

A POWERFUL PARTNERSHIP FOR America's Everglades

2017 Impact Report The Everglades Foundation & FIU Partnership

In this Issue

- 2 Opportunity Given: Meet FIU ForEverglades Scholarship Recipients
- 4 Communicating Science: Immersion through Interactive Experiences
- 6 Seagrass Die-off and How Freshwater from the Everglades gets into Florida Bay
- S FIU Scientists: A Cornerstone to The Everglades Foundation-led Synthesis Effort
- **9** Collaborative Everglades Learning
- **10** Everglades Foundation Ecologist Bridges Science with Policy
- First Ever Florida Bay Forever Forum

OPPORTUNITY GIVEN EET THE FOREVERGLADES SCHOLARSHIP RECIPIENTS



Algae give clues about the fate of sea level rise

TIU Ph.D. student Viviana Mazzei received the 2016 Everglades Foundation FIU ForEverglades Γ Scholarship to examine sea level rise. Adapting to sea level rise requires good predictions of sea water distribution into the future. Mazzei is using one of the Florida Everglades' tiniest communities to track where salt water is intruding and predict where it may effect ecosystems in the future.

Mazzei is examining communities of algae to help resource managers pinpoint the areas that need freshwater most. Known as diatoms, these microscopic algae are a great indicator of environmental changes, including increased salinity and higher concentrations of phosphorus brought on by salt water encroachment caused by sea level rise and a lack of freshwater in the Everglades.

"There are ways to map that now, with aerial photography, for example, but it takes a while to see the effects of saltwater that way," Mazzei said. "The turnover rate for micro-organisms is so fast that we will be able to see the changes happening in the environment more quickly."

In 2000, the U.S. Congress authorized the Comprehensive Everglades Restoration Plan to restore, preserve and protect the water resources of the Everglades. Mazzei says early indicators of environmental changes underscore the need to expedite large scale freshwater restoration. Mazzei is conducting her research as part of FIU's Florida Coastal Everglades Long Term Ecological Research (FCE LTER) Program.



Viviana Mazzei examines algae in Everglades National Park

The FCE LTER Program is part of the Institute of Water and Environment, a preeminent program of Florida International University.

For more information, visit http://fcelter.fiu.edu/ and http://inwe.fiu.edu/

Alligators dig change

TIU Ph.D. student Bradley Strickland also received the 2016 Everglades Foundation FIU ForEverglades Scholarship to Γ study alligators, one of the Everglades' most famous predators. They sit at the top of the food chain and influence the world around them by how they hunt and what they eat. But Strickland believes they also impact the ecosystem from the bottom of the food chain up.

Strickland is investigating how alligators move nutrients in the environment by digging out holes in the wetlands with their snouts, feet, and tails.

Known as alligator holes, these deep spots store water during the dry season to help the reptiles keep cool and successfully mate. They also provide an easy lunch, serving as refuge for wildlife such as birds, fish, insects, snakes, and turtles. Alligators also release their own waste into these holes, and their movement stirs up nutrients that stimulate the growth of algae in the water that form the base of the food web. Strickland is investigating this stimulatory role of the big predators by examining water and soil chemistry in the holes, relative to other places in the marsh.

"You are what you eat, so we can sample small fish and aquatic invertebrates, look at their make-up, and see what the food web structure is like," Strickland said. "If that structure is different in the alligator ponds than in the surrounding marsh, we can begin to measure what ecosystem-level changes are being made by the alligators." Strickland's research will aid resource managers in decisions about where to put water during ongoing restoration efforts in the Everglades.





the Everglades.



Strickland is also conducting his research as part of FIU's FCE LTER Program, which is dedicated to understanding how water, climate, and people impact



COMMUNICATING SCIENCE IMMERSION THROUGH INTERACTIVE EXPERIENCES

"It is imperative that the state has better control over where and when water is released to maintain natural ecosystem functions and the water supply to over 8 million people in South Florida."

