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Report of Coral Diseases in the Reef flats of Chetlat Island, Lakshadweep

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Original Article

Abstract

Diseases are major secondary stressor causing coral mortality in the reefs. Little is known about coral diseases in the Indian Ocean region, especially in the Lakshadweep archipelago. A study has been carried out in the lagoon of Chetlat Island, Lakshadweep along the southwest coast of India to document the presence of coral disease in Lakshadweep reefs. Survey for disease and lesions in scleractinians were conducted in the lagoon from January 2016- November 2018, which led to the identification of six coral diseases, two pigmentation responses, one growth anomaly and algal overgrowth. Mortalities caused by Black Band Disease (BBD), White Syndrome (WS), Pink Line Syndrome (PLS), Porites Ulcerative White Spot (PUWS), White Band Disease (WBD) and Porites Peeling Tissue Loss (PorPTL) disease were observed. Sand deposition on coral colonies appeared to be the reason for coral mortality in some areas. The findings of this study emphasize the need to conserve and preserve the biodiversity around this reef.

Keywords: *Coral reef, chetlat Island, black band disease, white band disease, pink line syndrome*

Introduction

Coral reefs are among the earth's most diverse ecosystems in terms of biodiversity and are widely recognized as the ocean's rain forest (Reaka-Kudla, 1997). Coral reefs are being degraded on a global scale due to various threats. While bleaching episodes leave a chance for corals to recover, the diseases of corals change the structure and functioning of coral reef communities by causing irreversible damage to the corals.

Coral disease epizootics have become a major threat to reef ecosystems globally, and increasing number of emerging syndromes have been reported over the past 20 years (Harvell *et al.*, 1999; Raymundo *et al.*, 2005). As the climate change is predicted to amplify host susceptibility, host range, pathogen survival and disease transmission (Myers and Raymundo, 2009), outbreaks are expected to increase worldwide in the future (Bruno *et al.*, 2007).

The Lakshadweep Archipelago was heavily affected by a coral bleaching event in 1998, which led to the coral mortality of up to 81% (Arthur, 2000). The ecological impact of bleaching on coral communities, and particularly its ability to increase coral susceptibility to infectious disease, is well-documented (McClanahan *et al.*, 2009). Diseases affecting hard corals have

become the most important factor in the decline of coral reefs in some regions (Weil, 2004).

Ravindaran *et al.* (1998) reported occurrence of BBD, WBD and Necrotic lesions from Kavaratti atoll, Lakshadweep. Nine coral diseases were described from the Gulf of Mannar that affected four coral species (Thinesh *et al.*, 2009). Kumar *et al.* (2014) surveyed the coral reefs of Gulf of Kutch (GoK) and reported five types of diseases.

However, not much information is available about the occurrence of coral diseases in Lakshadweep waters. The present study attempts to fill this gap by reporting the results of the surveys conducted to investigate the occurrence of diseases affecting reef-building corals in Chetlat atoll of Lakshadweep islands in the Indian Ocean.

Material and methods

Study Site

Chetlat is an atoll belonging to the Lakshadweep archipelago off the west coast of India in the Arabian sea. It lies between 11° 41' and 11° 43' N latitude and 72° 41' and 72° 43' E longitude having an area of 1.40 sq km. Chetlat lagoon is approximately 3 km long and 1 km wide at the broadest point with patchy reefs distributed all over the lagoon. Six lagoon reef stations of 1-3 m depth on the reef flat were selected for the study.

Data Collection and Analysis

Surveys were performed at each station using two belt transects of 30 m kept at 5 meters apart comprising ten 0.5 m^2 quadrates, during January 2016 to November 2018 in the lagoon of Chetlat atoll (Fig.1). Disease observations were made at the sites once in every four months from January 2016 to November 2018. Photographs of corals with disease symptoms were taken using Nikon underwater camera. Diseases were identified using underwater cards for assessing coral health on Indo-Pacific reefs (Beeden *et al.*, 2008) and with the help of experts in the field.

Results

Description of Diseases and Stresses

Our survey of the reefs of Chetlat Island revealed the presence of six diseases namely BBD, WS, PLS, PUWS, WBD and PorPTL disease affecting different genera of reef building corals. In addition, we have observed growth anomalies *viz.*, Trematodiasis, Porites Dark Discolouration Response and Algal overgrowth. Among the affected genera, Porites hosted the highest number with six coral diseases, followed by *Pavona* with two diseases and the remaining genera were affected by one disease each.

Fig. 1. Map of study area-Chetlat Atoll.

