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Koushik Sadhukhan
National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), NCCR Field Research Centre, Mandapam Camp, Tamil Nadu, India

CH Ramesh
National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), NCCR Field Research Centre, Mandapam Camp, Tamil Nadu, India

T Shanmugaraj
National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), NCCR Field Research Centre, Mandapam Camp, Tamil Nadu, India

MV Ramanamurthy
National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), Pallikaranai, Chennai, Tamil Nadu, India

Correspondence
Koushik Sadhukhan
National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), NCCR Field Research Centre, Mandapam Camp, Tamil Nadu, India

Assessment on recruitment density of branching corals *Montipora digitata* (Scleractinia: Acroporidae) in Talairi Island, Gulf of Mannar

Koushik Sadhukhan, CH Ramesh, T Shanmugaraj and MV Ramanamurthy

Abstract
Coral reef is vulnerable marine ecosystem which critically responses to the trifling environmental changes. Presently, this ecosystem is degrading at an alarming rate due to climate change impacts. Coral recruitment acts as positive health indicator for degraded reef ecosystem. During coral reef monitoring survey at Keezhakarai group of Islands in Gulf of Mannar, significant *in situ* recruitment of scleractinian branching corals *Montipora digitata* were recorded. Present study assess the recruitment density and percentage coral cover of this coral species by using LIT and quadrat sampling method. Average live coral cover was found to be higher in the site 2 (52.60±3.2%) followed by site1 (41.32±1.7%) and the recruitment density was recorded maximum at site 2 (7.72/m^2 - 9.56/m^2). Among the Physico-chemical parameters, sea surface temperature (SST) were found to be higher (31.87 °C) than the average SST ranges (28 °C-30 °C) in Gulf of Mannar. But, there is no bleaching of *M. digitata* were recorded during the survey. Intensive reef monitoring during summer and proper conservation management of this important ecosystem can improve the recruitment rate of corals and survival of newly recruited coral species.

Keywords: *Montipora digitata*, Talairi Island, Keezhakarai group

Introduction
Tropical coral reefs provide rich marine biodiversity and important good and services to the coastal populations [1 2]. Unfortunately, coral reefs near coastal zones are facing several disturbances such as bleaching, sedimentation, shoreline operation, destructive fishing, Macroalgal invasions, and disease outbreaks over the past few decades [3]. However, coral recruitment and successful survival of the recruited corals holds the key of reef resilience against the environmental and anthropogenic stress [4-6]. Coral recruitment process in GoM is on the rise since 2005 but several bleaching events (2010, 2012 and 2016) hinder the successful growth of the coral species in GoM. Coral reproduction and post larval settlement to the reef were also recorded during 2010 and 2013 which triggers the reef recovery process in GoM [7]. *M. digitata*, belonging to the family Acroporidae, commonly known as branching non Acropora corals, is one of the important contributor to the reef formation and it has been categorized as least concern by IUCN [8]. This species is grown at faster rate due to its asexual mode of reproduction as such Stag horn corals and acts as reef enhancer in the degraded reef. Hence, the present study estimated the significant recruitment density and the percentage live coral cover of *M. digitata* in order to assess the capability of the reef ecosystem to recover from various disturbances.

Materials and Methods
Study Area
Talairi Island is an extensive elongated island which located in between Lat 09°11'N and Long 78° 54'E and covering an area of 100 ha. Island is lying parallel to the main land with elevation of 3m from sea level and situated 9km away from the Keezhakarai group [9]. The Island has a dense vegetation comprising of Thespesia, Salvadora and Pemphis trees. Talairi and Valai Island is connected by a narrow channel which gets submerged during the high tide [10].

Data collection

During coral reef monitoring activities, intensive field surveys were conducted during August, 2018 to April, 2019 at different islands of GoM to assess the benthic faunal communities. LIT and quadrate sampling method [11] were employed in duplicate at four different sites of Talairi Island to estimate the live coral cover and recruitment density of coral species during the month of April 2019. A 20 m long flexible underwater tape was laid parallel to the shore in the selected reef sites at a distance of 5m-7m. A total of 8 transects were plotted in four sites which covered 320m^2 of total survey area. Observations were noted on the transect line, (20 × 2m) 1m on each side of the tape, as per the standard code used for reef monitoring and coral colonies were counted on each quadrate area to measure the density of the population. Field data were collected by skin diving. Location of the sampling area were marked with GARMIN e-Trex handled GPS device (Fig.1).

