2018

ForEverglades Impact Report

A Powerful Partnership for **AMERICA'S EVERGLADES**

THE EVERGLADES FOUNDATION

FIU Arts, Sciences & Education

School of Environment, Arts and Society

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IS EVERGLADES RESTORATION GOOD FOR FISH?

> "It's critical to understand how the current environmental conditions in the Everglades are impacting our recreational fisheries as this knowledge will help determine how the fisheries may react to planned restoration efforts. The ForEverglades Scholarship is allowing me to further my thesis research on how water flow changes associated with restoration in the coastal Everglades may impact recreational sportfish habitat by altering their food supply and predators."

Florida's economy depends on healthy fish, but little is known about how Everglades restoration efforts affect some of the state's most lucrative sport fish.

FIU student Cody Eggenberger received the 2017 Everglades Foundation FIU ForEverglades Scholarship to examine the impact of Everglades restoration on snook and tarpon in Florida Bay. Nestled between the Everglades and the Florida Keys, Florida Bay experienced major changes since the Everglades were drained for agriculture and development, including reduced water flow, high salinity and water contamination.

Eggenberger, a master's student in the Department of Earth and Environment, is trying to find out how predators and oxygen levels in the water influence where the sport fish go and where they live. Recreational fishing is an important social and economic activity in Florida. The industry is worth $7.6 billion and supports nearly 109,300 jobs, according to the National Marine Fish Service.

"Florida is the fishing capital of the world," Eggenberger said. "It's crucial to understand what environmental conditions are needed to maintain healthy and sustainable sport fish populations. It's critical to the economy."

To follow the fish, Eggenberger implanted tags in nearly 60 snook and tarpon. He did this alongside Jennifer Rehage, researcher in the Florida Coastal Everglades Long Term Ecological Research (FCE LTER) Program. He is relying on the nearly 50 acoustic receivers placed by the Ocean Tracking Network and the FCE LTER Program throughout Florida Bay to know when and where fish are using habitats. He is also using oxygen loggers to measure levels in the water, net hauls to count the number and location of prey, and longline fishing to count the number and location of predators. The information could pave the way for better resource management and restoration practices in the Everglades.

Housed at FIU and funded by the National Science Foundation, the FCE LTER Program is dedicated to understanding how hydrology, climate change and people impact the Florida Everglades. Eggenberger's research is also funded by the South Florida Water Management District and The Everglades Foundation's FIU ForEverglades Scholarship.

ENGAGING RESIDENTS FOR FASTER EVERGLADES RESTORATION

> “Working at The Everglades Foundation this semester has been an inspirational experience. The Foundation is a place where scientists are supported and given the freedom to complete interesting research that eventually informs real policy decisions at the state and federal level. Working on this project has exposed me to the high standard of scientific research at this level of influence, as well as the teamwork, passion, and dedication required to make the positive changes that we wish to see in the progress of Everglades restoration a reality. I am grateful to my mentors, Dr. Stainback and Dr. Bhat, and The Everglades Foundation for giving me the opportunity to be here, and to see real change in action.”

Chloe Vorseth, an FIU Environmental Studies M.S. graduate student and 2017 ForEverglades Fellow, is working with Dr. Mahadev Bhat in the Department of Earth and Environment and Dr. G. Andrew Stainback at The Everglades Foundation to examine what people know about the Everglades, how they use the ecosystem and their attitudes, including what they are willing to pay for different restoration options. By understanding the needs and wants of the public, her research can inform Everglades restoration policy and implementation.

A component of this work, which is centered on placing value on the ecosystem services associated with Everglades restoration, involves analyzing data from a survey done with collaborators at FIU, University of Florida, and The Everglades Foundation. This survey queried Florida residents about their attitudes toward restoration and how much they are willing to pay for the benefits of Everglades restoration such as increases in wildlife populations in the park, improvements in estuarine habitat in Florida Bay, and reduction in polluted discharges from Lake Okeechobee.

