

# Researchers work to bring Biscayne Bay back from the brink

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Credit: Florida International University

At the southern end of Biscayne Bay, FIU Institute of Environment researcher Piero Gardinali is slicing through the water.

A triathlete, Gardinali is used to seeing kayakers and jet skiers zip by him on the surface as he swims toward the Miami Seaquarium. On the shore, sunbathers relax and others play catch with their dogs.

Beneath the water, seagrasses sway as if dancing to a beat. Fish, stingrays and even lobsters wander by.

But the usually serene bay that serves as a playground for locals and tourists alike would begin sending warning signs about its own health.

In August of 2020, hundreds of barracuda, eels, lobsters, pufferfish, toadfish, rays and snook in the northern bay died on a single night, their rotting carcasses bobbing on the water's surface and creating a stench detectable for miles. An algal bloom quickly followed and white foam accumulated on the water's surface, both indications of underlying concerns.

## **Pulling back from disaster**

The FIU Institute of Environment quickly took action, deploying automated surface vessels, buoys and researchers who collected water samples. In the days that followed, they monitored the bay for clues about what had happened, though many suspected a long-simmering problem a century in the making.

Few other organizations could match the institute's efforts to determine what was taking place on the bay. Designated a Program of Distinction in Environmental Resilience by the state of Florida and falling within FIU's College of Arts, Sciences & Education, the institute has focused heavily on monitoring of coastal waters.

"If we don't attack this right away, if we don't put all of our best thinking, all of our best management, best practices in terms of infrastructure, revitalization," said Todd Crawl, director of the institute, "this will become a common event, and that's not a term I ever want to hear about Biscayne Bay."

## **Reckoning with history**

A large part of the problem affecting Biscayne Bay is man-made.

In the early 1900s, developers dredged the bay to create Miami Beach and Star Island. They also built causeways to connect those islands to the mainland and added more islands still, forever altering the flow of water throughout the bay.

Back on the mainland, construction activity likewise would contribute to eventual problems in the freshwater bay. In the late 1940s, canals were carved into the Everglades, so more land could be used for farming and other industry. Those same canals are still used today to periodically lower the levels of Lake Okeechobee in central Florida, a source of irrigation for a \$1.5 billion-a-year agricultural industry that produces sugar cane, winter vegetables, citrus and rice. Lowering the lake level flushes already nutrient-rich waters through the fertile farmlands around the lake and then to urban coastal areas.

Along the way, the water collects grass clippings, pesticides and fertilizers from landscapes that homeowners try to keep green year-round. Septic tanks built throughout South Florida likewise contribute to a toxic stew that spews into Biscayne Bay with every rainfall, discharge and flush, fueling the growth of algae and weedy plants at the bottom. As temperatures rise, this organic material eats up the available oxygen, said James Fourqurean, director of the institute's Coastlines and Oceans Division. That, in turn, kills off fish and seagrasses. Without the latter to do the clean up work, the bay becomes murkier. The conditions become ripe for [algal blooms](#) and fish kills.

## **Monitoring the bay**

Gardinali, the triathlete and associate director of the Institute of Environment, is a chemist who has studied the bay for decades. After the August fish kill, he was on the water directing efforts to collect water

quality samples. He saw first-hand how researchers used an autonomous surface vessel that zig-zagged its way south along the bay hunting for clues to what was happening under water.

The institute's CREST Center for Aquatic Chemistry and Environment also deployed buoys to monitor the available oxygen in the water and to provide a clearer picture of how many nutrients are swirling about the bay.

Marine sciences Associate Professor Kevin Boswell envisions a future where countless other stationary buoys and autonomous surface and underwater vessels constantly monitor the bay. The sensors on such devices would communicate findings to a computer that relays results to researchers and would use artificial intelligence to guide the autonomous vessels to investigate trouble spots. Perhaps inexpensive sensors could line the docks of waterfront homes to collect data.

Information from these sources would be publicly available to residents and tourists. For [decision-makers](#) in government, the information could help them devise better policies and management efforts to keep the bay healthy.

If funded, this real-time system would provide a much needed baseline of the bay's health and would be used to better monitor conditions of the bay. For now, Crowl, the institute's director, continues to host frequent meetings with local and state officials to share all available data on Biscayne.

## **Taking action**

The seagrass die-offs, fish kills and algae blooms can be remedied by curtailing sewage leaks, converting [septic tanks](#) to centralized wastewater treatment, cleaning and treating stormwater and reducing fertilizer

overuse.

Coastal communities are taking heed.

The city of North Bay Village signed a memo of understanding with FIU to explore ways to help the bay. Researchers are working with the small municipality, located on two islands in the middle of the bay, to develop methods of restoring seagrass beds.

The Miami-Dade County mayor created a chief bay officer position to advise the mayor and county commissioners about the bay's health and to serve as a liaison between the county and other stakeholders.

In February, Coral Gables passed a resolution to curb the amount of fertilizer entering the bay.

Still, expensive problems are not easy to solve. A November sewage leak fouled Biscayne Bay's waters, leading officials to temporarily declare an emergency to keep swimmers away from South Beach and Virginia Key.

Researchers at the Institute of Environment say we must get a handle on what's happening in Biscayne Bay. And we must do it now. Before hotter summers, calm wind and excess nutrients do their worst. Before the damage becomes permanent and people like Piero Gardinali—who views the bay not as just a body of [water](#) to put under a microscope but as source of life itself—will no longer be able to swim among the fish who play and forage in the seagrasses while families enjoy a care-free day in the sun.

How's Biscayne Bay doing day to day? See for yourself by checking out the [live data](#) coming from monitoring buoys set in place by researchers within FIU's CREST Center for Aquatic Chemistry and Environment.

Ready to share knowledge about Biscayne Bay conservation efforts with your students? The College of Arts, Sciences & Education has developed [educational modules](#) for science teachers to use in the classroom.

Provided by Florida International University

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