DESPITE VOCIFEROUS OPPOSITION, A HARBOR BRANCH SCIENTIST IS BRINGING FRESH SPARKLE TO FLORIDA'S POLLUTED WATERS

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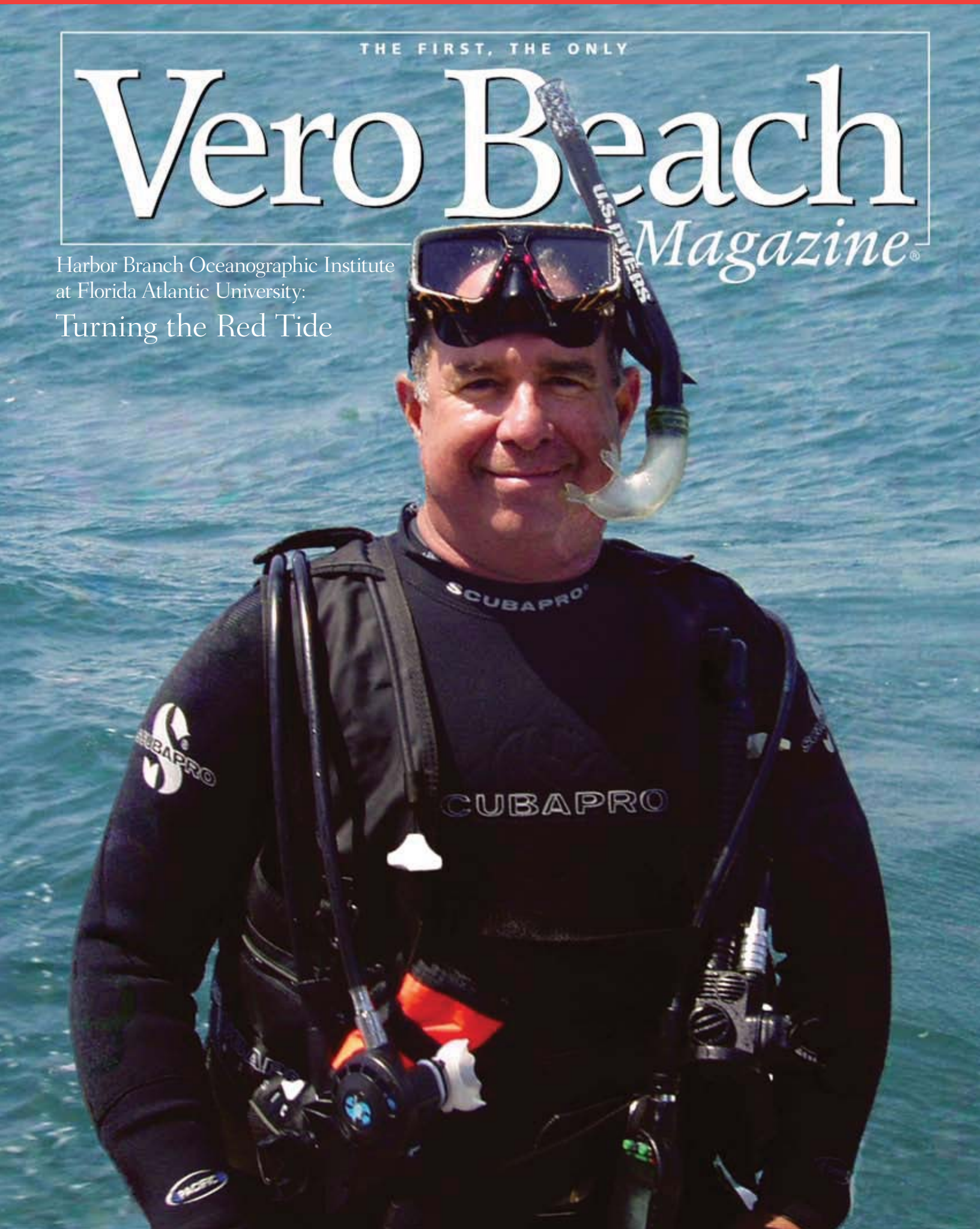
Harbor Branch Oceanographic Institute at Florida Atlantic University:

Turning the Red Tide



Despite vociferous opposition, a Harbor Branch scientist is bringing fresh sparkle to Florida's polluted waters.