Black Band Disease (BBD)

BBD was observed on *Pavona varians* (Verrill, 1864) (Fig. 2A) which is caused by microbial mat dominated by the cyanobacterium *Phormidium corallitycum* (Rützle and Santavy, 1983). The algal colonization was observed on the denuded skeleton of the colony.

White Syndrome (WS)

WS on *Porites* sp. (Fig. 2B) was manifested as linear, distinct band of tissue loss that revealed a bare, white, intact skeleton. No distinct pigmentation, band, mat or skeletal damage was observed. WS is a common coral disease in the Indo-Pacific (Weil *et al.*, 2006). It is a collective term for conditions producing white symptoms on the GBR (Willis *et al.*, 2004). WS has been reported from other areas including Philippines (Raymundo *et al.*, 2005) and Indonesia (Haapkyla *et al.*, 2007).

Pink Line Syndrome (PLS)

PLS is another Indo-pacific coral disease, characterized by a band of pink-pigmented tissue separating dead skeleton from apparently healthy tissue. This band begin as a small ring and progress outward horizontally across the coral colony. In the observed colonies, algae (Fig. 2C) colonized the dead portion. The responsible cyanobacterium was reported to be *Phormidium valderianum* (Ravindran *et al.*, 2006).

Porites Ulcerative White Spot (PUWS)

PUWS (Fig. 2D) which is found mainly on *Porites* sp. is characterized by discrete, bleached, round foci ranging from three to five mm in diameter, affecting three to four polyps and the surrounding coenosteum. Bleached foci were either recovered (*ie.* regained zooxanthellae), or progressed to complete tissue loss with exposure of the underlying skeleton (Raymundo *et al.*, 2003).

