

Genetic Analysis Finds Link in Coral Diseases

New research links two known coral diseases, skeletal eroding band and Caribbean ciliate infection, to a single originating pathogen. Studying the physical symptoms along with their genetic makeup, researchers were able to compare the disease-causing pathogens. Understanding these pathogens will prove instrumental in designing mitigation strategies to protect the remaining corals worldwide.

Over the past 30 years, there has been a significant loss of coral coverage worldwide. Reports indicate that the Indo-Pacific region has experienced an estimated 50% loss whereas the Caribbean has experienced a shocking loss of nearly 80% (Gardener et al. 2003; Bruno and Selig 2007; Pollock et al. 2011). These remaining corals are under immense pressure from climate change, declining water quality, pollution and coral disease. Within the last 10 years, coral disease incidents have increased significantly, further stressing the remaining corals (NOAA). Coral disease can be caused as either a biological response to bacteria, fungi or virus, or through a physical response to changes in water quality or pollution (NMFS, 2001). Unfortunately,

there is a lack of information concerning most of these diseases and, in some cases, isolated research has led to the same disease being classified under different names around the world.

SEB versus CCI

A new study, led by the University of Milan and the Marine Research and High Education Center of the Maldives, worked to link two known coral diseases, skeletal eroding band (SEB) within the Indo-Pacific and Caribbean ciliate infection (CCI) in the Caribbean. Through studying the physical manifestation of the disease and genetic diversity of the infecting agents, single celled organisms known as *Halofolliculina ciliates*, researchers were able to compare these two diseases to determine if they were actually the same.

The Debate

Both SEB and CCI attack healthy coral tissue, leaving a thick dark-gray band between healthy and infected areas. SEB, one of the first documented and described coral diseases within the Indo-Pacific (Antonius 1999), is known to affect over 82 different types of coral species (Page et al., 2015).

Originally it was thought that this disease was introduced to the Caribbean (Croquer et al., 2006) to eventually become what is now known as CCI. This point is quite contentious within the scientific community as researchers have not yet been able to fully investigate the diseases to determine if the two diseases are in fact related.

The Study

This research worked to fill in these knowledge gaps and settle this debate once and for all. By investigating each disease, researchers could determine if the disease pathogens were genetically related or if they represented different species of *Halofolliculina*.

Corals were sampled between June 2017 and October 2019 within the Caribbean (Curaçao and Bonaire), the Red Sea (Saudi Arabia) and the Indian Ocean (Republic of the Maldives). In each location, small coral fragments were collected from diseased coral. The idea was to identify any differences in color or shape of the disease ciliates.



A reef coral (*Diploria labyrinthiformis*) infested by the Caribbean Ciliate Infection. Photo by Simone Montano

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The Results

Scientists were able to show strong correlations between the pathogens known to cause SEB and CCI and documented similarities within lesion and settlement patterns of the disease in all three locations. Overall, there was no significant difference within the distribution, settlement patterns or general size of the disease agent within the infected corals.

Furthermore, in all samples, the disease caused tissue loss and bare skeleton, which were covered by loricae, the hard casing of the ciliates. These ciliates settled within clusters which appeared as dark spots on the coral. In high densities, this eventually formed a black or dark green band between healthy and infected tissues. From visual inspection, the disease-causing agent appears to be identical between the Caribbean, Indo-Pacific and Red Sea.