Fig 1: Study area (Talairi Island)

Results and Discussion

Benthic community analysis in Talairi Island revealed that reef is highly diverse with different live form categories such as CB, ACD, ACB, CM, CS, CE and CF. Massive corals and Non-Acropora branching corals were found to be the dominant live form categories in Talairi Island. Among the coral species, *Montipora digitata* were recorded with high percentage of benthic cover (42.80%) in Site2 followed by Site1 (29.50%) **(**Fig.2). Adult colony of *Acropora Formosa*, *Montipora foliosa*, *Porites lutea*, *Porites solida* and *Echinopora lamellosa* were found to be abundant in all study sites. Estimation of water quality parameters in study area (Table1) infers that sea surface temperature (SST) was found to be 2 °C higher (32.07±0.04) than the average SST recorded in GoM earlier [12 13]. Bleaching of *Porites* sp. was observed during the survey. No bleaching were recorded for other species due to rise in SST. Water pH varied from 7.3 - 8.2 at all stations (Table1). Average percentage of coral recruitment was uniformly dominated by *M. digitata* (76.0%) in compared to other corals species (Fig.3). A total of 395 coral recruits were counted of which 298 colonies were of *M. digitata* and rest of the 97 colonies were of other species recorded from the study sites. Average recruitment density of *M. digitata* was recorded maximum at site2 (8.64 individuals/m^2) and then followed by site1 (6.22 individuals/m^2) and site3 (5.12 individuals/m^2) (Fig.4). Newly recruited colony size of *M. digitata* ranges from 0.7cm to 2.8cm in site2. Young colony of *M. digitata* which ranges from 3.2cm-6.0cm were abundant in site3. Average recruitment density of *M. digitata* was least in Site 4 (3.12/m^2). Among the other corals, newly recruited colonies of *M. foliosa* (9%) and *Echinopora lamellosa* (7%), *Acropora Formosa* (5%) and *Acropora gemmifera* (3%) were recorded from the study sites (Fig.3).

Table1: Physico-chemical parameters of sampling stations

	Latitude	Longitude	pH	Temp	Depth	Salinity
Site1	N09°11.103'	E078°55.968'	7.54±0.9	32.16±0.3	1.6±0.06	33.93±1.2
Site2	N09°11.108'	E078°55.811'	7.68±0.2	32.42±0.2	1.74±0.2	33.78±0.9
Site3	N09°11.081'	E078°55.725'	7.3±0.6	31.3±0.5	1.75±0.2	33.75±0.8
Site4	N09°11.077'	E078°55.419'	7.65±0.1	32.41±0.2	2.57±0.4	33.72±1.0