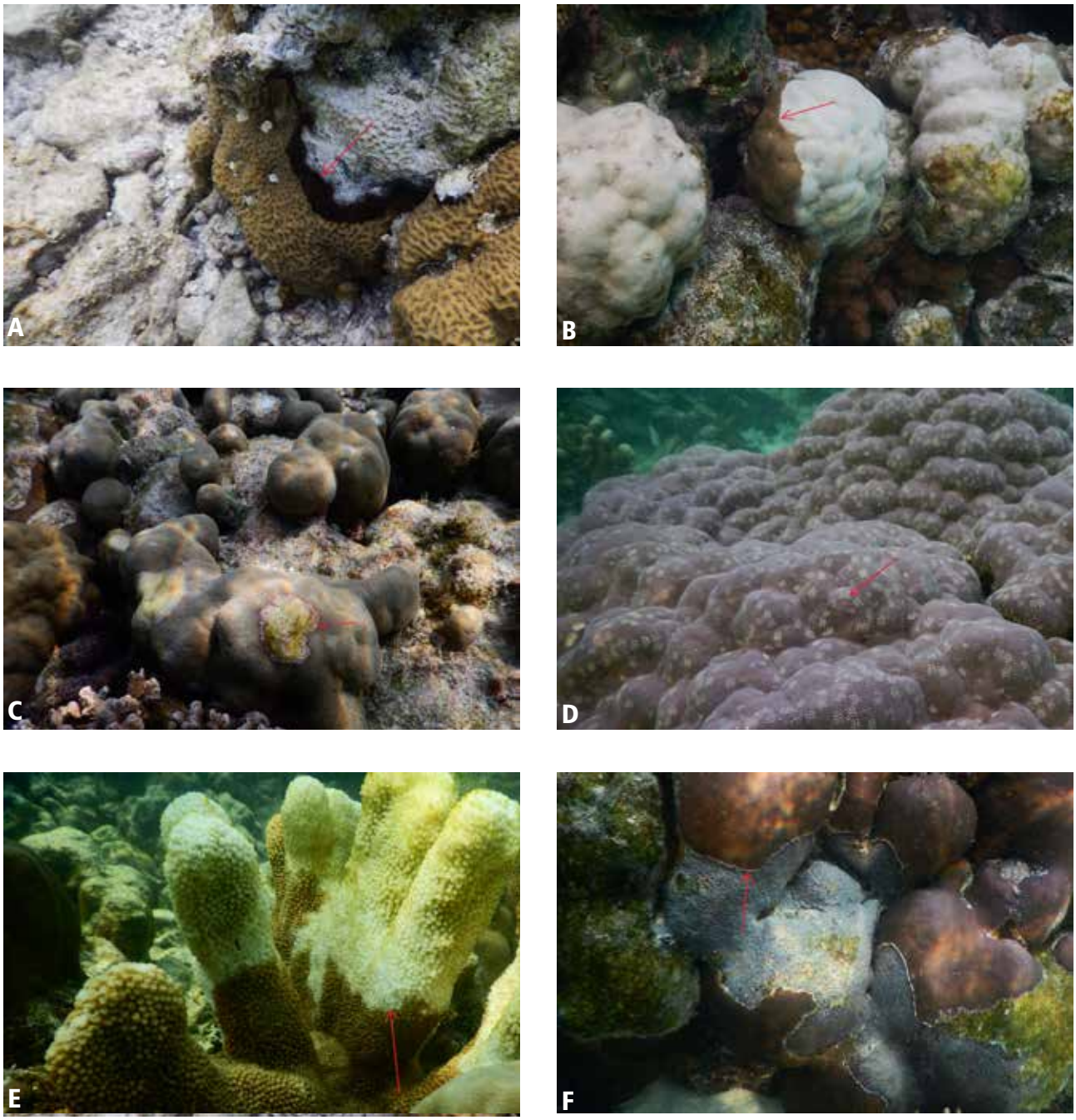

Fig. 2. Photographs illustrating the coral diseases observed in Chetlat reef. (A) BBD on *Pavona varians* colony (B) WS on *Porites* sp. (C) PLS on *Porites* sp. (D) PUWS on a massive *Porites* colony (E) WBD on *Isopora palifera* colony (F) PorPTL

White Band Disease (WBD)

WBD on *Acropora* sp. was observed from several sites during the survey. The tissue peels off from the affected colony of *Isopora palifera* (Lamarck, 1816), leaving behind exposed white skeleton that are promptly colonized by filamentous algae (Fig. 2E). WBD is characterized by complete tissue loss in Acroporid corals. The disease shows a sharp separation between apparently healthy coral tissue and exposed skeleton.

Porites Peeling Tissue Loss (PorPTL)

Coral lesions consistent with diseases recorded within the surveyed area were indicative of PorPTL of unknown etiology (Fig. 2F). PorPTL disease is characterized by tissue loss appearing at the base of massive *Porites* sp. and progressing upwards (Salimi *et al.*, 2017). The lesion edge was distinct, with the tissue peeling off, the bare skeleton appearing gray and algae colonized some parts of the skeleton.

Growth Anomalies (GA)

GA have been found on *Pavona* sp. during the disease surveys in the reef (Fig. 3A). Our understanding of coral disease etiology has advanced, considerably in recent years but the cause of coral GAs remains largely unknown. Injury to cells from ultraviolet (UV) radiation and stressors such as sedimentation, turbidity and seasonal temperature rise have been suggested as playing a role in triggering GA formation. GAs are often progressive and can result in host mortality (Aeby *et al.*, 2011).

Porites Trematodiasis

Some colonies of *Porites* sp. at Chetlat reef were spotted with pink swollen nodules (Fig. 3B). These swollen nodules represent a condition called "Porites Trematodiasis" which is due to infection by a digenetic trematode, *Podocotyloides stenometra*. It has a complex life cycle involving a molluscan as the first intermediate host, massive coral *Porites* as the second intermediate host, and coral feeding fish as the final host (Aeby, 2003).

Porites Dark Discolouration Response (PDDR)

The colonies affected by the PDDR were characterized by small to large areas of purple discoloration on *Porites* sp. The cause of PDDR remains largely unknown. Diseased coral showed