Vorseth is also estimating the value other ecosystem services that are likely to be impacted by Everglades restoration, such as climate change mitigation and the protection of the drinking water supply for southeastern Florida.

“If we can understand the value of the Everglades to average Florida residents, we can assign dollar amounts to different restoration projects,” Vorseth said. “Putting the value of an ecosystem in monetary terms is something people can understand. This will, hopefully, motivate decision-makers to increase the speed of restoration.”

While work on this project is ongoing, preliminary results show that Floridians would derive significant value from Everglades restoration regardless of where they reside in the state. When completed, this research will help policymakers and others understand how Everglades restoration impacts the well-being of Florida residents and shed light on the tradeoffs involved with different restoration options.

RESEARCHER DESIRES A SUSTAINABLE EVERGLADES

> “I am passionate about this project because as a hydrologist with an integrated watershed management specialization, I wish to see how modeling will feed into decision making, bridging the gap between science and application.”

Small-scale droughts can have big effects on the Florida Everglades.

FIU Ph.D. student Anteneh Abiy received the 2017 Everglades Foundation FIU ForEverglades Scholarship to dig deep into the abnormally low rainfall events. He doesn’t have to go too far into weather data to begin his work. 2017 was drier than usual. The Everglades received six inches of rainfall less than the annual average.

Fresh water in the Everglades feeds into the Biscayne Aquifer, the main water supply for Broward, Miami-Dade, Monroe and Palm Beach counties. Small-scale drought events have cropped up over the past two decades, leaving lasting impacts on the counties water supply.

“Drought is a cancer. Its effects creep up little by little and you don’t notice them until it’s too late,” Abiy said. “You can’t predict when drought will happen. But, with the right information, you can design sound strategies to better store water in the Everglades, manage our water supply and take action immediately.”

Rainfall puts fresh water into the Everglades. But lack of it causes communities to pump more water out from the ground for people to drink, cook with and clean with. At the same time, drought causes ground water levels to drop and salt water from the ocean to creep into the ground water. The effects of increased demand from people and saltwater intrusion circle back to impact the Everglades.

As part of his research, Abiy will present different management options that take into account how drought, sea-level rise and water consumption all interact to affect the Everglades. He hopes the information will inform sound water management to ensure a sustainable future for the Everglades.

“Drought is a global phenomenon. What we learn about it in the Everglades can be applied to anywhere it happens,” Abiy said. “If I can help uncover how drought affects our water supply, I feel like it would have helped people. I feel like I would have accomplished something with my life.”

Abiy relies on climate data collected by the Florida Climate Center and the Florida Coastal Everglades Long Term Ecological Research (FCE LTER) program. Housed at FIU and funded by the National Science Foundation, it examines how water, climate and people impact the Everglades. His research is funded in part by The Everglades Foundation’s FIU ForEverglades Scholarship.

Has Everglades Restoration **BEEN EFFECTIVE?**

A decade-long study of phosphorus concentrations can give us some answers.

FIU masters student Shishir Sarker investigates the effectiveness and progress of Everglades restoration efforts by analyzing changes in total phosphorus concentrations in water and soils.

Although phosphorus is an essential nutrient for plant growth, it also acts as a contaminant with the potential to cause eutrophication - a detrimental excess in richness of nutrients. Given that the Everglades is naturally a very low nutrient system, any additional amount of phosphorus in surface water can disrupt the entire balance of the ecosystem and remain within the soils for long periods of time, further disrupting the ecosystem balance.

Through his research with FIU's Department of Earth and Environment, Sarker has worked with Dr. Rene Price from FIU and Dr. Yogesh Khare from The Everglades Foundation to interpret total phosphorus trends both in the water and soil within the Everglades Protection Area over the span of a decade. While results were mixed, they found that, overall, restoration efforts have lowered phosphorus levels, positively impacting ecosystem recovery.