Tn a complex political environment, understanding of Senate Bill 10, sponsored by state Senator Rob Bradley and supported by state Senate President, Joe Negron. Florida Legislature passed SB 10 passed on May 2, 2017 to respond to the water crisis facing coastal estuaries and the Everglades. SB 10 expedites a reservoir project south of Lake Okeechobee in the Everglades Agricultural Area, thus providing a mechanism to get more water south. From an airboat, you can see that the Everglades is mostly flat, and the subtle differences in topography means that a change of just a few inches in elevation can be the difference between a tree island or a flooded slough. "It is imperative that the State has better control over where and when water is released to maintain natural ecosystem functions and the water supply to over 8 million people in South Florida," Wendelberger notes. She points to clusters of tiny apple snail eggs laying on sawgrass along the slough while an endangered Snail Kite, which feeds almost exclusively on the apple snails, hovers above. Wendelberger explains the need for water, at the right time and in the right ways, to maintain the critical ecosystem necessary for both species to exist. Through these immersive airboat tours, Wendelberger serves a critical role in communicating complex scientific processes and providing knowledge and experiences that can inform proper political decisions. This summer, she will lead the John Marshall Everglades Internship program, where our future stakeholders will have the opportunity to learn about such dynamics first-hand. She hopes that the FIU ForEverglades Scholarships will engage more scientists in order to advance restoration efforts that will improve the future for all Floridians.

Lecosystem dynamics and accelerated changes occurring within the Everglades must extend beyond communications with the scientific community to reach all stakeholders that depend on the River of Grass. That is the work and task of Dr. Kristie Wendelberger, Outdoor Education and Outreach Coordinator at the Everglades Foundation. A recent Ph.D. graduate of FIU and the FCE LTER, Kristie has researched long-term coastal plant community changes while evaluating their response to sea level rise. Her knowledge of ecosystem indicators is helping to guide conservation action, and it motivates her every time she hops onto an airboat. As she guides interested visitors through this complicated ecosystem's structures and functions, guests get a glimpse into the historical narratives and rapid changes that have led to compartmentalization of the once-expansive Everglades. Viewing the landscape of changing vegetation, Kristie grabs a clump of periphyton – a mix of algae and cyanobacteria that is characteristic of the Everglades - and encourages participants to touch it, while she describes the importance of studying these organisms as indicators of the system's health. These healthy algae mats that form the basis of the Everglades' food web under natural conditions where nutrients are scarce, are a stark contrast to the toxic algae that bloom when nutrients pour into our coastal estuaries and harm both wildlife and tourism. The water in the Everglades moves slowly, much like the progress of the Comprehensive Everglades Restoration Plan (CERP). Getting the different stakeholders to agree

on appropriate restoration priorities and strategies has long been a challenge of CERP, and one that is at the heart

Communicating science is a powerful key to Everglades Restoration. Help support students like Kristie, Viviana, and Bradley and the ForEverglades Scholarships by scanning the code or visiting https://give.fiu.edu/give-now/school-of-environment-arts-and-society/



- Dr. Kristie Wendelberger



SEAGRASS DIE-OFF AND HOW FRESHWATER FROM THE EVERGLADES GETS INTO FLORIDA BAY



Map of Everglades National Park showing how freshwater flows into Florida Bay from Shark River Slough and Taylor Slough. Rred arrows include the current, un-restored distribution of flow. The zone in orange indicates the region where frequent hyper-salinity events occur and the epicenter of seagrass die-off.

team of researchers from FIU and the Everglades A Foundation have been at the forefront of tracking changes in Florida Bay that are caused by reduced water flows from the Everglades. They have produced a synthesis of this research for the public, available at http://www.evergladesfoundation.org/evergladesscience-forum/

Florida Bay lies at the tip of the Florida peninsula, nestled between the Florida Keys and the mainland of Everglades National Park. Scientists have long known that Florida Bay does not receive enough freshwater to sustain the health of this important estuary and hotbed of recreational fishing.

Published scientific studies have documented how salinity throughout Florida Bay was much lower before the freshwater flow from Lake Okeechobee was disconnected from the Everglades during the first half of the 20th century.

Evidence from sediment cores suggests that freshwater flows were reduced by about 59%, causing salinities in Florida Bay to rise between 5 and 20 parts per thousand (ppt) higher than historical conditions.

