

## Algal Dominance and Impacts of Tourism on Coral Reefs in Casurina Beach, Karainagar Island, Jaffna Peninsula, Sri Lanka

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**ABSTRACT:** *Coral reefs at Casurina beach in the Karainagar Island of Jaffna peninsula, Sri Lanka are among the most heavily explored destinations for coastal tourism. We investigated the impact of algal overrunning and tourism on coral reefs over the last eight years. Coral reefs in Casurina beach are largely used by native fishermen for artisanal fishing, sea cucumber collection and for tourism. Baseline survey results indicated a vast competition and phase shift of corals to algal state. At present 52% of the coral reef area is covered with fleshy macroalgae and dead coral, which are more than one year old, and covered by turf or encrusting coralline algae. Increased number of tourist visits and boating act as chronic anthropogenic disturbances causing loss of coral cover, increased algal growth and degradation of ecosystem services in coral reefs.*

**Keywords:** *Coral reefs, macroalgae, turf algae, tourism, resource management*

### INTRODUCTION

Sri Lanka has well developed coral reef hotspots at various extent in its' coastal belt but they are considered as most vulnerable marine ecosystems. Coral reefs can be found in the waters warmer than 18 °C (Glynn and D'Croz, 1990), thus the warm tropical Indian Ocean waters around Sri Lanka makes a perfect area for coral growth. Coral reefs in the northern part of the Sri Lanka are barely explored scientifically in terms of its' presence, health and even the deployment of marine resources are quite different from the other part of the country due to the past war dilemma. Especially the status of coral reefs and coral species in Jaffna Peninsula has been briefly studied (Rajasuriya, 2007; Rajasuriya and White, 2007).

Karainagar Island is one of the major seven islands of Jaffna peninsula and located in the north west coast of it. Casurina is well known destination of Jaffna peninsula for coastal tourism due to white sand beaches, mangroves, casuarina trees, palm trees and coral reef patches. Advancement of technology and transport facilities have the rapid progression in exploring underwater world and tourism-oriented activities in the coastal environment (John and Julia, 2006). Karainagar Island just start to experience the latest facilities in the underwater world

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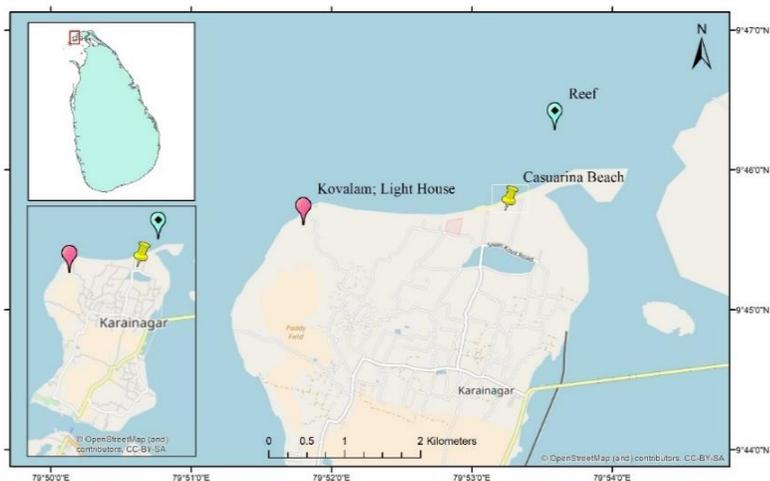
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marking the coral reef spots and fishing groups, boating to reef regions and snorkeling without proper awareness about the value of marine ecosystems. The health status of coral reefs in this site has been identified as poor in relation to its' live coral cover percentage (Ashani *et al.*, 2017). Most of the coral reefs were found dead and covered with turf or macro algae. Also, continuous landing of tourists in the reef region causes sedimentation and increase the vulnerability of coral survival. Coastal tourism has been thought of as a low-impact activity for coral reefs than extractive resource utilization of reef resources in the world (Talge, 1993). Thus, our research study was aimed to identify the current status of coral reefs and the effects of tourism on the coral reefs at the Casurina beach, Karainagar Island in order to provide a baseline data for monitoring and conservational activities to protect the marine environment.

