rich in biodiversity. The genus *Sinularia*, the soft coral used in reef building, is composed of about 170 species worldwide.

This number is more than any stony coral genus. Soft corals are more adapted to the changing environment than the stony corals. They are more adapted to temperature and sedimentation when compared to stony corals.

The capacity of soft corals to secrete mucus layer on their body surface and shed off the deposited silts and sediments is helping them to survive in heavy sediment waters like Gulf of Kachchh. Since they predominantly reproduce vegetatively, they can rapidly cover the degraded reefs (Dahan & Benayahu 1997; Highsmith 1982; Jackson 1985). But during the follow-up study, the percentage cover of soft coral was reduced. Same type of seasonality of soft coral was noticed in Pirotan Island also (Chandran *personnel comm*.).

During March 2015, the percentage cover of DC was increased by reduction of DCA which may increase the space for new coral recruit settling (Fig.3). This may co-inside with the forthcoming coral spawning event in the Gulf. If the situation is persists, the coral cover of the island at stations 1 and 2 may have the possibility to increase in the coming decades.

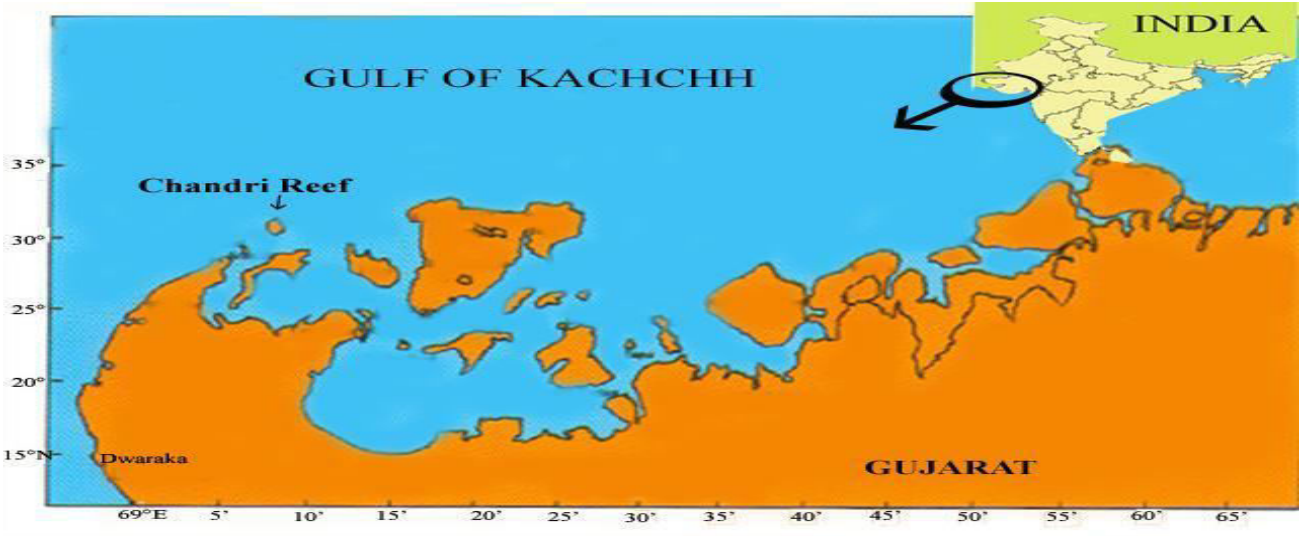


Figure -1 map showing the study area - Chandri reef, gulf of Kachchh – India



Figure-2 soft coral colony, *sinulariapolydactyla* recolonized on the **C**handri reef

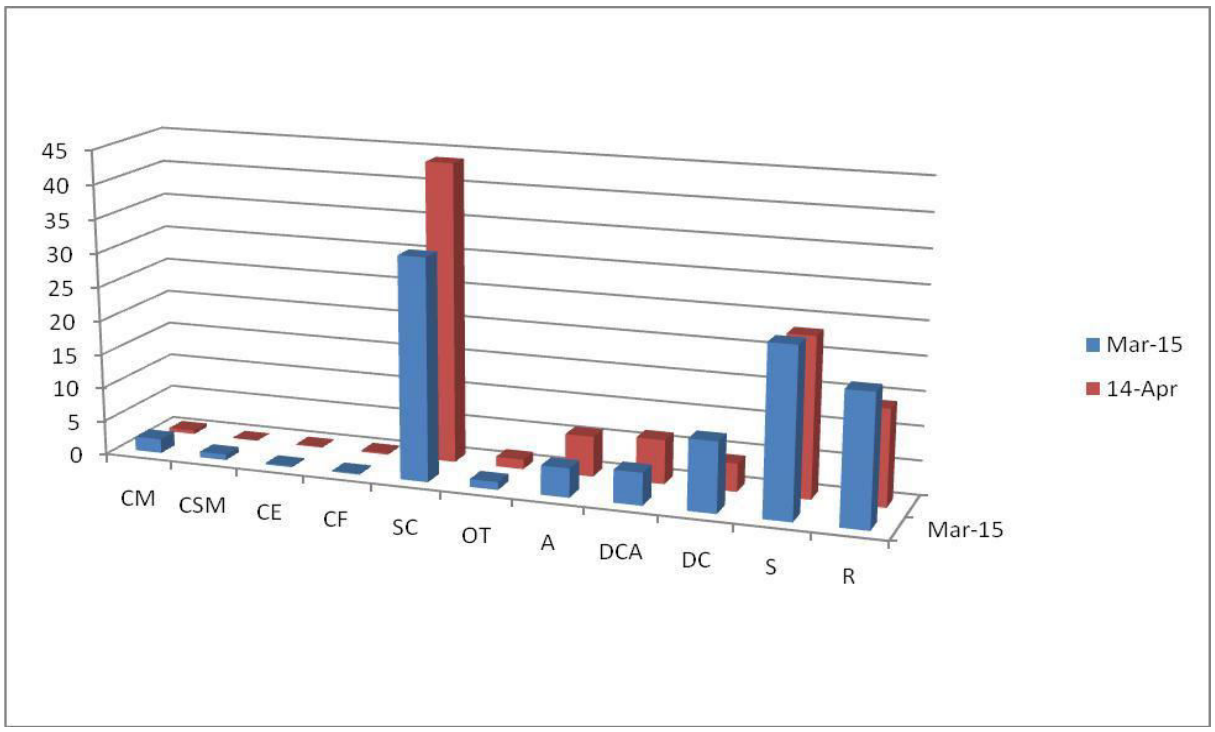


Figure 3. Variation in the life form covers at station 1 after a period of one year

Conclusion and recommendation

Re-colonization of the soft corals on the degraded reefs may give more resilience to the reefs to recover. Soft corals are comparatively more adapted in the adverse hydrographic condition than the hard corals. Fish herbivores and other functional groups of invertebrates can be rehabilitated when the soft corals re-colonize the degraded reefs and make the reef a habitat. Coral reef restorationists can be considering soft corals as a candidate species for degraded reef ecosystems. Gulf of Kachchh MNP authority can continue active steps towards restoring the reefs. Equal importance should be given to restore the native soft corals along with hard coral species. This is essential for securing the survival and recovery of coral reefs of the Gulf of Kachchh in the coming decades.

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