Sarker and his team examined total phosphorus in surface water from 2004 to 2016 and observed that concentrations in water decreased across the Everglades Protection Area during that time frame, but remain above the ecological threshold (>10 μg/L) in some areas. Trends in soil total phosphorus decreased from 2004-2014, but increases were observed in Water Conservation Area 3 (WCA3), possibly due to nutrient inputs from the Miami canal. Moreover, Sarker found that areas experiencing higher concentrations in total phosphorus for both water and soil had something in common: their proximity to canal or water discharge points. In areas less than one kilometer away from a canal or water discharge points, both soil and water total phosphorus concentrations were higher.

"It's really nice to observe that restoration is working for most parts of the Everglades Protection Area, but more effort is still needed to control phosphorus inputs near canals or discharge stations. We need to closely examine the Everglades soil phosphorus content as it has a huge impact on the enrichment of total phosphorus in water columns," urges Sarker.

With the Everglades currently reduced to half of its historic size, Sarker explains the value of better understanding the effects of total phosphorus in the Everglades, and how this can impact future restoration efforts:

"This research helped me to understand the different aspects of phosphorus and its detrimental effect on our natural ecosystem and how we can control them. I hope my research contribution will help restoration managers to take more effective actions toward Everglades restoration."

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AS SEA WATER MOVES INTO THE EVERGLADES, **MARSHES COLLAPSE:**

Bridging Science and Water Management Practices to Implement Solutions

Decades of reduced water flow and the effects of climate change on sea-level rise are causing rapid saltwater intrusion into the southern Everglades. Scientists warn that one of the most alarming consequences of saltwater intrusion is that sawgrass marshes, which are adapted to freshwater, are collapsing when exposed to salt.

The collapse of sawgrass marshes matters a lot – when it happens, the ground loses elevation, allowing saltwater to more easily invade, worsening saltwater intrusion and creating a domino effect that perpetuates the issue and creates trouble for an already imperiled Everglades ecosystem.

In an effort to understand why and how marshes are collapsing, a team of researchers from Florida International University (FIU), The Everglades Foundation, Everglades National Park (ENP) and the South Florida Water Management District (SFWMD) are exposing freshwater and brackish sawgrass marshes to varying concentrations of salt and measuring the responses of plants, microbes, algae, and soils. What they have found so far is that even small increases in salt are causing freshwater-adapted plant roots to die. When roots die, the organic (peat) soils rapidly decompose, leading to marsh collapse and elevation loss.

This collaborative project aimed at understanding the causes and mechanisms of sawgrass marsh collapse is spearheaded by FIU scientists Drs. Tiffany Troxler, John Kominoski and Evelyn Gaiser, along with Ph.D. candidates Ben Wilson, Viviana Mazzei, Shelby Servais and Sean Charles, and done in collaboration with Dr. Stephen Davis from The Everglades Foundation as well as Dr. David Rudnick from the ENP and Drs. Fred Sklar, Chris Madden, and Carlos Coronado-Molina from the SFWMD.

Among the most important aspects of this study is that as a result of collaborations with the SFWMD and local partners, scientific findings are being directly translated into water management actions that can be taken to improve freshwater flows and slow down both saltwater intrusion and the process of marsh collapse.

This research was conducted with support from the Florida Sea Grant and the Florida Coastal Everglades Long Term Ecological Research Program, part of the Long Term Ecological Research Network established by the National Science Foundation.

Ben Wilson FIU Ph.D. Graduate

"Because South Floridians rely on the Everglades for many services, such as aquifer recharge and hurricane protection, the loss of coastal marshes is an issue we hope to give more attention to. Working on this project with multiple stakeholders and end-users has really allowed me to see the importance that science plays in ecosystem management and policy."

Shelby Servais FIU Ph.D. Graduate

"As a graduate student, I benefited from working on a multi-institution collaborative project. Working with colleagues from the South Florida Water Management District, Everglades Foundation, and the Everglades National Park provided the opportunity to ensure my research has broad impacts on Everglades Restoration and the well-being of South Florida residents who depend on services that the Everglades provides."

