

IS THE (RED) TIDE

Scientists are working to learn more about what

by Janina Birtolo



Red tide.

Those words are likely familiar to anyone who has spent even a brief time in Southwest Florida. The algal blooms they describe are as much a part of life here as sunshine, warm weather, and hurricanes. And, like hurricanes, red tides are just about as unwelcome. They can litter the beaches with dead fish and cause respiratory problems even for people who don't live near the coast. They can have a negative impact on tourism and demand countless dollars in cleanup and other economic costs. And their occurrence and severity can be difficult to predict.



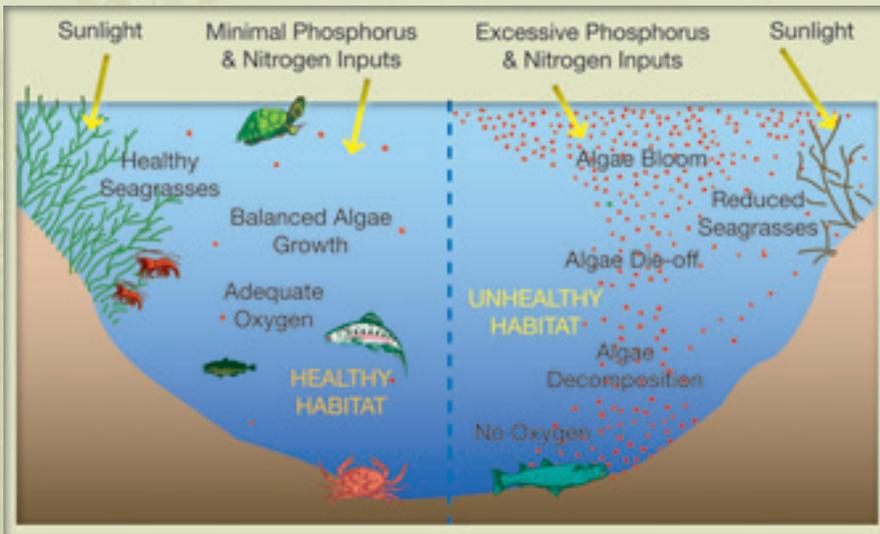
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TURNING?

causes the unpleasant algal blooms

Greg Le Blanc of Captiva Kayak Co. & Wildside Adventures cleans up dead fish littering the shoreline; a striped mojarra succumbs to the toxic algae on Captiva's bay side (inset).





Fertilizer runoff adds excess nitrogen and phosphorus to the water, stimulating algae growth. Algae blooms may reduce oxygen levels and block needed sunlight from reaching seagrass communities, and the resulting losses in habitat and fish populations can be catastrophic.

So what can be done about red tides? That's just one of many questions about red tide that scientists and governmental agencies are exploring. Definitive answers are hard to come by at this point. But there is some hope on the horizon.

WHAT IS RED TIDE?

The cause of red tide has been answered in the short form, although the complex factors that lead to an occurrence are still a little murky. There is, in fact, even some confusion about the term itself.

"Red tide has become a generic term for lots of different types of algal blooms," explains Frank Alcock, assis-



tant professor at New College of Florida and director of the Marine Policy Institute (MPI) at Mote Marine Laboratory in Sarasota. "But many of those are caused by nontoxic algae."

The term is also something of a misnomer, as red tides aren't always red. They can make the water appear a yellowish green—or not even be visible.

So let's start with some simple definitions and explanations. The red tides along the Southwest Florida coast are caused by the massive multiplication—a "bloom"—of tiny, single-celled algae called *Karenia brevis*, a species of phytoplankton found on the West Florida Shelf. According to the MPI's 2007 Red Tide Assessment, *K. brevis* can survive in water temperatures ranging from 48°F to 92°F but grows best when the water is between 72°F and 82°F. Its growth rates may also be affected by the amount of sunlight or shade.