Salinity increases due to reduced freshwater flows are known to be accentuated by droughts. These can lead to chronic hypersalinity driven by large rates of evaporation off the surface of the expansive, shallow Florida Bay.

Some of Florida Bay's highest salinity values were recorded during the drought of the late 1980's and coincided with a major seagrass die-off that began in 1987. This event was a major catalyst, along with other hydrological and ecological problems across the greater Everglades, for the development of the Comprehensive Everglades Restoration Plan (CERP), intended to improve freshwater flows and drought resistance across the Everglades and in ecologically and economically important estuaries like Florida Bay.



However, in 2015 more than 25 years later, the continued lack of freshwater flow through Everglades National Park combined with a drought caused hypersalinity conditions that drove yet another massive seagrass die-off in Florida Bay. This die-off continued through 2016 and even led to a large algal bloom that consumed much of the western bay during the summer

FIU's long term monitoring of Florida Bay has and fall of 2016. provided compelling evidence of Shark River Slough's influence in freshening western Florida Bay, and When considering mechanisms for refreshening water demonstrates clearly that Shark River Slough flows supplied to Florida Bay to reduce the likelihood of these are capable of moderating developing hypersalinity hypersalinity events and associated seagrass die-offs, it conditions during drought. is imperative to understand how freshwater gets into Florida Bay. The Florida Bay Scientific Review Panel, which was assembled by the National Fish and Wildlif Foundation, the National Park Service and the South Florida Water Management District to investigate the causes of the 1987 seagrass die-off, stated that "Freshw ter is delivered to Florida Bay through Taylor and Sha River Sloughs and coastal drainage outside of these sloughs."

Taylor Slough provides a direct source of freshwater to eastern Florida Bay. However, this slough is quite sm and does not freshen the entire bay. Shark River Sloug is much larger and delivers significantly more freshwater flow toward Whitewater Bay and the southwest coast, but its contribution to Florida Bay is indirect and its effect on bay salinity is relatively unquantified.





Published studies have, however, shown that there is a connection between Shark River Slough and Florida Bay. Given that the volume of freshwater flow in this massive slough will nearly double with the restoration of the Everglades, its contribution to Florida Bay is likely to be very important.

fe	Based on what was learned from long-term monitoring
	following the 1987 seagrass die-off, it will take years,
	likely decades, to recover from this most recent die-off.
va-	Algal blooms that afflicted Florida Bay a few years
rk	after the 1987 die-off are just beginning to materialize
	and are anticipated to cause further damage to benthic
	habitats. We need to restore the flow of freshwater to
	Everglades National Park—through both sloughs—so
0	that these water masses can converge in the north-
all	central region of the bay and help prevent future
gh	hypersalinity from reaching the detrimental levels we
-	saw in the summers of 1987 and 2015.

FIU SCIENTISTS A CORNERSTONE TO EVERGLADES FOUNDATION-LED SYNTHESIS EFFORT



The Comprehensive Everglades Restoration Plan (CERP) is a partnership between the state of Florida and the federal government to restore America's Everglades while maintaining critical flood control and water supply services to the growing population of South Florida. Although it was signed into law in 2000 advancement of the 68 CERP project components has been slow. Current restoration activity is piecemeal and indefinite relative to the ambitious timeline set out in the original planning document. This delay, resource managers and policy makers claim, is partly a result of insufficient information on how to prioritize limited restoration dollars, recognizing the needs of the environment while considering threatened and endangered species, exotic invasive species, and issues related to climate change.

The Synthesis of Everglades Research and Ecosystem Services (SERES) project was designed to address these management needs while also considering the costbenefit of different restoration paths entailing different storage strategies. The SERES Project was was funded by the U.S. Park Service through the Critical Ecosystem Studies Initiative (CESI). The Science Department at the Everglades Foundation managed the SERES Project, but its success depended on numerous other Everglades scientists from academia, consulting, and agencies such as the U.S. Geological Survey. The Everglades Foundation team was led by Drs. Stephen Davis (Ph.D. from FIU in 1999), Melodie Naja, and Tom Van Lent. From FIU, Drs. Evelyn Gaiser, Mike Ross, Jay Sah, and Joel Trexler were all involved throughout the multi-year project, making substantial contributions in areas of water quality, landscape ecology, and trophic dynamics.