## METHODOLOGY

Coral reefs at the Casurina beach (9.764397° N, 79.885849° E) Karainagar Island of Jaffna Peninsula, Sri Lanka (Figure 1) was surveyed according to the standard reef check methodology (Hodgson *et al.*, 2006) to identify the percentage cover of benthic categories of the coral reef ecosystem. Depending on the presence of reefs, the surveys were done by snorkeling and SCUBA diving at depth between one to five meter shallow dive and six to twelve meters medium dive. Coral reef ecosystem benthic data were collected by using five 20 m long Line Intercept Transect (LIT) method with three replicates set apart by 5 m towards reef the outer reef slope. The substrate or benthic categories including hard coral (HC), soft coral (SC), dead coral covered with turf algae (DCA), sponge (SP), nutrient indicator algae (NIA), coral rubble (RB), hard substrate of dead coral (RC), sand (SD), silt (SI) and others (OT), sea anemones, tunicates, gorgonians or non-living substrate types were recorded at every 0.5 m along the transect line (Hodgson *et al.*, 2006).



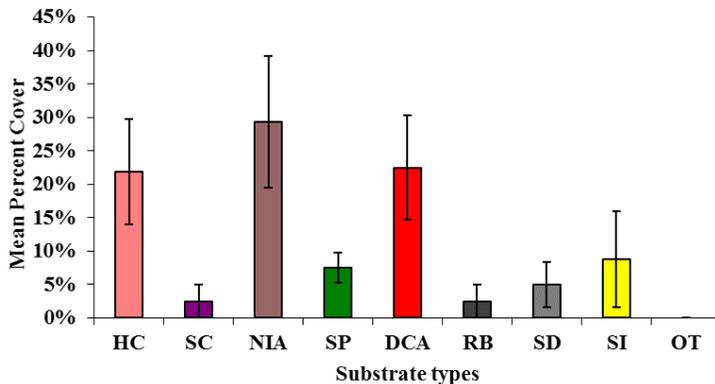
**Figure 1. Sampling locations in the Casurina beach and Kovalam light house**

This study was conducted according to the compliance with laws and regulations established by the Sri Lankan government authorities of Wildlife Conservation and Marine Environmental Protection Authority permits, and with the permission of Sri Lanka Navy Headquarters. All the above data were collected in the pre-formatted underwater datasheets and transferred to the automated excel spreadsheets which were programmed by Reef Check

for statistical analysis according to the standard reef check methodology (Source: <http://www.reefcheck.org/ecoaction/monitoring-instruction>). Values and tourism effects on coral reefs were assessed through a questionnaire survey, semi structured interviews, and key informant interviews with tourists, boat operators, native fishermen, local people, fisheries officers, and fisheries society members.

## RESULTS AND DISCUSSION

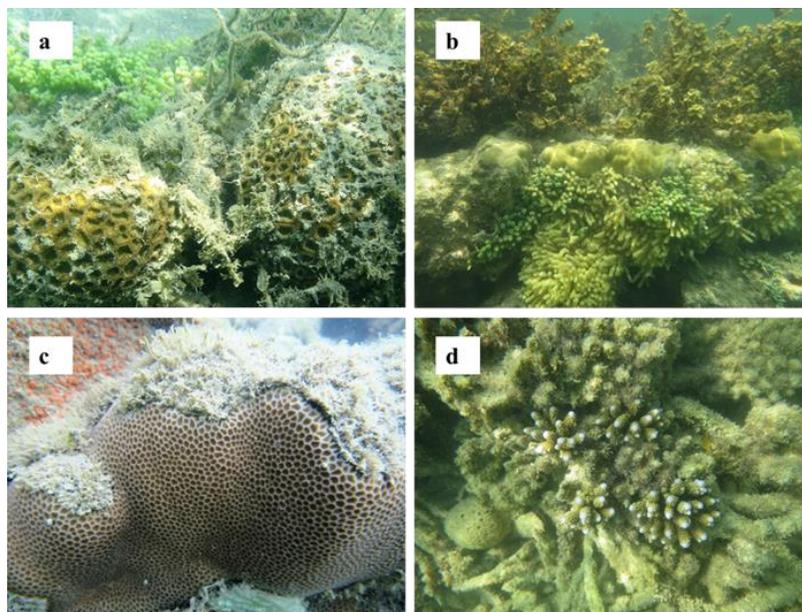
The case study and surveys revealed that ecological and economical values of coral reefs were, disturbed while tourism activities have significant impact on the coral reef sites in the Casurina beach, Karainagr Island. According to the underwater visual surveys with LIT method, there were only 25 % live coral cover including both soft and hard corals (3% soft corals and 22% hard corals) found. Further, 52% of the coral reef habitat was dominated by nutrient indicator algae or macro algae (29%), turf and encrusting coralline algal cover was 23% (Figure 2 and 3). This type of status viewed as heavy competition between of corals and algal communities and causing increased mortality to corals (McCook *et al.*, 2011). Over growth of *Sargassum Sp.*, *Caulerpa sp.*, and *Turbinaria sp.* are the most common and dominant macroalgae species found in the coral reefs. The algal dominance in this site revealed that there were considerable impacts caused by tourism activities for last eight years than ever before.



