

First report of White Syndrome Disease on branching *Acropora* at Saya de Malha, Mascarene Plateau

Ranjeet Bhagooli^{1,2,3*}, Shakeel Jogee¹, Deepeeka Kaullysing^{1,2}, Sundy Ramah^{1,4}

¹ Department of Biosciences and Ocean Studies, Faculty of Science & Pole of Research Excellence in Sustainable Marine Biodiversity, University of Mauritius, Réduit 80837, Republic of Mauritius

² The Biodiversity and Environment Institute, Reduit, Republic of Mauritius

³ The Society of Biology, Reduit, Republic of Mauritius

⁴ Albion Fisheries Research Centre, Ministry of Blue Economy, Marine Resources, Fisheries and Shipping, Albion, Petite Rivière, 91001, Republic of Mauritius

* Corresponding author:
r.bhagooli@uom.ac.mu

With the potential to cause rapid and large-scale reef decline, coral diseases represent a prominent global stressor to coral reef ecosystems (Aronson *et al.*, 2003; Harvell *et al.*, 2007). The Western Indian Ocean (WIO) is not spared from coral diseases. Observation of coral diseases in the WIO dates back to 1991 when the Skeletal Eroding Band (SEB) coral disease caused by the pathogenic protozoan, *Halofolliculina corallasia*, was reported around Mauritius Island (Antonius (1991) in Antonius and Lipscomb, 2000). A study by Goreau in 1998 (cited in Hilbertz and Goreau, 2002) observed Porites Line Disease in massive *Porites* sp. in 1997 in Seychelles. In Zanzibar, *Vibrio coralyticus* was isolated from diseased *Pocillopora damicornis* (Ben-Haim and Rosenberg, 2002). White Syndrome Disease (WSD) was reported, at prevalence levels below 1.5%, in the south-west reef systems of Madagascar (Sheridan *et al.*, 2014). Studies conducted around Reunion Island, Mayotte, and South Africa revealed the occurrence of six coral diseases: Growth Anomalies, Black Band Disease, Skeletal Eroding Band, WSD, Pink Line Syndrome and *Porites* White Patch Syndrome (Séré *et al.*, 2015). In the same study, spatial heterogeneity in disease prevalence among the sites was also observed, where Reunion Island had the highest disease prevalence rate ($7.5 \pm 2.2\%$) compared to South Africa ($3.9 \pm 0.8\%$) and Mayotte ($2.7 \pm 0.3\%$) (Séré *et al.*, 2015). It was further reported that WSD and Black Band Disease were more common, and *Porites* and *Acropora* were the most disease-vulnerable genera. WSD, amongst other coral diseases such as Brown Band, SEB, Black

Band and Ulcerative White Spot, was also reported as one of the most prevalent coral diseases among seven islands of the Maldivian Archipelago where the overall estimated disease prevalence was around 1.51% (Montano *et al.*, 2015). More recently, Bhagooli *et al.* (2017) observed Brown Band, SEB, White Band, White Plague, Growth Anomalies, and Pink Pigmentation Response in corals in the lagoonal area of Mauritius.

The only coral disease observations from the poorly studied Saya de Malha region revealed two types of coral diseases: one isolated Black Band case and the highly abundant Porites Line Disease (PLD) (Hilbertz and Goreau, 2002) at the northern region on Ritchie bank and at depths of less than 20 m. The same PLD-affected corals that survived the 1998 bleaching event were found dead in 2002, most probably as a result of the disease (Hilbertz and Goreau, 2002). Although being remote and distant from terrestrial influences, the submerged Saya de Malha bank located in the WIO holds evidence of coral diseases and requires further studies.

The second leg of the EAF-Nansen research survey cruise in May 2018 at the Saya de Malha bank provided an opportunity to use the Video-Assisted Multi Sampler (VAMS) to collect coral samples. At location 39 ($10^{\circ} 22.6501'S$; $62^{\circ} 12.362035'E$) on the Saya de Malha bank, WSD was observed on *Acropora* sp. which was collected (Fig. 1) from a depth of 30 m. Such environments are characterised by low coral