K. brevis produces a powerful collection of neurotoxins called brevetoxins. When fish, marine mammals, or people inhale or ingest these toxins, the toxins attack nerve cell membranes, leading to disruptions of muscle function and, eventually, cardiac and respiratory distress. In people, the effects are usually not fatal and symptoms clear up when the red tide moves on. Marine life is not so fortunate. In 1996, red tide killed 149 manatees in Southwest Florida. In 2004, 107 bottlenose-dolphin deaths were linked to red tide along the Florida

Panhandle. In 1947, the beaches in Venice were covered with thousands of dead fish as a result of red tide.

Red tides have been occurring along the Gulf Coast of Florida for a long time. Records indicate occurrences of these algal blooms as far back as the mid-1800s, but scientists suspect they've been occurring since long before then.

WHAT TRIGGERS A BLOOM?

Pinpointing exactly what triggers a red tide bloom is where things get murky. *K. brevis* is extremely slow growing. Cells typically undergo only one cell division every two to three days. Other species of phytoplankton will divide three or four times each day. So what causes *K. brevis* to find enough nutrients to outgrow competing phytoplankton?

For a while, many pointed to coastal runoff and pollution as the culprit. But, as Alcock found, the answer isn't so simple. As he wrote in the MPI assessment he authored, "Coastal pollution is often depicted as either the primary cause of red tides or as something that's incapable of affecting them. Neither position stands up to scrutiny."

Today, Alcock says, scientists are close to consensus on the idea that coastal pollution doesn't initiate a red tide bloom. Typically, blooms originate ten to fifty miles offshore. But there is some evidence that, once a bloom reaches the coast, runoff pollution can help to sustain or even enlarge it by providing nutrients on which the algae can feed.

"There are various recipes for creat-

Frank Alcock studies red tide as the director of the Marine Policy Institute at Sarasota's Mote Marine Laboratory (left); an image depicts *Karenia brevis*, a tiny, single-celled algae found on the West Florida Shelf (below).



ing a red tide,” Alcock notes. “It doesn’t lend itself to identifying a single cause.”

Indeed, a “recipe” chart included in the MPI report shows just how complex the question of cause is. Initial factors include upwellings of deep, nutrient-rich water along the continental shelf, rainfall, and even dust clouds from the Sahara Desert.

Early last November, scientists from the National Oceanic and Atmospheric Administration (NOAA) presented a new theory, proposing that nutrients from the Mississippi River might play a role. The idea is that, as the river flows into the Gulf of Mexico, early summer winds push the nutrients, especially nitrogen, eastward toward Florida. While other algae that reproduce more quickly get most of this nitrogen, they may convert it to a form that *K. brevis* (a very opportunistic feeder) can use. Because of *K. brevis*’s whip-like tail, it can also swim to the bottom of the Gulf and feed on the nitrogen that drifts downward. Upwellings in the water in late summer and early fall bring *K. brevis* back to the surface, in concentrations large enough to produce a red tide.

“The NOAA theory is plausible,” Alcock says. “But there are still lingering questions.

“We don’t know what causes red tide to die off in nature,” he continues. “One theory is that it doesn’t die, it just moves and breaks apart when it gets away from the coastline. There was a red tide bloom off Jacksonville last summer. It didn’t originate in the Atlantic, so it must have traveled the Gulf Stream. Does it have something like a genetic clock? We haven’t studied it enough, and there’s no consensus.”



A red tide outbreak caused a host of dead fish to wash ashore on Captiva’s bay side (above); a dead goliath grouper lies on the shore near Jensen’s Marina in Captiva (below).

IS THERE A SYMBIOTIC RELATIONSHIP?

Alcock found one food supply theory promising enough to include in his recipe chart. But like red tide itself, this theory shows just how complex the picture is.

Trichodesmium is a kind of bacteria that is found throughout the world’s oceans. And *Trichodesmium* blooms often precede or accompany *K. brevis* blooms. The theory holds that *Trichodesmium* may provide food for *K. brevis* by taking nitrogen from the air, digesting it, and excreting it in a form that *K. brevis* can use. To do this, *Trichodesmium* requires a sufficient supply of iron, and the growing desertification in Africa, which has increased the

amount of iron in the dust clouds that eventually make their way to Florida, could be contributing to this supply.