**Figure 2. Mean Percentage cover of coral reef site in the Casurina beach at 1 to 3 m depth** HC- all living hard coral, SC-soft coral, DCA- dead coral more than 1 year old and may be covered by turf or encrusting coralline algae, SP- Sponge, NIA- nutrient indicator algae or macro algae, RB-broken coral pieces or rubble, SD- sand, SI- silt and vertical bars represent +1 standard error

Elevated sea surface temperature (SST), overfishing of fish and invertebrates, and tourism causalities pause the regeneration of corals, loss of biodiversity, lower fish abundance and increasing algal coverage can cause the coral phase shifts to macro algal or turf algal reefs (Wild *et al.*, 2014 and Burke *et al.*, 2011) around the world. However, there were no any records of SST impacts and overfishing threats to coral reefs of Casurina beach. Since, the pressure of poor tourism practices causing greater impacts on the coral reef ecosystem structure at present.

Coastal tourism in the Casurina beach is geographically focused on two major accessible reef areas near to Casurina site and in the Kovalam light house region of the Karainagar Island (Figure 1). Records of local governing bodies like Divisional Secretariat and Pradeshiya Sabha revealed that 95% of annual visits since 2010 (60,000 to 88,000) occurred in the Casurina site rather Kovalam site.



**Figure 3. Coral-algae dominance observed during the transect surveys**

(a) visible sedimentation., turf algae and macroalgae overgrowth on *Favia* and *Favites sp* sp. (b) overgrowth of macroalgae of *Turbinaria sp.* on the coral species of, *Porites solida* (c) overgrowth of turf algae on *Goniastrea retiformis* (d) Tiny hairy like turf algae are assemblages of young *Acropora sp.* colonies and other juvenile brain coral overwhelmed by turf algae. These visible grazing indicates the grazing pressure and sedimentation

The major reef based tourism activity is the vessel-based operations where a single boat carry 10 to 15 passengers for a single trip to coral reef area and about 10 boat trips every day. The survey confirmed that anchoring, boat operation and tourist behavior cause coral reef degradation, disturb the nature of the sea floor, benthic animals and physical injuries to sessile species. Anchoring causes damages for fish nesting for spawning, breeding and feeding grounds. Boat operations cause damages when they collide with coral reefs killing large areas of corals and reef-dwelling organisms. Propeller action of boat engines generate waves increasing the sedimentation and smother reef-dwelling organisms. Displacements of juveniles and breeding marine animals like shark, sea cucumber, turtle and coral associated species are resulted due to the propeller action and collisions by engine boats. During our study period we observed that irresponsible or inexperienced tourists, swimmers and snorkelers regularly crush and break fragile, branching and plate corals and other reef-dwelling organisms with fins, equipment and trampling on reefs. Stirring up the bottom sediment of reef sites causing lesions and difficulties in breathing of corals leading to less competitive to macro algae growth. Further, collection of branching, encrusting, fan and leathery corals by tourists threatening the coral communities.

Majority of tourists visits to Casurina beach for boating to reef region to watch coral reefs (61 %). Unfortunately, most of the tourists, local people and even the native fishermen of Casurina beach site not aware about the significance and condition of coral reef ecosystem amenities. Only 9 % of fishermen aware about the values of coral reefs, others thought it as rocks and areas where algae can grow. These effects due to the destructive tourism practices reveals consequences of unhealthy coral reef ecosystem at high levels of continuous stress of coral reef sites particularly in a small area. This would result in loss of biological diversity, ecological degradation and economical loss since the integrity of coral reef ecosystem start to decline (Burke *et al.*, 2011). Therefore, irreversible, ecological loss can be happened unless control measures implemented to conserve this fragile ecosystem. Such efforts will improve overall quality of the corals reef ecosystem and it will result in good quality and attractive corals. It will increase the enthusiasm to protect coral reefs and also benefit the tourism activities (Shafer, 2000).

## CONCLUSIONS

This study revealed that Increased number of tourist visits and boating act as chronic anthropogenic disturbances causing loss of coral cover, increased algal growth and degradation of ecosystem services in coral reefs in the Casurina beach. Therefore, strong control measures need to be implemented to conserve this fragile ecosystem.

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