Bleaching Power

Marine bacteria rout coral's colorful algae

By JOHN TRAVIS

Underwater rainbows stripped of their colors, bleached coral reefs have attracted worldwide attention in the last decade or so. While the natural beauty of coral is no doubt one reason for the public and scientific concern, fascination with coral bleaching also stems from speculation that its increasing frequency is a harbinger of global warming.

That conjecture stems from the knowledge that abnormally warm waters can bleach coral, apparently by straining the fragile symbiotic relationship between the transparent coral polyps and the vivid algae that live inside them. Other environmental stresses—ultraviolet light, pollution, changes in water oxygenation—may also spur bleaching, however.

"Whenever the symbiosis gets stressed, the coral kick the algae out," says Chris D'Elia, director of the Maryland Sea Grant College at the University of Maryland at College Park. This expulsion robs the coral of its color and, if the algae don't quickly recolonize the polyps, eventually kills the coral.

Now, a surprising new element has entered the complicated story of coral bleaching. The bleaching of one species of coral, and thus perhaps others, stems from the presence of a specific bacterium, according to a report in the April 4 NATURE by Ariel Kushmaro, Eugene Rosenberg, Yoshi Loya, and their colleagues at Tel Aviv University.

While scientists had previously linked infectious microorganisms to other coral diseases, the new report is the first solid evidence implicating bacteria in bleaching. "It's our feeling the causative agent of the bleaching is bacteria," says Rosenberg.

The Israeli investigators also suggest that the bacterium they've isolated may help explain how high water temperatures threaten coral: In warmer water, the microbe-induced bleaching occurs more quickly. "It's provocative as heck," says D'Elia.

It was in the summer of 1993 that the investigators first noticed bleaching of coral found in the Mediterranean Sea off the coast of Israel. Not present in enough quantity to form true reefs, this coral, a species called *Oculina patagonica*, is thought to be a recent immigrant from the waters around South America, most likely transported accidentally in the ballast water of a ship.

The Tel Aviv group examined bleached and unbleached specimens of the coral with an electron microscope. In every sample of bleached coral, but in none of the healthy specimens, the scientists found clusters of rod-shaped bacteria known as vibrios.

Certain species of these aquatic bacteria induce diseases in fish and other animals, including people. A vibrio is the agent responsible for cholera, for example. The vibrio found with the bleached coral hasn't been observed before, say the investigators. "It doesn't fit any species we know," says Rosenberg.

Intrigued by the presence of the vibrios in the bleached coral, the investigators conducted a series of tests to establish whether the bacteria were innocent bystanders or malefactors caught at the scene of the crime.

In one set of experiments, the researchers placed about 5 million vibrios directly on healthy coral, then placed the coral in an aquarium. When the temperature of the water was 25°C, slightly warmer than the coral thrives in, bleaching occurred in 6 to 8 days. Even when the scientists simply added vibrios to the surrounding aquarium water, 90 percent of the coral surface bleached within 44 days.

If they also added antibiotics to the water, the investigators could prevent the bleaching. Nor did bleaching take place if the aquarium water was a chilly 16°C, about the lowest temperature to which the coral is exposed naturally.

These tests and others persuaded the group that the vibrios somehow give rise to bleaching.

"We have no proof the bacteria directly attach to or kill the algae. All we know is the algae are gone. We don't know the mechanism," says Rosenberg.

The accusation leveled against the vibrios has drawn interest and skepticism from other coral researchers.

Garriet W. Smith of the University of South Carolina in Aiken, who has been studying the microbes associated with numerous coral species, hesitates to accept the claim of the Israeli group. He believes the presence of the vibrios is probably a result of the bleaching rather than its cause. Smith notes that he and his colleagues routinely find vibrios in bleached coral samples.

Smith argues that populations of the microbes naturally increase on coral when it is stressed, much as some opportunistic bacteria grow better in sick people. He suggests that exposure to massive quantities of vibrios simply adds another insult to coral already stressed by being in an aquarium of warm water. "I think if you add any bacteria to coral in an aquarium, [the coral] will bleach," says Smith.

Rosenberg counters that the vibrios cause bleaching even when the coral is kept at 20°C, a temperature at which he says *O. patagonica* thrives. Moreover, Rosenberg told SCIENCE NEWS, he and his colleagues have also exposed their coral to a number of other bacteria they had discovered on their bleached and unbleached specimens. The vibrios were the only ones to prompt bleaching, he says.

Kushmaro *et al.*/NATURE

Investigators from Israel charge that bacteria cause the bleaching seen in part of this coral colony.

Nevertheless, Rosenberg quickly acknowledges that the vibrios from the Mediterranean coral may not explain bleaching elsewhere. The investigators have already determined that the bacteria do not induce bleaching in coral from the Red Sea, though the group is looking to see whether that coral has its own bacterial bleaching agent.

"There's no question about this specific case," contends Rosenberg. "The generality of the finding is the question now." □