TURNING THE RED TIDE

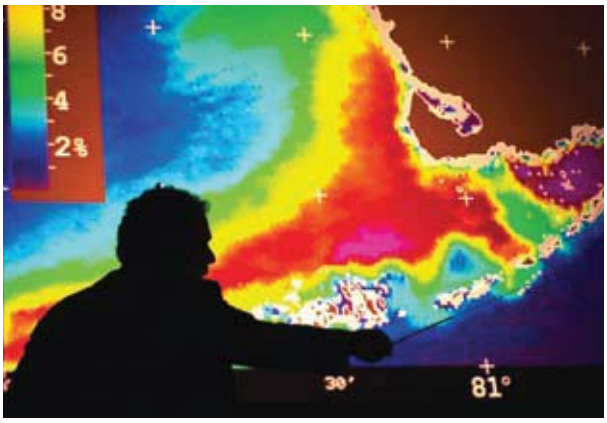
BY DEBORAH BORFITZ
PHOTOGRAPHY COURTESY OF HARBOR BRANCH OCEANOGRAPHIC INSTITUTE AT FAU

Back in the 1980s, marine ecologist Brian Lapointe may have been the only person in Florida who knew that the state had a serious water quality problem brewing along its coast. He identified the culprit as unhealthy levels of nitrogen-rich runoff into the Everglades and other seemingly pristine inland waterways. The theory, which singled out man's responsibility in generating much of the suspect effluent, was controversial and unpopular because correcting the problem would require painful economic and regulatory adjustments.

These days, owing to some peculiar happenings in the Atlantic Ocean, Lapointe's theories are gaining traction. A research professor at FAU's Harbor Branch Oceanographic Institute in Fort Pierce, he is one of the nation's top experts on "harmful algae blooms," including Florida red tide. His premise is that agricultural and urban runoff emanating from the state's watersheds, coupled with sewage outflows directly into the estuaries and coastal ocean, are behind the massive algae blooms that have sporadically occurred off Florida's coast for the last 100 years. The result has been large numbers of dead fish and paralyzed sea turtles, he points out, and – at least when the public is properly notified – eerily vacant beaches.

A major catalyst for the development of harmful algal blooms is the release of water from Lake Okeechobee during high-rain seasons either east to the St. Lucie River, west to the Caloosahatchee River, or south through a series of canals to Florida Bay between Everglades National Park and the Florida Keys. Vero Beach residents will remember that the last major red tide occurred on the state's east coast in the fall of 2007, a decidedly dry year almost everywhere except the Ocala area. That year, heavy rainfall landed in the St. Johns River, which flows northward to Jacksonville before connecting – with its own nutrient-rich load – to southerly-moving, long-shore currents.

Although it's been a problem over much of coastal Florida, red tide has been most prevalent on the state's southwest coast. It became catastrophic in 2005 after a colossal volume of fresh water from three overlapping hurricanes poured into the Caloosahatchee River and was discharged into the Gulf of Mexico before being pulled north by prevailing winds.



Harbor Branch research professor Dr. Brian Lapointe uses satellite imagery to show how algae blooms flow from Florida Bay to the offshore coral reefs of the Florida Keys.

A prerequisite for a red tide bloom is a "stratified water column," whereby fresh water, loaded with nutrients from land, shoots offshore atop denser oceanic water. As Lapointe would later prove when he sampled water on behalf of Lee County, the Caloosahatchee River had an unusually high concentration of ammonium linked to urea-based fertilizers and sewage, both of which can stimulate red tide events. The scientist says he also recorded abnormally high levels of phosphorus discharging from the Peace River, which runs through the state's phosphate mining region and mixes with the nitrogen-rich discharges of the Caloosahatchee off Lee County's shore.

When the Franklin lock on the Caloosahatchee discharged all that water from Lake Okeechobee and the upland basins, large quantities of ammonium were carried as far as 30 miles out to sea. Combined with the phosphorus discharges from the Peace River, the result was "persistent red tide for almost all of 2005," says Lapointe. "It was one of the largest red tide events in the history of Florida."