SERES Project Meeting in December 2014

The SERES team reviewed the relevant literature and developed and evaluated five Everglades restoration scenarios in both ecological terms and in terms of what people care about (e.g., ecosystem services). The results were synthesized and used to address key science management questions provided by direct dialogue with managers, policy makers, and key opinion leaders. As a final product of the SERES Project, the team is preparing a set of papers for publication in a dedicated issue of Restoration Ecology, a peerreviewed journal that "fosters the exchange of ideas among the many disciplines involved in the process of ecological restoration..." Davis noted that "Restoration Ecology is an ideal venue for communicating the SERES Project's work to the community. That we can produce an entire issue speaks to the amount of quality science produced by this outstanding team of Everglades experts."

Dr. Gaiser noted that most of the papers have already been submitted for peer-review, and several of them have been accepted, including a paper she co-authored with Drs. Naja and Childers (formerly at FIU and now at Arizona State University) entitled: "Water Quality Implications of Hydrologic Restoration Alternatives in the Florida Everglades USA." "The SERES Project was a great opportunity for FIU's scientists to apply their expertise in such a multi-disciplinary synthesis effort. We hope these papers inspire more effective decisions in the Everglades and other ecosystem level large-scale restoration planning," stated Gaiser. The SERES Special Issue of Restoration Ecology is expected to be published sometime in the fall of 2017.

COLLABORATIVE EVERGLADES LEARNING

 $E^{\rm very\,\,day\,\,For Everglades\,\,Scholarship\,\,alumnus}_{\rm Gregory\,\,Koch\,\,connects\,\,a\,\,multi-generation\,\,of}$ visitors, volunteers, and educators in an effort to expand conservation education. Koch discovered his passion for communicating science while working on his Ph.D. dissertation at FIU, studying how ecosystem metabolism responds to changing hydrology and phosphorus availability in Taylor River.

Now at Zoo Miami Foundation, he serves as the Director of Education and Volunteer Services. The knowledge he gained as a result of the ForEverglades Scholarship - and from the Everglades research community - directly shapes the zoo's learning programs and our community's understanding of the Everglades landscape.

One of Zoo Miami's educational priorities is to play a central role in telling the story of Everglades wildlife and ecology as well as the critical need for Everglades conservation and restoration.





The centerpiece of these efforts is the opening of *Florida*: Mission Everglades, the zoo's newest wing of exhibits and experiences focused on the international treasure located in our backyard.

As with Everglades science, collaborative partnerships are vital to the success of Everglades learning within tangled web of Everglades restoration. Through a series of memoranda of understanding and years of extensive engagement, a four-pronged group has formed. FIU, The Everglades Foundation, Everglades National Park and Zoo Miami now work together on both Everglades and general conservation efforts to engage the public and improve science literacy.

"Our partnerships perfectly connect Everglades National Park's splendor, FIU's science, and Everglades Foundation's salience with Zoo Miami's scale of nearly 1 million annual visitors," highlights Koch, as he leads groups across a seamless bridge between formal classroom education and informal zoo learning.

Greg Koch shown below taking hydrologic measurements in Taylor River

BRIDGES SCIENCE WITH POLICY

Steve Davis feels extremely fortunate to be where he is today. As the Everglades Foundation's Ecologist, he is able to apply his skillsets in science and communications to help protect and restore an ecosystem that he has had the pleasure of working in for more than 20 years. Davis is also involved with collaborative research in the Everglades and continues to work with many of the same colleagues and mentors.

Dr. Davis received his Ph.D. from FIU in 1999 with his research in the mangroves along lower Taylor Slough at the interface of the freshwater Everglades and Florida Bay. "My dissertation project was part of a larger study funded by the South Florida Water Management District that was focused on understanding how freshwater flow restoration might affect the exchange of carbon, nitrogen, and phosphorus throughout this dynamic zone," recounted Davis. "This was a time when the Comprehensive Everglades Restoration Plan was still in development, so a lot of agency-sponsored research was being focused on these important management issues."