Viviana Mazzei FIU Ph.D. Graduate

"This project was an amazing collaborative effort to assess the effects of saltwater intrusion on different ecosystem components through experiments done in the southern Everglades. My research within this project looked at how periphyton and the diatoms that inhabit these algal mats respond to monthly pulses of experimentally elevated salinity."

Sean Charles FIU Ph.D. Graduate

"We are so lucky to do research in the Florida Everglades, one of the most beautiful, exciting and diverse places on earth. Hopefully our research will inform policy decisions that will preserve this incredible place for future generations. We focus on the soil because if we lose the soil, we lose the Everglades."

Hurricane Irma
IMPACTS TO THE EVERGLADES

On the morning of September 10th, 2017, Hurricane Irma, one of the strongest hurricanes on record, made landfall in the Florida Keys and took aim west, sparing Floridians in the state's densely populated eastern coast from the hurricane's most destructive power. Hurricanes are a natural and common occurrence in the Everglades as they are part of the natural processes shaping the landscape by throwing mud onto the coast and helping to build up the land. During hurricane Irma, the mangrove forest acted as a wave barrier against storm surge protecting the rest of the system. Restoration of the Everglades ecosystem to build its resilience to changing conditions is critical to protect South Florida. Hurricanes also bring destruction to natural systems including visible damage to mangrove forests.

Dr. Stephen Davis from The Everglades Foundation had the opportunity to fly over the Everglades the day after the hurricane. The first after-storm images he captured showed defoliated trees throughout the coastal mangrove forests and dark, stained water draining from the wetlands into the Gulf of Mexico. Scientists from the Florida Coastal Everglades Long Term Ecological Research (FCE LTER) program quickly mobilized teams to assess the effects of the storm and secured RAPID funding from NSF (to Florida International University) and NASA (University of Maryland) to determine the damage and recovery on the ground and from the air.

Their work shows that about half of the coastal mangrove forest canopy was destroyed. A 3-10 centimeter storm surge precipitate – mud from the Gulf of Mexico – was deposited onto the forest floor, bringing high increases in salinity that triggered unfavorable conditions for mangrove survival. In terms of recovery, however, storm surges can represent good news. As Dr. Evelyn Gaiser, Principal Investigator of the FCE LTER, notes "the storm surge deposit contains phosphorus-rich mud and the availability of this nutrient helps the seedlings recover. Moreover, these seedlings are able to grow faster because the canopy above them has opened up and more light can get to them."

Months after the initial observations, the team of scientists has detected signs of recovery in several trees, but mortality continues to occur in areas where storm surge salts are likely concentrating and causing tree death. Looking out to the future, they anticipate that if the region is hurricane-free for several years, the forest may continue to recover. Their hopes are that the 2018 hurricane season is calm, as the forest is still in a fragile state.

The team leading this NSF and NASA-sponsored work includes Dr. Evelyn Gaiser, Dr. Jennifer Rehage, Dr. John Kominoski, Dr. Tiffany Troxler, Dr. Michael Heithaus, Dr. Keqi Zhang, Dr. Edward Castaneda, Dr. David Lagomasino and Dr. Temilola Fatoyinbo, as well as Dr. Stephen Davis from The Everglades Foundation.

The power of hurricane Irma pulling water out of Florida Bay. Prior to the storm's passage there was no standing water between the Key Largo Interagency Science Center and Pelican Key in Florida Bay. Photo taken by Tom Frankovich, FIU, on September 10th, 2017.

Hurricane Irma pounding the Everglades. Mangrove trees were defoliated in lower Shark River, ENP. Trees with leaves remaining appear in green and are mostly limited to fringing shorelines. Photo courtesy of Dr. Stephen Davis, The Everglades Foundation, Tiffany Troxler, with FCE LTER FIU, and Gary Lickle, The Everglades Foundation Board Member taken on October 6th, 2017.