Lapointe's views have long been hotly debated within the Florida red tide research community. Prior to his work for Lee County, some

While investigating Palm Beach County's waters, Dr. Lapointe collects the invasive green seaweed Caulerpa racemosa *from coral reefs at a depth of 90 feet off Juno Beach.*

This aerial photo of Looe Key reef, located four miles south of Big Pine Key, shows an area where Brian Lapointe and his Harbor Branch colleagues have monitored nutrients and algae for more than 25 years.

Charlie Yentsch, a colleague of Lapointe and founder of the Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor, Maine, lowers a Secchi disc into the red tide bloom off Sanibel Island in September 2005.

researchers termed Florida red tide a "natural process," which they claimed was linked to iron-laced dust blowing from Africa. The theory was that this dust promoted the growth of a certain type of nitrogen-fixing algae in offshore waters that released ammonium, initiating red tides, which then came onshore. For years, state scientists and water managers adhered to this improbable wind theory.

According to Lapointe, however, 10 years of satellite tracking of currents in the Gulf of Mexico has shown that little circulates in or out of a "forbidden zone" on the wide continental shelf off Southwest Florida. As a result, river discharges build up like dirty water in a bathtub and become easily stratified on top of the denser, more saline Gulf of Mexico water, "so that the coastal area is naturally predisposed to this."

Lapointe's work was the first to prove that the nitrogen source fueling red tides off Lee County's Sanibel Island in 2005 was pollution caused by human activities, and not from African dust-generated nitrogen. Back in the lab at Harbor Branch, nitrogen isotope analysis of the red tide organism – *Karenia brevis* – pulled from the scene fingerprinted agricultural runoff and sewage as the nitrogen sources. Cell particles were predominantly 35 microns in size, precisely that of *K. brevis*, the microscopic dinoflagellate which produces a neurotoxin that disrupts the normal neurological functioning of many animals. In humans, says Lapointe, *K. brevis* causes breathing problems as well as skin irritations and burning eyes, impacting health and comfort as well as rec-

reation and tourism. As part of the 2005 red tide event, in concert with the freshwater/saltwater stratification, it also resulted in a "dead zone" by depleting the coastal waters of oxygen, thereby causing widespread mortalities of fishes, sea turtles, birds and manatees.

Following the 2008 publication of a paper in the journal *Harmful Algae* describing the 2005 red tide bloom, Lapointe traveled the globe speaking to other academics about his discoveries. Further research confirmed that the linkage between land-based runoff and red tides is what happened after 2006, when the floodgates were shut and the coastal waters off Lee County began to clear up. Red tide was almost immediately replaced by stacks of seaweed on beaches in Southwest Florida, including those of Sanibel Island. Lapointe's research noted that while these red drift seaweed blooms are not directly toxic like red tides, they are still considered harmful algal blooms because they also lead to depleted oxygen, dead zones and loss of fisheries habitat.

The formation of this excessive seaweed biomass was supported by low-flow conditions from the Caloosahatchee River, when sunlight and nutrients recycled from the previous red tides are allowed to mix on the coastal sea floor. The non-toxic seaweed blooms can sometimes be even more problematic than red tides in terms of the impact on tourism – especially when the stench gets so bad that visitors start checking out of hotels. All that rotting organic matter consumes oxygen and results in high concentrations of hydrogen sulfide, the "rotten egg" smell that is toxic and should be avoided.

Nitrogen-rich fresh water releases from Lake Okeechobee southward through the Everglades also contributed to massive blooms of phytoplankton in Florida Bay, leading to the die-off of sponges, sea grasses and coral – the marine pollution problem Lapointe spends most of his time investigating. In the early 1990s, increased water flows from the Shark River Slough and Taylor Slough initiated a phytoplankton bloom that led to the formation of a dead zone in Florida Bay increasing the occur-

Buoyant plumes of lower-salinity, algae-rich water flow from Florida Bay through the tidal passes of the Florida Keys in 1993, mixing with the bluer waters of the Atlantic Ocean.