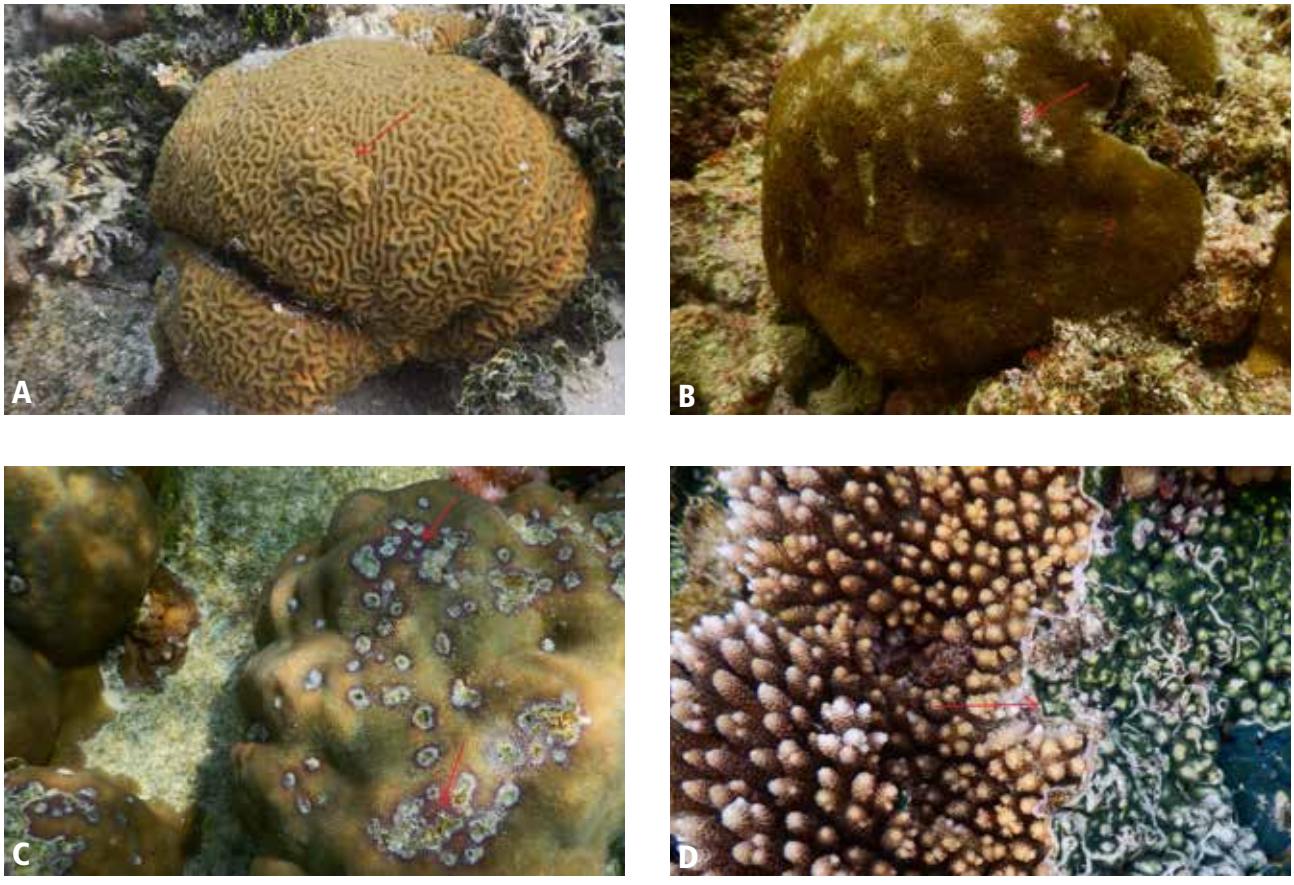

Fig. 3. Photographs showing pigmentation response, growth anomaly and algal competition in Chetlat reef. (A) Growth anomaly on *Pavona* sp. (B) Trematodiasis on *Porites* sp. (C) PDDR (D) Algal overgrowth on *Acropora* sp.

multifocal, coalescing, circular or irregular lesions with tissue loss distributed on the surface of the colony (Fig. 3C). The discolored tissue increases in size and spreads to other parts of the colony.

Algal Overgrowth

Fleshy algal overgrowth was observed on live branching *Acropora* sp. with considerable damage to the coral tissue (Fig. 3D). Competition between hard corals and benthic algae is fundamental to the overall status of coral reefs, especially during reef degradation. Excess nutrient supply results in an increased growth of benthic algae leading to the consequent reef degradation (Lapointe, 1997).

Discussion

This study provides baseline information on the status of diseases affecting hard corals in a previously unsampled reef. Our surveys documented the presence of six different coral diseases, two pigmentation responses, one growth anomaly and one algal overgrowth in the reef of Chetlat Island. The most commonly observed disease was WS, and signs of compromised health were observed in the study area, including pigmentation response, sand deposition and algal competition. At some study sites, sand depositions on live corals due to natural current inside the lagoon constitutes one of the potential causes of coral tissue loss. *Porites* was the most affected genera by pigmentation response, and it appears to respond to a variety of stresses by producing pink or purple pigmentation (Willis *et al.*, 2004). The study area was affected by a mass bleaching event in 1998 but the currently available data do not allow us to confirm a relationship between the past thermal stress and the current status of coral diseases. However, the expected future increase in Sea Surface Temperatures (SST) (Kleypas *et al.*, 1999) could lead not only to new bleaching events but also may promote the spread of coral pathogens by increasing their growth rate and virulence (Ben-Haim *et al.*, 2003), and by reducing the immune response in coral hosts (Palmer *et al.*, 2011). Considering the rise in SST (Kumaresan *et al.*, 2018), and bleaching events in the Lakshadweep reefs (Arthur, 2000), a better understanding of the actual and potential impact of infectious diseases on coral ecosystems is fundamental to conservation planning.

We hope that our preliminary study will stimulate the interest of coral pathologists and promote future in-depth investigations focusing on coral diseases in Lakshadweep reefs. The knowledge generated through these investigations will also contribute substantially to develop a management plan to conserve the coral reefs.

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