NOW OR NEVERGLADES: POLICY & SCIENCE COME TOGETHER TO PROTECT AMERICA'S EVERGLADES

In April 2018, The Everglades Foundation was joined by anglers, representatives from the fishing, boating, and real estate industries, numerous elected officials, and Everglades scientists for a summit with one unifying goal: protecting America's Everglades.

Organized by The Everglades Foundation, America's Everglades Summit in Washington, D.C. took place on April 24-25 with the purpose of raising awareness in both Congress and the White House of the need to restore the flow of clean freshwater from Lake Okeechobee back to the Everglades and Florida Bay. The Everglades, which recharges the water supply for one in three Floridians, is home to 78 threatened or endangered species, supports agriculture and world-class recreational fisheries in its surrounding estuaries, and attracts millions of tourists to South Florida.

At the Summit, the impacts of the current water management system and the need to support the Everglades Agricultural Area (EAA) reservoir project in this year's Water Resources Development Act (WRDA) legislation were a few of the critical issues discussed. The EAA reservoir is a key project in the Comprehensive Everglades Restoration Plan and is expected to reduce the damaging discharges to the Caloosahatchee and St. Lucie Rivers and redirect water south to the Everglades. From lectures highlighting the economic importance of the Everglades, to FIU Principal Investigator of the FCE LTER program Dr. Evelyn Gaiser's talk on "How Science Fits In," the Summit left little room for doubt regarding the need for Everglades restoration efforts.

The sheer diversity of people invested in protecting the Everglades speaks volumes of its pivotal role in South Florida, as Eric Eikenberg, CEO of The Everglades Foundation, explains.

"This past April, over 200 Floridians from all walks of life – anglers, realtors, conservationists – brought energy and passion to our nation's capital for America's Everglades Summit," explains Eikenberg. "Together, we walked the halls of Congress and met with over 50 members, while delivering two clear asks: to authorize the Everglades Reservoir through the Water Resource and Development Act and to fund the Everglades restoration project."

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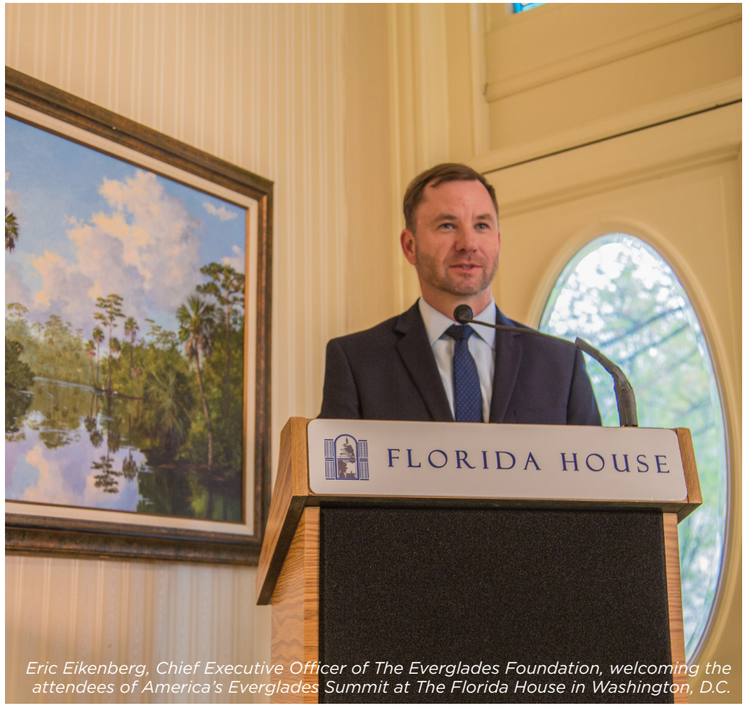

Eric Eikenberg, Chief Executive Officer of The Everglades Foundation, welcoming the attendees of America's Everglades Summit at The Florida House in Washington, D.C.