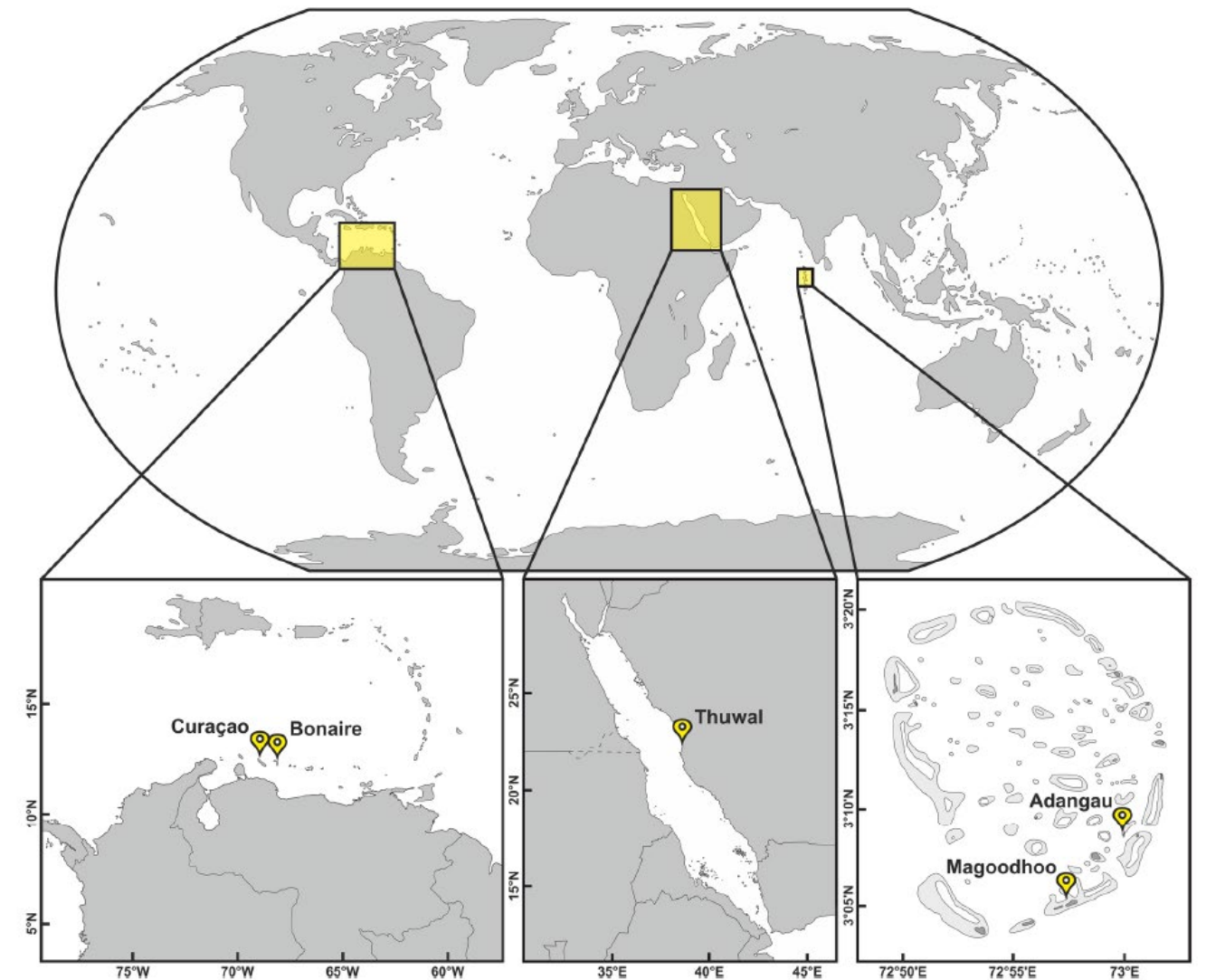
The DNA sequencing conducted in this experiment was the first of its kind for this species and will serve as the baseline for future genetic evaluations of this and related species in the future. Although the visual manifestation of these diseases was very similar, they were previously thought to be caused

by two different pathogens. This DNA sequencing was able to prove that the ciliates known to cause both diseases are in fact related. Although there were a few genetic differences, this could be a result of biogeographical separation in their evolution, since ciliates often have high genetic diversity. Therefore, it's possible that they represent a single species. Researchers concluded that the pathogen causing both of these diseases are related.

Understanding and being able to treat coral disease will become increasingly important as the threats against corals continues to increase. The more we understand about these diseases, the more likely a treatment can be prescribed to help restore the reefs to a healthy state. Furthermore, finding links between known diseases, such as these, will help coordinate effort and maximize research efficiency.

For more information see:

[Montano, S., Maggioni, D., Liguori, G., Arrigoni, R., Berumen, M.L., Seveso, D., Galli, P., Hoeksema, B.W. \(2020\) Morpho-molecular traits of Indo-Pacific and Caribbean Halofolliculina ciliate infections. Coral Reefs 39 \(2\): 375–386.](#)



Sampling localities in the Caribbean Sea (Curaçao and Bonaire), Red Sea (Saudi Arabia), and Indo-Pacific (Republic of the Maldives)

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