THE EVERGLADES FOUNDATION

FIU Arts, Sciences & Education
Florida International University

A POWERFUL
PARTNERSHIP FOR

AMERICA'S EVERGLADES

2019
FOREVERGLADES
IMPACT REPORT

A POWERFUL PARTNERSHIP FOR **AMERICA'S EVERGLADES**

Over the last 10 years, scientists from The Everglades Foundation have conducted collaborative research with Florida International University (FIU) faculty through the Florida Coastal Everglades Long Term Ecological Research Program (FCE LTER) on topics ranging from economics, ecology, water quality, groundwater hydrology, climate change to geomorphology. In 2013, the Foundation formalized this relationship with FIU through a memorandum of understanding to advance research and develop solutions to protect and restore **America's Everglades**. Both organizations agreed to support graduate students working on projects that improve our knowledge and management of the Everglades ecosystem. In total, more than 20 FIU graduate level students have been supported by the Foundation through the **ForEverglades Scholarship** program. In 2015, this synergy was further strengthened by the establishment of a 1:1 fund matching program for the **FIU ForEverglades Scholarship**. To date, the FIU ForEverglades Scholarship program has supported the research efforts of 9 students from the FIU School of Environment, Arts and Society. This partnership is paramount to both organizations – **educating the next generation of Everglades stewards while advancing the common goal of Everglades protection and restoration**.

THE EVERGLADES FOUNDATION

FIU
Southeast Environmental Research Center

FIU
Institute of Water and Environment

FCE LTER

CONTENTS

RESEARCHER TRACKS FEISTY GAMEFISH FOR CONSERVATION

CARISSA GERVASI

A 2018 FIU ForEverglades Fellow who wants to help Florida's recreational fishing industry.

Anglers love to catch crevalle jack – they are impressively big, move quickly and put up a great fight, making them ideal for sport-fishing – but anglers and guides alike have noticed a dramatic decline in their catches.

Carissa Gervasi, an FIU environmental studies student, is researching how effectively marine reserves protect and restore populations of crevalle jack, an economically important catch-and-release fish. She is zeroing in on reserves throughout Florida Bay and the impacts of no fishing and restricted fishing on their abundance, size and behavior. Her research can inform management plans for the unregulated species.

Recreational fishing influences marine behavior, including where and when fish move. Gervasi is implanting small acoustic tags into fish to track their movements. She is relying on citizen scientists – many local anglers – to capture and tag the gamefish, and to share their fishing experiences with her through surveys. An extensive network of underwater acoustic receivers throughout the Florida Everglades is being used to track fish movement, recording both date and time which helps us to understand where, when and why they move. Gervasi is also examining crevalle jack ear bones that retain the chemistry of the bodies of water where they live.

"If a management plan is going to be created for crevalle jacks, knowing their movement and migration patterns is vital so that the scale of management can match the scale of movement," said Gervasi, a Ph.D. student in the Department of Earth and Environment.

Crevalle jack and other saltwater gamefish in the Everglades bring in more than $883 million in annual revenue to the state. Jack fish, as they are known colloquially, also play an important role in the environment. An apex predator, they help maintain balance in the food web.

"Ensuring their survival is critical to restoring a functional ecosystem that will thrive into the future," Gervasi said.

Gervasi is conducting research under the guidance of Jennifer Rehage, coastal ecologist in FIU's Institute of Water and Environment. Her work is funded in part by The Everglades Foundation's FIU ForEverglades Scholarship.

ALGAE GIVE CLUES INTO EVERGLADES RESTORATION SUCCESS

ERIC MASSA

A 2018 FIU ForEverglades Fellow who wants to know if Everglades restoration is working.

Eric Massa, a graduate student at FIU, is turning to periphyton – spongy, soggy mats of algae, bacteria, fungi and microbes floating in freshwater – to determine if projects intended to protect and restore water resources are meeting Everglades nutrient standards. Most of the Everglades has low nutrient levels under natural conditions, but agriculture, development and water management have caused phosphorus levels to skyrocket. Massa is evaluating phosphorus levels in the Everglades and predicting periphyton collapse, allowing resource managers to evaluate restoration success.

