Killer CLOD strikes Indo-Pacific reefs

Over the next few weeks, dozens of biologists, particularly seaweed specialists, will receive a postcard of this color picture. But rather than discuss the pleasantries of a tropical vacation, the writing on the back warns these researchers to look out for this telltale orange color when they dive along reefs in Indo-Pacific. Their sightings will help researchers determine the extent of a plague that seems to have taken hold in these waters.

Photos: Littler, Littler/Smithsonian

March of orange microbes (close-up at right) leaves a trail of dead, white algae (above).

Though these 4-inch-wide patches brighten the underwater landscape, they also forewarn of the spread of coralline lethal orange disease (CLOD), says Diane S. Littler, a marine botanist with the Smithsonian Institution's National Museum of Natural History in Washington, D.C.

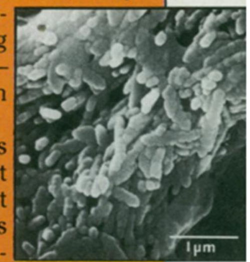
She and her husband, Mark M. Littler, first noticed an orange coating on the seaweed in the Cook Islands last year. They then studied it more intensively in Fiji. CLOD, a bacterial infection, has spread also to Papua New Guinea and the Solomon Islands. The bacteria seem most prevalent in the Cook Islands, where they now infect up to 5 percent of the reef seaweeds, says Diane Littler.

CLOD microbes attack coralline algae, underwater plants that deposit calcium carbonate in their tissues as they grow. "Most bacteria would infect just the surface layers [of a plant]," Diane Littler says. "But somehow these [bacteria] are killing the [plant] clear down to the calcium carbonate.... It kills everything in its path."

All that remains is a white strip, a ghostlike reminder of where algae once grew. Judging from the amount of white present a year after they first noticed the orange patches, the bacteria "did quite a lot of damage" in the Cook Islands, she reports.

When healthy, these algae form a hard surface that resists being battered by waves better than does coral itself. Because they are so tough, these seaweeds form the outer rim of many reefs and protect coral from the roughest water, says Diane Littler. Also, coralline algae help cement reefs together.

Once the algae disappear, the reef begins to disintegrate. Therefore, she worries that this newly discovered epidemic — the first documented in reef-building algae in the Indo-Pacific — could wreak havoc on many reefs.



Moreover, the microbes work quickly and do not seem too picky about their quarry. The Littlers placed 10 different species of red coralline algae next to an infected plant. By the next day, each species had developed an orange spot of its own. Also, the Smithsonian botanists have observed that the bacteria reproduce by producing 1- to 2-millimeter-wide orange droplets on the patch's surface. Waves sweep the droplets away, which can still infect a plant 2 weeks later, plenty of time to travel hundreds of miles, says Littler.

Diane Littler has turned over samples of the CLOD bacteria to the University of Maryland at College Park for analysis. Meanwhile, the Littlers' initial observations have been accepted for publication in the journal CORAL REEFS.

– E. Pennisi

Axon acts: The unbearable likeness of being

The epithet "you worm" might gain new meaning if researchers are right that two proteins recently found in the brains and spinal cords of chicks are shared by at least one and perhaps many other species. Two papers in the Aug. 12 CELL describe the proteins, netrin-1 and netrin-2, and their close similarity to the protein unc-6, known to be a key factor in the neural development of the nematode, or common roundworm.

Neurons have three parts: a cell body; the winding axon that transmits a nerve signal to the next cell; and dendrites that branch out from the cell body and receive input from axons of other neurons. Axons, then, provide the main communication link for nerve cells. "Netrins are signals that diffuse through the cellular environment and which attract the axons to their targets," explains Marc Tessier-Lavigne, a Howard Hughes Medical Institute researcher at the University of California, San Francisco, and a coauthor of both papers.

T.E. Kennedy, *et al.*/CELL

Cells engineered to secrete recombinant netrin-1 protein (bottom) attract growing axons from a piece of embryonic rat spinal cord (top).

In 1988, Tessier-Lavigne, Marysia Placzek, Jane Dodd, and Thomas M. Jessell, then all at Columbia University in New York City, were the first to describe chemotropism at work in the spinal cord. Though they couldn't identify the protein responsible for this phenomenon of chemical attraction, they knew that neural axons responded to a signal from cells in the lower spinal cord of embryonic rats.

One hundred years ago, the Spanish neuroscientist Santiago Ramón y Cajal postulated that diffusible chemical attractants weave neural networks by sending signals to the developing brain. The discovery of the netrins reinforced Ramón y Cajal's early theory by isolating two of the postulated chemical attractants that direct movement and growth of axons in the spine.

"This work provides the first convincing demonstration of an endogenous chemoattractantlike molecule within the developing vertebrate nervous system," says Jessell, a Howard Hughes Medical Institute researcher at Columbia University.

The team purified the two netrin proteins from 25,000 embryonic chick brains and obtained a partial amino acid sequence of the proteins. They then cloned the genes encoding the proteins and engineered cell lines to secrete netrins. Finally, they added the netrins to petri dishes containing pieces of rat spinal cord.

Viewed microscopically, the axon tips — called growth cones — reached toward the netrin-secreting engineered cells. "The novelty of our research is that the netrins are the first diffusible chemoattractants to be isolated," says Tessier-Lavigne. "Previously, people had identified other types of molecules that can guide axons, such as diffusible inhibitors of axon growth."

Just as axons in the brain can be summoned to the lower spine, they can be turned away. Tessier-Lavigne explains that repellent molecules, such as a group known as collapsins or semaphorins, send a chemical message to axons, saying, "Don't come this way." Neurobiologist Corey S. Goodman, a Howard Hughes Medical Institute researcher at the University of California, Berkeley, believes that these attractant and repellent molecules may work simultaneously in embryonic development.

– G. Marino