This massive bloom of red drift algae washed ashore on the Gulf Coast's Sanibel Island in January 2007. Like red tide, red drift algae is an indicator of excessive land-based nutrients.

rence of coral diseases and die-off in the Florida Keys.

Water managers mistakenly believed the algae bloom was being caused by high salinity killing sea grasses, making fresh water diversions from Lake Okeechobee into the Shark River Slough (the primary source of water for Everglades National Park) seem like an ecologically sound proposal. "Since then, they've put the water elsewhere," says Lapointe. Increasing storm-water runoff was released after 1996 into either the St. Lucie or Caloosahatchee rivers, creating a new avalanche of problems for marine life and local tourism.

Brian Lapointe trained at Woods Hole Oceanographic Institution on Cape Cod and developed a strong bond with his mentor, the late biological oceanographer John Ryther. The two first worked together on a waste-water recycling aquaculture project from 1973 to 1977. After Lapointe finished his Ph.D. in 1982, they collaborated on seaweed research in the Florida Keys. Both men became employees of Harbor Branch in 1983 in the newly created Division of Applied Biology.

Recalling that researchers from Woods Hole had noticed how excess phosphorus was linked to red tides off Sarasota back in the 1940s, Ryther assured Lapointe that excess nutrients would result in similar problems with harmful algal blooms in the Florida Keys. Further study of the prospect led the pair to become the first to recognize that nitrogen-rich agricultural runoff from sugar farms was negatively impacting Florida Bay and the Keys region. "At the time everyone thought the Everglades was a big filter that sucked all the nutrients out," Lapointe explains.

In a 1996 article in *New Scientist*, Lapointe was credited with debunking that myth. In the same piece, Everglades National Park scientists vociferously disagreed, saying the park's water was as good as distilled and could be used in lab experiments. As explained in an investigative report published in the *Miami New Times* nearly seven years later, many scientists at the time held fast to the politically correct notion that the words "Everglades" and "nitrogen" should never be ut-

tered in the same breath. The idea that nitrogen could travel from sugar plantations to Florida Bay was considered laughable. Vero Beach-based novelist and *Miami Herald* columnist Carl Hiaasen's 2004 book *Skinny Dip*, in which a marine biologist runs a lucrative scam with an agribusiness where he falsifies water-quality reports from the Everglades, clearly borrows from this real-life controversy.

Mystery readers who want to get a better feel for Lapointe's mindset have only to read any of the best-selling books in the "Doc Ford" series by another Florida novelist, Randy Wayne White. The author has made it no secret that his feature character, marine biologist Doctor Marion Ford, is modeled, in part, after Lapointe – including his one-time lab and stilt house in the Keys.

The idea that excess nutrients were causing a greater loss to coastal fisheries than overfishing captured White's attention because, in addition to being a writer, he was a charter fishing captain on Pine Island in Lee County and familiar with the Caloosahatchee River, red tide and fish kills.

White contacted Lapointe in the early 1990s when he was writing *The Man Who Invented Florida*, which was published in 1993. In his author's note, White states that "Marion Ford drew heavily from the work of Dr. Brian Lapointe." As White recently explained, "So fertilizer caused plant plankton to grow – it just made sense. And so I adopted this fact into the Doc Ford philosophy. I'm no scientist, but I read a lot and I've become aware that there are not many independent thinkers in this world. When I stumble across one, I try to use them as much as I can."

Once some of Lake Okeechobee's excess water was diverted to the Caloosahatchee River in the mid-1990s, the red tide situation in front of White's house on Pine Island visibly worsened. "There were dead fish everywhere and the manatees were dying," Lapointe recalls.

After the 2005 red tide debacle, almost everyone became convinced that the phenomenon was all about nutrient runoff. Pollution-caused red tide blooms was the topic of a standing-room-only forum hosted in Englewood by the Sierra Club of Southwest Florida last year, where Lapointe was a keynote speaker.