"If water quality improvement efforts can be better targeted for locations that are at risk of periphyton mat collapse, then restoration funds can be spent more efficiently," said Massa.

Periphyton is a great indicator of ecosystem health. It can absorb contaminants and remove them from the environment. It is also home to small creatures, including insects and worms, and a source of food for fish, invertebrates and tadpoles. Extensive and cohesive periphyton mats are indicative of a healthy environment, but too much phosphorus can cause periphyton mats to collapse, causing a cascade of changes at the base of the food web.

Massa is conducting research under the guidance of Evelyn Gaiser, aquatic ecologist in FIU's Institute of Water and Environment. His work is funded in part by The Everglades Foundation's FIU ForEverglades Scholarship.

EVERGLADES SCHOLAR BRINGS TOGETHER STAKEHOLDERS FOR COMMON-SENSE RESTORATION

CHLOE VORSETH

A 2-year FIU ForEverglades Fellow (2017-2018) who wants to make Everglades restoration practical.

Working to identify the most economically, environmentally and socially viable restoration plan, Vorseth, an FIU environmental studies master's student, is relying on input from a variety of experts and stakeholders.

"Due to a lack of cooperation and understanding of complex, ecological processes, Everglades restoration efforts have been stagnant," she said. Using different restoration scenarios developed by The Everglades Foundation, Vorseth is leading focus groups with key stakeholders, encouraging them to learn from each other and reach a consensus on one restoration plan. She is also relying on environmental experts from FIU and The Everglades Foundation to rate the benefits of each scenario. Using input from both groups, she will identify the scenario that best meets the desired outcomes.

"I hope the face-to-face interaction and the decision-making methods employed in my study will pave the way for compromise and consensus," Vorseth said. "We need restoration that meets the needs of all stakeholders and the environment."

U.S. Congress passed the Comprehensive Everglades Restoration Plan to restore and protect the water resources of the Everglades in 2000. The more than 60 projects proposed were expected to be completed by 2030, but population growth, political issues, economic issues, logistical delays and other factors have slowed that timeline significantly.

The Everglades is the largest tropical wetland ecosystem in North America. It is home to more than 70 endangered and threatened species of animals and plants, it offers people a variety of recreational opportunities, and it protects communities from flooding and storms. The Everglades also feeds into the water supplies of 16 counties, including Broward, Miami-Dade and Palm Beach counties.

Vorseth is conducting research under the guidance of Mahadev Bhat, professor in FIU's Department of Earth and Environment and Department of Economics, and Andrew Stainback, ecological economist at The Everglades Foundation. Her work is funded in part by The Everglades Foundation's FIU ForEverglades Scholarship.

Chloe Vorseth presenting her research titled "utilizing multi-criteria analysis and analytical hierarchy process to facilitate Everglades restoration decision making" at the Greater Everglades Ecosystem Restoration (GEER) conference in April 2019.

FROM MENTEE TO MENTOR

CLIFTON RUEHL

ForEverglades Scholarship Alumni

Clifton Ruehl, recipient of the 2008 ForEverglades Scholarship, currently works as an Associate Professor of Biology at Columbus State University. He credits the scholarship with driving and supporting his graduate research, which helped him secure a postdoctoral position and eventually his current faculty position.

In 2008, as a student at FIU, the ForEverglades Scholarship supported Ruehl's snail research and allowed him to determine that the density of snails (important grazers) in karst wetlands, like the Everglades, was much lower than in other aquatic ecosystems despite the large amount of food available in the systems. Based on these findings, an outdoor lab experiment established that phosphorus enrichment sped snail growth and reproduction slightly more than threats of predation (e.g., crayfish), which slowed growth and reproduction. A field experiment in the Everglades supported these findings and revealed that threats of predation could mask nutrient enrichment effects on population dynamics. Importantly, these findings could explain why some species show no response to nutrient enrichment.

"The scholarship provided funds that allowed me to explore the use of new techniques in diet analysis, improve the quality of the data for two experiments, and learn from a number of different scientists," said Ruehl.

The support received from the ForEverglades scholarship, he explains, led to his current role at Columbus State University.

