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Community structure and coral health status across the depth gradients of Grande Island, Central west coast of India

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HIGHLIGHTS

- Grande Island is less explored for its biological diversity and this study provides the first comprehensive report on the coral community structure.
- Live coral cover and its diversity were high in the mid-shelf zone (5–8 m) compared to the shallow (<5 m) and deep zones (>8 m).
- Competition posed by turf algae and sponges was the predominant stressor affecting the live coral colonies.
- Coral diseases such as white plaque disease and trematodiosis were common among the live coral colonies.

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ABSTRACT

The Grande Island, located at the central west coast of India is one of the less studied coral reef systems in India. In this study, we provide a comprehensive description of the coral community structure and health status of corals across the spatial scales at different depths in Grande Island. Such descriptions provide a baseline for evaluating future community changes and effective conservation in the face of changing climate scenario. Individual benthic components and the coral health were quantified using line-intercept transects and belt transects respectively along three depth zones: shallow (<5 m); mid-shelf (5–8 m) and deep zone (>8 m). Average live coral cover was high in the mid-shelf zone (8.05 ± 3.98%) compared to the shallow (1.92 ± 2.01%) and deep zones (2.12 ± 0.05%). In total, 15 genera of corals were recorded in Grande Island of which 14 genera were present in the mid-shelf and shallow zone and six genera in the deep zone. *Turbinaria* and *Goniopora* spp. were dominant in the mid-shelf zone. Whereas, *Pseudosiderastrea* and *Porites* spp. were dominant in the shallow and deep zones. Potential threats to the corals in Grande Island include diseases and competition posed by algal turf and boring sponges. An average of 53.2% of the live corals was affected by algal turf intrusion; 2.7% by boring sponges and 2.6% by diseases that include white plaque disease and trematodiosis. Understanding the physical processes around Grande Island will reveal more about the distribution and colonization of coral communities and their vulnerability to changes in the future.

1. Introduction

Coral reefs are biodiversity hotspots that provide numerous ecological and economic benefits (Moberg and Folke, 1999). India comprises four major coral reef formations along its 7500 km vast coastline viz. Gulf of Kachchh and Lakshadweep archipelago on the west coast and Gulf of Mannar & Palk Bay and Andaman & Nicobar Islands on the east coast. Coral reefs cover an approximate area of 2375 km^{-2} in India. Lakshadweep reefs are the coral atolls, and the other major reefs are of fringing and barrier types. There are also many coral formations located near shore as a small detached patch or platform reefs along the central west coast of India comprising Maharashtra and Goa between 15°33′N and 73°27′E (Nair and Qasim, 1978; Qasim and Wafar, 1979). The biological structure and ecological status of these patch reefs remain relatively less studied compared to the other major reefs in India. In this study, we addressed the gap in knowledge by undertaking the first broad-scale survey of the patch reefs along Grande Island, an exposed rocky island, located off Marmagoa Port in Goa focusing on the coral community structure (diversity, density and taxonomic composition of scleractinian corals) and health status of reef building corals.

Sexual mode of reproduction and ensuing larval dispersal by the ocean currents had enabled the corals to colonize distant marine