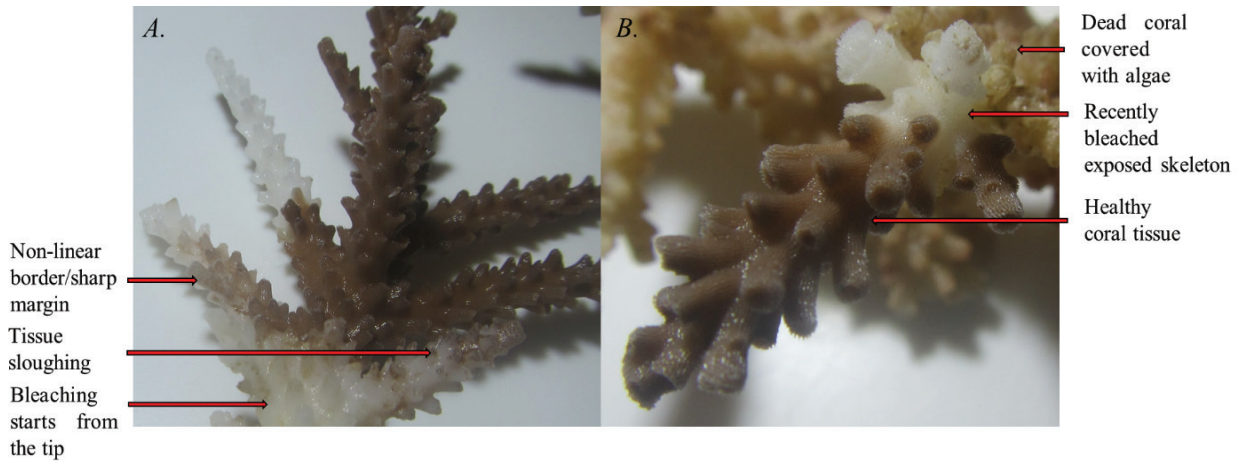


Figure 1. White Syndrome Disease (WSD) on *Acropora* sp. (A and B) collected from 30 m at Saya de Malha bank.

cover and possibly reduced frequency of warm temperature anomalies. Ramah *et al.* (2021) indicated that at location 39, the general live hard coral cover was estimated at 9-33%. The corals observed at location 39 included *Acropora*, *Porites*, *Lobophyllia*, *Goniastrea* and *Favites* species. WSD in *Acropora* sp. was observed only among the collected coral samples. It is noteworthy that high coral cover (>50%) and warm temperatures are two important prerequisites for outbreaks of WSD. Depth is also an important factor in the distribution of WSD, with a reduction of 89% and 43% in live coral cover at 5 m and 20 m, respectively, associated with WSD (Hobbs *et al.*, 2015). WSD on *Acropora* corals have been commonly reported from depth ranges of 5 m (Hobbs *et al.*, 2015; Hobbs and Frisch, 2010), 4-6 m (Roff *et al.*, 2011), and 20 m (Hobbs *et al.*, 2015).

It is also worth highlighting that corallivorous gastropods generally feed on Acroporids in large masses (high density aggregations) (Bruckner *et al.*, 2017; Kaullysing *et al.*, 2017; Kaullysing *et al.*, 2020). For instance, the corallivorous gastropods *Drupella* are attracted to other *Drupella* individuals forming an aggregation to feed over corals (Cumming, 2009a; 2009b). However, during this survey, not a single corallivorous individual was collected and/or observed in the vicinity of the coral. Moreover, it has been reported that corallivorous gastropods occur in lower densities in deeper waters (6-9 m) (Scott *et al.*, 2017). Thus, the possibility of the white patches being those of predation scars was ruled out.

WSD appears to be quite common in the WIO (Sheridan *et al.*, 2014; Séré *et al.*, 2015; Montano *et al.*, 2015). WSDs are a group of coral diseases characterised by diffuse patterns of tissue loss that expose the underlying bare white coral skeleton (Raymundo *et al.*, 2008;

Roff *et al.*, 2011). The lesion boundaries of WSD can be linear, annular or irregular, and the coral tissue bordering the lesion can sometimes become pigmented (Roff *et al.*, 2011; Beeden *et al.*, 2008). In *Acropora* corals, the disease can be observed originating at the base of coral branches that are found in the middle of the colony (Roff *et al.*, 2011). The rate of tissue loss caused by this disease has been recorded to range from 0 to 1,146 cm² per week (Roff *et al.*, 2011). The bacterium *Vibrio owensii* has been isolated as the main pathogenic agent of WSD in *Monitpora capitata* (Ushijima *et al.*, 2012). WSDs have been observed to progress at a rate not exceeding 20 mm per day. The most common host of this disease is *Acropora* corals (Raymundo *et al.*, 2008; Roff *et al.*, 2011), but it has also been observed in *Turbinaria* (Dalton *et al.*, 2009). WSDs have been recorded in the reefs of the Indo-Pacific (Roff *et al.*, 2011; Dalton *et al.*, 2010), Caribbean (Weil and Hooten, 2008), Pacific Ocean (Aeby *et al.*, 2010). The prevalence of WSD is moderately high, usually not exceeding 10% (Roff *et al.*, 2011). The prevalence of WSD is usually higher in winter months (Roff *et al.*, 2011). However, Aeby *et al.* (2010) reported no influence of season on the prevalence of WSD. Bruno *et al.* (2004) also reported an increase in the prevalence of WSDs in densely populated coral communities with increasing temperatures.

This first observation of WSD on the branching *Acropora* coral at a depth of 30 m at the southern Saya de Malha bank is indicative of the possibility of more infectious biotic stressors to the deep and 'pristine' coral reef ecosystem at that bank. Further in-depth characterisation and distribution studies of prevalent diseases and inter-species susceptibility to diseases are warranted to thoroughly understand the impacts of coral diseases at the Saya de Malha bank, for enhanced and adaptive

coral reef management and conservation strategies and efforts, especially in an era of global climate change.

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