Looking back at his time as a ForEverglades scholar, Ruehl nostalgically remembers the annual dinner: "The dinner was held at Mar-a-Lago. Donald and Melania Trump were there shaking hands and I am pretty sure that Aretha Franklin sang. All of that seems really bizarre now," he recalls.

While Ruehl's fellowship ended over a decade ago, he still uses the mentoring skills he picked up from his research at the time.

"As a fellow, I was able to mentor several undergraduate students that were helping with my experiments. That taught me important leadership and communication skills," Ruehl said.

Today, he teaches classes and mentors undergraduate students in research and gets the opportunity to take part in his university's study abroad programs, where he joins students on international trips so they can get first-hand experiences with different landscapes and habitats. "Taking students that have never boarded an airplane to experience different cultures and traditions in another country while learning ecological and evolutionary principles is quite rewarding," he says.

FROM RESEARCH TO APPLICATION

JULIANA CORRALES

ForEverglades Fellowship Alumni

Juliana Corrales, a ForEverglades Scholarship alumni, currently works as a research environmental engineer at the Center for Water Resources at RTI International. In this capacity, Corrales applies hydrologic analysis and modeling techniques to a broad range of emerging water resources problems, including water allocation and climate change adaptation. She applies hydrologic models in order to assess local and regional impacts on water availability by changes in the climate, population and land use associated with urbanization, industrial growth and expansion of agriculture fields. To add to her technical modeling work, Corrales leads capacity building workshops in Latin America and the Caribbean on the use and application of these models.

Recently, Corrales has begun to focus her research on the development, analysis and application of spatially based watershed models for watershed planning, ecological and climatological analyses, and the investigation of cost-effective measures, such as green infrastructure interventions, for water security.

"Having received the ForEverglades Scholarship for three consecutive years allowed me to conduct my doctoral dissertation research with the constant guidance and support from The Everglades Foundation's interdisciplinary team of scientists. I had the opportunity to learn from their expertise and to have one-on-one meetings that helped me to better understand essential concepts for the development of my research," Corrales said.

The ForEverglades Scholarship not only gave her the financial support she needed to pursue her research, but also gave her an excellent platform to learn about environmental leadership and responsibility, something that she tries to apply in her daily work.

THE LOST SUMMER OF 2018
ALGAL BLOOMS IN FLORIDA

DR. STEVE DAVIS
Director of Communications & Senior Ecologist, The Everglades Foundation

Algae blooms are a global phenomenon which are most often fueled by excess levels of nitrogen (N) or phosphorus (P) – both essential elements for life and common components of fertilizers. Many countries with significant populations or agricultural activity are increasingly experiencing these blooms. While some blooms are natural, global runoff of fertilizer and domestic wastewater production are fueling an increase in the frequency and duration of blooms, making them much more severe and frequent.

Whether in freshwater lakes or coastal bays, algal blooms further degrade water quality, leading to reduced water clarity and depletion of oxygen. Certain kinds of algae can produce toxins, creating an additional threat to the environment and to human health. These Harmful Algal Blooms (HAB) are often associated both with species of blue-green algae and the organisms that cause red tide.

Red tide forms through natural processes on the Florida Shelf and prefers warm marine waters, especially at salinity levels above 24 parts per thousand. Florida's recent red tide was first noted in October 2017, about one month after the passage of Hurricane Irma, and stretched from the Florida Keys up to the Naples area.

As we moved into the warmest months of 2018, the red tide expanded up to the Sarasota- Bradenton areas and intensified, particularly in the area outside Charlotte Harbor and the Caloosahatchee River Estuary. This red tide persisted into early 2019, making it one of the top five longest duration red tide events on record. It was also notable for wrapping around the Florida Keys and spreading up the east coast for a brief period in October 2018.

Florida red tide is attributable to the over-growth of a marine species of algae, called Karenia brevis or K. brevis for short. Wind, ocean currents and temperature all play a role in bloom formation. Red tides were observed by the Spaniards in the 1500's near Tampa Bay, centuries before Lake Okeechobee began discharging the way it does today. However, once a bloom is triggered, K. brevis needs a supply of nutrients to sustain itself, and that is where pollution from Lake Okeechobee has played a role. Discharges from Lake Okeechobee likely provided a local source of nutrients that sustained this bloom as it has moved closer to shore.

