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INTERSPECIFIC INTERACTIONS OF CORALS IN THE SHALLOW WATER REEFS OF SOUTH ANDAMAN WITH SPECIAL REFERENCE TO *ACROPORA* SPECIES

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ABSTRACT: Competition between sessile organisms is a routine affair related to survival on coral reefs, and the anthropogenic activities initiating the process of phase shift in reef habitat where macroalgae, which is fast growing and persists to be dominant affects the reef ecology. Although a slower growth rate of scleractinian corals ultimately creates a lesser scope for settlement in the reef habitat, which leads to competitive interactions among the corals. A total of 103 Interspecific coral competitive interactions were recorded from the reef areas of South Andaman. Interaction between *Acropora formosa and Porites* spp. were found to highest in all the stations viz. 46.15%, 44.83%, 22.22% at North Bay, Marina Park and Chidiyatapu respectively. The highest number of interactions were observed in North Bay (65) followed by Marina Park (29) and Chidiyatapu (9). Crustose coralline algae and corallivorous fishes were found to play a major role between the interactions build up by *Acropora* species of corals.

Key words: Interaction, *Acropora*, space, South Andaman

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INTRODUCTION

Competition is prevailing between various occupants of the coral reef ecosystems worldwide. The competition existing in between coral is not a new event, as it was reported much earlier by Darwin (1842) as coral sometimes abolishes their neighbouring colonies and prompts to overgrow them, its probable ecological significance was investigated primarily by Lang (1971,1973) on the pugnacious of Atlantic corals. Mainly the competitive interactions between corals were considered as steady and hierarchical (Lang 1973, Connel 1976). But Sheppard (1979) and Bak et al (1982) have discovered that size of colony, contact position, environmental circumstances, sweeper tentacle development and the existence of epifauna may amend the outcome of interaction. Reef corals primarily spread themselves in the available space by dispersing their planula larva into the reef area or by the attachment of their fragmented polyps (Connell, 1973; Highsmith, 1982).Another phenomenon is the formation of larger sized coral colonies due to rapid growth, eventually occupies the reef area (Dana 1846; Buddemeier and Kinzie, 1976; Hughes and Jackson, 1985; Potts et al. 1985).

Scleractinian corals and algae are the chief space consumers in the reef area, whereas soft corals are mostly an insignificant group (Benayahu and Loya 1981). Occupying a space in the light zone is one among the processes on reef flats and it initiates the competitive interactions between differently co-existing coral populations (Connell, 1973; Lang, 1973). Reef-building scleractinian corals requires space on hard substratum for the settlement and metamorphosis of their planula larvae into coral polyps. Apposite space on reef flats is a limiting resource for the settlement, growth, and reproduction of tropical reef corals (Connell et al. 2004, Birrell et al. 2008, Foster et al. 2008). Competition among reef corals for substratum space is a main practice on tropical reefs, and time periods regulate their arrangements of diversity and abundance (Connell et al. 2004).

Corals uses a selective mechanism to compete for space and coral species differs in employing type of interaction involved during an interspecific competition (Lang and Chornesky 1990).Direct interaction and overgrowth involves tissue damage via mesentrial digestion, as described by Lang (1973), or sweeper tentacles, as described by Richardson et al. (1979) and Wellington (1980).

In the present study, naturally occurring interspecific competition between *Acropora* spp. with other corals were studied on the reefs of South Andaman. No specific work has been carried out on the interspecies interaction from these islands, so the present work will throw a light on the scenario of degrees of intensity of reef coral interaction and that can utilize for long term monitoring to evaluate the potential outcome of these interaction.

MATERIALS AND METHODS

Surveys were conducted from November, 2015 to April, 2016 and natural encounters of *Acropora* spp. with other coral species were recorded with the aid of belt transects (30m × 5m) (Hill and Wilkinson 2004) employed in the shallow (<5 m depth) reef area at three stations namely Marina Park, North Bay and Chidiyatapu (Fig. 1) in South Andaman.