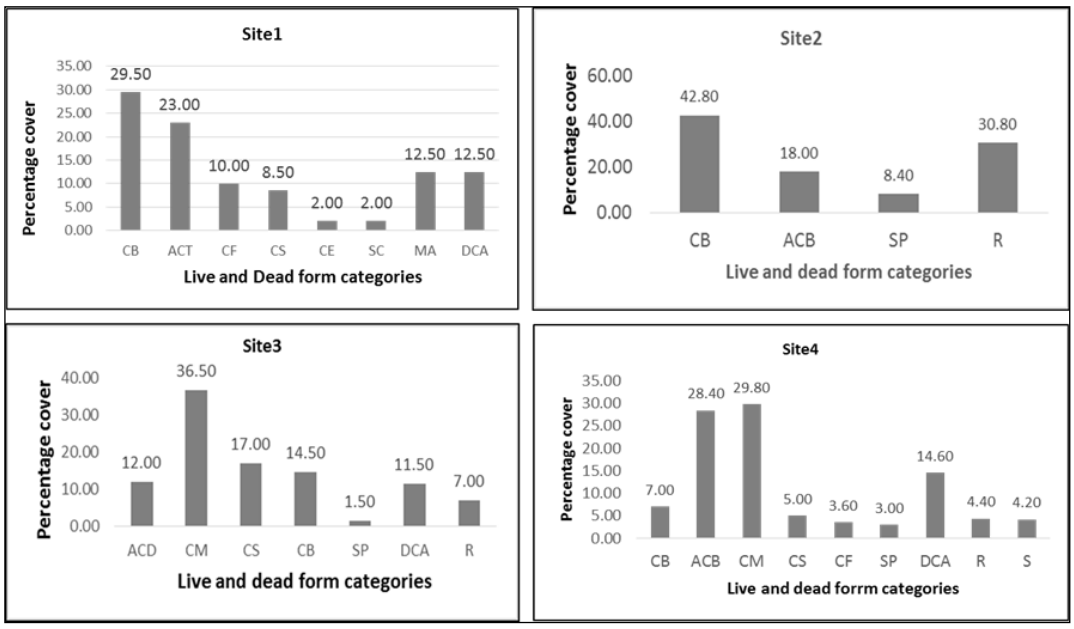

Fig 2: Percentage cover of live and dead form categories at all study sites

Successful recruitment of coral species consistently depends on the coral reproduction, survival of larvae and successful post larval settlement in the favorable environment [14]. In GoM, coral reproduction and spawning has been recorded in March every year [15]. In present study, no direct observation was made on coral spawning. But it has been presume that high recruitment density of *M. digitata* recorded in Talairi was due to the successful coral reproduction and post larval settlement on the dead reef. *M. digitata* has a strong power of regeneration with growth rate of 30.5mm/year and it act as reef enhancer alike *Acropora* or staghorn corals [16].

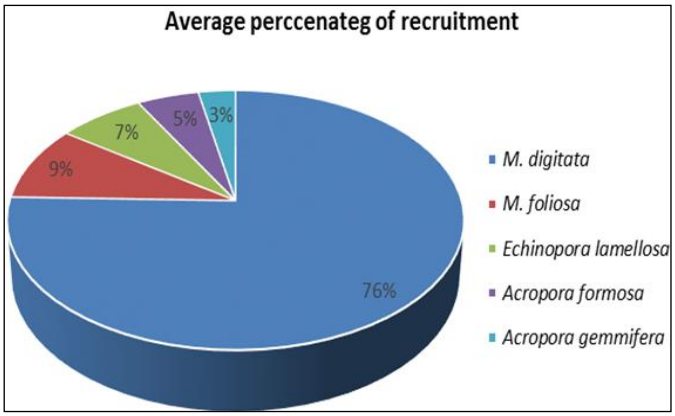

Fig 3: Recruitment coverage of different coral species in Talairi Island

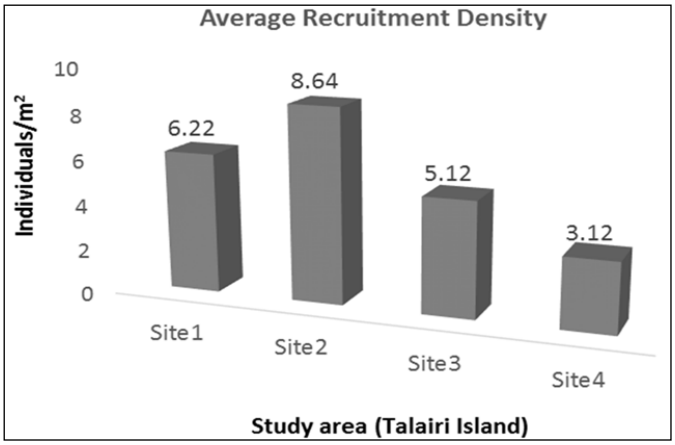

Fig 4: Recruitment density of *Montipora digitata* in Talairi Island

Significantly, average recruitment percentage and recruitment density (7.72/m^2 - 9.56/m^2) of *M. digitata* was found to be abundant in Talairi reef. Growth rate monitoring of new recruits needs to be investigated for understanding the recruitment pattern of *M. digitata* in Talairi reef. Newly recruited and young colonies of corals are the key driving forces of reef recovery and it increase the potential resistance to the reef against environmental stress [17]. But successful recruitment and survival of young colonies often faced critical environment due to increased SST, bleaching event, sedimentation, macro algal invasions and anthropogenic stresses which results in mass scale mortality to the reef [18 19]. The mean fluctuation recorded in hydrogen-ion concentration was very less in study sites and the pH remained alkaline throughout the survey period which is suitable for the coral health. The present range of SST varied from 31.30 °C±0.5 to 32.42 °C±0.2 in study sites which is high when compared to optimum SST (30 °C) for the better coral growth [20]. In GoM, sedimentation rate ranged from 1.97 mg/cm^2/day to 12.31 mg/cm^2/day in Tuthukodi and Vembar [21]. In present study, sedimentation rate was not measured, but it is obvious that significant live coral cover at all study sites and rapid recruitment of *M. digitata* triggers the reef recovery process in Talairi Island. Further monitoring of water quality parameters and coral health during the summer season can evaluate the reference point of environmental stress to the Talairi reef environment. Authorities involved in management and protection of coastal shallow reef environment should restrict the threats and allow the corals to recover. Present results and findings act as a substantial information to make future strategy for conservation plan and to estimate recovery status of a degraded reef in GoM.

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