While we associate blue-green algae blooms with freshwater because of the massive and intense blooms observed on Lake Okeechobee and in the Caloosahatchee and St. Lucie Rivers, species of blue-green algae exist in both freshwater and in marine environments and are among the oldest forms of life on Earth. Blue-green algae or cyanobacteria are actually photosynthesizing bacteria. So, in some ways they are both plant-like and animal-like.

The species of blue-green algae we typically see blooming in south Florida freshwater environments gets a lot of attention because it can produce dangerous toxins that harm the liver and may affect neural function in humans and animals. The frequency and duration of blue-green algae (and other species) blooms are increasing both globally and locally. Like the red tide, blue-green algae blooms need substantial quantities of nitrogen and phosphorus as fuel for growth and maintenance of the bloom.

The relationship between blue-green algae and red tide is a source of study and an issue currently being addressed by the state of Florida as a result of Governor DeSantis' Executive Order that established a Blue-Green Algae Task Force and Chief Science Officer and enhanced integration with the State's existing Harmful Algae (Red Tide) Task Force. Their mission will be to study the problem and identify priority projects that help reduce the loads of nutrients (both nitrogen and phosphorus) that are fueling these blooms. Everglades restoration is at the top of that list, as it re-directs polluted Lake Okeechobee water away from the Caloosahatchee and St. Lucie by storing, cleaning and sending that water south to the Everglades and Florida Bay.

SALTWATER INTRUSION
& THE EVERGLADES

THE IMPORTANCE OF FLOW RESTORATION FOR COASTAL HABITAT STABILITY

DR. EVELYN GAISER

Professor and George M. Barley Jr. Endowed Chair of Everglades Research, FIU

Coastal wetlands are rapidly changing due to reductions in freshwater delivery, land conversion on their landward side and sea-level rise on their marine side. These pressures cause increased rates of seawater intrusion, which allows salt to infiltrate our groundwater supply and stresses wetland organisms adapted to fresher conditions. Florida International University (FIU) and The Everglades Foundation scientists have been collaborating on multiple studies to determine how and why ecosystems change in response to saltwater intrusion, and to use that understanding to inform better freshwater management. Their research suggests that restoring freshwater flows will improve the ability of coastal wetlands to adapt to rising seas by reducing the salt stress on key organisms and ecosystem functions.

Recently a team of scientists from both organizations, including researchers Edward Castaneda, Evelyn Gaiser, John Kominoski, Sparkle Malone, Mike Ross and Tiffany Troxler (FIU) and Steve Davis (The Everglades Foundation), identified a region of the coastal Everglades where experimental studies could be conducted to test factors that might enhance resilience to sea-level rise. The land is located on the mitigation bank property of Florida Power and Light (FPL), a region FPL has preserved, and is part of the historic eastern Everglades system.

The team proposed three studies including: (1) an evaluation of how this region has changed since prior FIU studies in the area over 20 years ago, (2) an experimental study to determine how nutrient availability and mangrove addition influences marsh resilience to sea-level rise, and (3) an evaluation of how water flow variability influences the ability of the marsh to remove carbon dioxide from the atmosphere.

The scientists are working with FPL's environmental team, including Joseph Sicbaldi and Russell Hunt, who oversee the restoration and monitoring at the mitigation bank. Locations have been identified and field reconnaissance has begun for implementing these projects. They anticipate these long-term studies will be an important platform for undergraduate and graduate student research associated with the Florida Coastal Everglades Long-Term Ecological Research (FCE LTER) program at FIU.