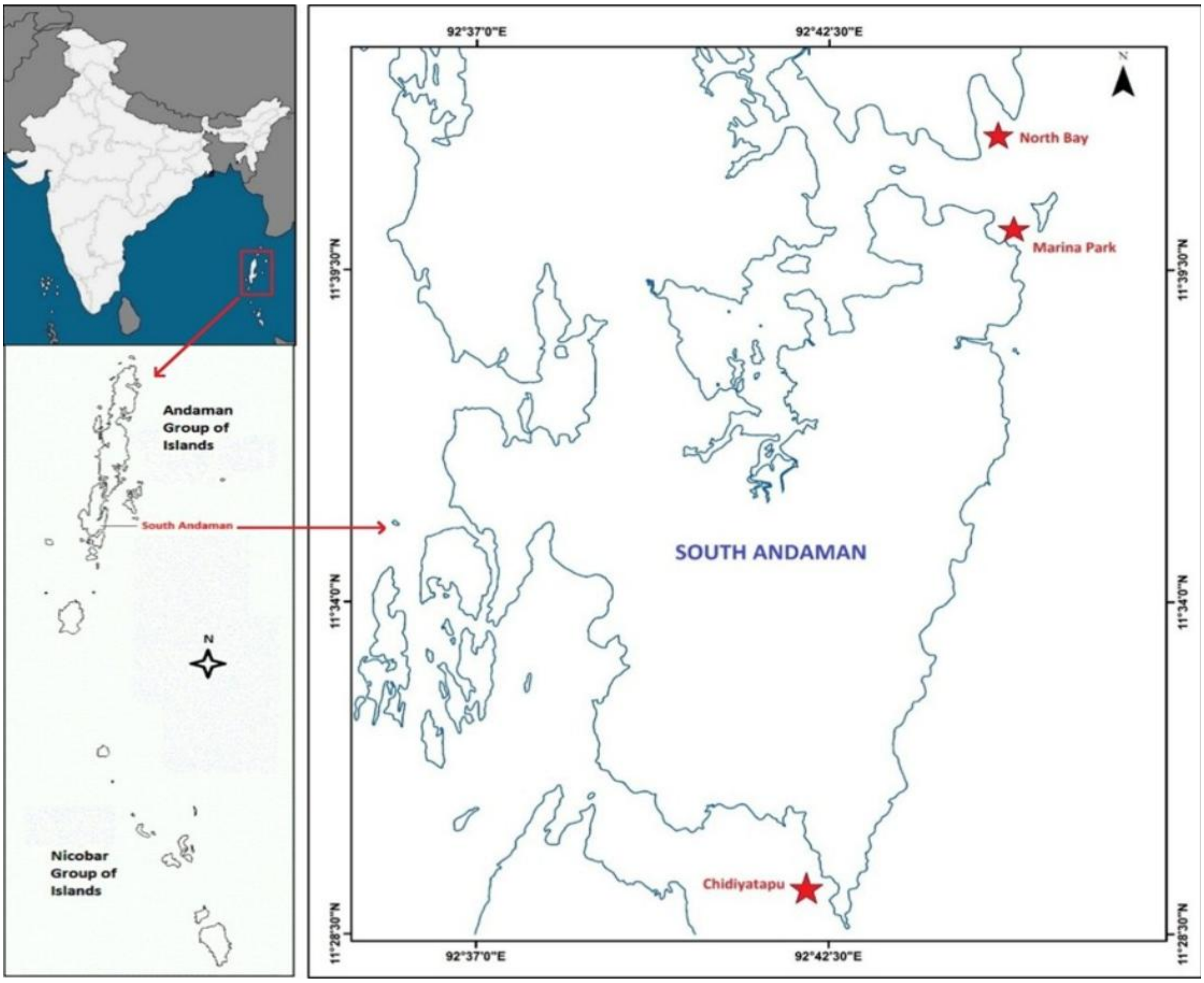
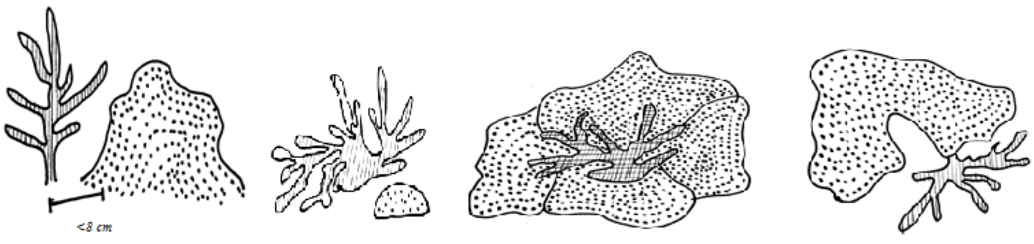