Another significant source of food for *K. brevis* may be the very fish that it kills during a bloom. Alcock points out that dead fish often drift to the bottom of the ocean before floating to the top. During that time, it’s quite possible that a large amount of nutrients is dispersed, allowing the red tide to expand and continue the cycle.

Once the algae have bloomed and reached the coastline, the possible role of coastal runoff comes into play. When there is no bloom, it’s likely that other faster-reproducing phytoplankton have the edge in feeding on the nutrients in

PHOTOS BY JIM ANDERSON





Red tide outbreaks off of Sanibel Island have caused everything from fish kills to bad vacation memories.

runoff. But with greater numbers and proximity, *K. brevis* may be able to surmount its initial disadvantage. And the nature of today's fertilizers is a genuine cause for concern, as Alcock explains.

"The urea content of fertilizers in the last ten years has skyrocketed," he says. "Urea is very easy for red tide to [metabolize] and use."

WHERE DO WE GO FROM HERE?

So is there anything that can be done about red tide? Like so many questions connected to this topic, the answer seems to be a definitive "maybe." Scientists have discovered ways to kill the algae, but those methods may not be applicable outside the laboratory.

Ozone is one possibility that is being explored and shows promise. It can kill or inhibit *K. brevis* and destroys the brevetoxins it produces. It can also oxidize decaying fish and re-oxygenate waters where an algal bloom has depleted oxygen. But ozone is toxic and kills indiscriminately (although its toxicity lasts only for seconds before it dissipates).

"Some of the technologies—like ozone—if we knew the particular depth where the bloom was just starting in the water column, it's possible we could shut it down before it reached critical mass," Alcock says. But there are a lot of "ifs"

still to be worked out.

The same "possible" pertains to clay flocculation, another promising treatment. Used successfully to protect aquaculture facilities in Asia, the method involves spraying an area with clay slurry from a boat. As the slurry drifts to the sea bottom, it binds with the algae, forcing them to the seabed and, ideally, burying them there. But so far, the method has only been effective in controlled areas, with minimal to moderate tidal flows and winds.

"Right now, there is technologically nothing we can do to stop a bloom," Alcock says. "But we might be able to protect a shellfish bed or canal."

WILL WE EVER DEFEAT RED TIDE?

It's a safe bet that red tide will be with us for some time to come. But that doesn't mean the picture is entirely bleak. More needs to be done, but, as with the control techniques, some areas look promising.

The MPI report is a significant first step. When Alcock started gathering the research and information for it, he was taken aback by some of the attitudes he encountered. "We had some fairly acerbic meetings at the time," he says. "There were frustrations all around. The scientists knew things but couldn't con-

vey them. And to me, it was pretty straightforward that it was extremely important to reduce coastal runoff and pollution. I didn't see the sense in having a huge amount of controversy about cautionary prevention."

Alcock's first task, then, was to take the scientific data and translate it from jargon into easily accessible language. He also wanted to gather as many perspectives as he could. "If we want people to listen to us, we have to listen to them," he explains. "So I met with members of the Sierra Club as well as the scientists. You don't manage environments; you man-

Mote Marine Laboratory uses autonomous underwater vehicles (AUVs) to study the ocean and the ocean floor in order to learn more about issues like red tide.



TOP PHOTO BY JIM ANDERSON; BOTTOM PHOTO COURTESY OF MOTE MARINE LABORATORY

RED TIDE SAFETY TIPS

Since *Karenia brevis*, the algae responsible for red tide, emits toxins, it's advisable to follow some precautions during a red tide bloom. Here are some helpful guidelines:



- Shrimps, crabs, scallops, and lobsters are **safe** to harvest and eat because they do not accumulate the brevetoxins in the meaty tissue normally consumed. It is not a good idea, however, to eat the livers or other organs.
- The fillets of fin fish caught during red tides are **safe** to eat, so long as the fish is behaving normally. As with shellfish, however, it is not a good idea to eat livers or other organs.
- Oysters, clams, mussels, mollusks, and whelks are **unsafe** to harvest and eat during a red tide. These filter feeders may accumulate brevetoxins in their tissues. Pay attention to shellfish alerts, as the toxic effects may not diminish for several weeks after a red tide bloom is over.
- Seafood is **safe** if ordered in a restaurant or bought in a grocery store. The Florida Department of Agriculture and Consumer Services maintains a strict safety protocol for commercial fish. There have been no reported cases of neurotoxic shellfish poisoning from the eating of commercially harvested shellfish.
- Swimming and spending time at the beach is generally **safe** for most people during a red tide bloom, although some people have reported skin irritation after swimming. Those with asthma or other respiratory problems are advised to avoid the beach during blooms.