TRACKING POLLUTION WITH EMERGING TECHNOLOGIES

MEHENUR SARWAR

A 2-year ForEverglades Fellow (2015-2016)

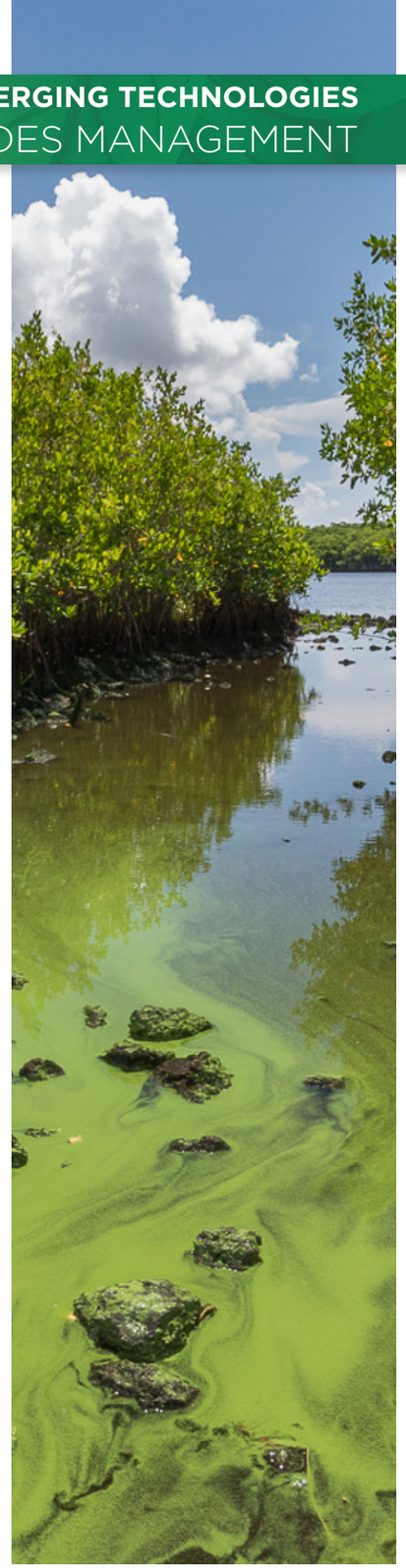
Mehenur Sarwar, a Ph.D. candidate in the FIU Nano-bioengineering & Bioelectronics program, received a 2-year ForEverglades Fellowship (2015-2016) and started developing a sensor that enables detection of ultra-low levels of ortho-phosphates in Everglades water. This device can lead to solutions for scientists seeking to track phosphate contamination in aquatic environments, and thus, contribute to our understanding and management of water quality in the Everglades.

Phosphate is utilized by plants as a nutrient source. It is a growth limiting factor and, thus, commonly used on agricultural land. This phosphate-based fertilizer is one of the primary contributors to inorganic phosphate in bodies of water. At the point of application, the inorganic phosphate concentrations exist in the higher parts-per-million (ppm) range. However, due to inorganic phosphate runoff into adjacent bodies of water, the concentration naturally dilutes into the parts-per-billion (ppb) range. Monitoring inorganic phosphate at the ppb level will allow us to identify “hotspots” and handle them accordingly.

Monitoring excess inorganic phosphate in environmental water samples can aid in tracking aquatic “dead zones” caused by algal blooms. These algal blooms emerge due to excess inorganic phosphate in the water, much of which comes from agricultural runoff. Measuring inorganic phosphates in the environment, can make it possible to identify this issue and begin implementing solutions. The ideal sensor to tackle this problem must be near-instantaneous, disposable, portable and able to geolocate each measurement rapidly.

To maximize detection sensitivity and minimize interference, Sarwar and her team are developing a 3-D printed optical system which uses a fluorescent sensor to determine the concentration of phosphate. A bacterial protein with a fluorophore and an extremely high affinity for phosphate is used to develop the sensor and detect ultra-low levels of phosphate in the environmental sample. In the field, a smart phone with specialized software will be directly connected to the device and quantify the inorganic phosphorus. The whole system will be portable and can simultaneously geo-tag the phosphate concentration.

The current gold standard technique to determine the level of orthophosphate used a chemical known as ammonium molybdate which reacts with phosphate to form a blue colored complex. This assay is toxic and requires continuous supply of reagents. The device that Sarwar is in the process of developing is an innovative solution for tracking phosphate contamination in aquatic environments.



HOW WILL PEOPLE BE IMPACTED BY EVERGLADES RESTORATION?

