Geographic analysis offers new insight into coral disease spread

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In the last 30 years, more than 90 percent of the reef-building coral responsible for maintaining major marine habitats and providing a natural barrier against hurricanes in the Caribbean has disappeared because of a disease of unknown origin.

Now a University of Florida geographer and his colleagues applied Geographic Information Systems, known as GIS — as well as software previously used to examine human illness — to show where clusters of diseased coral exist. Their findings, published this month in the journal PLoS One, may help scientists derive better hypotheses to determine what contributes to coral disintegration.

"What you'll find is that spatial techniques have been used relatively little in the coral research community," said paper co-author Jason Blackburn, a UF professor of geography and member of UF's Emerging Pathogens Institute. "With these methods, we gain a better understanding of the disease's distribution across the reef."

Microbiologists and toxicologists often run laboratory tests on small samples of Acropora species of coral to determine the factors that contribute to white-band disease, known as WBD. It's visually identified as a white band moving from the base of the coral up, killing the coral tissue as it goes, leaving only the exposed coral skeleton behind.

Laboratory results spur a range of theories of causation — anything from opportunistic pathogens to specific bacterial infections. Other scientists

suggest that WBD is not the result of an outside agent, such as bacteria, but rather a stress response from the coral in reaction to changes in the marine environment, such as ocean pollution and rising ocean temperatures due to climate change.

Yet the cause remains unclear. The goal of this current study was to use GIS and spatial analysis to search for patterns in a WBD outbreak that might point to a mode of transmission or cause, Blackburn said.

"What we wanted to test is how much data scientists should gather to get the full picture of disease," he said. "What we found was that colony-level sampling, where individual Acropora colonies are counted and checked for disease, can show a far different picture of white-band disease than where only presence/absence of coral and disease are mapped."

The researchers used data gathered in 2004 from scientists stationed at Buck Island National Monument in the U.S. Virgin Islands. Rather than determining only whether coral was affected by WBD, samplers at the station counted the individual number of healthy and non-healthy coral colonies. University researchers were then able to use this information in the Disease Mapping and Analysis Program, known as DMAP. The free software, designed by the University of Iowa initially to study Sudden-Infant Death Syndrome, was used to create maps of WBD prevalence and to locate areas with significant disease clustering.

"While the focus of our study was on a specific white-band disease outbreak, our methods could be used to determine if there's a spatial component to just about any type of situation that might be present in an underlying population," said Jennifer Lentz, a Louisiana State University graduate student who is lead author on the paper. "For example, you could use these same techniques to determine whether people with cancer are clustered in a given geographical area, and if so is there

something about those locations that might be contributing to the increased prevalence of cancer."

The researchers determined that 3 percent of the Acropora coral around Buck Island had WBD. They also found the locations of significant disease clusters, information scientists can then use to narrow where they should take samples for further laboratory tests. This is the first of several studies established by the researchers exploring which types of spatial analysis are the most appropriate for various types of coral data from the Caribbean.

For thousands of years, Acropora was the predominant coral in the Caribbean, but more than three decades of disease have destroyed the species ability to survive, forcing marine life out of their coral habitats, which exposes them to attack by predators.

"When these structures are gone, certain fish species have nowhere to go," said Lentz. "Whole marine communities start to collapse."

Provided by University of Florida

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