Figure 1: Map showing the locations of study stations in South Andaman

Marina Park reef is an assemblage of concrete structures that assists a high abundance of *Acropora* spp., with high anthropogenic pressure, whereas North Bay reef comprises of moderate density of *Acropora* species of corals in the natural habitat that is 50m away from the beach, however Chidiyatapu reef is 200m far from the beach consisting amoderate proportion of both live and dead corals.

Interaction between the coral colonies were counted as (i) close proximity (> 8cm) in distance, (ii) Canopy overlapping, (iii) overgrowing on another colony and (iv) direct interaction (fig. 2) following Dai, 1990. A close proximity was recognized, when the margins of two adjacent colonies growing near to the other one with a distance of 8cm, but has no contact with each other at present. Canopy overlapping was documented when a coral canopy was found to be growing on above to the other colony, by scattering its canopy onto the surface of the other coral colony, while the over growth of the colony was directly observed when a coral colony was growing on to the other coral colony whereas direct interaction was recognized when the coral colony was partly covering the other colony with a visible line of tissue damage.



(a) (b) (c) (d)

Figure2: Types of Interactions: (a) Close proximity, (b) Canopy Overlapping, (c) Overgrowth, (d) Direct Interaction

RESULTS AND DISCUSSION

To survive corals possess a variety of active and passive defences, passive defences includes aggregation, overgrowth of competitors and fusion of conspecifics, whereas active defences are in the form of cnidae and allelochemical compounds that can deter overgrowth and predation (Bruno and Witman, 1996, Maypa and Raymundo 2004).

All forms of interactions that were found in the field showed several different type of interactions with colonies of different species, where CCA is also found to play a major role as a cementing layer for *Acropora* spp. to settle, as most of the *Porites* spp. were found be grazed by corallivorous fishes and thus providing a surface available for any kind of settlement and crustose coralline algae gets easily settled on the grazed rough surface of *Porites* spp. and indirectly creating a platform for *Acropora* spp. larvae to settle, and once the *Acropora* spp. settles on *Porites* spp. it starts damaging the *Porites* spp. surface and the line of tissue damage is easily visible (Plate 1).

The majority of interactions has been found between *Acropora* and *Porites* species, due to differentially oriented growth, *Acropora* corals expand two dimensionally across the substratum or three dimensionally into the overlying water column (Lang and Chornesky 1990).The potential longevity and large size of many corals together with rapid growth by some species eventually produces crowding in some reef communities (Dana, 1846; Buddemeier and kinzie, 1976; Hughes and Jackson, 1985; Potts et al, 1985; Barnes and Chalker,1990; Harrison and Wallace. 1990). Space competition studies tend to focus on coral-macro algae interactions, but coral-coral, coral-soft coral, coral-sponge (and so on) competitive interactions can also have important consequences for overall ecosystem health, as it is an important process determining the structure and composition of benthic communities in coral reefs (Lang and Chornesky1990; Karlson 1999). In particular, competition between hard coral and benthic algae is considered fundamental to the overall status of coral reefs, especially during "phase shifts" in which reefs dominated by reef building corals become dominated by macroalgae (Littler and Littler 1984; Lapointe 1989; Done 1992; Hughes 1996; Miller 1998).

