New DNA array sheds light on coral disease

February 4 2009

The answer to what's killing the world's coral reefs may be found in a tiny chip that fits in the palm of your hand.

Scientists at Lawrence Berkeley National Laboratory and the University of California, Merced are using an innovative DNA array developed at Berkeley Lab to catalog the microbes that live among coral in the tropical waters off the coast of Puerto Rico. They found that as coral becomes diseased, the microbial population it supports grows much more diverse.

It's unclear whether this surge in microbial diversity causes the disease, or is a result of it. What is clear is that coral disease is accompanied by a microbial bloom, and the DNA array, called the PhyloChip, offers a powerful way to both track this change and shed light on the pathogens that plague one of the ocean's most important denizens.

"The PhyloChip can help us distinguish different coral diseases based on the microbial community present," says Shinichi Sunagawa, a graduate student in UC Merced's School of Natural Sciences who helped to conduct the research. "This is important because we need to learn more about what's killing coral reefs, which support the most diverse ecosystem in the oceans. Losing them is much more than losing a reef, it means losing fish and marine mammals, even tourism."

Worldwide, coral is threatened by rising sea temperatures associated with global warming, pollution from coastal soil runoff and sewage, and a number of diseases. The organism's acute susceptibility to

environmental change has given it a reputation as a canary in the coalmine: if it suffers, other species will soon follow.

Fortunately, there are ways to give coral a health checkup. Scientists have recently learned that healthy coral supports certain microbial populations, while coral inflicted with diseases such as White Plague Disease support different populations.

Understanding these microbial shifts could illuminate the magnitude and causes of coral disease, and possibly how to stop it, which is where the PhyloChip comes in. The credit card-sized chip can quickly detect the presence of up to 9,000 species of microbes in specially prepared samples of air, water, soil, blood, and tissue. The chip is carpeted with thousands of probes that scour a sample for the unique DNA signatures of most known species in the phyla bacteria and archaea. Specifically, the probes bind with a gene, called 16S rRNA, which is present in all life.

Developed by Gary Andersen, Todd DeSantis, Eoin Brodie, and Yvette Piceno of Berkeley Lab's Earth Sciences Division, the PhyloChip offers a quick and low-cost way to canvas environmental samples for the presence of microorganisms.

"It's a fast and inexpensive way to conduct a complete microbial community assessment of healthy and diseased corals," says DeSantis.

In this study, the PhyloChip was used in conjunction with a more common technique, clone library sequencing, to analyze healthy and diseased samples of the coral Montastraea faveolata, which were plucked from reefs in the waters off Puerto Rico. The PhyloChip analyses, which were conducted at Berkeley Lab, found more species than the slower and more expensive clone sequencing technique.

But neither technique yielded what the scientists anticipated. The diseased coral was expected to contain the pathogen Aurantimonas corallicida because the coral exhibited symptoms identical to another coral species stricken by the pathogen. In this case, however, A. corallicida was not found.

"We need to determine what comes first: the disease or the microbial population change," says DeSantis. "We don't know if the disease-associated microbial population kills the coral, or if the microbes are simply feeding on dead coral tissue."

Adds Sunagawa, "We have only recently realized how microbes, and microbial diversity, play an important role in the health of coral reefs. And the PhyloChip offers a great way to catalog the microbiota associated with coral reefs around the world."

Source: Lawrence Berkeley National Laboratory