age people. I'm pleased now to see more of a discussion and more attention on the things we all agree we need to do. We're having a constructive dialogue rather than rumors."

Once the report was finished, Alcock set about getting it to the people "who need to know." He compiled a list of three to four hundred county commissioners, legislators, and community leaders and also worked with the Sierra Club to get the report out on its network. Now he hopes to work with chambers of commerce and tourist bureaus, both to publicize the information and to obtain a better understanding of the economic impact red tide may have.

"It would be great having the business and tourist industries working with the scientists," he says, "so people know

where they can get reliable information."

Alcock is less optimistic about securing funding for needed research. "Much of what we need to do is tied to the budget crisis," he explains. "It was a pretty big fight to get \$2 million [for research] back into the budget. The immediate horizon doesn't look that good. But how much and how quickly we learn is going to be an outgrowth of how much money we want to put into it."

He does, however, have words of praise for the Florida Fish and Wildlife Research Institute, which does a good job of finding red tides and notifying others about them, and the Florida Department of Agriculture and Consumer Services, which keeps red tide-infected shellfish from public consumption. "They run a tight ship," Alcock says. "It's perfectly

fine to eat fish and shellfish from restaurants and grocery stores."

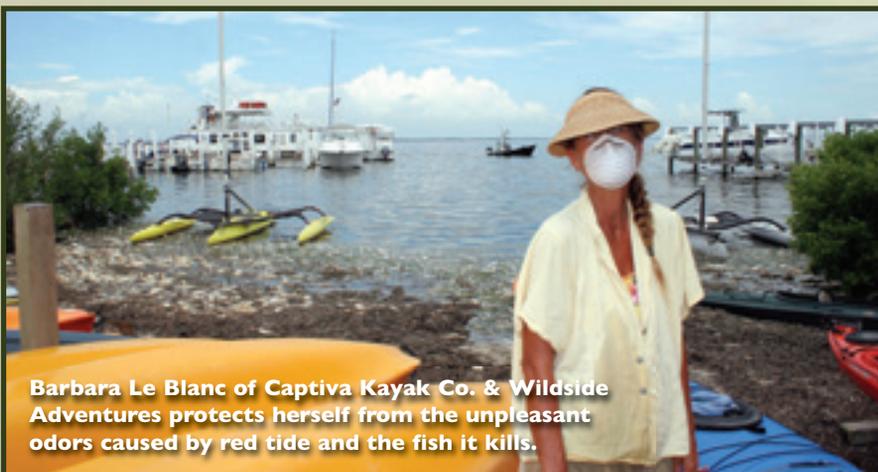
And he is encouraged by the ordinances regulating coastal runoff being adopted by such communities as Sarasota and Sanibel. Ultimately, however, the battle against red tide will be won by knowledge and understanding—by what the scientists can learn and by their ability to get that information to the public. 🌿

Janina Birtolo is an award-winning freelance writer and television producer with a fondness for the environment and the arts. She also writes and performs one-woman shows based on historical characters.

FOR MORE INFORMATION

Those who are interested in reading the entire Marine Policy Institute Red Tide Assessment can access it online at www.mote.org/mpi. (Click on the link for Red Tide Assessment.) The executive summary and conclusion provide a good overview of the findings and recommendations, but the body of the report clearly explains the complexity of the issue. There is also a helpful glossary and extensive bibliography.

The Mote Web site also has a link to add your name to a list for future red tide information and alerts.



Barbara Le Blanc of Captiva Kayak Co. & Wildside Adventures protects herself from the unpleasant odors caused by red tide and the fish it kills.