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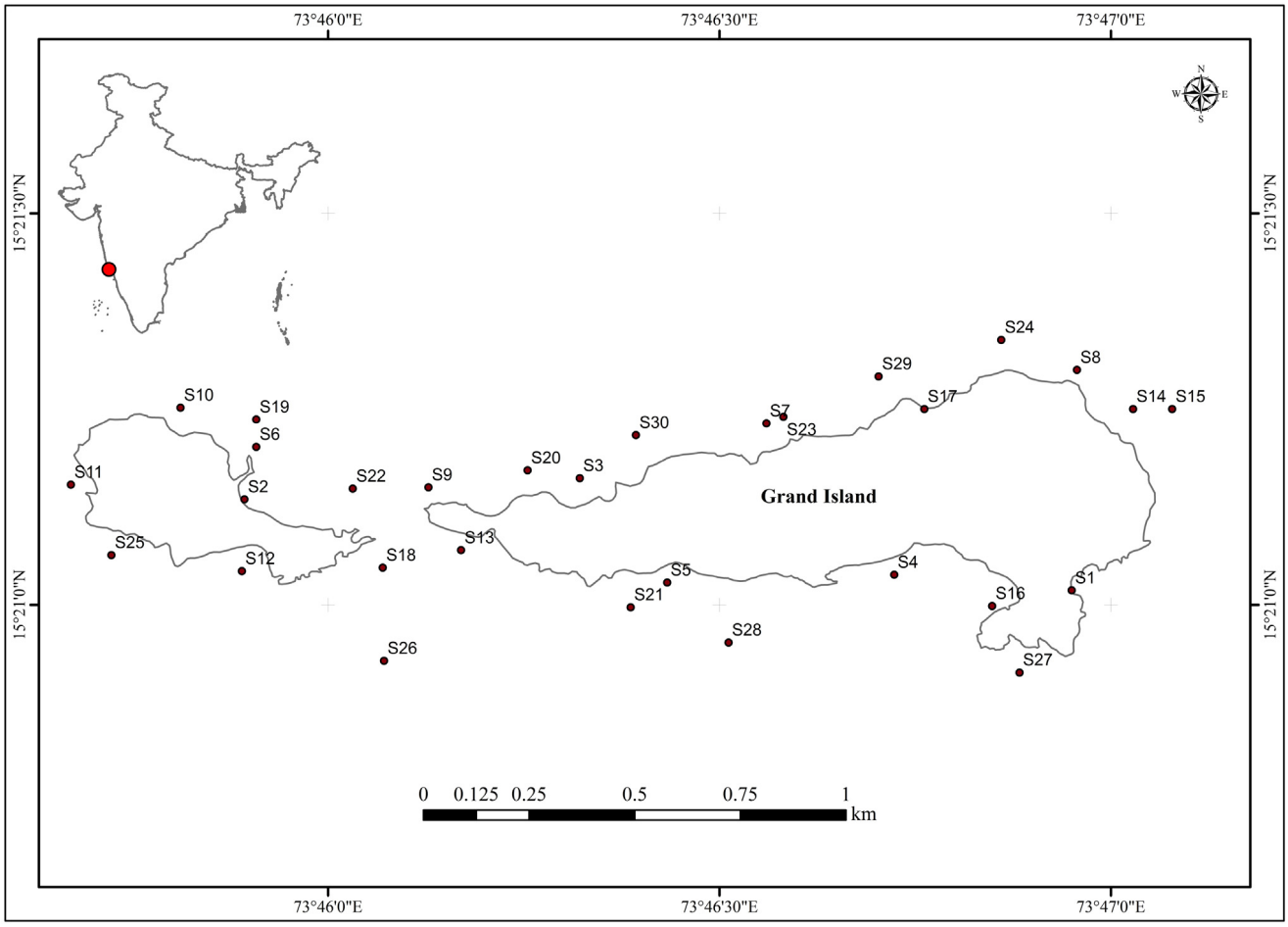

Fig. 1. Map showing the study locations around Grande Island at different depth zones. S1–S15 (shallow zone); S16–S25 (mid-shelf zone) and S26–S30 (deep zone).

habitats such as isolated islands (Richmond, 1987; Carlson and Olson, 1993; Torda et al., 2013) and establish their population. This process of larval dispersal from a parent reef and its subsequent settlement and growth in a remote habitat is termed as connectivity, and it determines the distribution, genetic structure and population dynamics of corals in distant shallow marine habitats (Cowen and Sponaugle, 2009; Jones et al., 2009). The Grande Island in Goa (15.352°N; 73.773°E) comprises natural habitats such as coral patches, submerged rocks encrusted with corals, sandy bottoms and artificial habitats such as shipwrecks. The complex habitat structure provided by the coral patches and submerged rocks acts as a habitat for breeding, feeding and shelter for variety of benthic organisms including reef fishes (Sreekanth et al., 2015).

In general, the isolated islands that lack any human impacts are characterized by rich biodiversity dominated by corals and fish communities. Any variation in the structure of reef communities is more likely to be attributed to the natural factors such as habitat availability, predation (Thorson, 1950), sedimentation (Hodgson, 1990; Gilmour, 1999), light availability (Mundy and Babcock, 1998), and species competition (Birrell et al., 2005). However Grande Island in Goa is a tourism hotspot witnessing an average of 6–7 boats comprising 7–12 tourists every day during the peak tourist season between October and April (Personal communication). The wealth of marine life had invited a variety of anthropogenic stressors such as uncontrolled tourism activities like recreational SCUBA diving, snorkelling and recreational fishing. In addition, overfishing, discarded fishing nets and littering also exaggerate the risk to corals in Grande Island.

In this study, our primary aim was to provide a comprehensive description of the coral community structure across depth gradients of Grande Island. Specifically, we compare and contrast the coral communities in the shallow (<5 m); mid-shelf (5–8 m) and deep zones (>8 m) around the Grande Island. Secondly, we examined the relationship between the depth and the average percent cover of various benthic components such as corals, soft corals and macroalgae. Furthermore, we assessed the health status of live corals and potential threats to the corals in Grande Island. Documentation of the diversity and community structure of corals in a region is essential to identify areas for conservation, recreation and evolving specific management principles. Also, such data will serve as a baseline for evaluating changes in the future due to the changing climate and environmental scenario.

2. Materials and methods

2.1. Study site

The study sites around Grande Island were selected randomly across different depths and the number of study sites at each depth zone was determined based on the visibility. The substratum around the Grande Island was categorized in to three distinct zones based on depth. The shallow zone (<5 m), that largely comprises rocks with intermittent sand patches. This was followed by a mid-shelf zone (5–8 m) that comprise a flat sandy substrate with small rocks and deep zone (>8 m) that comprise rocks further up to the depth of 14 m. In total, 15 sites were selected in the shallow zone; 10 sites in the mid-shelf zone and 5 sites in the deep zone (Fig. 1).