Little did he know where his experience at FIU would take him.

In 2001, Davis landed a faculty position at Texas A&M University as an Assistant Professor of Wetland Ecology in the Department of Wildlife and Fisheries Sciences. The Florida Coastal Everglades Long-Term Ecological Research (FCE-LTER) program based at FIU, now in its 16th year, was just beginning to take shape at that time, and his research on the factors governing nutrient availability in the mangrove ecotone was recognized as an important component of this new FCE-LTER work.

"I was 30 at the time and really didn't look, dress, or feel like a professor," Davis joked. "However, I was blessed with an opportunity to teach and develop a new wetland research program in Texas while still continuing to grow an Everglades research program...with my own students."

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Shortly after gaining tenure and promotion at Texas A&M, Davis decided to come back to FIU for a sabbatical, to focus on his Everglades research. It was during that time he was made aware of a job opening at the Everglades Foundation and decided to apply. "I was ready for a change," said Davis. "More than anything, I was eager to get back to South Florida and re-focus my energies on the Everglades and the FCE-LTER program." Since beginning at the Everglades Foundation in 2009, Davis has felt right at home.

In addition to his duties at the Everglades Foundation, Davis is co-lead of the Biogeochemistry Working Group (with Dr. John Kominoski of FIU) and has been helping to synthesize the vast amount of water quality data collected across the FCE-LTER sites since 2001. Specifically, he and his co-authors are developing a paper to be submitted as part of a special issue of the journal Ecosphere. They are combing through the water quality database to understand how disturbances affect water quality across the freshwater and mangrove ecotone sites in both Shark River and Taylor sloughs.

Davis noted, "our paper will highlight one of the many values of longterm data collection—the ability to hindcast and understand eventdriven dynamics. We already know that canals are sources of nutrients to the Everglades. So, we are targeting other factors that may also contribute to nutrient release within the Everglades, including episodic disturbance events such as Hurricane Wilma (2005), a large fire in 2008, and an extended cold event in early 2010. We're seeing some interesting patterns in nitrogen and phosphorus across our sites and over time. In the end, our work will lay the foundation for understanding how these different kinds of episodic disturbance events affect the availability of nutrients in this low-nutrient wetland."

If this sounds like a merging of science and management, it should come as no surprise that it has been an area of investigation for Davis from the very beginning. It also fits squarely within the mission of the Everglades Foundation.

FIRST EVER FLORIDA BAY FOREVER FORUM

Following the 2015 Florida Bay seagrass die-off, the Everglades Foundation, FIU and Florida Bay Forever (a new Non-Governmental Organization - NGO - in the keys) co-hosted the Florida Bay Forever Forum to bring together community members and scientists from agencies, academia, and environmental NGOs to share observations and discuss concerns about the die-off and its causes and consequences.

Presentations by Florida Bay scientists were facilitated by Dr. Steve Davis and Captain Elizabeth Jolin, owner/operator of the Bay and Reef Company and co-founder of Florida Bay Forever. These presentations were followed by a nearly two-hour discussion and Q&A between Forum attendees and a science panel. Among those in attendance was U.S. Congressman Carlos Curbelo, who spoke about Everglades restoration and Florida Bay. Representatives from Bonefish and Tarpon Trust (BTT) and International Game Fish Association (IGFA) also participated in the discussion.

Brooke Black, BTT's Manager for the Florida Keys, and Jason Schratwieser, IGFA's Conservation Director, spoke about their own experience and observations of fishery declines in Florida Bay linked to the existing die-off as well as their organization's efforts to advance the science and understanding of these trends.

The Everglades Foundation and FIU hope to join forces again in 2017 to reconvene the Florida Bay Forever Forum, as evidence from late 2016 indicates that a large-scale algal bloom may be developing in Florida Bay.

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For more information on how you can become involved with the Everglades Foundation, contact Gloria Calle at gcalle@evergladesfoundation.org or (786) 249-4419.

For more information on how you can become involved with FIU's School of Environment, Arts and Society (SEAS), contact Stephany Alvarez-Ventura at <u>scaalvar@fiu.edu</u> or (305) 348-7313.

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