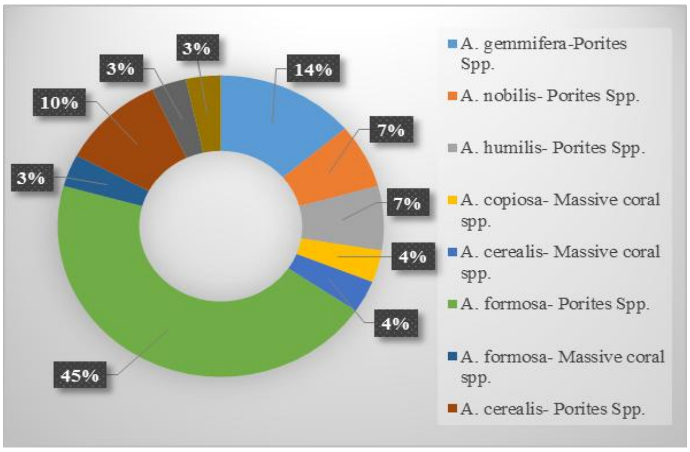


Figure-3: Interactions of *Acropora* species with *Porites* spp. and other massive corals at Marina Park

In the present study, *Acropora Formosa* was found extremely involved in all kinds of competitive interactions at all study sites. In terms of reef structure, all the study sites differed from each other, in which Marina Park entailed by an artificial reef composed of concrete structure that supports a large number of *Acropora* corals that leads to a condition of competition for space between the two adjacent coral species and it has been found that in Marina Park the highest recorded interaction was observed between *A. formosa* and *Porites* spp. (45%) and the least recorded was in between *A. Formosa* and massive coral species (3.45%); *A. Cythrea* and *Porites* spp. (3.45%) and *A. Copiosa* and *Porites* spp. (3.45%)(Fig. 3).

Besides the majority of competition between corals fall under the category of close proximity (60%) followed by Canopy overlapping (32%) and the least observed one was direct Interaction (8%), although overgrowth type of interaction was completely absent at Marina Park. Natural reefs of North Bay and Chidiyatapu have a moderate extent of coral reefs (Malakar and Venu, 2015). At North Bay, grazed surface of *Porites* spp. integrated with crustose coralline algae were found to play a key role in the competitive interactions existing around. Grazed surface occupied by CCA creates an opportunity for *Acropora* species to settle and metamorphoses, besides the steady substrate that they offer, specific morphogen from CCA provides cues for coral planula larvae to settle and metamorphose (Morse et al., 1988; Heyward and Negri 1999; Raimondi and Morse 2000). As a result of it most of the interaction in North Bay(Fig. 5)were observed in the form of overgrowth (29.23%) and canopy overlapping (27.69%), later followed by direct interaction (24.16%) and close proximity(18.4%).

