The White Stuff: Marine Lab Team Seeks to Understand Coral Bleaching

October 20 2009

Coral in the genus Pocillopore showing bleached and normal pigmented sections. Credit: NOAA Pacific Islands Fisheries Science Center, National Marine Fisheries Service

(PhysOrg.com) -- With technology similar to that used by physicians to perform magnetic resonance imaging (MRI) scans, researchers from six institutions -- including the National Institute of Standards and Technology -- working at the Hollings Marine Laboratory (HML) in Charleston, S.C., are studying the metabolic activity of a pathogen shown to cause coral bleaching, a serious threat to undersea reef ecosystems worldwide.

Coral bleaching is the whitening of living coral due to a disruption of the symbiosis (two organisms whose living together benefits both) with its

zooxanthellae, tiny photosynthesizing algae. These unicellular creatures reside within the coral's tissues and provide the host organism with up to 90 percent of its energy. It's the solar-derived chemical products of these algae that give the world's coral species a rainbow of vivid colors. Unfortunately, ecologically valuable coral colonies around the globe are being threatened by an ocean-dwelling bacterium known as Vibrio coralliilyticus. When the microbe becomes virulent, it can infiltrate coral and dislodge the zooxanthellae, causing the coral to lose its pigmentation. If symbiosis is disrupted long enough, the coral dies from starvation.

Environmental scientists have shown in laboratory experiments that the virulence of V. coralliilyticus is temperature dependent, causing bleaching at temperatures above 24 degrees Celsius (75 degrees Fahrenheit). These findings have raised concerns that increasing ocean temperatures—either through natural seasonal changes or climate change trends—may lead to increased risk of widespread coral bleaching. During the past two decades, it has been reported that nearly 30 percent of the world's coral reefs—and the ecosystems they support—have been severely degraded by bleaching.

In a recent paper in Environmental Science and Technology, the HML research team described how it used nuclear magnetic resonance (NMR) to study metabolic changes in V. coralliilyticus resulting from temperature effects. The technique allows discovery of small-molecule metabolism-related compounds that correlate with different biological conditions. In this study, the levels of three compounds—betaine, glutamate and succinate—that help regulate energy production and osmotic pressure (a mechanism for maintaining cellular integrity) in V. coralliilyticus were determined to vary significantly between 24 degrees Celsius when the bacterium is not virulent and 27 degrees Celsius (81 degrees Fahrenheit) when it is. These metabolic changes, the HML team believes, are clues to learning why the small temperature change can turn non-virulent V. coralliilyticus into a coral bleaching menace.

Future metabolomic studies of V. coralliilyticus are planned to better understand the complete temperature-dependent mechanism involved in its pathogenicity. The researchers hope that these findings will lead to a better understanding of the symbiotic relationships that exist in healthy coral and the potential impacts on those relationships under changing ecological conditions.

Teaming on this study with three NIST researchers were scientists from the Medical University of South Carolina, Tennessee Technological University, The Richard Stockton College of New Jersey, Mt. Holyoke College and the College of Charleston. The team included self-funded visiting scientists, graduate students from HML partner agencies and visiting undergraduate students funded through the National Oceanic and Atmospheric Administration (NOAA) and National Science Foundation programs.

The HML is a unique partnership of governmental and academic agencies including NIST, NOAA's National Ocean Service, the South Carolina Department of Natural Resources, the College of Charleston and the Medical University of South Carolina.

More information: A.F.B. Boroujerdi, M.I. Vizcaino, A. Meyers, E.C. Pollock, S.L. Huynh, T.B. Schock, P.J. Morris and D.W. Bearden. NMR-based microbial metabolomics and the temperature-dependent coral pathogen Vibrio coralliilyticus. *Environmental Science and Technology*, Vol. 43, No. 20 (Oct. 15, 2009).

Provided by National Institute of Standards and Technology (news : web)