Dr. Evelyn Gaiser giving her presentation on How Science Fits In

Panel Discussion 2 - How It Works: The Federal-State Partnership | From left: Joseph Bentz, U.S. Rep. Brian Mast (R-FL), Noah Valenstein, The Hon. Joe Negron (R-FL)

Panel Discussion 1 - Why It Matters: The Everglades as an Economic Engine | From left: Barry Grooms, Steve Friedman, Scott Deal, Perk Perkins, Connie Parker

Blue-green algae in the St. Lucie canal at the S308 Structure (Lake Okeechobee outflow) on July 3, 2018. *Photo by Edyna Garcia, The Everglades Foundation.*

THE GEORGE BARLEY WATER PRIZE

PRESENTED BY THE Scotts Miracle-Gro FOUNDATION

INSPIRE & INNOVATE

In 2016, The Everglades Foundation launched the largest water-based science prize in history, focused on ensuring our planet's clean water. Named after our visionary co-founder, The George Barley Water Prize was designed to incentivize scientists, entrepreneurs, and innovators to find groundbreaking solutions to solve large-scale phosphorus contamination.

Phosphorus contamination of freshwater ecosystems is a rapidly growing environmental crisis of international significance. Ecological impacts include changes in species composition, harmful algal blooms, depleted oxygen, fish kills, and ecosystem collapse. Currently, no cost-effective process exists for removing excess phosphorus from natural water bodies on a large scale.

The Everglades Foundation's George Barley Water Prize is incentivizing visionaries capable of developing such a process with an unprecedented $10 million prize.

Competitors are participating in four different stages of competition, designed to mimic the natural stages of technological development. Stages 1 and 2 have concluded, and Stage 3 (Pilot Phase) is near completion. Each of these 10 teams competed in Ontario, Canada treating water from the Holland Marsh for three consecutive months. Final test results are currently under review.

Through four years and four stages of competition, The George Barley Water Prize is disrupting current thinking and creating a community of innovators. Applications were received from 104 teams through the first two stages of the Barley Prize. These teams hailed from 13 different countries, including China, Japan, Sweden, Belgium, India, Australia, Germany, Canada, and Israel. Florida International University (FIU) was pleased to be among the stage 1 participants of the Barley Prize with "Remove, Optimize, Assess and Recover" (ROAR). FIU's solution applies a collaborative, interdisciplinary whole systems approach that removes and recovers phosphorus from lakes, wetlands and rivers while also soundly managing ecosystem integrity and society's needs. This holistic systems approach to reducing phosphorus waste requires attacking the problem across technological, social and ecological axes.

"The complexity and severity of the phosphorus problem demands collaboration among researchers, political and industrial leaders, and the public to ensure a sustainable future," said Dr. Evelyn Gaiser, Principal Investigator of the Florida Coastal Everglades Long Term Ecological Research Program and member of the FIU ROAR team.

The FIU ROAR team was among the applicants in Stage 1. Stage 1 winners included teams from Florida, Idaho, and the Netherlands. Stage 2 winners included teams from the Netherlands, Florida, and West Virginia.

Stage 3 teams will be awarded $800,000 and the top 4 winners will be invited to participate in Stage 4, testing their technologies to clean water from Lake Jesup for 14 months. Lake Jesup, one of the largest lakes in Central Florida, is heavily polluted by phosphorus.

The winner of the $10 million prize will be a green technology capable of removing excess phosphorus at a fraction of the cost of the currently implemented technologies. This would be a breakthrough that would benefit ecosystems around the world.

FUND A FELLOW
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 Fellowship
GIFTS TO $2,500	Partner of FIU-ForEverglades Fellowship
GIFT OF $10,000	FIU-ForEverglades Graduate Fellow Benefactor
GIFT OF $20,000	FIU-ForEverglades Doctorate Fellow Benefactor

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

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

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