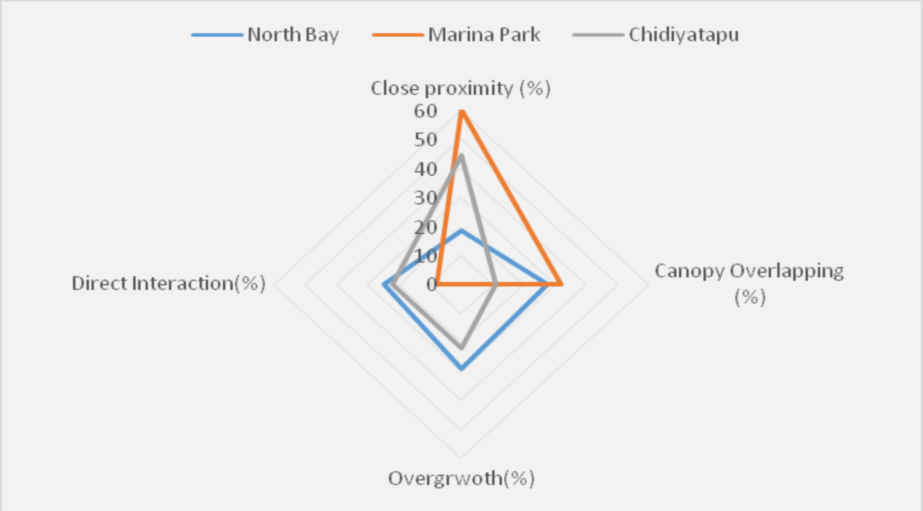


Figure 4: All the kinds of competitive interactions present in all the study sites.

The most extensively observed interaction was observed between *A. formosa* and *Porites* spp. (46%) and the least between *A. Subulata* and *Porites* spp. and *A. Hyacynthus* and *Porites* spp.(Fig. 5).

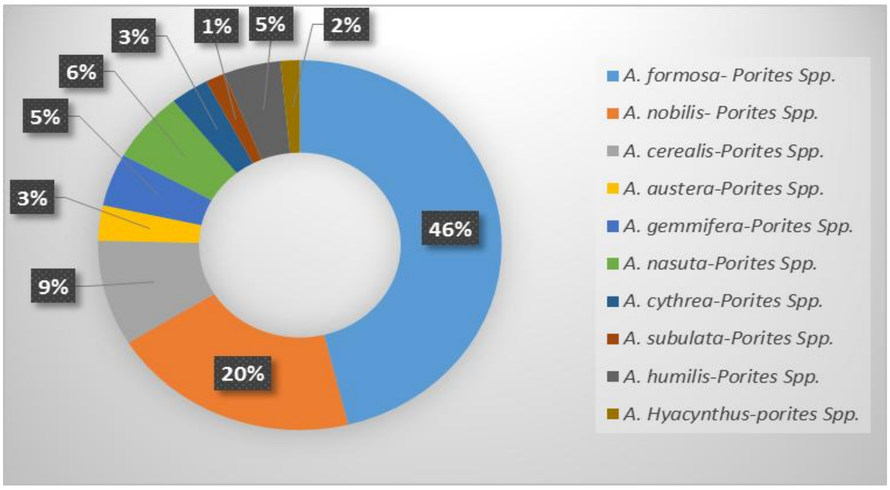


Figure 5: Interactions of *Acropora* species with *Porites* spp. at North Bay

Reef area of Chidiyatapu mostly comprised of dead corals (Malakar and Venu, 2015) and live coral cover is dominated by *Porites* spp. The most intense form of competitive interaction observed was close proximity (44.4%), followed by overgrowth (22.22%), direct interaction (22.22%) and canopy overlapping (11.1%) (Fig. 6).The highest degree of interaction was found in between *A. Formosa* and *Porites* spp. (23%) and the least were observed in between *A. austrea* and Porites spp.; *A. gemmiferra* and *Porites* spp. and *A. Formosa* and massive coral species11.11% .In terms of forms of competition involved, overgrowth was high at North Bay, Close proximity was recorded highest at Marine Park and Chidiyatapu.

Close proximity mode of interaction could lead to a severe consequences on the health of coral species that were engaged in the interaction, as *Acropora* corals are known to nurture quicker than other corals (Veron, 1986) and some of its species show a growth rate of 10 cm/year (Coles and Fadlallah 1991) and with due course of time after attaining suitable size, their sweeper tentacles can injure/kill the polyps of other interacting coral species (Richardson et al. 1979 and Wellington 1980).

Competition favours expanding, branching and overtopper species of corals at the expense of massive shapes (Mayer, 1918; Manton and Stephenson, 1935; Wells 1957) however many reef corals utilizes more than one mechanism of direct and indirect competition.