DR. ANDREW STAINBACK
Ecological Economist, The Everglades Foundation

DR. MAHADEV G. BHAT
Professor of Natural Resource Economics, FIU

The health of the Everglades is critical to south Florida's economy and to the quality of life for its residents. From enhancing the water supply for over 8 million people, to supporting multibillion-dollar commercial and recreational fishing industries, Everglades restoration will have a substantial impact on everyone who lives in southern Florida and for the millions who visit each year.

Understanding how people view these benefits and how different stakeholders will be impacted by restoration is important for making the policy and management decisions that will maximize the benefits to the environment, economy and quality of life for Floridians.

To gather some of this information, Dr. Mahadev Bhat, a faculty member at FIU, and Dr. Andrew Stainback, an economist at The Everglades Foundation, are collaborating on an ongoing project to understand how different stakeholders will be affected by restoration.

To accomplish this task, Bhat and Stainback are using a combination of surveys, focus groups and primary economic data.

One of the first steps in this project involved analyzing data obtained from a survey that was part of a collaborative effort between The Everglades Foundation, FIU and colleagues at the University of Florida. This survey was aimed at estimating how much Floridians are willing to pay for the benefits of Everglades restoration such as increasing wildlife habitats in Everglades National Park, enhancing fish habitats in Florida Bay, and reducing discharges to the Caloosahatchee and St. Lucie rivers and estuaries.

The results indicated that Floridians from diverse political perspectives, age groups, and income levels are very concerned about the health of the Everglades and are willing to pay to restore it – up to $1 billion dollars per year. Interestingly, concern and support for Everglades restoration was substantial in all regions of the state, even in areas as north Florida and the panhandle, located far away from the Everglades.

Currently, surveys and focus groups are being conducted with a diverse array of stakeholders, such as businesses dependent on tourism, recreational anglers in Lake Okeechobee and coastal estuaries, visitors of Everglades National Park, and others to quantify and value the benefits of restoration and understand how these benefits may vary among different stakeholders.

They are planning to use the results from this work with information from scientists and other experts to help develop decision support tools that can be used by decision-makers and resource managers to understand the implications of different restoration options for the economy and quality of life in south Florida.

Economics and social science research are important to understanding the Everglades and the implications of restoration. Not only can this research be used by policy makers and resource managers but, hopefully, it can help the public better understand the important value that the Everglades provides and the stakes involved in restoration decisions.

"The results indicated that Floridians from diverse political perspectives, age groups, and income levels are very concerned about the health of the Everglades and are willing to pay to restore it – up to $1 billion dollars per year."

FUND A SCHOLAR
FUND OUR FUTURE

Powerful partnerships are fueled through the shared belief and investment of supporters like you. With only one goal, we work together to protect and restore **America's Everglades**. Join us and invest in the young minds that will forever benefit this national treasure - 100% of your gift will directly support these students and their quest to understand, solve, and advocate for Everglades restoration solutions.

GIFTS TO $1,000	Friend of FIU ForEverglades Scholarship
GIFTS TO $2,500	Partner of FIU ForEverglades Scholarship
GIFT OF $10,000	FIU ForEverglades Graduate Scholar Benefactor
GIFT OF $20,000	FIU ForEverglades Doctorate Scholar Benefactor

AS AN FIU FOREVERGLADES SCHOLARSHIP SUPPORTER YOU WILL
have the opportunity to meet with scholars in the field and learn about their research, and be recognized on The Everglades Foundation and FIU CASE websites and publications

OUR DEEPEST THANKS TO OUR SUPPORTERS *Dr. Evelyn Gaiser, The Doug Williams Group, Thomas Kenan Foundation Inc., The Everglades Foundation*

FUND A SCHOLAR

CONTACT US

The Everglades Foundation
Gloria Calle | 305-251-0001
gcalle@evergladesfoundation.org

FIU College of Arts, Sciences & Education
Evelyn Gaiser | 305-348-6145
gaisere@fiu.edu

CONNECT WITH US

FIUCASE	EVERGLADESFOUNDATION
FIUCASE	EVERGLADESFOUNDATION
FIUCASE	EVERGFOUNDATION
CASE.FIU.EDU	EVERGLADESFOUNDATION.ORG

FCE-LTER FUNDED BY NSF COOPERATIVE AGREEMENT #DEB-1237517