COMBATING THE RED TIDE

The red tide has been inflicting North America for centuries. But only now is a concerted scientific attack being made on the problem.

BY JOAN AREHART-TREICHEL

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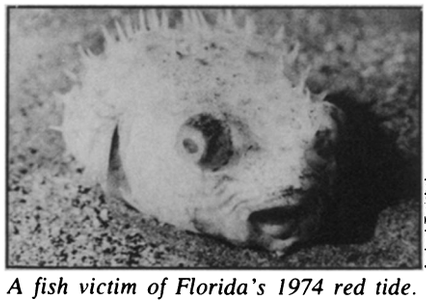
G. excavata *magnified 16,200 times, showing the grooves where its flagella originate.*

During the winter and spring of 1974, the West Coast of Florida was ravaged by its 25th major red tide since 1844. A Sarasota boy almost died eating clams poisoned by the tide. Hundreds of thousands of dead and smelly fish littered beaches. Millions of tourist dollars were lost.

In the fall of 1972, the lower New England coast experienced its first red tide. Twenty-six people were poisoned by tide-contaminated shellfish. The Massachusetts shellfish industry closed down; public confidence was shaken. Even today, the industry has returned to only 60 percent of its pre-1972 level.

Last autumn, the gusty Santa Ana winds blew from the desert into the Los Angeles-Long Beach Harbor, stirring up the red tide. The tide depleted the harbor of oxygen, so that hundreds of mussels and other fish died. . . .



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A fish victim of Florida's 1974 red tide.

The red tide is obviously a national problem, and the cost exceedingly high—human deaths and disability, unsightly and smelly beaches, major economic blows to the tourist and fishing industries. If Americans can get to the moon and send spacecraft past Jupiter, why haven't they conquered such a mundane problem? The scientific funding powers simply have not deemed it top priority. Research grants have tended to swing with the red tide so that research has been largely disjointed, sporadic.

Fortunately, there are signs that the tide

is now turning. The first international conference on the red tide was held a few months ago in Boston, courtesy of the Massachusetts Science and Technology Foundation, the National Sea Grant Program and other Government agencies. Red tide researchers are starting to work more closely together, at both the national and state level, as they attempt to pinpoint the causes of the tide and design ways of combating it.

The red tide, contrary to its name, is not a tide at all, but billions of one-celled marine organisms known as dinoflagellates that come together periodically in coastal waters. When the dinoflagellates congregate, they make the water red or brown in color, hence the name "red tide."

During the past decade or two, investigators have found that red tides are caused by several species of dinoflagellates, and each species makes a toxin that has somewhat different effects (SN: 6/8/66, p. 490; 8/14/71, p. 111). For instance, the New England species, *Gonyaulax excavata*, has caused human deaths off the coast of Canada, but the Florida species, *Gymnodinium breve*, and the California species, *Gonyaulax polyedra*, have not yet triggered any human fatalities. Investigators have also made ample progress in figuring out the chemistry of the toxins (SN: 2/5/72, p. 90; 3/29/75, p. 210) and in learning how the toxins hurt fish and people.

However valuable this information, it is not as critical as figuring out why the red tide forms in the first place. If investigators could pinpoint the causes, then they might well find ways of combating the tide or in actually preventing it. A number of scientists have been looking at nutrients, trace metals and sewage runoffs in the ocean, ocean salinity and temperature, winds, light and other factors that might trigger the congregation of the red tide organisms.

"Not one has turned out to be a specific triggering factor," reports Beverly Roberts, one of the red tide investigators at the Florida Department of Natural Resources Marine Research Laboratory in St. Petersburg. "However, all of these factors appear to play some role."

Dorothy Soule, a red tide researcher at the University of Southern California, tends to agree: "It appears to be the combination of factors, rather than any specific factor."

"To be frank," admits Vincent R. LoCicero of the Massachusetts Science and Technology Foundation and manager of the recent international red tide conference, "although investigations over the past five years have identified a host of contributing factors to the red tide, we are no closer to pinpointing the specific set of conditions which accounts for it."

True or not, scientists at least know enough now to monitor for red tide. For 12 years Florida, and for three years New England, have had monitoring stations that take red tide toxin from clams periodically. The toxin is then injected into mice. The rate at which the mice die gives scientists an indication of how much toxin is in the water and how imminent a tide is. "Such monitoring," LoCicero says, "is a more valuable indicator of a red tide than is the color of the water, and our ability to prevent deaths from shellfish poisoning has been largely due to monitoring."

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Roberts prepares culture of G. breve.

As Roberts point out, though, such monitoring is really after the fact. "By the time shellfish are toxic, the tide is already here," she says. What would be more helpful, in the view of Edwin Joyce of the Florida Department of Natural Resources in Tallahasee and director of the Marine Research Laboratory in St. Petersburg, would be a technique for detecting the tide well in advance. And, in fact, research toward this goal is underway.