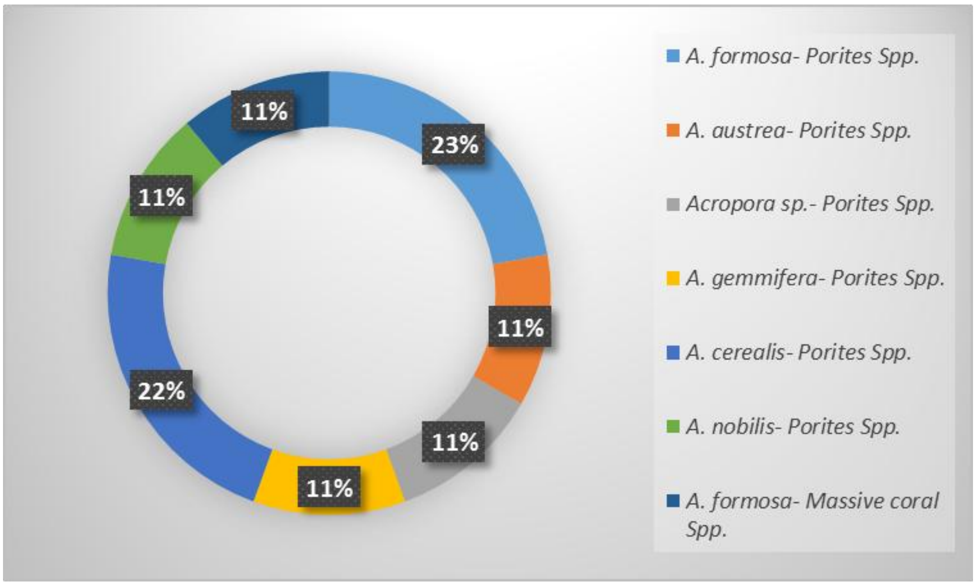


Figure 6: Interactions of *Acropora* species with *Porites* spp. and massive coral at Chidiyatapu

CONCLUSION

Growth of reef corals are co-related with the occupation of the space, limitation in space at the reef flat creates a situation of close interactions including competition. Several biotic and abiotic habitat components especially artificial surfaces, crustose coralline algae and corallivorous fishes play a vital role in these interactions. Knowledge over these kind of interactions which are directly affecting the survival and sustainability of these biodiversity rich habitats has been missing from the reef areas of these islands. The results from the present study would be utilized to study their long term impact on coral health as well as their sustainability.

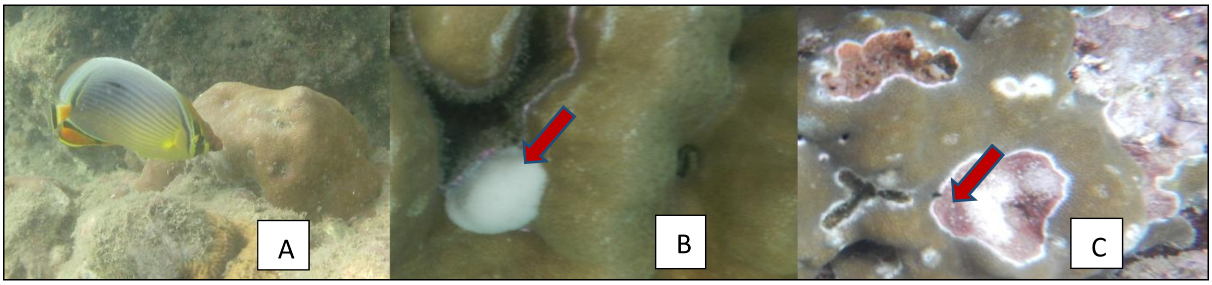


Plate 1: (A) *Chaetodonlunulatus* grazing the *Porites* colony, (B) Porites colony grazed by corallivorous fish, (C) Crustose Coralline Algae getting settled on a grazed surface of *Porites* colony

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