Florida Governor Charlie Crist and Department of Environmental Protection (DEP) Secretary Michael Sole "have taken all this nutrient research very seriously and are developing better water management

policies based on it," says Lapointe. In a letter sent to Sole in January of this year by the U.S. Environmental Protection Agency (EPA), assistant administrator Benjamin H. Grumbles virtually guarantees it. In the letter, Grumbles states that "numeric nutrient water quality criteria" are necessary for the state to meet the requirements of the Clean Water Act and it "expects to propose" the criteria for lakes and flowing waters within 12 months and for estuaries and coastal waters within 24 months.

The EPA plainly states that "water quality degradation due to nutrient over-enrichment is a significant environmental issue in Florida," affecting "approximately 1,000 miles of rivers and streams, 350,000 acres of lakes, and 900 square miles of estuaries." In certain locations in the Sunshine State "levels of nutrient pollution (notably phosphorus and nitrogen) have not significantly improved since 1980." Further, "harmful algal blooms" occurring inland and near shore are typically caused by excess nutrients and "pose threats to public drinking water and recreational sites."

Establishing what nutrient concentrations are "too high" is an important first step, Lapointe believes. Nutrient over-enrichment "starts in fresh water and flows to the sea from there." Protecting freshwater simultaneously protects downstream estuaries and coastal waters.

Lapointe is accustomed to being a catalyst for change. Installation of a central sewer system was mandated for Monroe County in 1998 by then-Gov. Lawton Chiles, based in part on Lapointe's findings that Keys sea grasses and coral reefs were being seriously imperiled by sewage nutrients originating from septic tanks up and down the Keys. More recently, Lapointe and his Harbor Branch colleagues provided the first "compelling scientific evidence" linking a proliferation of invasive green seaweed blooms on coral reefs between Miami and Palm Beach County to the discharge of 400 million gallons per day of nutrient-rich sewage into the ocean. "The Gulf Stream will not carry it all away," says Lapointe. "We debunked that myth, too."

Perhaps most rewarding to the scientist is that he has been vindicated for his long-held position that nitrogen runoff from the Everglades Agricultural Area was destroying Florida Bay. Even the National Academy of Sciences supported "Doc Ford" at the end of the day. "That's one reason why implementation of the Comprehensive Everglades Restoration Plan has made very little progress," says Lapointe. "Water managers had been largely ignoring the 'N' word."

Lori Cloutier, former conservation chair of marine issues for the Sierra Club of Southwest Florida, says, "Brian Lapointe is one of the top marine scientists in the world as far as I'm concerned. What he did by telling the truth and going up against other government-paid scientists was a big step for his field. The 2000 Environmental Report put out by the South Florida Water Management District didn't even mention the word nitrogen. It was all about phosphorus." There was no accountability until Lapointe provided the "other half of the puzzle" using unbiased, peer-reviewed science.

The sad reality is that, despite the best efforts of Lapointe and other like-minded scientists, the state's ecological problems will continue to mount so long as the practice of releasing storm water from Lake Okeechobee persists. The coral reefs in the Keys also won't be coming back any time soon. "It's emotional for me," Lapointe confesses. "I grew up in South Florida and learned to dive there. I still have a home in the Keys."

Last year, when they surveyed Looe Key off Big Pine Key during the International Year of the Coral Reef, Lapointe and his colleagues were shocked to discover that the number of algal species had increased 40 percent since they began monitoring nutrients there 25 years ago. Nutrient concentrations, on average, had more than doubled.

Whether it's a seaweed bloom killing coral reefs in the Keys or devastating sea grasses off the Treasure Coast or a red tide creating a dead zone and economic panic on the southwest coast, "the common thread," says Lapointe, "is excessive land-based nutrients from urban and agricultural areas. The fact is, Florida is awkwardly distinguished as the only place in the world where scientists continue to devise alternative, politically correct hypotheses in search of unlikely evidence."

Lapointe adds that we should also consider that Southwest Florida has not been plagued by red tides in the three years since the excess Caloosahatchee River discharges ended in 2006 and South Florida entered a period of prolonged, record drought. "It is impossible to explain this with African dust or other alternative offshore upwelling theories," he says.

The fact is, it supports exactly what Lapointe concluded long ago about the role of land-based runoff. As the scientist himself quips, "Once again, Mother Nature is the final arbiter of a scientific controversy – and, right now, she's giving me the nod." ❀