Soule and her colleagues at the University of Southern California, for instance, are finding that they can predict red tides well in advance by detecting changes in heavy metals, salinity, oxygen, acidity, bacteria, viruses, winds and other factors in the Los Angeles-Long Beach Harbor. They have also learned that spring tides are not likely to cause oxygen depletion of the water and fish kills as are fall tides.

Then in Florida, starting this month, the National Aeronautics and Space Administration and the State of Florida will cooperate in trying to make long-range predictions of Florida red tides. A LANDSAT satellite will fly over Florida, specifically the St. Petersburg coastal area, every 18 days to see whether it can detect any change in water color. At the time the satellite flies over, a boat will be sent to the same area to collect water samples for the tide. That way, Ross McCluney, a NASA physicist working on the project, explains, satellite results can be compared with biological results.

McCluney admits, however, that "We're not too optimistic about being able to see the red tide from the satellite because the color change is subtle, and the sensor on it is designed to look at land, not water, so the imagery in the water sensor is dark. However, we have developed an aircraft instrument designed to look at the water, so it has the high sensitivity to see dark patterns coming out of the water. Besides that, it has better wavelength coverage than the LANDSAT imagery." So this instrument will be flown over the St. Petersburg-Tampa coast once a month or so also to probe for the red tide.

In addition, McCluney, who is an optical oceanography expert, will be attempting to measure the optical properties of the red tide organism. "It involves some sophisticated optical instrumentation," he says, "some of which I already have and some of which is being built for me."

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When the ocean blushes crimson

For many years the red tide was nothing more to me than visions of blossoms floating on waves, or a kissing cousin to the Red Sea. Then came our annual family vacation on the Gulf Coast of Florida during the spring of 1974, and did my visions change!

The red tide first hits you a block or two away from the beach—an odorless, but virulent aerosol toxin that claws at your eyes, throat and nasal passages and makes you retch like a consumptive. The aerosol, researchers believe, is not the same as the tide toxin that kills fish or poisons people. "It is ironic," declares Wynn H. Hemmert of the Florida State Division of Health in Jacksonville, "that we know the least about that aspect of the Florida red tide problem which poses the greatest public health hazard in terms of the number of people affected."

Then, if you choke your way onto the beach, you are overwhelmed by the tide's real splendor—not ravishing red surf but thousands of dead fish littering the sand, insects feasting on their bloated bellies. Municipal trashmen simply cannot keep up with the daily shipments of stink which can last for weeks or even months, depending on how long it takes the red tide organisms to disperse.

The only recourse against these affronts to your health and senses, at least until scientists come up with some solutions, is to wear a surgical mask, retreat to an air-conditioned condominium or get the next flight out for Sioux City.

—Joan Arehart-Treichel

. . . Red Tide

Once he has measured the optical properties of the organism, the information will be put in a computer model that predicts what color the ocean would be during the red tide.

"So one approach," McCluney concludes, "is empirical. We'll try to look at the imagery and correlate it with what we learn from the boat. And the other approach is to do a math model of the whole process optically and to see how the light behaves, and to predict what you would see, and to see whether what you see in the satellite and aircraft are what you predicted on the computer."

Even if long-term prediction of red tides becomes possible, of course, better methods will have to be developed for combating the adverse effects of the tide. And the Marine Research Laboratory at St. Petersburg is also working toward this goal. It is designing special nets that can be used by local boats to scoop up dead fish before they strike beaches. Joyce visualizes the approach being like snow removal up north. When a tide isn't present, the nets can be stored, and shrimpers and other boats can go about their business.

Good long-term prediction of tides and oceanic fish cleanups still won't be a panacea for shellfish and human poisoning, though. Which brings up this question: Will prevention of the tide ever be possible? And if so, should it be tried, considering the tide's place in the natural scheme of things?

Twenty years of research into the tide has convinced the folks at the Marine Research Laboratory in St. Petersburg that prevention is unlikely. The lab has already tried spraying preventative chemical from airplanes onto the tide, and it didn't help. And even if a preventative were to become available, it would be unwise to use it, they believe, since the tide has been a part of the Gulf ecosystem for at least 150 years. What's more, there seems to be an increase in the number of shrimp and crabs in those years following tides, which benefits the fishing industry.

"So removal of the tide," Joyce asserts, "would be not only unfeasible, but probably unwise. Hence, we're trying to alleviate its harmful effects while preserving its good ones."

LoCicero, deeply concerned about the impact of New England tides on human health and on the New England fishing industry, disagrees: "I'm a positive thinker. If we can identify the causes of the tide, let's try to prevent it. Where the means of such prevention call for the introduction of foreign elements into the environment, this should be done with due regard to the balance of the ecosystem."

With her research findings and California's lesser tide problem in mind, Soule takes a middle stance: "I think it is more a matter of keeping the red tide organisms from coming together into blooms, than of eliminating them." □